3RD INTERNATIONAL MEETING OF EARLY-STAGED RESEARCHERS IN PALAEONTOLOGY

KRASIEJÓW (OPOLE VOIVODESHIP, POLAND),
MAY 18 – 21, 2018

ABSTRACT BOOK

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ABOUT THE CONFERENCE LOGO

Logo designed by Klaudia Kardynał.

As you may know, Poland is divided into sixteen districts named voivodeships – in view of the fact that the conference will be held in the Opole region, we have decided to create a logo to reflect this, as in previous years. The logo illustrates the contours of Opole Voivodeship, filled in with the local colours, yellow and blue. In addition, it depicts the local 'VIP', the dinosauriform *Silesaurus opolensis* that was unearthed from Upper Triassic strata.

EDITORS

DOROTA KONIETZKO-MEIER, ELENA JAGT-YAZYKOVA,
JOHN JAGT, ELŻBIETA M. TESCHNER

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INVITED SPEAKERS

Carole T. Gee – Bonn University, Germany

John W.M. Jagt – Natuurhistorisch Museum Maastricht, the Netherlands

Martin Košťák – Charles University Prague, Czech Republic

Dick Mol – Natural History Museum Rotterdam the Netherlands

Eric Mulder – Museum Natura Docet Wonderryck Twente, the Netherlands

SOFT SKILLS IN SCIENCE: PUBLISH AND FLOURISH, NETWORKING, AND THE NUTS AND BOLTS OF GIVING A GREAT TALK

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In today's world of global science, rapid communication, and social media, soft skills in science are more important than ever, for effective communication skills are essential for showcasing good research and a smart, savvy scientist. *Soft skills* are the personal attributes that one needs to thrive in a work environment. For many jobs, these capabilities include a multitude of personality traits such as verbal, nonverbal, and writing skills, critical thinking, a positive attitude, adaptability, conflict management skills, and a strong work ethic. For early-stage researchers in paleontology, there are additional skills that can prove to be advantageous to establishing a scholarly career, all of which can be learned and practiced. Here I identify three major areas that will be discussed in this keynote lecture and offer a brief list of "Dos and Don'ts."

Publish and flourish. While most stressed-out scientists think of it as "Publish or perish," the pressure to publish scientific work can be looked at from a more positive point of view. Writing a scientific manuscript, submission of the manuscript to a good journal, and follow-through on the publication process can be enjoyable stages of completing a scientific study. Assuming that an early-stage researcher has well-preserved fossil material, a fresh or innovative approach, solid results, and fascinating issues for discussion, there are several other points to keep in mind in regard to publishing a great, widely cited paper.

- Publish in the international language of science, English.
- Survey journals in your research discipline and target an international journal with a sterling reputation and as high an impact factor as possible.
- Check to see that the aims and scope of your study match those of the journal.

- Tailor the speciality level of discourse in your manuscript to your audience—the readers of that journal.
- Because it is the most widely read part of your study, make your title catchy, yet informative. You can use linguistic devices such as a hanging title, a question mark, alliteration, sibilance, or imagery to pique interest.
- The second most widely read part, the abstract, needs to be interesting, informative, and well written; a good model is the "*Nature* paragraph summary," available at https://cbs.umn.edu/sites/cbs.umn.edu/files/public/downloads/Annotated_Nature_abstract.pdf.
- Adhere to the formal structure of a scientific paper, namely, IMRAD+C (this mnemonic device will be explained during my keynote).
- Start all paragraphs in your text with a strong topic sentence.
- Lastly, re-read the Guidelines to Authors of your targeted journal and follow all instructions as closely as possible before online submission.

Networking. Interacting with others on a personal level to exchange information and establish contacts, particularly at scientific conferences, can boost your career and be personally satisfying. At the very least, making new friends will make this meeting, as well as future ones, more enjoyable. I call this the art of making scientific small talk. Small talk exchanges have a beginning ("Hi, my name is . . ."), a middle ("I really liked your talk and want to ask you about . . ."), and an end ("Oh, the session is starting up again—see you at the icebreaker tonight!"). If you are shy, you can think of phrases in advance and rehearse them before going to social events and mingling at coffee breaks. Your goal is to build a circle of friends, acquaintances, and scientific allies of age cohorts (students at your same level) and of older scientists who may turn out to be your next supervisor, reviewer, or employer.

The nuts and bolts of giving a great talk. A single excellent talk given at an international meeting can make a huge impact on your visibility, reputation, and popularity in the global community. Here are the nuts and bolts, or practical tips, for giving a memorable talk.

- Make the title of your talk catchy, too. A talk title can be flashier, but any humor should be dry, which means that it should be funny for its intellectual content.
- Follow the IMRAD+C structure of a paper.

- Carefully construct your talk to follow the excitement curve, with a flashy beginning and a flashier ending, with a shallow valley between them.
- Think big, bold, and colorful when designing all of your slides.
- Put only one idea or concept on each slide.
- If you want to present more complex ideas or relationships, then layer the ideas one by one, using a series of slides instead of complex animation.
- Each slide should include at least a small but an appropriate image, even if you have to present mostly text.
- Prepare for the worst-case physical conditions, such as a room that is too bright (resulting in low contrast in your slides) or one that is too wide or too long (your lettering will appear too small on the slides).
- This means that there should be good contrast between font color and background color, but the contrast should not be too strong, that is, not a white font on a stark black background or vice versa.
- Standard Powerpoint aspect ratio is 4:3, not 16:9.
- A sans serif font such as Arial is the most legible.
- Font style should be the same in all your slides.
- Use large font sizes, for example, Arial 36 pt. or larger for slide titles, 24 pt. for bullet-point lists, 18 pt. for labels, and 14 pt. for photo credits.
- Two-channel communication means that the images and text on your slides should back up your spoken information; the audience should hear it and read it at the same time.
- Stay just under your time limit to avoid public embarrassment and unprofessionalism.
- Practice, practice, practice your talk in advance to get the timing down to the exact minute. Multiple rehearsals will also help you to roll out your ideas in a smooth way and to get your wording down pat.
- Remember my metaphor being on the roller coaster. It’s too late now, just enjoy the ride.
- Smile and give a great talk.

BLOOD-THIRSTY LIZARDS IN THE WORLD'S OCEANS – 92- TO 66-MILLION-YEAR OLD MOSASAURS

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The first fossilised remains of enigmatic animals, for which much later the name **Mosasauridae** (superfamily Mosasauroidea; Squamata) was coined, were unearthed from subterranean galleries to the south of the city of Maastricht in southern Limburg (the Netherlands) in the latter half of the 18th century. Today, much progress has been made in our knowledge of this diverse and long-lived group of marine lizards with paddle-like limbs that radiated into aquatic environments around the globe during the early Late Cretaceous (middle Turonian, *c*. 92 Ma) and died out abruptly at the Cretaceous-Paleogene (K/Pg boundary), 66 myr ago. They inhabited a wide range of marine settings of varying water depths, including shorelines, estuaries, shallow epicontinental seas and deep-water, open pelagic zones.

Figure 1: *Engraving depicting the recovery (October 1778) of the type specimen of Mosasaurus hoffmanni from subterranean galleries of the Sint-Pietersberg, Maastricht, the Netherlands (from: Faujas de Saint-Fond, 1799-1803).*

Most recently, even mosasaur remains from freshwater settings have been recorded from Hungary and France and it would thus appear that they were more than occasional migrants also in rivers and streams. All in all, in less than 10 million years' time,

mosasaurs underwent a major adaptive radiation (four subfamilies: Mosasaurinae, Halisaurinae, Plioplatecarpinae and Tylosaurinae), evolving from terrestrial and/or semi-aquatic ancestral forms (Cenomanian-earliest Turonian) to obligatorily aquatic, giant-bodied, marine lizards with a near-global distribution. By the end of the Turonian Stage, there were representatives of six genera.

Figure 2: *HJ Excavation of the holotype of Prognathodon saturator, nicknamed Bèr; ENCI quarry, Maastricht (1999-2000) (photograph: NHMM).*

Close to their demise at the K/Pg boundary, 10 genera are documented, clearly indicating that mosasaurs were 'alive and kicking' and that their extirpation was more or less instantaneous.
Recent research, carried out by a relatively small group of palaeontologists and biologists (who meet every 3 or 4 years to discuss these fascinating creatures), has focused on alpha taxonomy with some cleaning up having been done), their distribution in particular areas as linked to upwelling along continental margins (e.g., Morocco, Angola), success stories of actively swimming species such as *Mosasaurus hoffmanni*, ecological niches occupied (tooth form, dentition types, isotopes in tooth enamel, dietary requirements) and trophic structures. In addition, finds of several exquisitely preserved skeletons have allowed insights into (contours of) skin and scales, but also internal organs and cartilaginous oesophagus rings and even skin pigmentation. Other anatomical features, such as sclerotic rings, tooth replacement patterns and skull design related to eye size, have also been considered in recent years.
All in all, we now have a much better picture of mosasaur anatomy, their geographical and stratigraphical distribution and their place in Late Cretaceous ecosystems, but more remains to be discovered. During this talk some of the most appealing discoveries of late will be shown, complemented with data on a number of recent finds

from in the Maastricht area, the birthplace of mosasaurs, and on the public appeal they are having in the region

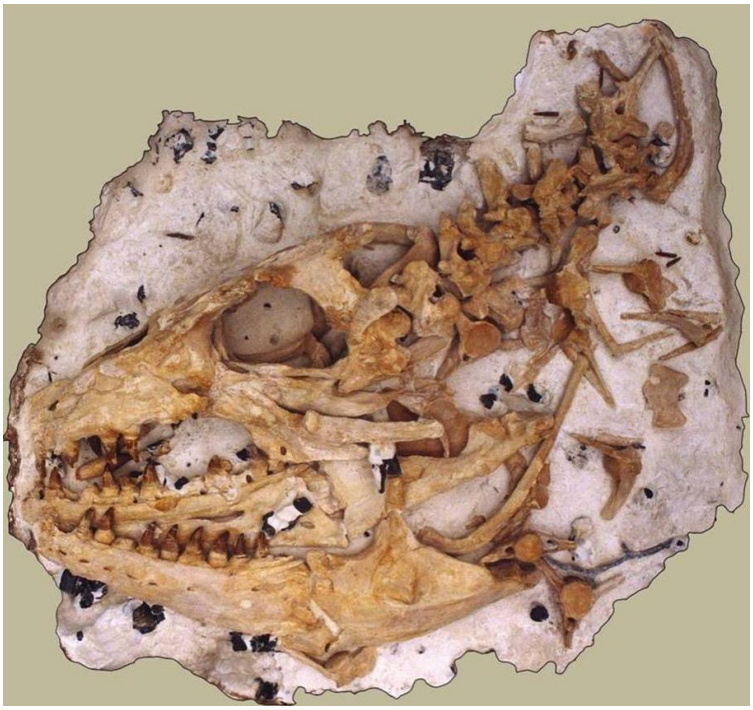

Figure 3: *The skull of the holotype of Prognathodon saturator, now residing in a specially designed 'Mosaleum' on the inner square of the Natuurhistorisch Museum Maastricht (photograph: S. Graatsma).*

Figure 4: *Bèr's skull and skeleton in aluminium on the A2 motorway tunnel wall (exit) near 'de Geusselt' in the northern outskirts of Maastricht (photograph: NHMM).*

EXTINCT COLEOID CEPHALOPODS AS NATURAL ARCHIVES

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Coleoid cephalopods (subclass Coleoidea; with more or less developed internal shells) rank amongst the rather rarer of extinct invertebrates, with the exception of two prominent groups: belemnites (order Belemnitida) and, in part, sepiids (order Sepiida). Both groups originated during the Mesozoic and, while belemnites became extinct at the end of the Cretaceous, sepiids survived the Cretaceous-Paleogene (K/Pg) boundary and started their diversification during the Paleogene.

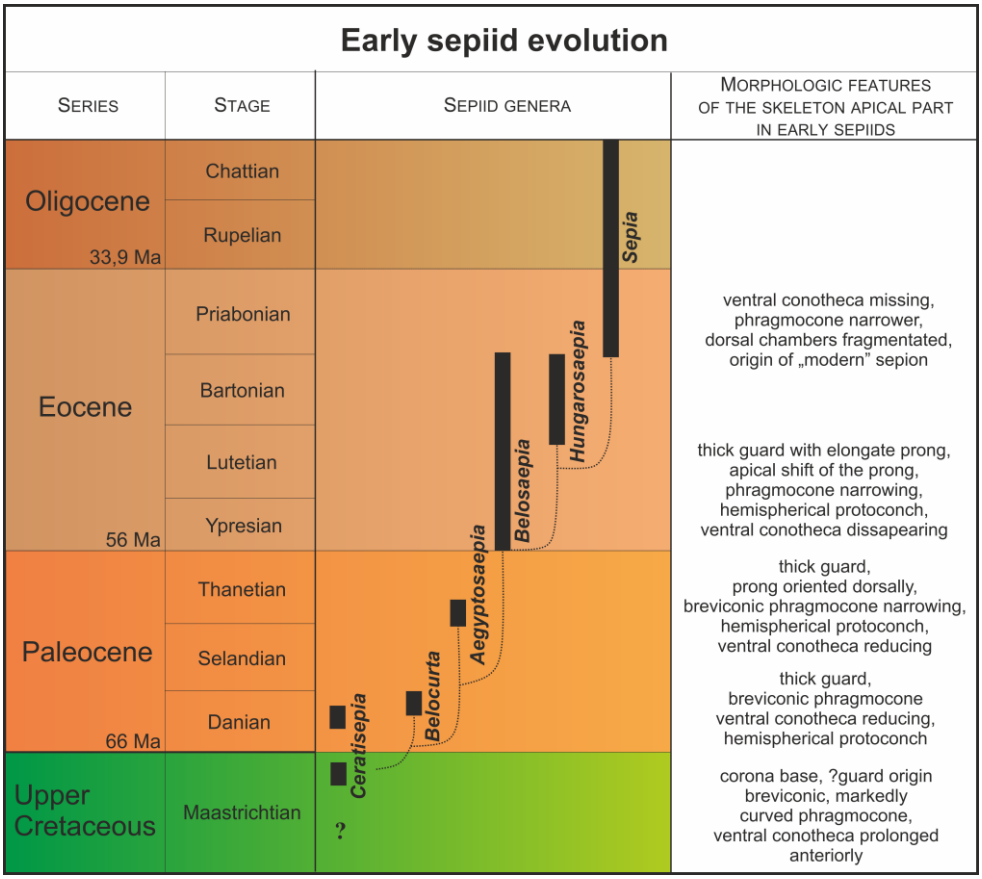

Figure 1: *Stratigraphical distribution of early sepiid genera and their phylogenetic relationships (Košťák et al., 2013).*

Belemnites are commonly used for biostratigraphy, palaeobiogeography and palaeoecology. Moreover, their calcitic rostra provide geochemical standards for oxygen stable isotopes ($\delta^{18}O$ – PDB [Peedee Belemnite] standard) and carbon stable isotope data ($\delta^{13}C$) can be applied in stratigraphical calibrations and palaeoecology. Therefore, they play a key role in interpretations of Mesozoic ocean palaeoclimates. Even more importantly, also strontium isotope data ($^{87}Sr/^{86}Sr$) can be extracted from their internal shells. Sr isotope values varied significantly during the Jurasssic and Cretaceous. In this respect, these data can also be used for direct chronological calibrations and correlations (for example, the last remaining boundary between systems, i.e., the Jurassic-Cretaceous [J/K] boundary).

Sepiid coleoids (ancestors of Recent cuttlefish) are less frequently used in palaeoecology. However, their palaeobiogeography and migratory routes are of prime importance for molecular analyses and phylogeny. Finally, recently discovered soft tissues of fossil cuttlefish have made significant contributions to help solve the problem concerning both microbody origin and melanin resistance in deep (geological) time.

THE MASTODONS OF MILIA (GREVENA, NORTHERN GREECE): THE LONGEST TUSKS IN THE WORLD

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Introduction

Palaeontological research and systematic excavations in the area of Milia, near Grevena (northern Greece) were initiated in 1996 by the Aristotle University of Thessaloniki, following the find of a partial skeleton of Borson's mastodon, *Mammut borsoni* (Hays, 1834), which was unearthed from unconsolidated sandy deposits of the River Aliakmon. The fragmentary skeleton includes portions of the skull with molars and very long tusks, measuring up to 4.39 metres – a real sensation! In 2007, the so-called Milia team from Thessaloniki recovered a second, more poorly preserved partial skeleton of a large and heavily built *Mammut borsoni*. Measurements along the outer margin of the gently curved tusks were 4.58 m and 5.02 m, respectively. This pair of tusks constitute the longest tusks ever discovered in the world. The specimen is identified as an adult male in the prime of his life. Both partial skeletons, from 1996 and 2007, have been identified as males, based on the large size of bones and tusks. In proboscideans, male individuals develop larger tusks than females.

Figure 1: *Start of the excavation, July 2007.*

The 2007 excavation

The excavations of the second partial skeleton of Borson's mastodon, with extremely long tusks, at Milia in the summer of 2007 attracted global media attention. Why? Well, it was not because of the extreme conditions (40 degrees Celsius) under which the Milia team worked at the sand pit. Initially a huge excavator removed large quantities of sand so that the layers with the fossil remains of some 3 million years in age could be more rapidly reached. The team excavated the remains of this huge pachyderm from strata laid down by a high-energy river. Some of the bones have been lost, probably washed away by the river at the time. But, the true icons of the mastodon, its long upper tusks (in excess of 5 metres) behaved as a barrier on the river bed and in this manner 'caught' many elements of the skeleton.

It was the uniqueness of the finds that shed light onto the size of these mastodons. Never before had such partial skeletons been found anywhere in the world. For the first time, it was now possible to calculate the size and weight of these extinct creatures. But, the new discoveries also begged new questions. How could animals manoeuvre in a wooded area with such extreme long tusks?

The Milia fossils are considered to be palaeontological heritage. As such, they have been studied by scientists from all over the world. The tusks and skeletal parts have been assessed, published and put on display. In 2014, the Milia mastodons brought the palaeontological community that is concerned with proboscideans to northern Greece. More than 150 scientists from almost 40 countries attended the International Conference on Mammoths and their Relatives (ICMR) at Grevena and Siatista.

Figure 2: *The international Milia team next to the longest tusks in the world.*

Two different species of mastodons

Remains of two different species of mastodons are known from Milia; Borson's Mastodon (*Mammut borsoni*) and the Auvergne Mastodon (*Anancus arvernensis* (Croizet & Jobert, 1828)). These two species probably co-occurred here about 3 to 3,5 million years ago.

Mammut borsoni is the largest known species of mastodons. It was described for the first time in 1834, on the basis of a single molar which displays the typical, comb-shaped ridges. The animal was very sturdy, with bulls attaining shoulder heights of almost 4 metres and often developing enormous tusks.

Anancus arvernensis was relatively small and equipped with very slightly curved tusks (the genus name, *Anancus*, literally means 'without a curve'). The average shoulder height of this species did not exceed 2,40 metres and, like other proboscideans, there was a rather marked sexual dimorphism. Overall, bulls were much larger, as were their tusks.

Mammut borsoni is a "zygodon mastodon", because this type of mastodon species had molars with comb-shaped ridges. The dentition was a perfect instrument to tear and grind food items such as twigs from shrubs and trees. The upper jaw tusks, formally referred to as "incisives", are not covered with enamel. These tusks are almost straight and slightly bent upwards at the tip. The lower jaw has a receding chin with incisives as well. These lower tusks are significantly smaller than those in the upper jaw.

Anancus arvernensis is a "bunodont mastodon" having molars with blunt dental knobs, suggesting that this animal had a diet of softer food, including leaves, fruits and small twigs. The relatively small and barely curved tusks are also characteristic of this species. In addition, the lower jaws did not always have tusks.

In the small Natural History Museum of Milia near Grevena, the outcome of the 1996-2018 scientific investigations and excavations at the sand pit of Milia has been put on display. The museum shows the public a long-vanished environment (some 3-3,5 million years ago) with impressive creatures such as mastodons equipped with tusks up to 5 metres in length! The Guinness World Record of the longest tusks, ever discovered in the world, can be seen right here!

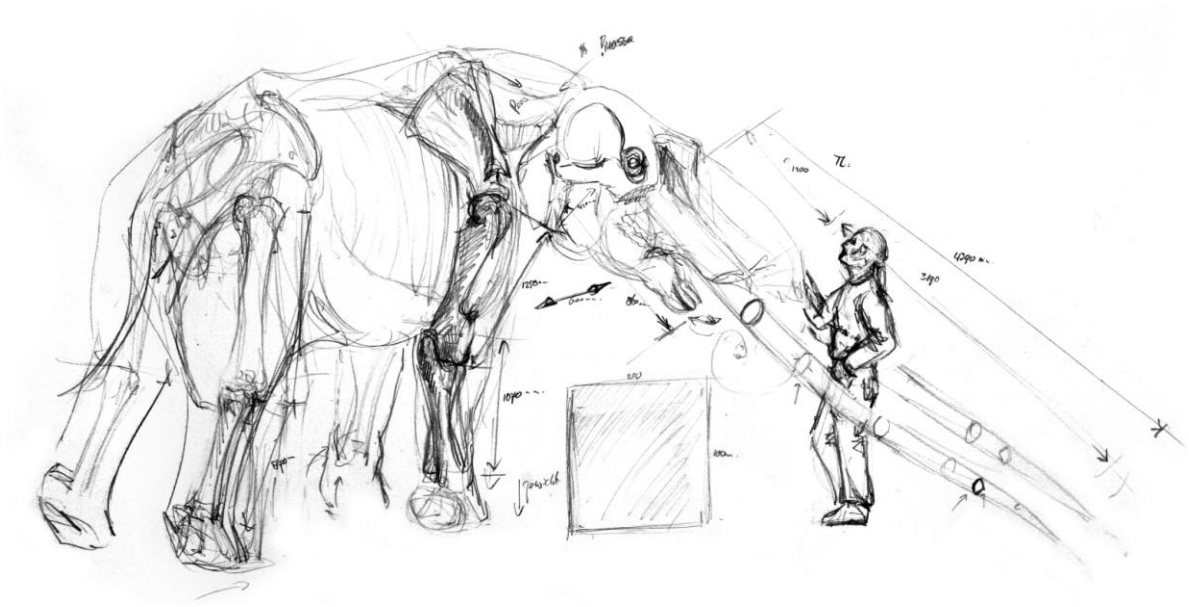

Figure 3: *Start of the reconstruction of Mammut borsoni, Borson's mastodon, by the Dutch artist Remie Bakker, based on scientific data.*

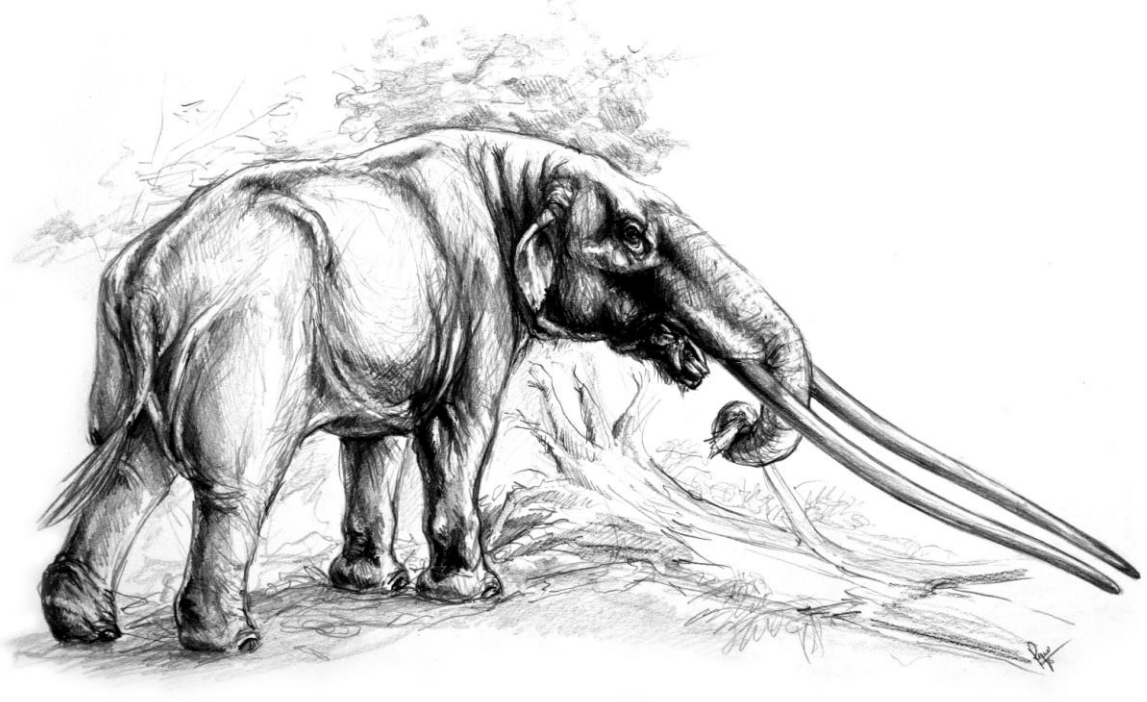

Figure 4: *Reconstruction (by Remie Bakker) of Mammut borsoni, based on discoveries at Milia (Grevena, northern Greece).*

FROM FISH HEAD TO HUMAN SKULL: A CLOSER LOOK AT AN EVOLUTIONARY PROCESS

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Evolution is the biological term to define the process of change in all forms of life from generation to generation, ultimately culminating in new species. DNA (**D**eoxyribo**N**ucleic **A**cid) is the key molecule that makes this process possible. It is the blue print for (embryonic) development, form and function of all organisms. Changes (mutations) in DNA-molecules cause alterations in appearances and in properties of the organisms concerned. These alterations may turn out to be favourable in a changing environment. The result is an “origin of (new) species by means of natural selection”, as formulated by the most famous biologist of all times, Charles Robert Darwin (1809-1882). His evolutionary theory was published in 1859. This was an enormous achievement, taking into account that Darwin did not know anything about DNA molecular biology.

Figure 1: *Our auditory canal and Eustachian tube are derived from a gill opening of an ancient jawless fish.*

Quite recently, it has become apparent that within a developing embryo, chemical gradients affect the expression of genes (parts of DNA). This is how the differentiation of embryonic tissues is realised: head-tail orientation, the forming of a head, etc. It is appealing how molecular biological studies of, for instance, the origin of limbs has helped us understand the anatomy of the paired fins of a Palaeozoic lobe-finned fish and to grasp how the evolutionary process from fin to limb took place. This synthesis of embryology and palaeontology is called evolutionary developmental biology; in short “evodevo”. It is a hot item in modern-day natural sciences.

However, a relationship between embryology and evolutionary biology was already established in the nineteenth century. If we refer to Charles Darwin as “the pope of evolution”, then we can regard the German zoologist Ernst Haeckel (1834-1919) to have been “more Roman than the Pope”. As a contemporary, he was after all Darwin’s advocate in mainland Europe. Inspired by others, Haeckel formulated his so-called “biogenetic law” in 1866. This law states that, 'Ontogeny is a recapitulation of phylogeny.' This means that the embryonic development of a living vertebrate is a summary of the evolution of the vertebrate group [phylum] as a whole. In other words, and looking at ourselves: the embryonic development is a summary of the sequence of this series: fish - amphibian - reptile - mammal.

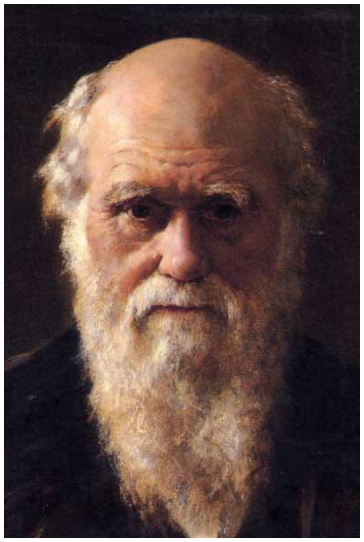

Figure 2: *Charles Darwin (1809-1882)*

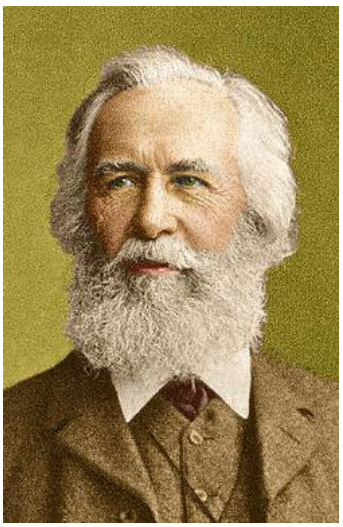

Figure 3: *Ernst Haeckel (1834-1919)*

Haeckel's Law can be tested by taking a closer look at a selection of major cranial changes in the evolutionary pathway from fish head to human skull.

The first bony tissue

The skeleton of the oldest vertebrates (jawless "fishes") consisted of cartilage. The skull for holding the brain (the neurocranium) was cartilaginous. This ancient type of skull is retained by extant sharks and rays. But, during the early evolution of the vertebrates there was selective pressure to develop a bony armour, a product of the ectoderm. This was the first step towards the development of a real skull. The ecological driver was the presence of invertebrate predators, such as *Anomalocaris*, eurypterids and nautiloids that were already present in Cambrian and Ordovician seas. The bony armour covering the ancient vertebrate head is known as dermatocranium. Thus, early vertebrates (jawless "fishes", ray-finned and lobe-finned fishes) from the Silurian and Devonian had a two-layered skull: a neurocranium covered by a dermatocranium. Remnants of these two layers can still be seen in the human skull: the skull base consists of neurocranial elements, while the braincase is derived from the dermatocranium.

From gill arch to jaw

The jawless ancestors of sharks and rays, ray-finned and lobe-finned fishes and tetrapods had under their neurocranium a whole series of gill openings that were supported by gill arches. The first jaw evolved because of a major mutation in the gene complex that controlled the formation of the gill openings and their supporting gill arches. The jaw originated from the third arch. The fourth arch was affected as well: the upper part became the stapes (one of the auditory ossicles) in tetrapods. The third gill opening, originally bounded by the third and fourth gill arch, lost its function. It became the spiraculum in sharks and rays, and the auditory canal and Eustachian tube in tetrapods.

During the embryonic development of tetrapods a first step towards a pharyngeal (mouth-throat) cavity with a gill system was formed, but the primordial gill grooves would not open. This still holds true for extant tetrapods. Improbable as the evolution of the jaw may seem at first glance: evolution repeated itself. The extant moray eel has only one gill arch left. It is provided with teeth and it is functional as a second (pharyngeal) jaw!

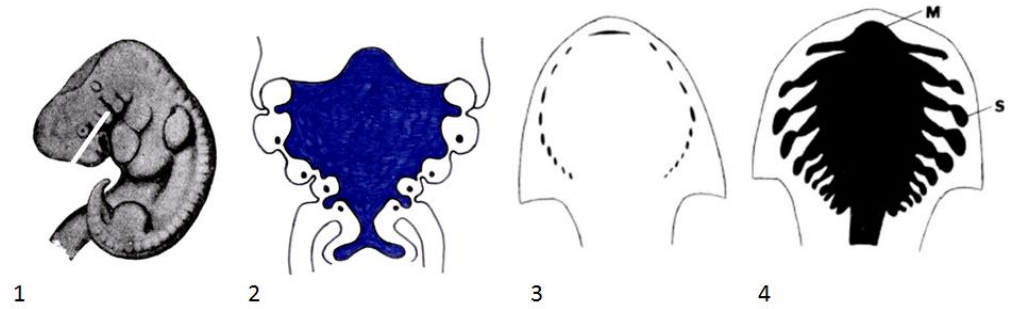

Figure 4: *1: Human embryo of about four weeks old, with a length of 7 mm (From Hertwig, 1920). Oblique line indicates pharyngeal (mouth-throat) section. 2: Cross section through the pharyngeal cavity of a human embryo, about four weeks old. The four pairs of pharyngeal pouches and external gill grooves are visible, bounded by the gill arches. Note the cross sections of blood vessels in the gill arches. At the bottom, the primordial lungs are situated. 3: Ventral view of the head of an ostracoderm, a jawless "fish" from the Devonian period, about 400 million years ago. Except for the mouth, a large number of gill openings are visible. 4: Pharyngeal cavity after removal of the ventral bony plates, m: mouth, s: spiraculum (3 and 4 from Romer, 1962, adapted). Embryo and ostracoderm not to scale.*

The origin of the neck

In fishes, the pectoral girdle can be considered as part of the head, because the structure is covered by the edge of the gill lid, with the operculum as main component. During the transition from lobe-finned fish to tetrapod, the gill lid disappeared. Therefore the connection between the head and the pectoral girdle was lost; hence the neck was formed. A major evolutionary advantage is that the head will not be shaken by every step that is taken. Thanks to the vestibular system (for equilibrium), every tetrapod can anticipate the inevitable shocks while walking. Moreover, in the course of evolution the scapula became proportionately much larger and heavier. It became important as an attachment point for the foreleg, which developed from the pectoral fin.

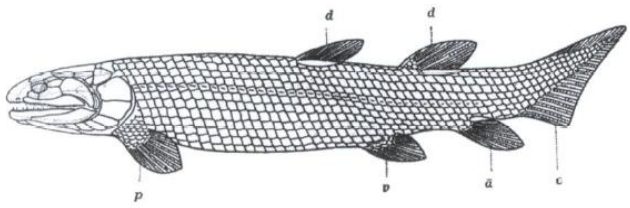

Figure 5: *The Devonian lobe-finned fish Osteolepis macrolepidotus, related to the tetrapod ancestor (From Boule & Piveteau, 1935).*

Figure 6: *The Carboniferous amphibian Eogyrinus attheyi. Note that head and shoulder girdle almost retain one coherent structure (From Boule & Piveteau, 1935).*

Evolution of the lower jaw

With the emergence of the jaws from the third pair of gill arches, the evolution of the jaws had not yet ended. In all non-mammalian tetrapods, the lower jaw is made up of several elements, including the tooth-bearing part, the dentary. The lower jaw of a reptile hinges via the quadrate with the skull. Fossils show that during the evolution from reptile to mammal, all lower jaw elements were reduced, with the exception of the dentary. Most elements disappeared completely. Two became auditory ossicles, additional to the stapes. The quadrate turned into the incus. The articular, a major toothless component hinging with the quadrate, became the malleus. In palaeontology, mammals are defined by a lower jaw that consists of only one element: the dentary.

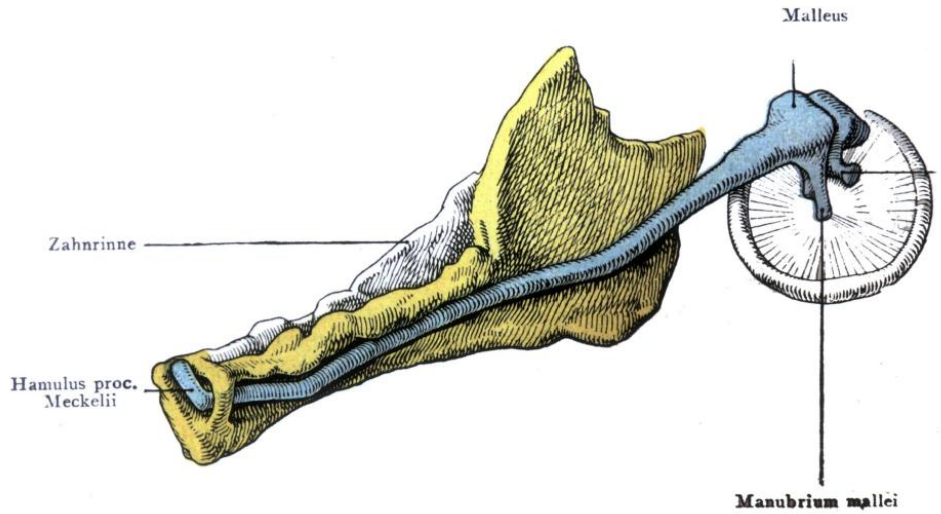

Figure 7: *Medial view of the right dentary of a human embryo of three months old, with a head-coccyx length of 8 cm. (From Hertwig, 1920). Incus and tympanic membrane are also visible. Note the cartilaginous extension of the malleus along the medial side of the dentary. In this embryonic stage the lower jaw consists of a number of elements. This is a temporary reptilian character in a mammalian embryo.*

Haeckel's "biogenetic law": right or wrong?

At an age of around three months, the lower jaw of a human embryo shows a temporary reptilian character: it consists of a number of elements. However, at that embryonic stage, the vascular system in the vicinity of the heart is comparable to that of a lungfish. Therefore it can be concluded that, in essence, Haeckel's biogenetic law is valid. Ultimately it only needs to be slightly modified.

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ABSTRACTS: ORAL AND POSTER PRESENTATIONS

ISOLATED THEROPOD TEETH FROM THE LOWER CRETACEOUS (UPPER BARREMIAN) OF VALLIPÓN (TERUEL, NORTHEAST SPAIN)

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Since the 1990s the study of isolated theropod teeth has undergone a notable degree of development. During these years, the study of qualitative and quantitative characters, as well as the use of multivariate and cladistic analyses, have demonstrated that isolated theropod teeth can provide taxonomic information at the family level. The scarcity of theropod skeletal remains in the Iberian Peninsula makes the study of isolated teeth of particular interest. The aim of the present study is to evaluate theropod palaeobiodiversity from the site of Vallipón.

The Vallipón fossiliferous site is located near Castellote (Teruel province, northeast Spain). Palaeogeographically, it is located in the Morella subbasin, within the Cretaceous Maestrazgo Basin. The site appears in transitional sediments of the lowermost part of the Artoles Formation, which is late Barremian (Early Cretaceous) in age. The fossil content includes abundant marine and continental vertebrates, as well as invertebrates, algae and plant fragments.

The theropod teeth have been studied using qualitative and quantitative features, including morphometric measurements, multivariate statistical analysis and cladistic analysis. The results reveal an association of both large- and small-bodied tetanuran theropods. The large-bodied tetanurans are represented by a single baryonychine spinosaurid; its teeth are characterised by conical crowns ornamented with flutes and serrated carinae bearing minute denticles. The small-bodied theropods are represented by at least eight morphotypes of more derived tetanurans, maniraptorans and dromaeosaurids, with minute ziphodont crowns. The results provide valuable information and are congruent with the known theropod record from the Lower Cretaceous of the Iberian Peninsula and western Europe.

EARLY HOLOCENE FAUNAL REMAINS FROM THE MORA CAVORSO CAVE (CENTRAL ITALY): AN ARCHAEOLOGICAL AND ENVIRONMENTAL PERSPECTIVE

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The present work focuses on the study of faunal remains collected from lower Holocene strata, dated between 13,460±50 and 7,385±40 BP, from the Mora Cavorso cave (central Italy, Latium). The aim of this project was to perform a complete palaeontological analysis in order to discern the agents behind the formation of the deposit, to establish if human presence could be attested within the cave during these chronologies and to provide an environmental reconstruction of the landscape surrounding the cave.
From the lower Holocene levels analysed, 1,405 remains of vertebrates have been collected. The faunal assemblage includes*: Erinaceus europaeus, Lepus* sp., *Sciurus vulgaris, Glis glis, Eliomys quercinus, Arvicola amphibius, Microtus* (*Microtus*) *arvalis, Martes* sp.*, Sus scrofa, Cervus elaphus*, *Capra ibex, Rupicapra pyrenaica ornata* as well as taxa of certain Neolithic contamination, such as Ovis vel *Capra* and *Bos taurus*. Among other finds, it is significant to note the abundance of *Marmota marmota*, which occurred last in the central Apennine mountains during the Younger Dryas or the early Holocene.
Taphonomic analysis has highlighted the presence of a burnt incisor and a jaw of *Sciurus vulgaris* which suggest that a variety of activities were carried out by humans within the cave. Moreover, their presence is confirmed by a single piece of flint. However, a large portion of the bones accumulation seems attributable to natural processes. Finally, data collected from these lower Holocene levels have allowed us to provide a preliminary reconstruction of the environment of the Simbruini Mountains. In this time span, characterised by dramatic climate change, a significant increase of forest growth, in comparison with the Upper Pleistocene, has been recognised.

LATE DEVONIAN PHYLLOCARID CRUSTACEANS OF KOWALA QUARRY (HOLY CROSS MOUNTAINS, CENTRAL POLAND)

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During the Devonian, phyllocarids (Crustacea, Malacostraca) constituted a very diversified and widely distributed subclass of malacostracans. From other malacostracans they are distinguished by a bivalved carapace and a characteristic terminal part of the abdomen (the so-called furca), which consists of a main spine (telson) and two lateral spines (rami). Phyllocarid fossils have also been recovered from Devonian strata of the Holy Cross Mountains.
In upper Fransian and lower Famennian (Upper Devonian) sediments outcropping at Kowala quarry, phyllocarids are the second most numerous type of fossil arthropods, after Thylacocephala. They are represented by mostly fragmentary remains of abdomens, furcae and rare carapaces illustrating various degrees of completeness. Among the material collected there are also two complete specimens. Three different phyllocarid genera (*Echinocaris, Montecaris* and *Dithyrocaris*) have been identified based on morphological features. The first two genera include also two new species; one of *Echinocaris* and the other of *Montecaris*. Two specimens of the latter are slightly damaged, which is here interpreted as evidence of fish predation. The third genus, *Dithyrocaris*, is represented only by a single, albeit articulated furca, which reveals previously undescribed features such as lateral telson spines. This is the very first record of this genus from Poland and from central Europe for that matter.
Remains of Phyllocarida from the Upper Devonian at Kowala quarry have augmented our knowledge of body morphology and palaeoecology of these arthropods. They allow us to track their palaeogeographical range within the contact area between the Palaeotethys Ocean and the seas of Laurussia.

PALAEONTOLOGICAL EXCAVATIONS AS A DRIVER FOR DEVELOPMENT OF LOCAL COMMUNITIES

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In 2013 an expedition of the Perm Natural History Museum started annual stationary excavations at a distance of 100 km from the city of Perm, on the site of the steppe mammoth *Mammuthus trogontherii*. Since then also part of the lower jaw with a tooth of a second individual of the same species and separate fragments of bones of other mammals (horse, deer, elk, fox and mouse) have been recovered. These finds, of middle Pleistocene age, are unique for the Russian standards. Thanks to the comprehensive scientific research carried out by the museum and the effort to promote the history of the excavations themselves, the steppe mammoth from the village of Kazanka has now become known not only in the Urals but across Russia, both among professional communities (scientists, museum workers) and among the general public interested in natural science. This could become an important driver for tourism in the entire region.

However, the rural settlement where this important story is unfolding did not see any changes initially. The scientists and museum workers who came to the excavation site were not involved in local life, even though school kids of the local school rarely go to the city and have almost no connection with the "big world", a situation which is quite common in Russian villages.

In 2017 a social project was developed based on the educational, cultural and tourist potential of these unique palaeontological excavations, which was directed to give local children a chance to obtain new knowledge and skills through communication with experts in various fields and to broaden their outlook. The project was proclaimed winner of the III All-Russian competition "Cultural mosaic of small towns and villages" of the Timchenko Foundation and received financial support. As a result, children could visit the excavation site, go on tours to other regional museums and participate in joint activities with the best specialists in the area.

The project implies further development of cultural and scientific links with the regional centre through various events and the possibility of developing the excavation site as an important tourist attraction.

IN PURSUIT OF THE FIRST "POLISH DINOSAURS"

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Dinosaurs were a major component of terrestrial ecosystems during the Mesozoic. Despite their rich representation in the global fossil record, records of their presence in sediments across modern-day Poland were for many years restricted mainly to ichnofossils. Focusing on Europe, remains of Late Triassic theropod dinosaurs are rare.

During the history of palaeontological research in Poland, some fossils were described as representing dinosaurs. In these cases, these usually have turned out to be erroneously identified records (i.e., "jaws and teeth" of the purported sauropod named *Succinodon putzeri* in fact represented a piece of driftwood with calcareous tube linings of boring bivalves). However, a recent re-evaluation of the alleged dinosaur *Velocipes guerichi* has demonstrated that it is a medium-sized theropod. The material (partial fibula) was collected from Upper Triassic (Norian) strata at Kocury (Upper Silesia) in the second half of the nineteenth century. For a long time, the bone was considered to have been lost during World War II, but we have been able to trace it in the archives of the Geological-Palaeontological Institute and Museum of the University of Hamburg, Germany. The presence of a pronounced tubercle for *M. iliofibularis* and concave medial side of the bone hints at affinities with Neotheropoda. In addition to its re-evaluation, we have also identified the original site of *Velocipes* near Kocury and have performed preliminary excavations in recent years. This has resulted in the collection of new remains of terrestrial archosaurs, including osteoderms of aetosaurians.

Along with recent discoveries of dinosaurs from Upper Triassic deposits of the Silesia region, the partial fibula of *Velocipes guerichi* is the sole record from Poland that can be undoubtedly assigned to Dinosauria. New and rediscovered localities with records of Mesozoic terrestrial ecosystems may hopefully lead to future discoveries that will improve our knowledge of dinosaurs and other Mesozoic vertebrates across the territory of modern-day Poland.

FISH ASSEMBLAGES FROM THE AUCE (SĀTIŅI), KŪMAS AND ALŠI FORMATIONS (UPPER PERMIAN, LOPINGIAN) OF LATVIA

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The first detailed description of fish assemblages from Upper Permian (Lopingian Stage) strata assigned to the lowermost Auce (Sātiņi), the middle Kūmas and uppermost Alši formations is presented here. The material described was obtained at the Kūmas quarry in southern Latvia. The formations studied comprise carbonate deposits such as limestones, either fossiliferous or barren.

Eleven limestone samples were collected from different sites at the quarry. The height of the exploratory outcrop was approximately 16-17 m and the total weight of samples reached 219,6 kg. The samples were dissolved completely at the micropalaeontological laboratory of the Faculty of Chemistry and Geosciences at Vilnius University using buffered 85% acetic acid solution. The sample residue was dried and sieved. Tiny fish remains were handpicked and separated under a binocular microscope into microslides.

659 fish microremains were collected. Chondrichthyans comprised a single poorly preserved tooth and 88 dermal denticles, while of osteichthyans 67 scales and 503 dental elements were noted. The majority of chondrichthyan dermal denticles identified belonged to euselachian sharks. A single poorly preserved tooth can be attributed to a euchondrocephalan, ?*Helodus* sp. All material of bony fishes can be assigned to the subclass Actinopterygii. The actinopterygian scale assemblage was subdivided into specific areas of the fish body, such as scales of the posterior lateral flank, caudal peduncle, pectoral peduncle and caudal fulcrum.

In comparison to Karpėnai quarry, located in northern Lithuania, microremains of fishes are relatively common at Kūmas quarry. However, for now it is difficult to identify fish species on the basis of the morphology of isolated scales or dermal denticles, because of a lack of comparative material in the region of Lithuania-Latvia.

THE ROLE OF FAUNA WITHIN ARCHAEOLOGICAL CONTEXTS: A LATE PLEISTOCENE CASE STUDY OF THE GROTTA MORA CAVORSO (ROME, CENTRAL ITALY)

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Palaeontological studies have increasing importance in archaeology. The long-standing excavation of the Grotta Mora Cavorso (Rome, central Italy) has provided the opportunity to endorse the key role of faunal remains for a precise interpretation of the archaeological contexts. The site has been carefully investigated through an interdisciplinary approach combining archaeological, archaeozoological and palaeoecological analyses.
The Grotta Mora Cavorso is a multi-tunnel karst cave, with a complex stratigraphy extending from late Pleistocene to Recent times, investigated since 2006. The cave is known mainly as one of the largest and best-preserved Neolithic burial sites in Europe, but it is also one of the few caves of Latium showing upper Pleistocene deposits that have been dated as 40 ka BP and younger.
The present research focuses on the study of abundant faunal remains collected from the deepest upper Pleistocene layer (e.g., L7). This layer includes several taxa and is of great palaeontological interest as demonstrated by the occurrence of some anatomically connected skeletons. A marmot (*Marmota marmota*), an Apennine chamois (*Rupicapra pyrenaica ornata*), which to date is the earliest reliable record of this subspecies from central-southern Italy, and of a wolf (*Canis lupus*) which is among the largest and best-preserved Pleistocene specimens from Italy.
The results provided by a detailed study of this assemblage, although still preliminary, have been essential for the correct archaeological interpretation of this context which is otherwise barren. Moreover, palaeoecological inferences of taxa examined have allowed to provide a first environmental reconstruction of the Apennine landscape surrounding the cave; this was characterised by wooded areas with open-spaces and glades.

TAPHONOMIC ANALYSIS OF REMAINS OF PLEISTOCENE *URSUS ARCTOS* FROM LA SASSA CAVE (SONNINO, ITALY)

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The present work focuses on a taphonomic study and spatial analysis of remains of *Ursus arctos* from the upper Pleistocene of La Sassa cave (central Italy, Latium), dated at 30,210±180 BP (GrA – 64830). The bones studied, 41 in total, were collected from a well-defined area (Room 6) of the cave. The specimens include mainly fragments of skull, teeth, long bones, carpal and tarsal bones and phalanges; some of them are partially covered with calcite concretions.
Several bones in partial anatomical connection, recovered from the central area of Room 6, were attributed to a single adult individual of *U. arctos*. Further isolated bones documenting at least one additional adult individual were recovered slightly more to the north. Therefore, the remains analysed belong to at least two individuals.
The taphonomic results suggest natural death in prone position for the anatomically connected bear skeleton and little post-depositional disturbance of the distribution of the bones. Cut marks or traces of human activities are absent, but there are gnawing traces of rodents on a few bones.
The study of the brown bear remains from La Sassa and the particular taphonomic context have increased our knowledge of the past geographical distribution of *U. arctos.* The anatomically connected brown bear is one of the best-preserved specimens of this taxon in central Italy for this time interval.

PRELIMINARY DATA ON LATE CRETACEOUS DINOSAUR EGGSHELLS FROM LIVEZI (HUNEDOARA COUNTY, ROMANIA)

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Maastrichtian terrestrial deposits from the Haţeg Basin have provided numerous fossils, representing a rich vertebrate association with dwarf dinosaurs.
In addition to osteological remains, numerous eggshells belonging to the oospecies *Megaloolithus siruguei* have been discovered. Such eggshells are common finds at many fossiliferous sites. The most significant palaeontological occurences are those from Tuştea, Nălaţ-Vad and Totești, where eggs and even egg clutches have been recovered. Because of the absence of associated embryos, two dinosaur groups were linked to these eggs: hadrosaurs and sauropods.
The purpose of the present study is to compare the recently discovered eggshells and eggs from Livezi with those already known from other sites.
The eggs from Livezi measure 20 cm in diameter, being significantly larger than those from Tuştea. The average thickness of the eggshells from Livezi is also larger than the average eggshell thickness previously reported from Haţeg Basin sites. Eggshell thickness distribution is bimodal or polymodal, suggesting a great variability. The cause of this variability (parataxonomic or taphonomic) in still uncertain, and more detalied studies are needed in order to understand it.

A GEOPARK FOR THE PERMIAN PERIOD: ENVIRONMENTAL EDUCATION POTENTIAL COMPLIANCE WITH CRITERIA OF UNESCO GEOPARKS

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Geoparks are protected natural areas, representing geological heritage, landscapes and geomorphological diversity of territories and providing its complex sustainable development. At present, the European Geopark Network, formed in 2000, and the Global Geopark Network which has been operating since 2004, includes 142 geoparks around the world. They are focused on complex estimates of the territory and its sustainable development, inclusive of all aspects: not only geoheritage preservation itself, but also formation of geoecological consciousness, discovering educational, tourist and economic aspects of complex territorial development. All those criteria are included into the UNESCO compliance self-estimation form as an obligatory stage to be included into the Global Geoparks Network.

The so-called "Main Permian Field", i.e., historically significant outcrops of rocks of the Permian Period, discovered by the Scottish geologist Roderick Murchison in 1841, are currently put forward for the Permian Geoparks, the first one in Russia. At the stage of self-made estimation we have to assess educational activities, both already existing and future ones, in the territory proposed for the creation of a Geopark of the Permian Period. This area is located within the catchment of the Sylva and Iren rivers, close to the town of Kungur. Several outcrops of Upper Permian marine strata are represented there, as well as Kungur Ice Cave, which is the single affordable one to the general public in Russia; sediments here are also of Late Permian age. The scientific research module of Perm State University, used as a research and studying base for several types of investigations (geographical, geological, biogeocenological and biological) is located within the territory suggested for the Geopark. This territory is also a popular destination for rafting across the River Sylva with amazing cliffs; a former part of a great barrier reef. A state-of-the-art review and criteria compliance will be summed up in this presentation.

NEWLY COLLECTED REMAINS OF MOSASAURS IN RUSSIA

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During the Late Cretaceous large parts of European Russia and Siberia were inundated by epicontinental seas. In spite of this the fossil record of marine reptiles in Russia, including mosasaurs, is still scanty.

The study of mosasaurs from Russian territories began in the nineteenth century. In recent years, new mosasaur material has been collected from over 62 localities. The majority of known specimens are represented by isolated bones of skull and postcranial skeleton. More or less complete skeletons are very rare. Such finds include a partial skeleton of *Prognathodon lutugini* from Campanian strata in eastern Ukraine, an incomplete skull of *Mosasaurus hoffmanni* from upper Maastrichtian deposits at Penza and a partial skeleton of presumably *M. hoffmanni* from Maastrichtian strata in the Saratov area.

The most recent overviews of mosasaur remains from this territory were published in 1999 by Pervushov and co-authors and in 2000 by Storrs and co-authors. However, the taxa listed by those authors were not described, nor illustrated.

Lately, the most significant and interesting mosasaur material comes from Campanian deposits at the locality of Beloe Ozero (Saratov area). Remains include a frontal of *Clidastes propython*, which expands the known geographical range of both the species and the genus *Clidastes*. From the same locality are extraordinarily large cervical vertebrae that could be attributed to a specifically indeterminate form of the genus *Halisaurus*. Additional specimens originate from Turonian deposits of the Russian Far East (Chukotka region), including the caudal fragment of a vertebral column of an indeterminate tylosaurine (Tylosaurinae indet.). These remains expands geographical range of number of taxa, constitute one of most northerly known mosasaur bones in the world and are important for palaeogeographical reconstructions.

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INTERACTIVE RECONSTRUCTION OF *DIMETRODON GRANDIS*

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In the 1960s, the so-called dinosaur renaissance started and new interpretations of palaeontological facts and fossils created a novel look at dinosaurs. To date, it has been amply demonstrated that some dinosaurs had a cover of feathers, were warm blooded and displayed complex behaviour. In 2012, J. Conway and C.M. Kosemen published their book entitled “All Yesterdays” and palaeoart started to affect paleontology. This trend is currently limited to dinosaurs and almost does not touch early synapsids. However, newly acquired data on synapsids enable us to suggest that they were much more progressive than assumed previously.

The present work is devoted to the reconstruction of *Dimetrodon grandis*, an Early Permian synapsid. We have reconstructed it as a scientifically accurate 3D model, taking into account the latest research results obtained by S. Hartman including a new sail shape, a new back curvature and a high walking pose, contrary to old reconstructions, which represent Dimetrodon with lizard-like attributes. We suggest putting this reconstruction on display in the Museum of Permian Antiquities (Perm, Russia) using the adaptive multiplatform scientific visualisation system SciVi that has been developed at Perm State University. To make the exhibition interactive we suggest using light direction sensors connected to the visualisation system that enable to show how *Dimetrodon* rotated its sail to the rays of light in order to heat its body. The museum visitors can apply a torch to the sensor and see *Dimetrodon* react on a volumetric projection screen.

The proposed exhibition popularises modern-day palaeontological knowledge of *Dimetrodon grandis* in an interactive way, presenting scientifically accurate multimedia content and thereby taking a big step towards a synapsid renaissance.

UPPER DEVONIAN BLACK SHALE SEDIMENTS AND PALYNOFACIES ANALYSIS (WOODFORD SHALE AND SAPPINGTON FORMATION, MONTANA AND OKLAHOMA, USA)

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Palynofacies analysis is a rapidly developing branch of palynology. The most important aim of palynofacies analysis is to reconstruct palaeoenvironments and depositional conditions.
This method was applied in a reconstruction of depositional environments represented by Upper Devonian black shale deposits. The first section studied was located in the northern USA (Bridger Mountains, Montana; Peak 9559 section), which was dated as not older than the VCo miospore Zone. These results correspond with the *trachytera* to *expansa* conodont zones of the upper Famennian. The second section is situated in the southern USA (Arbuckle Mountains, Oklahoma; I-35 section); for this, it was not possible to establish a detailed miospore zonation. Ultimately, this section was dated as Frasnian-Early Carboniferous.
Samples taken from both sections show a marked predominance of amorphous organic matter, most likely of phytoplankton origin. The commonest palynomorphs are prasinophytes, especially *Leiosphaeridia*. Acritarchs are also present. Among land-derived palynomorphs, the most abundant are plant remains. Miospores are limited in number and occur only as isolated specimens.
Based on the entire palynomorph assemblage, the depositional environment can be described as an open-marine, deep-water basin. Moreover, the number of the land-derived palynomorphs increased upwards in the both sections. This is interpreted to reflect a weak regression signal. The high abundance of prasinophytes might also be related to high primary productivity. Both sections studied are similar on the basis of palynofacies and also indicate closely comparable depositional conditions.

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SUMMARY OF RESEARCH OF MICROVERTEBRATE FAUNAS FROM THE KRASIEJÓW PALAEONTOLOGICAL SITE

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For many years, research of early Norian faunal assemblages of the palaeontological site of Krasiejów has focused almost entirely on remains of large vertebrates. As a result, several new taxa have been described, e.g., *Silesaurus opolensis*, *Polonosuchus silesiacus*, *Stagonolepis olenkae*, *Cyclotosaurus intermedius*, *Metoposaurus krasiejowensis*, *Ozimek volans* and *Paleorhinus*. Almost all of these taxa were of medium or large size. Our knowledge of small-sized animals from Krasiejów quarry was restricted to material of small fish and reptiles collected during the earlier years of excavations. Until recently small vertebrate fossils were considered only marginally and most scientific research concentrated on previously described taxa of medium- and large-sized amphibians and reptiles.

In 2015 we started a novel excavation project based on the “screen washing” technique. During three field seasons we processed large samples of sediments in this way. The result of this was a rich collection of microfossils, of at least 2,000 specimens, illustrating a range of taxa. The material comprises mainly teeth and some bone fragments with taxonomically important features. Based on these we have been able to differentiate taxa of different groups of vertebrates. Initial identifications document more than 20 tooth morphotypes that most probably illustrate different species of several taxonomic groups. Most numerous are remains of hybodont sharks and actinopterygian fish. We have also found rich and diverse remains of tetrapod fossils such as small temnospondyls, lepidosauromorphs, archosauromorphs and cynodonts. Most of them have not yet been recorded, neither from the locality studied nor from other Upper Triassic occurrences in Poland. Similar microfaunas are known from localities with Upper Triassic rocks in North America (New Mexico; Chinle Formation) and Europe (United Kingdom).

THE IMPACT OF IMPROVED PALAEONTOLOGICAL KNOWLEDGE ON GRAPHIC RECONSTRUCTIONS OF EXTINCT ORGANISMS

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Can we find out what extinct animals really looked like? This task has always been one of the most interesting, yet challenging. People are constantly fascinated by the unknown. A lack of particular fossil finds has fueled people's curiosity with regard to the reconstruction process. Over time, new discoveries and scientific publications have presented sufficient finds to fill gaps in palaeontological information gradually. Nowadays, artists who participate in the process of anatomical reconstructions of extinct animals have access to a larger data set to support their work. However, there remains a lot to be discovered and every day could bring new information and change our concept of the appearance of extinct animals. The main aim of the present talk is to trace the evolution of the artists' approach to this issue, following changes at the level of scientific knowledge. I would like to stress the importance of reconstructions for both science and popularisation of science. Graphic reconstructions continue to be of significant value. To prove this and to demonstrate the connection between the quality of palaeontological reconstructions and the level of scientific knowledge a brief overview of the most important illustrations of extinct animals will be presented: from the seventeenth century until today.

STUDENTS' IDEAS ABOUT HUMAN PALAEONTOLOGY: INQUIRY AMONGST SIXTH-GRADE STUDENTS OF PRIMARY EDUCATION IN MADRID (SPAIN)

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In Spanish primary education, palaeontological topics studied are related mainly to hominid palaeontology and evolution. These topics are taught in subjects linked with to the social sciences, with a meagre coverage in the natural sciences.
In May 2016, in order to evaluate general knowledge of sixth-grade students of primary education in the city of Madrid, pupils from two schools filled in a questionnaire regarding their concepts of human evolution. This test contained: answers to chosen questions, true or false sentences and an open question. It included general, socio-cultural, spatio-temporal and anatomical topics that were considered valuable contents for primary education in Spain. For statistical analyses, the Mann-Whitney U test was performed.
Only 37.5% of pupils answered more than half of the questions correctly. All topics received less than 55% of correct answers; the spatio-temporal and general topics received most of the correct answers. These results show that the level of knowledge of hominid palaeontology and evolution amongst primary education pupils from Madrid falls short of the level stated by Spanish Educational Law. The scores obtained by the students do not show statistically significant gender differences (p-values >0.05), but do reflect significant differences between the two schools (p-value = 0.03). Since both schools used the same books, the reasons for these differences are not clear yet.
These preliminary results should be analysed further by inclusion of additional schools and pupils from Madrid. It will also be interesting to study if there are differences with other Spanish autonomous communities.

THE FOSSIL RECORD OF PHASMIDS (INSECTA, PHASMATODEA)

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Phasmatodea is an order of mostly tropical insects that includes three morphological types commonly referred to as stick insects, leaf insects and stick bugs. Their most characteristic feature is their perfect camouflage. This phenomenon of blending in with the environment is called mimetism, which in Phasmatodea is extremely developed.

One can raise the question, 'When did phasmids "start" to mimic the environment they inhabited?'. Fossil remains of phasmids are rarely found; mostly they are represented merely by isolated wings. The oldest phasmatodean taxon known is from the Triassic, but some remains indicate the presence of this order already in the Permian. However, the earliest mimetic phasmid, *Cretophasmomima melanogramma*, was described from Lower Cretaceous sediments of northern China. The wing morphology of this species reveals a close similarity to the *Gingko*-like plant *Membranifolia admirabilis* that is found in the same deposits. The earliest representative of the contemporary phasmid clade (Neophasmatodea, family Phasmatidae) is *Echinosomiscus primoticus*, which was described from Cenomanian amber of Myanmar. The thorny appearance of this species suggest that this insect mimicked tree bark, similar to extant stick bugs. Another example is *Eophyllium messelensis* from Eocene deposits of Germany; this has been considered to be the oldest putative leaf insect, perfectly imitating leaves.

These three examples show that mimetism as a defence strategy developed early (at least as old as the Early Cretaceous) in phasmid evolution. This camouflage remained very effective, as is shown by the rapid increase in number of phasmid forms during the Paleogene and Neogene; in addition, modern phasmids still rely on it.

LATEST PLEISTOCENE SMALL MAMMALS OF THE MORA CAVORSO CAVE (LATIUM, CENTRAL ITALY): LAYER 5

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The present research examines Late Pleistocene small mammals from the Mora Cavorso Cave (Latium, central Italy), a multi-tunnel karst cave, located at 715 m above sea level, on the eastern slopes of the Simbruini Mountains, *c*. 150 m above the upper Aniene River valley.
The layer studied (L.5) comprises a silty, pale reddish-brown palaeosoil, with abundant decimetre-sized clasts and several patches of carbonate crust. It also yielded some flint artifacts typical of the latest Epigravettian, and numerous mammal remains. A tooth of *Marmota marmota* from this layer was radiometrically dated at 13,460±50 years BP (14,175-13,910 years cal. BC).
Specimens collected from layer L.5 have been identified as *Talpa romana, Talpa caeca, Sorex samniticus, Rhinolophus ferrumequinum, Myotis emarginatus, M. bechsteinii, Miniopterus schreibersii, Marmota marmota, Clethrionomys glareolus, Arvicola italicus, Chionomys nivalis, Microtus* (*Microtus*) *arvalis, M.* (*Terricola*) *savii, Apodemus* gr. *sylvaticus-flavicollis, Eliomys quercinus* and *Mustela nivalis.*
The aim of the present research is to investigate and reconstruct the palaeoenvironment of this faunal assemblage.
In view of the fact that most numerous remains are assignable to *M. arvalis* (*c*. 70%) and *A. italicus* (*c*. 16%), the assemblage may be considered typical of an open and relatively humid environment, near fresh stretches of water. Moreover, *C. glareolus*, *A.* gr. *sylvaticus-flavicollis* and *E. quercinus* suggest a palaeoenvironment characterised by sporadic woodlands. The presence of these taxa suggests cool palaeoclimatic conditions in the area, in agreement with the chronology of the layer which corresponds to the late Marine Isotope Stage 2 (Older Dryas).

DIGAPP AND TAPHONOMAPP: TWO NEW OPEN-ACCESS MOBILE APPS FOR PALAEONTOLOGICAL AND ARCHAEOLOGICAL RESEARCH

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In the last decade, the use of new technologies has become widespread and has led to an indisputable improvement of different procedures and methodologies. One of these new technologies is very common in our day to day lives: mobile applications. Nowadays, mobile apps are starting to be used for diverse purposes, not only for recreation, and there is even a great variety of mobile apps which can be helpful to archaeological and palaeontological research and excavations. However, few of them are actually professionally used, since researchers hesitate to use these over a physical medium. Nevertheless, paperless recording of archaeological and palaeontological data has proved to be very effective and efficient. DigApp and TaphonomApp are two new open-access mobile apps created by the authors to aid archaeological and palaeontological excavations and taphonomic analyses. Researchers can easily customise the apps according to their research, without the need of any prior programming knowledge. The use of these apps makes the data, such as x, y and z co-ordinates, taxonomic or anatomical identification, trend, plunge or length measurements easily and readily accessible since recollection, eliminates human error through automation, improves the consistency of terminology, increases the security of data since these are stored in the cloud and backed up daily and overall increases efficiency, which is key to carrying out any scientific study.

NEW DATA ON LATE CRETACEOUS BENTHOS FROM OPOLE (TURONIAN) AND CRACOW (CAMPANIAN): EVOLUTIONARY AND PALAEOECOLOGICAL IMPLICATIONS

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Inoceramids (Bivalvia) and atelostomate echinoids are two of the most often collected groups of Late Cretaceous benthos throughout the world, as both are commonly present in considerable numbers, are diverse and have great stratigraphical value. Yet, the different taxonomic schemes used and application of subgenera, subspecies and forma-level taxa points to a low resolution of the actual biological boundaries between the forms described. Rich material of Turonian inoceramids from Opole and Campanian atelostomate echinoids (*Offaster-Galeola* lineage, *Echinocorys*, Micrasteridae) from Cracow, collected by the author, is considered an ideal base for upcoming studies of ecophenotypes, taphotypes and evolutionary changes as factors that shape taxonomic divisions.
Preliminary information on other benthos from both areas mentioned is presented as well. Some of groups noted are common and diverse, while almost never referred to in the literature. For example, Turonian oysters from the Opole area are ubiquitous, but they were not even listed in a 1991 monographic, taxonomic treatise of the fauna. Some common sclerobionts (serpulids, cheilostome bryozoans) from both Opole and Cracow lack modern revisions, such as the ones recently carried out for the Bohemian Cretaceous Basin, the area of Le Mans (France) or Saxony. Asterozoans (asteroids and ophiuroids) have only recently been identified in Upper Cretaceous sediments of Poland, in spite of the fact that they are consistently present when probed for, and *Pycinaster* (Asteroidea; Cracow) and *Ophiotitanos* (Ophiuroidea; Opole) are taxa noted from Poland for the first time. Material of gastrochaenid bivalves (borers) from Opole is interesting within the context of some recent works, including results of the first autopsy of a Recent teredinid shipworm *Kuphus*.

CALCAREOUS NANNOPLANKTON OF ALBIAN-CENOMANIAN DEPOSITS OF THE CRIMEAN PLAIN

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During prospecting for oil and gas, Albian-Cenomanian deposits were discovered in wells in the northwestern part of the Crimean Plain and special attention was paid to their lithological composition and stratigraphical position within the section. Summary results of long-term research of these deposits were presented in a paper by R.I. Leshchukh (1992). He indicated that mass accumulations of shells and moulds of the mollusc *Aucellina gryphaeoides* Sowerby (intervals 2727.0-2728.0 m, 2619.0-2620.0 m and 2603.0-2604.0 m of the Kashtanovskaya-1 well), which is characteristic of upper Albian–lower Cenomanian deposits, are stratigraphical benchmarks only for upper Albian rocks. Our studies indicate that the mutual relationships between Albian and Cenomanian deposits have been insufficiently investigated.

Calcareous nannoplankton is found in dark-grey argillites in the interval 3311.0-3317.0 m in the Kashtanovskaya-1 well (Plate 1): *Eiffellithus* aff. *monechiae*, *E. hancockii*, *Hayesites albiensis*, *Rhagodiscus angustus*, *Prediscosphaera cretacea*, *Broinsonia* cf. *matalosa*, *Zeugrhabdotus bicrescenticus*, and species of the genus *Watznaueria*. The presence of the zonal species *Eiffellithus* aff. *monechiae* and *Hayesites albiensis* in the complex dates those deposits as late Albian (nannoplankton subzone NC10a). The early Cenomanian nannoplankton complex is established in the interval 2619.0-2667.0 m: *Broinsonia signata*, *B. enormis*, *Helicolithus anceps*, *H. trabeculatus*, *Eiffelithus turriseiffelii*, *Tranolithus gabalus*, *T. orionatus*, *Corollithion kennedyi* (three forms), *Zeugrhabdotus embergeri*, *Z. xenotus*, *Z. bicrescenticus*, *Gartnerago theta*, *Loxolithus armilla* and others (nannoplankton subzones UC1d-UC2a). In the interval 2753.0-2758.0 m, we found a depleted nannoplankton complex (*Eiffelithus turriseiffelii, Zeugrhabdotus xenotus*, *Watznaueria britannica* and others), which does not allow determination of the boundary between the Albian and Cenomanian.

These results show that it is necessary to reconsider the previously established idea of the stratigraphical position of the oil/gas-bearing strata in the Cretaceous sections of the Crimean Plain.

ON THE VERTEBRATE PALAEOBIODIVERSITY FROM THE MIDDLE BLESA FORMATION (BARREMIAN) OF NORTHEAST SPAIN

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Palaeontological research of the Blesa Formation (Barremian, Oliete Subbasin, Maestrazgo Basin, northeast Spain) dates back to the 1990s. Recently, stratigraphical and sedimentological research has been published in which the Blesa Formation is subdivided into three, unconformity-bounded sequences: the lower, middle and upper Blesa. The purpose of the present study is to revise the vertebrate fossil record from the middle Blesa sequence, which consists of oyster-rich limestones and marls with terrestrial influence with marine and terrestrial vertebrate remains deposited in a shallow, restricted bay.

The vertebrate-bearing facies of the middle Blesa sequence typically includes bony remains of Pycnodontiformes, Osteichthyes, turtles, plesiosaurs, crocodylomorphs, pterosaurs and dinosaurs.

Here we present new fossil material recovered from the marine limestone levels. We have a single vomer of a pycnodontiform that is morphologically similar to that of *Arcodonichthys pasiegae*, and abundant isolated carapace plates of an unidentified turtle. Plesiosaurians include isolated teeth, vertebral bodies and appendicular elements, while remains of archosaurs comprise several crocodylomorph cranial remains, the anterior end of a pterosaur skull (provisionally assigned to Ornithocheiroidea indet.), a single vertebral centre and one dorsal vertebra assigned to Ornithopoda indet, and Deinonychosauria indet., respectively, and an ischium of a sauropod, probably titanosauriform.

Our results show the significance and abundance of marine and terrestrial vertebrate remains in the middle sequence of the Blesa Formation. The large number of different clades of marine vertebrates recorded provides a good example of the coastal palaeobiodiversity in the Iberian Peninsula during the Barremian.

TESTING VARIATION IN BODY SIZE IN POPULATIONS OF *BOS PRIMIGENIUS* FROM SOUTHERN AND CENTRAL ITALY

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Variations in body size of *Bos primigenius* during the Pleistocene and Holocene have been noted by several authors. According to those, the aurochs was generally characterised by a relative increase in size during the Middle Pleistocene and a decrease during the late Late Pleistocene and in particular during the Holocene.
In the present study several postcranial remains (radii, metacarpals, metatarsals, calcanei, astragali and tibiae) of aurochs from different central and southern Italian localities were investigated by means of the Size Variation Index (SVI) in order to evaluate body size variation of aurochs populations during the Middle and Late Pleistocene and Holocene. This Index is useful to document body size in a population when remains are numerous but fragmentary. The localities considered were plotted into a time-calibrated series and dating of these localities has been taken from the recent literature.
The SVI, calculated for all samples considered, shows a variation in body size of aurochs. During Middle Pleistocene an increase in body size from MIS 12 to MIS 7 is observed; differences are statistically significant. Populations from MIS 9 localities are smaller than those from MIS 7 and this difference is statistically significant ($p < 0,001$). At the end of Pleistocene a decrease in size is observed: aurochs from the upper Upper Pleistocene are significantly larger than those from the Holocene.
Results of our research confirm the presence of variation in body size in *Bos primigenius* during the Pleistocene and Holocene in Italy.

AVIAN ASSEMBLAGES FROM THE MORA CAVORSO CAVE: TAPHONOMIC STUDIES AND ARCHAEOLOGICAL INTERPRETATION

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Early and middle Holocene avifauna is poorly studied in Italy and taxonomic and taphonomic details are rarely provided. The present work analyses bird remains collected from Holocene levels of the Mora Cavorso cave (central Italy) and, in part, fills this gap in our knowledge and adds additional data on avian fossils from the Italian peninsula. Moreover, our taphonomic study of remains has shed light on the formation of this deposit, thereby contributing to a better understanding of the site itself.

The samples studied have been collected from levels dated as early Holocene (8,770±60 and 7,385±40 BP), Neolithic (6,505±50 and 6,000±45 BP) and Bronze Age (2nd millennium BC). They comprise 143 bones that belong to the class Aves and are grouped as follows. Five specimens from lower Holocene layers (M.N.I. 1; unknown sex); 58 specimens from Neolithic layers (M.N.I 7; male 5, unknown sex 2); 80 specimens from Bronze Age layers (M.N.I. 13; male 8, female 1, unknown sex 4).

Bone accumulation is attributable mainly to natural agents and predatory activity of diurnal and nocturnal birds. However, a remarkable exception is constituted by the presence of a few bones from the Neolithic layers that have burn marks, perhaps related with human subsistence.

The data of the present study add to information on Holocene bird remains in Italy. They have been compared with those of five of the most relevant and well-studied Holocene Italian avian assemblages. These comparisons strongly encourage further research in this undervalued field of study.

A MODERN ANALOGUE FOR HEMIPARASITIC WOODY SPECIES IN THE FOSSIL RECORD: *KRAMERIA LAPPACEA*, A LIVING HEMIPARASITIC SHRUB WITH DISTINCTIVE WOOD

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Living plants are used as modern analogues for fossil species in climate and habitat reconstructions. *Krameria lappacea*, commonly known as the Peruvian rhatany, is a long-lived, woody hemiparasite in the cold deserts of the Andes. In the fossil record, it is possible that there are species that are hemiparasitic that have gone undiagnosed as such. Here we identify criteria through the study of the wood anatomy of a known hemiparasite and reliable climate data that could lead to the recognition of hemiparasitic woody plants in the fossil record. In the thin-sectioned wood of eight individual shrubs of *K. lappacea*, cell dimensions and densities were measured, and standard wood indices were calculated. Comparisons of growth ring widths with mean annual temperature and precipitation for 25 years (1985–2010) showed no significant correlation, meaning the steady rates of growth observed in the growth rings of *K. lappacea* are not due directly to climate. It can be inferred that its growth is influenced by their parasitization of neighbouring species for water and mineral nutrients. Like most desert plants, the wood of *K. lappacea* possesses numerous vessels per unit area, narrow vessels, shorter vessel element lengths, and has vasicentric or vascular tracheids, which are distinctive features of xeromorphy. However, the wood of *K. lappacea* differs in lacking other characteristic dry-climate traits such as helical thickenings and grouped vessels, which may be attributed to its hemiparasitic lifestyle. This unusual suite of characters could be potentially used to identify a hemiparasitic woody plant in well-preserved fossil wood in the fossil record and thus infer the habitat and climate in which it lived.

VARIABILITY OF CRANIAL STRUCTURES IN EARLY TRIASSIC TEMNOSPONDYL AMPHIBIANS FROM THE EASTERN EUROPEAN PLATFORM

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The study of variability amongst Early Triassic temnospondyl amphibians from the eastern European Platform of Russia is an important step in precise phylogenetic distinctions within this group and for assessment of evolutionary pathways and biostratigraphy. In the course of the present work cranial material of labyrinthodonts housed in the collections of PIN RAS was studied. In total 126 skulls and large cranial fragments belonging to the Trematosauroidae were considered: *Benthosuchus sushkini*, *B. korobkovi* (Benthosuchidae) and *Thoosuchus yakovlevi* (Thoosuchinae). All specimens are of Early Triassic age, belong to the Rybinsk Horizon and originate from localities within the Moscow syncline and the Volgo-Ural anticline.

The variability in available post-metamorphic developmental stages of skulls specifies the presence in them of transformations in the structure of the middle ear and basicranial areas that are characterised as recapitulation transition from the Palaeozoic plan of organisation to Temnospondyli of the Mesozoic.

In the formation of trematosauromorphic features the skull structure in *Benthosuchus* preceded several parallel ways as is visible from distinctions in age variability in the species *B. sushkini* and *B. korobkovi*. Characteristics of trematosauroid paedomorphic tendencies are expressed only in *B. korobkovi*. In contrast, progressive changes in the same direction are expressed in both species, but in *B. korobkovi* they slowed down and were incomplete in comparison with *B. sushkini*. The same holds true for the rate of developmental changes in ornamentation of the dermal skull during submature stages of the trematosauroid *Benthosuchus*; this shows a wide range of individual variation which can be subdivided into two dominant modes.

The formation, during ontogeny, of features that characterise trematosauroids proceeds more rapidly in the primitive trematosauroid *Thoosuchus yakovlevi* than in other benthosuchids.

PALEOCENE ORTHOPHRAGMINIDS FROM THE LAKADONG LIMESTONE, MEGHALAYA (SHILLONG, NORTHEAST INDIA): IMPLICATIONS FOR REGIONAL GEOLOGY AND PALAEOBIOGEOGRAPHY

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Late Paleocene orthophragminids, hitherto poorly known from the Himalayan foreland basins, are studied from the Lakadong Limestone in Meghalaya, northeast India, in order to establish a systematic, biostratigraphical and paleobiogeographical framework for them in the eastern Tethys. In the Mawmluh Quarry Section (MQS) in the Shillong Plateau, to the southeast of Tibet, orthophragminids are associated with typical Paleocene orbitoidiform taxa endemic to the Indian subcontinent, i.e., *Lakadongia* Matsumaru & Jauhri (= *Setia* Ferràndez-Cañadell) and *Orbitosiphon* Rao, and various species of alveolinids, miscellaneids and rotaliids, characterising the Shallow Benthic Zones (SBZ) 3 and 4. The orthophragminids belong to two lineages of the genus *Orbitoclypeus* Silvestri: *O. schopeni* (Checchia-Rispoli) and *O. multiplicatus* (Gümbel), both well known from the peri-Mediterranean region and Europe (western Tethys). The latter species is identified here for the first time from the eastern Tethys. Previous records of the genus *Discocyclina* Gümbel from the Lakadong Limestone actually correspond to misidentified *Orbitoclypeus*; this implies that the late Paleocene orthophragminid assemblages from Meghalaya and eastern Tethys were less diverse than in the western Tethys. Our data, along with a review of previous Paleocene and Eocene records from India and Pakistan, suggest that *Orbitoclypeus* is the only orthophragminid in the Paleocene of the eastern Tethys, whereas *Discocyclina* first appears in Early Eocene times, being represented mainly by endemic taxa confined to the Indian subcontinent.

TETRAPOD DIVERSITY OF THE TREMP FORMATION IN THE ARAGONESE PYRENEES (SPAIN): CONFINING THE CRETACEOUS-PALEOGENE BOUNDARY IN A TRANSITIONAL ENVIRONMENT

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The Tremp Formation is a transitional-continental unit that outcrops in the southern Pyrenees (northern Spain) and includes the most diverse record of continental vertebrates of the uppermost Cretaceous in Europe. This formation is divided into four units: the two lower ones (*grey unit* and *lower red unit,* late Maastrichtian) contain plenty of vertebrate fossils (dinosaurs, crocodylomorphs, turtles, amphibians and squamates); by contrast, tetrapod fossils in the two upper units (*Vallcebre limestone* and *upper red unit*, Paleogene) are lacking.

Our study is based on data from 45 known and 5 still unpublished fossil sites located between the localities of Campo and Arén, in the Aragonese Pyrenees. The main aims are: 1) to analyse changes in palaeobiodiversity of the different groups of vertebrates throughout the stratigraphical succession, and 2) to constrain the stratigraphical position of the K/Pg boundary, reducing the uncertainty of its location.

The highest diversity of most of the groups is recorded in the *grey unit* and the middle part of the *lower red unit*, whereas in its upper part it seems to decrease. The fossils disappear near the top of the unit. The absence of vertebrate remains in this upper part may be related to taphonomic processes, because some fossiliferous sites appear very close to the Paleocene units, but only associated with certain local facies. These data suggest that the K/Pg boundary might be located somewhere between the top of the *lower red unit* and the base of the *Vallcebre limestone*, being confined to an interval of few metres.

FEEDING ADAPTATIONS OF PLEISTOCENE LARGE CATS FROM NORTH AMERICA

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Big cats ranked amongst the best-adapted predators at the top of food chain in North America during the Pleistocene. In addition to the ecological trend of a marked increase in body mass to fill the niche during the time when megafauna predominated terrestrial environments, big cats of North America developed such features as enlarged canines. This created new paths and methods to ensure successful hunts. Combining this with many other adaptations turned them into great predators and dangerous opponents to other predators during competition for prey. In this presentation I wish to illustrate the spectrum of features that those animals developed and describe their usefulness. Increased body size meant that they were more threatening competitors to predators such as the giant short-faced bears or dire wolves and was conducive to taking down much larger prey. However, the sabre teeth did not make it in the end because of lowered ability to adapt. Having said that, it also needs to be stressed that most adaptations of prehistoric American lions are found in present-day lion species. This shows that certain adaptations were useful and successful only under specific ecological circumstances that occurred during the Pleistocene.

THE PECULIAR CASE OF GRAZING SUIDS OF EASTERN AFRICA: DOCUMENTING THE SHIFT FROM OMNIVORY TO GRAZING WITH SURFACE TOPOGRAPHY ANALYSES OF MODERN AND FOSSIL SUIDS

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Most of the modern suids (Mammalia, Suoidea; pigs) are omnivorous, medium-sized, non-ruminating artiodactyls that inhabit forests or patches with dense vegetation. However, warthogs (*Phacochoerus* sp.) are adapted to open environment and consume mainly grasses. It has been suggested that during the Plio-Pleistocene at least three different predominant suid genera in Africa (i.e., *Notochoerus*, *Metridiochoerus* and *Kolpochoerus*) adapted towards grass eating. Isotope studies of enamel show a marked gradual shift from mixed diet towards grazing in all genera. In addition, their third molars become more hypsodont (i.e., increased crown height) and enamel crenulation more complex. Similar adaptations have been observed in other mammals already in the Miocene, when tropical C4 grasses started to spread.

In many cases the third molars are functionally the most important single tooth among suids, and often suids can be identified to genus level with only a third molar present. In the present study we analyse surface morphology of third molars of the three Plio-Pleistocene suid genera from the Turkana Basin (Kenya) and compare them to five different modern suid species from Africa (*Phacochoerus africanus*, *Potamochoerus porcus* and *Hylochoerus meinertzhageni*), Europe (*Sus scrofa*) and southeast Asia (*Babyrousa babyrussa*) in order to see if third molar morphology supports the specialisation for grazing of the Turkana Basin suids. We also include Miocene listriodon specimens in the analyses to have a browsing suid for comparison.

All third molars analysed were 3D-scanned with a hand-held PlanScan (Planmeca Oy, Helsinki, Finland) surface scanner. Fossil specimens were scanned at the Turkana Basin Institute (National Museums of Kenya) in Kenya, and modern specimens were scanned at the Museum für Naturkunde in Berlin, Germany. The 3D scans were analysed with R-package molaR, ArcGIS and SurferManipulator for mean slope of the surface (topography), angularity (slope of the slope), relief index (2D/3D area), Dirichlet normal energy of the surface (deviation of a surface from being planar), orientation patch count (surface complexity) and sharpness (areal proportion of steeply sloped elements to the rest of the surface).

Our results show that the fossil suids of Turkana differ from most of the modern suids by their occlusal surface topography. However, the modern grazing specialist, the warthog, has the most closely similar profile to the fossil suids. Our results indicate that surface morphologies of fossil suids are adaptations to diets containing high proportions of grass, and thus supports previous studies with different methods.

A MIOCENE–EARLY PLIOCENE PARATETHYS-TYPE OSTRACOD FAUNA FROM THE DENIZLI BASIN (SOUTHWESTERN ANATOLIA) AND ITS PALAEOGEOGRAPHICAL IMPLICATIONS

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The Miocene-Pliocene sedimentary succession of the Denizli Basin in southwestern Anatolia (Turkey) holds a unique, undisturbed stratigraphical record and provides an excellent opportunity to study long-term palaeoecological changes, using and characterising a previously poorly investigated Paratethys-like ostracod fauna. In the present study we focus on the sedimentary successions of the basin to elucidate the role of the region as a source/sink-area for Paratethyan ostracod biota.
The ostracods studied have been recovered from 106 samples collected from two different outcrop localities of Miocene–Early Pliocene age near the village of Babazanan close to the provincial capital of Denizli.
The lower part of the succession studied (possible Middle Miocene) consists of a Pannonian-type microfauna represented by brackish-water ostracods dominated by candonids associated with few leptocytherids and loxoconchids. Morphological similarities between the fauna studied and ostracods of Lake Pannon are remarkable; however, potential migration patterns still are unclear. The existence of an unknown intra-Turkish gateway between the Denizli Basin and the Paratethys is not to be excluded, even if there is no clear evidence up to now.
The ostracod fauna in the upper part of the section (possible Middle Miocene–Early Pliocene) suggests a pronounced change of pre-existing palaeoecological conditions. A shift towards a more freshwater-influenced setting is marked by the evolution of an endemic ostracod fauna. This development can be related to the progressive isolation of the basin and the formation of a terminal lake, coeval with the restoration of shallow lakes in adjacent basins in the area.

ASSESSING DIFFERENCES IN CARNIAN FORAMINIFERAL ASSEMBLAGES FROM THE EXTERNAL DINARIDES AND SOUTHERN ALPS IN SLOVENIA

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Triassic fossil assemblages found in the Southern Alps and External Dinarides have attracted the attention of regional geologists and palaeontologists for decades. The widely studied stratigraphy in the Southern Alps and External Dinarides provides a good framework and enables reliable correlations between fossil assemblages.

Environmental factors governing facies distribution of benthic foraminifera in Carnian sediments are currently poorly understood. The aim of the present analysis was to quantify and evaluate differences in the composition of foraminiferal assemblages from three Carnian sections in Slovenia. The sections studied are the Razor Limestone of early Julian age, the Stože section of Julian to early Tuvalian age, and the late Julian Lesno Brdo section. Differences in composition of assemblages were assessed using DCA and SIMPER analyses in PRIMER 5 and PAST software.

Results show a similarity in taxonomic composition between the Lesno Brdo and Stože sections. The locality of Lesno Brdo is characterised by an abundance of organic matter in marginal marine environments, whereas the succession at Stože was laid down in the middle ramp. The similarity between the two localities is interpreted to some sort of environmental stress. Samples from the carbonate platform at Razor, in contrast, show a higher diversity. The most commonly represented genera at Stože and Lesno Brdo are *Hoyenella*, *Aulotortus*, *Agathammina* and *Lamelliconus,* while an assemblage from Razor includes Duostominadae*, Aulotortus* and *Endothyranella*. The differences observed could be attributed to different environmental conditions and/or reflect slightly different ages of the sections, with Razor being slightly older than the other two.

FIXED PANELS AS TOOLS IN AREAS OF PALAEONTOLOGICAL INTEREST: THE CASE OF THE SOMOSAGUAS FOSSIL SITE (MADRID, SPAIN)

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The palaeontological site of Somosaguas holds a rich sample of vertebrate fossils, mainly mammals, from the Middle Miocene. It is located in Pozuelo de Alarcón (Madrid, Spain), inside the Somosaguas campus of the Complutense University. This unusual location offers an opportunity to show the site to students through a series of interpretative panels on its geology, fossil content and palaeontological studies.
The purpose of the present work is to analyse the success of these panels as tools in making these issues public, approximately one year after these were placed here. We interviewed 82 fourth-grade pupils from faculties adjacent to the excavation site, who answered multiple-choice test questions about their knowledge of the topics discussed on the sign boards, whether they had noticed them and when and how they learnt about the site.
The results show that the interpretative panels have been helpful in increasing the awareness of the site among students of neighboring faculties, with 15% of them learning about the fossil site through the panels, compared to 12% that learnt about it in preceding years. However, there are marked differences in knowledge of the site between the different university degrees, maybe because the entrance of the faculty of Social Work is closer to the excavation and the fixed panels than the entrance of the faculty of Political Sciences. Further outreach work is needed, though, as almost half (49%) of the undergraduates still do not know about the site.

SOME GEOLOGICAL NOTES ON THE KOLUBARA BASIN IN NORTHWESTERN SERBIA

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The Kolubara Basin is located in the northwestern part of Serbia, about 50 km south of Belgrade. It is the largest lignite-producing area in Serbia. It consists of several open-pit mines referred to as Field A, Field B, Field C etc. One of the largest and most active is Tamnava–West Field. Coal and its occurrences as well as structural, stratigraphical and palaeontological characteristics of the Miocene rocks of this area have a long tradition of investigation. Numerous papers have been published during almost a century. From the tectonic point of view, the Kolubara Basin is a young morphostructure that is related to the origin of the well-known Pannonian Basin. During the Miocene, a relatively thick sedimentary succession was laid down in this area (thickness > 800 m). Lower and Middle Miocene sediments are not visible at surface except along the basin margins. The Upper Miocene ("Pontian" *sensu* Stevanović) coal-bearing layers are widely distributed across the entire basin. At the top of the geological column, Quaternary sediments cover the coal series.

In a few places along the basin margins (Barajevo, Boždarevac), we have studied elements of the geological structure, as well as palaeontological and stratigraphical relationships of individual units and depositional properties. Macrofaunal remains found in the clastic-carbonate sediments confirmed the presence of the Sarmatian Stage (Middle Miocene). Typical marine-brackish molluscan taxa such as *Solen subfragilis, Psammobia labordei sarmatica, Donax lucida*, *Cerastoderma obsoletum, Irus gregarius, Mactra podolica, Calliostoma podolica* and others have been recognised. In addition, a diverse and well-preserved flora (*Ulmus carpinoides, U. longifolia, Cinammommum polymorphum, Populus latior, Acacia* sp., etc.) has been identified. This testifies to the existence of a sandy cove along the coast of the Paratethys Sea. In addition, this section is important because it also shows young, compressional tectonics and reversal movements along the fault system. On the adopted list of objects of geological heritage of Serbia, it has regional value. On the other hand, inside the Tamnava–West Field open pit, there are a few silty and marly interbeds that cut the coal-bearing series. Within these fine-grained sediments, mostly eroded and poorly preserved molluscs have been found (*Limnocardium zagrabiense*, *Limnocardium* sp. and *Congeria* sp.). In addition, abundant and diverse ostracod microfauna (predominantly of the genus *Candona*) confirm the existence of the long-lived Lake Pannon in this area.

BIOSTRATIGRAPHY OF DEPOSITS IN THE WAŁBRZYCH MIASTO AREA, POLAND

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The present work contains results of biostratigraphical studies of sedimentary rocks of Mississippian age in the area of Wałbrzych Miasto. Three exposures were sampled along the railway embankment near the railway station, two of which were not previously described. Rocks at the "M" and "P" sites belong to the Szczawno Formation, while those at the "Z" site are most likely to be included in the lower part of the Wałbrzych Formation. The state of preservation of these as in earlier works has changed and does not correspond to the description from previous years. Above all, no previously described fossils were found in it. Until now, these rocks were considered to be late Visean on the basis of invertebrate fossils such as goniatites, brachiopods and gastropods.

During our field work, a few macrofloral and macrofaunal taxa were found. For the first time, remains of *Calamites* (*Mesocalamites*) *renieri* were recovered from here, and this find raises doubts on the age assignment of the rocks studied, as this postdates the late Visean. A few faunal elements, *Posidonia* sp. and *Fenestella* sp., cannot be considered reliable age indicators. However, an exception is an ammonite of the genus *Nomismoceras*, which probably is indicative of the Serpukhovian (Namurian A).

This dating has been confirmed by palynostratigraphic research, which should be considered as preliminary. A rich, well-preserved miospore assemblage has been documented, in which the occurrence of two species, i.e., *Verrucosisporites morulatus* and *Crassispora kosankei*, deserves special mention. Their appearance determines the base of the Namurian and the rocks probably represent the Vm – *Verrucosidporites morulatus* (Pendlej) and SV (upper Arnsberg) miospore zonations of the upper Mississippian (Serpukhovian).

CHARACTERISATION OF THE BIOMINERAL MICROSTRUCTURE OF THE MODERN BRACHIOPOD *PAJAUDINA ATLANTICA* AND ITS RELEVANCE FOR THE FOSSIL RECORD

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Depending on the species, shells of modern rhynchonellide and terebratulide brachiopods consist of up to three calcite layers: the outer primary and the inner fibrous and prismatic layers. All shell layers consist of nannostructured calcite that is assembled to distinctly shaped mineral units.
We investigated the microstructure, texture and pattern of biopolymer distribution in the shell of the modern brachiopod *Pajaudina atlantica* Logan, 1988 with EBSD, biochemical etching, AFM and histological preparation methods. The thecideid brachiopod *Pajaudina atlantica*, of the subphylum Rhynchonelliformea, does not follow the above-described shell construction principles. Even though nannoparticulate calcite constitutes the entire shell, we did not observe the formation of any structuring of the shell ultrastructure into mineral units with clear-cut outer morphologies.
The microstructure of the shell of *P. atlantica* cannot be addressed to be similar to the primary shell layer of other modern brachiopod species as it was described in earlier studies. In contrast, we found the occlusion of biopolymer membranes within the entire shell. In other brachiopod shells the primary layer contains only minor amounts of biopolymers. Membrane distribution in the shell of *P. atlantica* is highly irregular and does not encase any mineral units, e.g. fibres, prisms. In conclusion we observe in *P. atlantica* a microstructure that has not yet been described.This observation expands our knowledge of fossil theicideid brachiopod microstructure and allows for a new interpretation of the geochemical data such as isotope ratios and trace element analysis, obtained from its shell.

THE EVOLUTION OF THEICIDEID BRACHIOPOD SHELL MICROSTRUCTURE

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The interpretation of geochemical proxies allows the reconstruction of past and present seawater chemical conditions and evolution with time. As proxy data are obtained from geological archives, e.g. carbonate shells of marine invertebrates, a substantial understanding of shell microstructures is of immense importance. With that knowledge a better understanding and interpretation of geochemical proxy data is possible. Their abundance in the geological record together with the chemical and structural stability of their low-magnesium calcite shells render brachiopods to be an important group within the invertebrates. Further, within the phylum Brachiopoda, theicideid brachiopods are particular due to their exceptional shell microstructures. Previous work suggests a progressive loss of the fibrous shell layer and the development of a “granular” microstructure, a process that started in the Jurassic and carries on until now. In the study presented here we discuss in detail patterns of shell microstructure of fossil and modern representatives of theicideid brachiopods and trace the evolution of shell organization and microstructure development from the Triassic to the present time. Our analyses were carried out with Electron Backscatter Diffraction, Scanning Electron Microscopy, and Atomic Force Microscopy. The study of biocalcite crystal morphologies, their patterns of orientation with time together with the distribution of organics within the shells give important indications for the interpretation of geochemical proxy data obtained from the study of these shells.

AN ENIGMATIC ARCHOSAURIAN SACROCAUDAL VERTEBRA FROM KRASIEJÓW

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Here we present a single large abnormal vertebra, which had previously been identified as *Stagonolepis olenkae* on account of its size and massive build. However, the shape of this specimen differs from that of the sacral and first caudal vertebrae of *Stagonolepis*. The vertebral body generally has a gracile build except in cranial view in which the anterior surface is larger than the posterior, indicating that this sacral vertebra was of a massive construction. Transverse processes or the vertebrae are short and do not progress in lateral and ventral direction. These last characters exclude this specimen from the group of crurotarsians (also *Polonosuchus*). The general build of this vertebra and the height of the neural arch is similar to vertebrae of *Silesaurus opolensis*; this dinosauromorph was probably related. This discovery indicates that a review of all large bones from Krasiejów that have previously been identified or described as aetosaurs, is called for.

THE NON-COELUROSAURIAN ORIGIN OF THE SCANSORIOPTERYGIDAE

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Scansoriopterygids were bizarre, arboreal dinosaurs that are considered as primitive paravians or even basal Avialae, belonging to the Coelurosauria. However, several features, such as the non-opisthopubic pelvis, the shape of ischium and numbers of caudal vertebrae indicate a basal position for this family in the dinosaur cladogram. For example, *Epidendrosaurus* has a very long third finger in the manus, which suggests a closer affinity to the Herrerasauridae (by several authors indicated as primitive dinosaurs, not theropods). *Tawa* has also been considered a primitive theropod; probably this genus was a theropod-like herrerasaurian, that has a long third manus finger and a primitive shape of the ilium in comparison to *Eodromeus* (an older and possibly more primitive theropod than *Tawa*). Additionally, the ichnogenus *Plesiornis* could be indicative of an ancestor of the Scansoriopterygidae by showing an opposite first finger in the pes; this is a more parsimious theory than the present view of primitive birds during the Early Jurassic.
The current view of the top position of the family Scansoriopterygidae in the lineage of the Herrerasauridae must be tested by additional observations and scientific research.

HOW TO PROVE BIOLOGICAL FEATURES IN PALAEONTOLOGY – THE EXAMPLE OF THE LATE TRIASSIC KRASIEJÓW FAUNA

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Metoposaurids are a group of temnospondyl amphibians known from almost all continents. Their occurrence is limited to the Middle-Upper Triassic. Palaeohistology is a new and precise method which yields new insights into the biology of animals but since it is a destructive method, material available for sectioning is severely limited. However, the fossil richness which is present at the palaeontological site of Krasiejów enables such an analysis. Therefore various bones of *Metoposaurus krasiejowensis* – long bones, dermal bones, ribs and vertebrae – have been studied histologically. This study shows a high histovariability in a single taxon which is visible between various bones, between the same elements from various skeletons, but also along a single bone (e.g., sectioning plane while evaluating the sections). To explain the origin of those phenomena the intraspecific and interspecific variability have to be defined. If comparing different taxa from one locality, as in the present study, it is important to remember to compare in-between one family and the closest relative group and not to compare Amniotes with non-Amniotes. It is also important to think about life adaptations; therefore an actively swimming organism should not be compared with a terrestrial one. To explain the histological variability more methods have to be applied. Help comes from classic geochemistry at the level of chemical elements. The variability in one taxon/one family from the same locality has been studied. To this end, changes along a single *Metoposaurus* bone (five sections in a humerus and five core-drills in an interclavicula) have been studied and evaluated in the light of bone genesis, histological growth and geochemical change. High-resolution sampling with the use of a scanning electron microscope with an energy-dispersive spectroscopy in point mode and X-ray fluorescence in mapping mode has been applied. Together with the use of different methods, it may be possible one day to explain biological features such as population ecology in a palaeontological context.

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LATE PLEISTOCENE FAUNAL ASSEMBLAGES FROM LA SASSA CAVE (SONNINO, CENTRAL ITALY): PALAEONTOLOGICAL AND ENVIRONMENTAL IMPLICATIONS OF A NEWLY EXCAVATED CAVE SITE

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The present work contributes to our understanding of the environment of Latium and knowledge of Late Pleistocene large mammals there by analysing the unpublished faunal assemblage from La Sassa cave (Sonnino, central Italy).
La Sassa cave is located in a small valley, near the village of Sonnino in the Ausoni Mountains, 80 km south of Rome. The site, discovered in 2014, has been excavated by the Institute of Archaeology of Groningen University and the University of Rome "Tor Vergata" since 2015. La Sassa is a multi-stratified cave with layers ranging from Late Pleistocene to Recent, which yielded a varied assemblage of finds including pottery, human and animal bones and lithic industry. Upper Pleistocene layers, detected in three of the nine rooms of the cave, have produced remains of a few large-sized mammals such as cave lion (*Panthera spelaea*), brown bear (*Ursus arctos*), spotted hyena (*Crocuta crocuta*), wolf (*Canis lupus*), horse (*Equus ferus*), red deer (*Cervus elaphus*) and coprolites of the brown bear. A single radiocarbon dating on a femur of a brown bear suggests an age of 30,210±180 BP (GrA-64830 32,664-31,946 cal. BC), although further dating is pending to establish whether these taxa lived in close temporal proximity.
The present research has two main aims: firstly, to carry out a careful taxonomic and taphonomic study of the >700 faunal remains in order to achieve a complete understanding of cave's deposit; secondly, to provide a preliminary palaeoenvironmental reconstruction of the area which, at present, seems to have been characterised by steppe and open woodland.

A NEW DEFINITION OF THE CAVE LION

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New facts on the classification of Pleistocene big cats of the genus *Panthera* are outlined. Some subspecies, formerly classified as separate species, are now regarded to be conspecificn with *Panthera spelaea*. Morphological analyses of skeletons were conducted in order to document exact differences between modern lions, cave lions and tigers. I found nearly 30 morphological skeletal characters in the skull and limbs, in addition to genetic and molecular data. Some clear differences between species in skull structure and sexual dimorphism were noted and these show closer relationships between cave lions and modern lions than between cave lions and tigers. Earlier, some researchers regarded cave lions as a subspecies of modern lions, while a few others assumed cave lions to have been more closely similar to tigers. My work shows that cave lions are not very good in biostratigraphical analyses, but the evolution of big cats is likely to be understood better on the basis of this. For future work on this subject, finds of fossil big cat remains from North Africa and the Middle East are needed.

MULTIVARIATE ANALYSIS OF EARLY PLEISTOCENE EQUID PHALANGES FROM OLTEȚ VALLEY, DACIC BASIN (ROMANIA)

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Lower Pleistocene sediments from the Olteț River Valley, deposited in the Dacic Basin, have yielded a diverse vertebrate fauna, from both a quantitative and qualitative point of view. This fauna includes cervids, bovids, elephantids, equids, as well as carnivores and primates. More than a thousand equid remains have been collected during 1960-1980 and attributed to six taxa. The present study revises equid phalanges from this site, using modern morphometric techniques, in order to understand the taxonomic affinities of early Pleistocene equids present in the Olteț Valley deposits better. Landmarks were established using a Microscribe MX digitiser for a number of 72 proximal, medial and distal equid phalanges from the collections of Emil Racoviță Institute of Speleology (Bucharest, Romania) and analysed using multivariate statistics. The data clusters in different morphospaces, highlighting morphological differences that may be of taxonomic significance. These findings will be further analysed alongside morphospaces generated for other osteological groups in order to define intra- and interspecific morphological variations within the equid taxa present in the deposit.

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NOTES

ABOUT THE CONFERENCE LOGO

Logo designed by Klaudia Kardynał.
As you may know, Poland is divided into sixteen districts named voivodeships – in view of the fact that the conference will be held in the Opole region, we have decided to create a logo to reflect this, as in previous years. The logo illustrates the contours of Opole Voivodeship, filled in with the local colours, yellow and blue. In addition, it depicts the local 'VIP', the dinosauriform *Silesaurus opolensis* that was unearthed from Upper Triassic strata.