Què tenim sota els peus?
550 milions d'anys d'evolució a Ponent i el Pirineu

EXHIBITION TEXTS

1. THE DIVISION OF TIME

Our planet's long history began around 4.6 billion years ago, the moment when, according to geological evidence, the Earth and all the other planets in the solar system were formed. The rocks which testify to such a distant time are difficult to find and, in general, have gone through major processes of deformation and heat. Life appeared soon enough: the first fossils of single-celled organisms are preserved in rocks from 3.7 billion years ago.

Nonetheless, fossils became much more abundant with the start of the great Phanerozoic aeon. This aeon began 541 million years ago and continues to the present day.

An aeon is the longest subdivision in the geological time scale. This enormous lapse of time is divided into intervals of different lengths, known as eras, periods, stages..., corresponding to geological or biological events which occur on the planet and are recorded in the rocks. Thus, for example, the border between different eras (the next-longest subdivision after the aeon) can be determined by great geological events which affect the whole planet and result in the extinction of many groups of organisms.

The time line of Lleida

The demarcation of Lleida is a territory with absolutely exceptional geological and palaeontological variety. Most of the time, to find a comparable level of abundance we must draw on enormous swaths of territory, even entire continents. In the rocks of Lleida, however, a good part of our planet's history is concentrated and, moreover, with a magnificent fossil record.

The planet's oldest rocks cannot be found in Lleida: on the time line of Earth's history, Lleida lacks the first few months. Nonetheless, the most interesting part, the Phanerozoic aeon, in which life becomes more diverse and abundant, appears nearly in its entirety.

Most of the rocks which form our landscapes contain fossil remains of the animals and plants which lived there during this long history. Lleida, apart from being a territory with a large quantity of fossils, conserves some absolutely exceptional deposits thanks to the quality of the fossils preserved or because they constitute the remains of animals and plants which lived in key moments of the history of life on Earth.

2. PALAEOZOIC: explosion of life

This era, which means "ancient fauna", began 541 million years ago and ended 250 million years ago. Curiously, the beginning and end of the Palaeozoic are defined by two different opposing biological events: an explosion of life and an extinction.

At the start of the Palaeozoic, in the Cambrian period, an enormous proliferation of marine organisms took place. Dozens of animal groups suddenly appeared, some of

whose descendants still live in our oceans and continents. The chemical conditions of the moment enabled many of these groups to develop hard external skeletons made of calcite, which significantly facilitated the fossilisation process.

The Cambrian explosion has been one of the great palaeontological enigmas for decades.

All the same, in recent years, thanks to the exploration of new deposits, it has become possible to prove that this explosion of life did not come all of a sudden, but rather unfolded over tens of millions of years. It has also been discovered that, before the Cambrian period, there already was an important amount of marine biological diversity. Unfortunately, the organisms forming these ecosystems were, for the most part, soft-bodied and, therefore, have left scant fossil remains.

Two hundred fifty million years ago, the Palaeozoic era ended with the extinction of most of the organism groups living on our planet, both marine and terrestrial.

Photo caption 1: During the Palaeozoic, the continental masses shift and merge into a single continent: PANGEA. © 2021 Colorado Plateau Geosystems Inc.

The oldest fossils in Lleida

The oldest fossils in Lleida were formed in this era and we find them in the heart of the Pyrenees. This extensive area is home to a whole series of rocks which have experienced enormous heat and pressure, as they have been involved in the formation of two great mountain ranges, the most modern of which is the Pyrenees per se. In the past, the Palaeozoic rocks had already been affected by the formation

of a great mountain chain which arose at the end of the Palaeozoic, the Variscan or Hercynian belt, which stretched over a good portion of Europe and northern Africa.

Due to our Palaeozoic rocks' eventful history, we normally find them quite folded, deformed and transformed from the point of view of their chemical composition and physical state. They are what we know as metamorphic rocks.

Metamorphic processes eventually make fossils disappear. Luckily, the Pyrenees contain large swaths of Palaeozoic rocks where the metamorphism has been mild enough for some intact or only slightly deformed remains to be conserved. They are Lleida's oldest fossils.

For nearly the entire length of time spanned by the Palaeozoic era, the area of what today is Lleida was submerged in the ocean. The fossils we find in the Pyrenean Palaeozoic rocks pertain to a whole series of organisms which lived in the sea. Some were cold seas of great depth; others, however, were shallower and more suitable for the development of life.

Photo caption 2: This reconstruction of the sea during the Silurian shows the marine environment in which these sediments were formed. Life, during the first periods of the Palaeozoic, evolved exclusively in seas. Illustration: Roc Olivé.

Photo caption 3: The urban and natural landscape of the Pyrenees is significantly influenced by the type of rocks we find there. Closed valleys, little cropland and the uniformity of

available building materials are the inheritance of this geological history of the Palaeozoic. Picture: Oriol Riart.

3. PERMIAN-TRIASSIC: life on Earth is on the brink of disappearing

The Permian is the last period of the Palaeozoic era and the Triassic, the first of the next, the Mesozoic era. What separates these two eras is the most severe mass extinction event seen by our planet since it began to harbour life. At the end of the Permian, nearly 90% of the entire world's species went extinct and, in fact, life was just a step away from totally disappearing from Earth. The causes of this episode have been debated for quite some time. It seems that one major factor was the formation of a single large continent, called Pangea, surrounded by a planetary ocean known as the Pantalassa. This would have radically changed the ocean and air currents and would have provoked climate change, responsible for the aridification of large continental areas. The merging of the different continents would also have signified the disappearance of large extensions of marine platforms, where life proliferated abundantly.

In the Pyrenees, the rocks formed during the Permian and early Triassic present very similar characteristics, and it is occasionally difficult to tell them apart. For this reason, we refer to all these rocks as belonging to the Permian-Triassic. These rocks are, in general, intensely red in colour, suggesting periods of great dryness and also the presence of river flows carrying sandy and muddy sediments. It consists, mainly, of conglomerates, sandstones and clays of a wine red colour which can be seen in the south of La Seu d'Urgell or on the outskirts of El Pont de Suert. There is also evidence of significant volcanic activity, and strata formed by volcanic materials are common.

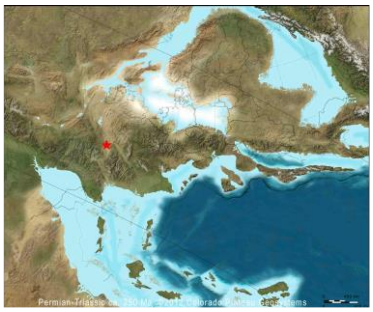

Photo caption 4: For the second time in Earth's history, all the continents group together into a single mass, Pangea, surrounded by Pantalassa, the global ocean. © 2021 Colorado Plateau Geosystems Inc.

Bone remains, plant impressions and ichnites

In the Permian-Triassic strata it is relatively common to find impressions of the trunks and leaves of the plants which used to live there. What proves harder is finding animal remains, particularly vertebrate animals. The findings consist in a few bone remnants and, especially, in ichnites, fossil footprints from different types of animals.

Thus, thanks to the ichnites, we know there were amphibians and different types of small reptiles, including synapsids. Synapsids constitute a large group of vertebrates that also covers us, the mammals. But the synapsids which lived in those times were quite different from the mammals of today. The strangest ones had large sails on their backs used to regulate temperature. Later, they started to acquire increasingly mammal-like traits, such as a more vertical leg posture (so their bellies ceased to drag along the ground) or the development of body hair.

Finally, the Triassic saw the emergence of veritable mammals, which, in the beginning, were quite modest in size, similar to a rat. These sizes were maintained through the whole rest of the Mesozoic, as another group of animals rapidly evolved and came to occupy the ecological niches reserved for larger animals: the dinosaurs. Other groups of reptiles occupied marine niches and the air environment. For many years, the Mesozoic has been known, informally, as the Age of Reptiles.

Photo caption 5: The Permian is a convulsive time, with the appearance of reptiles which occupy many ecological niches. The end of this period bears witness to the largest extinction event ever seen on our planet. Illustration: Óscar Sanisidro.

Photo caption 6: The Triassic sees a new radication of animals and plants, with enormous amphibians, widespread equisetids, ferns and conifers and the appearance of a very important group: the archosaurs. Archosaurs have enjoyed great evolutionary success and given rise to various groups, such as the dinosaurs (including birds), flying reptiles and crocodiles. Illustration: Óscar Sanisidro.

4. MESOZOIC: the domain of the reptiles

The Mesozoic (“middle fauna”) era lasted some 185 million years. Both its beginning and end were marked by the most significant extinction events in the history of the biosphere. The Mesozoic started with the catastrophic close of the Permian and saw its own finale with a similar event: 66 million years ago, the impact of an asteroid on the surface of the Earth provoked a series of effects which resulted in another great extinction. Numerous groups of organisms were affected, especially in the oceans, although this episode is popularly known because it represented the extinction of the dinosaurs and of the marine and flying reptiles.

As previously mentioned, the start of the Triassic is distinguished by the great extinction which occurred at the end of the Permian. Coastal and purely marine environments alternated through the rest of the Triassic, and the fossil record in the Lleida Pyrenees, constituted mainly of marine invertebrates, fish and other marine reptile remains, was significant. For the periods which followed the Triassic, the Jurassic and the Cretaceous, the rocks we find are located south of the Pyrenees. Nearly all the Jurassic and Cretaceous rocks of the Pre-Pyrenees are of marine origin: practically the entirety of the 185 million years of the Mesozoic are represented, in Lleida, by limestone, pumices and marls formed on the bottom of the sea, and, therefore, the fossils we find in them are skeletons of marine animals (molluscs, brachiopods, sponges, corals, etc.). Nonetheless, two moments have been registered, in the early and late Cretaceous, in which the atmosphere changed in more continental environments, leaving an exceptional geological and palaeontological record.

The marine fauna of the Jurassic

The Jurassic presents a wealth of marine fauna, especially in the rocks which record the first part of this period. The marls and limestones of the early Jurassic, or Liassic, contain an abundance of invertebrate marine fauna. Particularly striking is the finding from the town of Alòs de Balaguer, in La Noguera. It consists in a set of vertebra belonging to a large marine reptile from the ichthyosaur ("fish lizard") group. These animals are predators, quite similar in morphology to today's dolphins, and they constitute a clear example of how the environment where an organism lives moulds its body until it adopts the most appropriate shape for moving and living in those conditions.

Photo caption 7: Lleida is home to Jurassic rocks with an excellent fossil record. During this period, Lleida was a sea of shallow waters where, at times, life proliferated abundantly. © 2021 Colorado Plateau Geosystems Inc.

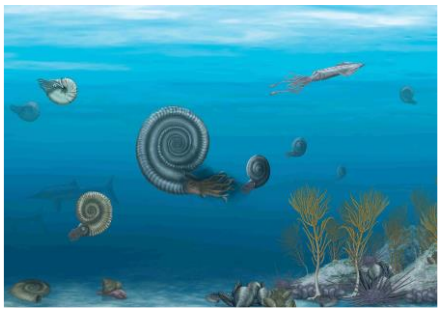

Photo caption 8: In this sea, there were dozens of invertebrate marine species, including groups of now-extinct cephalopods, like ammonites and belemnites. The remains of large marine reptiles, like ichthyosaurs, have also been found. Illustration: Roc Oliver.

The Cretaceous period

The extremely long period known as the Cretaceous is very well represented in the Lleida Pre-Pyrenean area. A good number of the main ranges and peaks are constituted, mainly, by Cretaceous rocks, among which limestones dominate. Most of these rocks were formed in platform environments, where the marine waters were close to the shore, warm and well-lit, at shallower depths. In Lleida we find important Cretaceous deposits of marine origin; for example, in the cols of Basturs (Isona and Conca Dellà), in Cabó or in the upper part of the Montsec range.

In the Montsec range, on the septentrional border of the county of La Noguera, exceptional palaeontological deposits have been preserved, known as the quarry of Meià and La Cabrua, which correspond to the old lithographic limestone mines abandoned in the 1910s. Geologists, palaeontologists and hobbyists, however, have continued returning to the quarries for decades, attracted by their fossil treasures, which consist in the remains of numerous species of plants, arthropods, fish amphibians, reptiles and birds which lived in the early Cretaceous, 130 to 125 million years ago, in a lagoon area of very calm waters quite close to the sea, in a tropical environment. The tranquillity of the waters enabled the exceptional conservation of the fossil remains and, in some cases, even the imprint of the soft parts of the organisms.

Photo caption 9: The widening of the north central Atlantic, as well as the opening of the Biscay Gulf, resulted in the individualisation of a small piece within the great plate puzzle: the Iberian plate or Iberia. © 2021 Colorado Plateau Geosystems Inc.

Photo caption 10: Right by the coast, where Montsec de Meià rises today, there was an extensive area of lakes. Many of the animals and plants that lived, as well as died, in their waters and banks were deposited on the muddy bottom, where they were fossilised. The special configuration of the lake (deep areas with no oxygen and a large supply of calcium carbonate) has permitted the exceptional conservation of these organisms. Illustration: Roc Oliver.

The end of the Mesozoic

In the Pre-Pyrenees, we also find the last chapter of the Cretaceous and, therefore, of the Mesozoic. The crisis of 66 million years ago, which was caused by the impact of an asteroid and represented one of the greatest extinction episodes in the history of life on Earth, is known by palaeontologists and geologists as the K/T boundary, from the German word *Kreide* (“creta”, the very abundant rock in the Cretaceous which serves as the period's namesake) and Tertiary, the period after the Cretaceous.

We find the K/T boundary recorded in the Pyrenean zone within the set of strata formed, primarily, by pumices, clays and limestones of continental origin, which constitute the Tremp or Garumnian Formation. These rocks contain the remains of the last dinosaurs of Europe and a whole series of organisms which lived alongside them. Particularly striking were the hadrosaurs, or duck-billed dinosaurs, animals which processed the vegetables which nourished them with an incredible battery of small, constantly regenerating teeth. In addition to the hadrosaurs, there were the giant titanosaurs, herbivores which, with a small head and an extraordinarily long neck and tail, could reach lengths of more than 20 metres. Other dinosaurs found in the rocks of the Garumnian are the nodosaurs, or armoured dinosaurs, and carnivorous dinosaurs of different sizes. These fantastic animals were accompanied by an abundance of fauna, including crocodiles, tortoises, flying reptiles, lizards, amphibians...

The plant deposits indicate a tropical climate, warm and humid, but with some phases of drought. The most recent strata of the Garumnian no longer conserve the remains of dinosaurs or the abundant life of their ecosystem, as these strata were formed after the great K/T boundary crisis. In these strata, fossil remains are scarce and speak to us of a world just beginning to recover from a great biological crisis.

Photo caption 11: The island of the dinosaurs. At the end of the Cretaceous, the Africa plate drifted north and pushed Iberia into the great Eurasian plate. This collision entailed the uprising and folding of a large volume of rocks, which ultimately formed the Pyrenean range. At the start of the folding, the emerged part of Iberia and part of today's France comprised a large island of the archipelago constituting southern Europe, where a whole series of rivers, lakes and deltas developed and became home to a wealth of fauna and flora.

Photo caption 12: Lleida conserves the best European deposits of the last ecosystems with dinosaurs, the ones which existed just before the fall of the large asteroid which caused the massive extinction event at the end of the Mesozoic. Illustration: Óscar Sanisidro.

5. PALEOGENE: the rise of mammals

After the major biological crisis of the end of the Cretaceous, which marked the end of the Mesozoic era as well, a new era began in which mammals took on a major role, especially in continental environments. It was the Cenozoic era or simply the Cenozoic ("new animals"). The Cenozoic is divided into three great periods: the Palaeogene, the oldest, and the Neogene and Quaternary, the most modern — although the latter has occasionally been included in the Neogene.

The protrusion of the Pyrenees, begun at the end of the Cretaceous as a result of the convergence of the Iberian plate and southern Europe, represented a drastic change in the geographical makeup of the peninsula's north. A vast arm of sea flowed into the Cantabrian zone and flooded the depressed region south of the Pyrenean range – that is, the entirety of the current Ebro Basin, which received contributions of tonnes of sediments from the surrounding mountain chains. Rivers and great lakes developed there, and the region was periodically submerged by the sea.

The Ilerdian, an exceptional record in El Pallars Jussà

The geological and palaeontological record of this period in Lleida is exceptional. We find fossil remains from the three epochs into which the Palaeogene is divided (from the oldest to the most modern: Palaeocene, Eocene and Oligocene). In the Pallars Jussà region, the record from the late Palaeocene and early Eocene is so complete and exceptional that a new

stage in Earth's history has been established: the Ilerdian. Effectively, not far from the city of Tremp, there appear a set of marine-originating strata which encompass a time lapse spanning 55.8 to 52.8 million years ago, with an extraordinarily complete geological record and exceptional fossil fauna. This exceptionalness led the Swiss geologists Lukas Hottinger and Hans Schaub, in 1960, to define this stage named after the Ilerda (Lleida) of yore.

The Eocene epoch

The continental Eocene has also released fossils of different types of vertebrates in deposits near the towns of La Pobla de Segur and Àger. The fauna content of these deposits includes diverse artiodactyl, perissodactyl, crocodile and primate species, and it reflects the great mammal diversification which occurred after the major extinction event 66 million years ago. After that point, numerous ecological niches were left free and were occupied by different mammal species.

At the end of the Eocene, there was the last entrance of marine waters into the great gulf which included current Central Catalonia. This flood enabled the development, in various spots, of coral reefs full of dozens of invertebrate species. They were warm waters, with a tropical climate, shallow and clear, ideal conditions for the proliferation of coral and other animals. The fossils that bear witness to this abundant biotic activity appear in a number of Pre-Pyrenean deposits, especially the sites located in the valley of Lord (Solsonès). Later, the marine gulf would be closed off by the Cantabrian zone and the waters would evaporate little by little until they disappeared. Evaporation caused the salts and chalks present in the waters to accumulate as sediment and form thick chalk formations, like the ones we can see north of Guissona. They are the last manifestation of marine waters in the current Ebro watershed.

The Oligocene and the end of the Palaeogene

The following period, the Oligocene, saw the establishment of what was already a strictly continental regime throughout the Ebro Basin. The climate was warm and humid, and both flora and fauna were abundant, as demonstrated by the extraordinary deposits surrounding the towns of Tàrrega and Cervera.

The rivers and lakes were home to communities of crocodiles and turtles that accompanied the diverse mammalian fauna, including, for example, the *Elomeryx*, one of the oldest known anthracotheres. The anthracotheres are an extinct group of semi-aquatic mammals which have been related to hippopotamuses and whales. We also find remains of *Entelodon*, an enormous omnivorous animal distantly related to pigs. The *Cainotherium* was a small artiodactyl (an animal with hooves and an even number of toes, like deer or pigs) which, due to its size and way of life, recalls a rabbit.

Photo caption 13: The sea's retreat from the Pyrenean zone toward the west and the upthrust of the Pyrenean mountain chain begin to give Lleida's geography an appearance which already seems familiar to us. © 2021 Colorado Plateau Geosystems Inc.

Photo caption 14: During the Eocene, areas of dense vegetation develop, similar to the jungles in existence now. It is in this environment where the first primates develop, along with other mammals, which will gradually configure a fauna that begins to resemble today's. Illustration: Mauricio Antón.

Photo caption 15: In the late Eocene and early Oligocene, marshy zones develop with an exuberance of forests and numerous mammal and reptile species. This is the environment revealed by the fossils of El Talladell and Cervera. Illustration: Mauricio Antón.

6. NEOGENE and QUATERNARY: the most modern periods in Earth's history

The last 23 million years of our planet's history have been divided into two periods: the Neogene and the Quaternary. The latter of the two is itself divided into the Pleistocene and Holocene and began 2.58 million years ago, with the first great ice age, which mainly affected the northern hemisphere.

In the final phases of the formation of the Pyrenees, the central part of Europe and the eastern Iberian peninsula undergo a period of extension. That is, a process representing the opposite of the compression which creates a mountain chain. This extension is translated into a series of faults and sunken areas (basins) where a great quantity of sediments ended up. The most famous of these basins are those of El Vallès, El Penedès or L'Empordà. But, surprisingly, mountainous areas also see the development of sunken zones surrounded by mountain chains. They are what geologists know as intramontane basins. It is the case, for example, of the basins of La Seu d'Urgell and La Cerdanya. In these depressed zones of the Pyrenees, there lived a great quantity of animal and plant species which we know thanks to a series of magnificent deposits, which have provided numerous fossils.

Both the animals and the plants are already quite similar to today's species. The flora indicates the existence, in that area, of a Mediterranean climate. The animals include horses (*Hipparion*), elephants, deer and also the hominid *Dryopithecus.*

The Pleistocene (2.58 million to 11,700 years ago) is characterised by a global cooling of the climate in the entire world, which results in significant ice accumulation in extensive continental areas and mountain ranges, especially in the northern hemisphere. For this reason, it is also known as the Ice Age. The Pyrenees were affected intensely by these glacial cycles (especially the last) and, in fact, we are currently in an interglacial cycle, that is, in a period of warm temperatures between two periods of ice. In Val d'Aran, the effect of the

glacial ice is seen clearly in the morphology of the valleys, lakes and high-mountain sediment deposits. The glacial valley of Hònt Hereda is an exceptional geological example of glacial morphology.

Photo caption 16: The vast extension of permanent ice which covered Europe at the end of the Pleistocene contributed to adding the penultimate touch to the territory's morphology, modelling mountains and valleys. © 2021 Colorado Plateau Geosystems Inc.

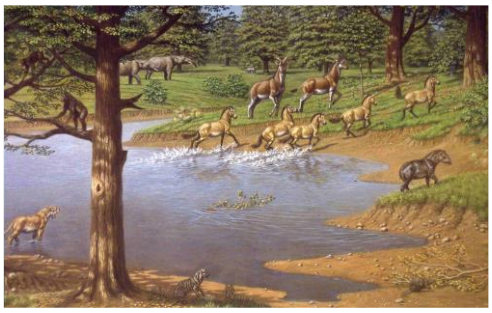

Photo caption 17: The Miocene sees the development of carnivores, elephants, horses and other forms of fauna quite similar to today’s, in an environment which gradually transitions from the savannah to a Mediterranean climate. Illustration: Mauricio Antón.

Photo caption 18: *Dryopithecus* is one of the first Simians discovered in Europe, approximately 11 million years old. It was adapted to the trees (hence the name of tree monkey) and had a frugivorous diet, based on fruits. The males presented well-developed canines, which points to aggressive behaviour between males and species, as in the case of modern primates. Illustration: Óscar Sanisidro.

7. ANTHROPOCENE: the effects of our presence on planet Earth

The impact of human activities on planet Earth generates a great deal of frequently worrying news on a daily basis. The uncontrolled exploitation of natural resources is provoking serious modifications in the environment, which could have harmful mid- and long-term effects: pollution, climate change, species extinction, invasive species, global pandemics... All these phenomena have to do, directly or indirectly, with human activity. Over the last few decades, the effects on the environment have accelerated and we are already beginning to see their worrying consequences.

The environmental changes provoked by human activity are of such magnitude that some scientists compare them to the environmental modifications which have entailed moments of change in geological time, whether of epoch, period or era. For this reason, and despite the fact that until now we have supposedly been living in the Holocene, the second period of the Quaternary, some scientists believe we are in a new period: the Anthropocene.

The fossil record of the Anthropocene

But are the changes produced by humanity really so radical that a change in geological stage can be established? What are the consequences of human activity?

There are many, but the most serious include: accelerated species extinction (at rates above those which occurred during the great extinction of the end of the Permian); levels of CO2 and methane in the atmosphere that lead to global climate warming; use of fertilisers which

have doubled the quantities of nitrogen and phosphorus in the soil; presence of plastics (frequently, in microscopic sizes) in all terrestrial ecosystems; deforestation; artificial modification of hydraulic ecosystems and the resulting abnormal distribution of sediments... All these consequences are leaving their mark, without a doubt, on the current geological record. It has been said that this mark will be easily recognisable for the geologists of the future and that the strata corresponding to the Anthropocene will be easy to identify, especially by the fossil record they will contain: technofossils (anything built using human technology: from a brick or a smartphone to a city). It has also been argued that chicken bones will represent typical Anthropocene fossils, given that the production of this animal, from the mid-20th century on, has grown massively to feed the whole world.

When does the Anthropocene begin?

Various beginnings have been proposed for the Anthropocene: the agricultural revolution 11,500 years ago, the start of the industrial revolution in the late 18th century, or the detonation of the first atomic bombs in the 1940s. There are even those who say the Anthropocene has yet to begin, given that, in the near future, the human impact on the Earth will be much greater than it is now, meaning then will be the time to declare the start of the new epoch.

The Anthropocene, however, has also kindled numerous doubts, both within the scientific world and among specialists from non-scientific branches. It has been argued that geological periods must be defined on a much larger scale and involve more evident changes. It has been pointed out, as well, that it is an anthropocentric term and, therefore, inappropriate, as it designates an interval of Earth's history referring, for the first time, to one species alone, we ourselves.

The purpose of the term Anthropocene should be to call our attention to the consequences of collective action and how we could, still, avoid the worst. It should be a warning for the world.

Quote: "The magnitude of what we are seeing in the sediments is as great, or even greater, than the one we saw to define other geological times in the past. From the mid-20th century

onwards, human impact has become a global, synchronous and accelerated phenomenon all over the world." Anthropocene Working Group, AWG.

8. PIONEERS

Lluís Marià Vidal Carreras (Barcelona, 1842 – 1922)

Mining engineer, geologist and pioneer photographer. While attending the Mining University of Madrid, in addition studying geology, he gained an interest in palaeontology and prehistory. After holding various professional positions, in 1888 he was sent to the province of Lleida as the head of mining resources, and around 1909, he directed the Commission for the Geological Map of Spain.

He was a member of numerous national and international scientific associations, serving as the president of the Hiking Club of Catalonia, the Barcelonian Aethaeneum and the Royal Academy of Arts and Sciences of Barcelona, an honorary member of the Natural Sciences Board of Barcelona and the vice president of the Geological Society of France.

He was a pioneer in mountain photography. He took what could be considered the oldest photographs of the southern sector of the Pyrenees, Val d'Aran and Andorra.

From his extensive body of work, particularly striking are the projects dedicated to the Catalan regions, especially his work on the demarcation of Lleida. In 1875, he published one of his great dissertations, *Geología de la provincia de Lérida* (geology of the province of Lleida), in which he presents a study covering a significant portion of the current Tremp-Montsec Unesco World Geopark.

Francesc Clua Anglès (Cubells, 1847 – Tàrrega, 1920)

Naturalist, writer, painter and prominent advocate for Catalan identity in Tàrrega. He was the founder of the Hiking Club of L'Urgell and La Segarra and a pioneer of scientific hiking in Catalonia. After marrying Filomena Terés, the daughter of a prestigious Tàrrega family, he moved to Tàrrega. He explored and collected fossils in El Talladell and publicised his findings. He collaborated with various institutions and scientists of the period, including

Charles Depéret, Lluís Marià Vidal and Norbert Font i Sagué. It was the latter's influence which led him, in 1908, to be appointed collector of the Martorell Museum in Barcelona.

Martí Madern Carreras (Cabanes, Alt Empordà, 1896 – Cervera, 1975)

Scholar of the Oligocene fossil flora of La Segarra. He was certified as a primary school instructor in Figueres. He joined the civil telegraph service and was sent to Cervera in the early 1920s. There, he juggled his job as head telegrapher with teaching high school students.

After the Civil War, the Oligocene limestone deposits around Cervera began to be tapped into for the production of cement. From that point on, he was able to pursue his great passion: the collection and study of the fossil flora preserved in these limestone formations. He collaborated with Josep Ramon Bataller, of the University of Barcelona, and Georges Depape, of the Free University of Lille in France, to whom he provided the material for the publication, in 1950, of *Flore Oligocène de Cervera (Catalogne)*. He published numerous notes disseminating knowledge on this flora, frequently in area magazines.

Madern was a great expert. He was deeply knowledgeable in natural history, mathematics, French and grammar, and he was a dedicated teacher. He also stood out for his knowledge of philatelics and meteorology. He kept in contact with the editors of the newspaper *La Vanguardia*, to whom he provided daily information on the meteorological conditions of the county of La Segarra.

Lluís Ferrer Condal (Barcelona, 1914 – 2011)

Physician, scholar and palaeontology enthusiast. When the years of mining the Meià quarry were over, and after the Civil War, this Lower Cretaceous site on Montsec was forgotten by a portion of the scientific world. In the early 1950s, interest in the findings was revived anew thanks to the selfless effort of Lluís Ferrer i Condal. He visited the quarry for the first time in 1950, while exercising as a doctor in the town of Salàs de Pallars. His enthusiasm led him to make countless weekend visits to the site, and he eventually compiled an important collection. Among its most remarkable pieces, there is a nearly complete frog (Eodiscoglossus santonjae) and the feather of a bird. He collaborated with numerous

researchers, in both the national and international sphere, to whom he gave tours of the site and provided pieces from his collection to study.

Manuel Riu Riu (Manresa, 1929 – Sant Llorenç de Morunys, 2011)

Historian and archaeologist, specialist in medieval history. Since childhood, he had a close relationship with Sant Llorenç de Morunys, where he had family roots on both his mother's and father's side. There, he spent nearly all his holidays and the Civil War. He was also very familiar with the county of Berguedà, as he completed his military service there and his wife was from Berga.

Riu was a pioneer in Europe when it came to introducing archaeological methods to the study of history, and he conducted a large number of excavations in the valley of Lord (Solsonès) and Berguedà. Implicated in numerous cultural associations, he was the heart and soul of the Lord Valley Interpretation Centre and Museum, which he inaugurated in 1947 with other town inhabitants and to which he provided a significant number of pieces.

He was also interested in palaeontology and he amassed a specimen collection from multiple geological ages, especially from the Priabonian Stage of the Eocene, which appears in extensive areas of the valley of Lord. This collection is stored and partially displayed at the Lord Valley Interpretation Centre and Museum.

Sant Llorenç de Morunys declared him an adopted town native. In 2003, he received the Catalan government's Cross of Saint George and in 2006, the City of Berga Prize for Culture.

Josep Duró Farràs (La Seu d'Urgell, 1928 – Andorra la Vella, 2000)

After graduating in medicine and surgery from the University of Barcelona, he immediately began working as a doctor in Sant Julià de Lòria i Canillo, Andorra. His father, Emili Duró Moles, was also a doctor.

Appointed Health Director of Andorra, he introduced compulsory school vaccination and annual pulmonary x-rays for the students of all the country's educational systems. He was an advocate of controlling population growth and the first to conduct regular analyses of all the country's water sources. He also exercised as a forensic physician for the General Council of the Valleys of Andorra.

A lover of palaeontology, he compiled a collection of Neogene fossils in L'Alt Urgell and La Cerdanya, which his family donated to the Catalan Palaeontology Institute. Part of this collection is exhibited, today, at the Dinosphere Musuem in Coll de Nargó.

His hobby started at a young age, when he discovered some fossils very close to La Seu d'Urgell. Years later, in a spot near Alàs, he came across a pair of mastodon tusks, and until the time of his death he continued to insist the whole animal had to be buried there. Over the years, it was discovered that L'Alt Urgell contained many ideal sites for conducting palaeontology studies, especially in Coll de Nargó. At around age 40, an accidental fall rendered him unable to continue practising in situ one of the activities he liked best: palaeontology.

A big cinema fan, he filmed institutional and recreational events, compiling an 8 mm film collection currently stored at the National Archive of Andorra.

A car-racing enthusiast as well, he won numerous trophies. For many years he was a doctor of the Andorra Automobile Club.

Maria Lourdes Casanovas Cladellas (Sabadell, 1934)

Palaeontology. She studied with the Sabadell palaeontologist Miquel Crusafont and earned her PhD in 1975 from the University of Barcelona, where she taught for four years. Her field of research includes the mammals of the Palaeogene (Eocene), primarily the ones found at the archaeological sites of Pallars Jussà and La Noguera. Along with her husband, the doctor Josep Vicenç Santafé, she introduced palaeoichnology (the study of trace fossils) to the Spanish state. Working as a team with J. V. Santafé and other palaeontologists, she completed an important body of research on the dinosaur sites of the Iberian Peninsula. She is the author of numerous scientific and nonfiction articles.

Josep Vicenç Santafé Llopis (Valencia, 1934 – Sant Quirze del Vallès, 2017)

Palaeontologist and politician. He worked as a primary school teacher in the Pious Schools of Sabadell. An amateur palaeontologist, he was a collaborator of the Sabadell City Museum, the embryo of what was to become the Sabadell Palaeontology Institute (the current Catalan Palaeontology Institute). Along with his wife, Dr M. L. Casanovas, he studied geology at the University of Barcelona in the 1960s, and in 1976, he obtained a civil service position from

the Barcelona provincial government and was assigned to the Catalan Palaeontology Institute. Two years later he submitted his doctoral thesis, dedicated to the study of rhinoceros fossils in Spain.

Along with Dr M. L. Casanovas and Drs Sebastià Calzada (of the Seminary Museum in Barcelona) and José Luis Sanz (of the Autonomous University of Madrid), he spearheaded the study of dinosaurs in the Spanish state. Out of the many areas where he worked, of particular note is the group of archaeological sites with dinosaur tracks in La Rioja, the Lower Cretaceous sites in Valencia, and, above all, the Late Cretaceous sites in the Lleida Pyrenees. He was the author of numerous scientific publications and nonfiction books on palaeontology. He served on the town council in Sant Quirze del Vallès.

Antoni Lacasa i Ruiz (Lleida, 1946)

A driving force, in the decade of the seventies, behind the Friends of Palaeontology group, along with Eduard Remacha and Josep Esteve. This group was absorbed by the Institut d'Estudis Ilerdencs (institute for Lleida-themed research) in 1977, and, together, they launched the first campaign to the Meià quarry archaeological site, in 1979. Although the primary purpose of this expedition was the classic quarry, most excavations took place at the Cabrua site, an outcrop already mentioned by other authors.

He actively participated in the 19 excavation campaigns which took place at these two sites until 1996. In addition, he took part in surveys and excavations in other outcrops, primarily from the Mesozoic Era, and, along with his colleagues from the association, was responsible for the palaeontology collection of the Institut d'Estudis Ilerdencs, which currently contains over 5,000 specimens.

He has written numerous scientific articles and nonfiction books on geology and palaeontology in Lleida, especially on the lithographic limestone fossils of Montsec, and he has served as an advisor and coordinator of the Geology and Palaeontology Section of the Institut d'Estudis Ilerdencs.