May 23, 2022

News and notes

Before going on to look at some of the terrestrial animals of the Jurassic Period, here are some news items that I thought were interesting.

Victoria Day

Queen Victoria, 1837 – 1901
Credit: Portrait by Franz Xaver Winterhalter, 1855,
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It's a holiday today in Canada, officially called Victoria Day, and also called the May Long Weekend or Firecracker Day (until firecrackers were banned). It was named in commemoration of Queen Victoria who was the Queen of the British Empire when Canada was granted semi-independence within the Empire in 1867. The legal process was through the passing of the British North America Act by the British Parliament in that year.

Since 1867 Canada has been a constitutional monarchy with the British sovereign as the Canadian head of state. While Canadians generally look favourably on the current monarch, Queen Elizabeth II, most would like to see Canada's attachment to the monarchy end with her. I think that we will keep Victoria Day, though.

In Western Canada, where I live, Victoria Day is the traditional day for putting in the garden. I'll be doing that after posting this to my blog.

Geopolitics

The war in Ukraine continues. Remembering that all wars involve deception, here are a few sites to observe changes in the war:

- Daily updates at the Institute for the Study of War.
- Live Map; regular updates to the changes in the on-the-ground situation.
- Oryx: Assessments of battlefield losses.
- Interesting interview of Larry C. Johnson by James H. Kunstler discussing the Ukraine War.

Research

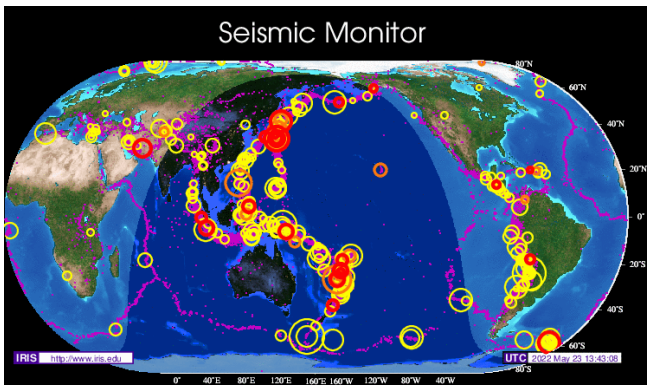
- Geophysics and studies of the Earth's interior: Kilometer-scale structure on the core–mantle boundary near Hawaii; Phys.org summary here.
- More geophysics: Seismic wave simulation using a 3D printed model of the Los Angeles Basin; Phys.org summary here.
- Research on tungsten and evolution of the Earth during the Precambrian: Earth's geodynamic evolution constrained by ^{182}W in Archean seawater; Phys.org summary here.
- Structural geology research: The folds and faults kinematic association in Zagros.
- Paleozoic ocean plate stratigraphy unraveled by calcite U-Pb dating of basalt and biostratigraphy.
- Plates tectonics: Taiwan's Crust Is Moving at 'Extreme' Speed.
- Earth's core: Unexpected flow behavior in liquid metals; journal paper here.
- Sedimentology: Tsunamites versus tempestites: Various types of redeposited stromatoporoid beds in the Devonian of the Holy Cross Mountains (Poland), a case study from the Ołowianka Quarry.

Paleontology

- Pleistocene bears: *Ursus etruscus* from the late Early Pleistocene of the Taurida cave (Crimean Peninsula); Eureka Alert summary here.
- High quality fossils: Amphibian and reptilian fauna from the early Miocene of Echzell, Germany.
- Slow-growing reef corals as climate archives: A case study of the Middle Eocene Climatic Optimum 40 Ma ago.
- Global record of "ghost" nannofossils reveals plankton resilience to high CO2 and warming; behind paywall, Live Science summary here.
- Also from Live Science: Meet 'Fiona' the pregnant ichthyosaur, Chile's oldest marine reptile mom.

- Crystal Palace dinosaurs: how we rediscovered five missing sculptures from the famous park.
- What happens after a mass extinction and there are no big plant eaters: The megaherbivore gap after the non-avian dinosaur extinctions modified trait evolution and diversification of tropical palms.

Volcanoes, Earthquakes and Geohazards



Link

- From the European Geosciences Union: Multilayer modelling of waves generated by explosive subaqueous volcanism.
- From the United States Geological Survey (USGS): Magnitude 4.7 Earthquake: West Coast of the Island of Hawaii.
- From NASA's Earth Observatory: Submarine Eruption of Kavachi Volcano.
- Worldwide Volcano News and Updates.

Environmental Geology and Hydrogeology

- Change in soil mineralogy at the site of a petroleum spill: Microbially Induced Anaerobic Oxidation of Magnetite to Maghemite in a Hydrocarbon-Contaminated Aquifer; Phys.org summary here.
- Urban geology research: Monitoring of land use land cover dynamics and prediction of urban growth using Land Change Modeler in Delhi and its environs, India.
- Pollution, prosperity and political organization: Different impacts of democracy and income on carbon dioxide emissions: evidence from a panel quantile regression approach.
- From the European Geosciences Union: Future water temperature of rivers in Switzerland under climate change investigated with physics-based models.
- From the Water Well Journal: A series of choices brought a Superfund site back to life and won an NGWA outstanding groundwater remediation project award.

Mining and Energy

- Genesis of the Zhaoxian Gold Deposit, Jiaodong Peninsula, China: Insights From in-situ Pyrite Geochemistry and S-He-Ar Isotopes, and Zircon U-Pb Geochronology.
- Downhole logging research for petroleum exploration: Bulk Density Response and Experimental Study of Pulsed Neutron-Gamma Density Logging.
- From the United States Energy Information Administration (USEIA): Stronger U.S. dollar contributes to higher crude oil prices in international markets.
- Also from the USEIA: Domestic Uranium Production Report - Annual.
- If you don't treat your staff well: How Allegations Of Bullying And Abuse Caused A Slump In Canadian Oil Trading.

From Out of this World

- Humans have big plans for mining in space – but there are many things holding us back; like gravity?
- Asteroid four times the size of the Empire State Building barreling toward Earth on May 27.
- From Universe Today: May 31st Could Be the Most Powerful Meteor Storm in Generations, or Nothing at All.

Geologists in the News

- Update on Retired British geologist, 66, facing death penalty in Iraq for 'smuggling ancient pottery'.

Exhibits and Events

- Check out this exhibit at the Manitoba Museum.

Link

May 23, 2022

Terrestrial Animal Life during the Jurassic Period

Figure 1 - Jurassic Diorama, Smithsonian National Museum of Natural History
Credit: Carl Malamud, Creative Commons Attribution 2.0 Generic license

The fossil record from the Jurassic Period shows that there was a great diversification of various vertebrate and invertebrate terrestrial animals following the End-Triassic Extinction Event. These various groups of animals included:

- Reptiles such as crocodylomorphs, lepidosaurs, and pterosaurs;
- Dinosaurs, both non-avian and avian (birds are dinosaurs!);
- Amphibians, including the ancestors of modern frogs and salamanders;
- Mammaliaformes, mammals their closest extinct relatives; and
- Insects and arachnids.

There are lots of dinosaur and mammal fossils from the Jurassic, so I am going to devote next week's blog to them. Let's take a look at some of the other terrestrial vertebrates from the Jurassic.

Crocodylomorphs

Crocodylomorphs, originated during the Late Triassic. The End-Triassic Extinction Event drastically reduced their diversity with many lineages going extinct. While many

crocodylomorphs were marine vertebrates, some were terrestrial such as *Litargosuchus leptorhynchus*.

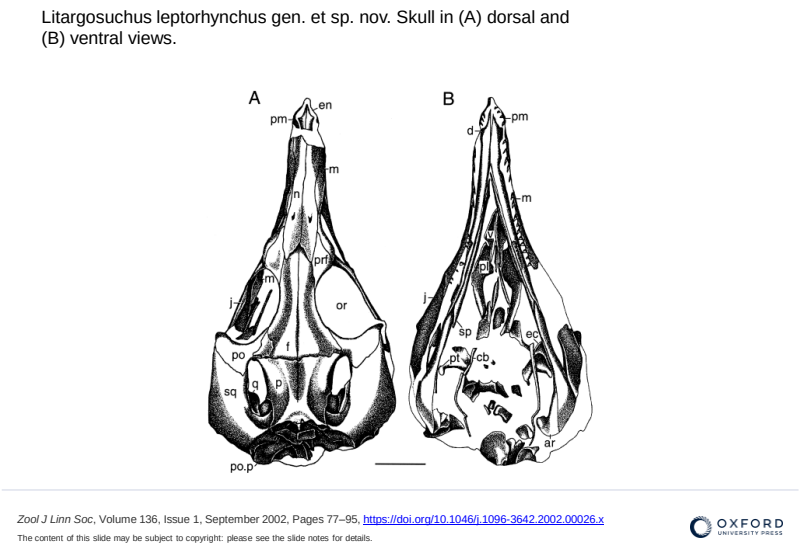


Figure 2 - *Litargosuchus leptorhynchus* Skull
Credit: Figure 1 in Clark & Sues, 2002

In 1988, James Kitching found the first fossils of *Litargosuchus* ("fast running crocodile") in Early Jurassic rocks in the Eastern Cape province of South Africa. Initially identified as another species, re-examination of the fossil in 2002 led James M. Clark and Hans-Dieter Sues to identify it as an new species. The fossils indicate that *Litargosuchus* was a small, fast moving predator. Researchers have identified only one species of the *Litargosuchus* genus: *L. leptorhynchus*.

Figure 3 - Reconstruction of *Litargosuchus leptorhynchus*
Credit: Smokeybjb, Creative Commons Attribution-Share Alike 3.0 Unported, 2.5 Generic, 2.0 Generic and 1.0 Generic license

Lepidosaurs

Lepidosaurs, a group that includes rhynchocephalians (tuataras) and squamates (snakes and lizards)have all been found in fossils from the Jurassic. Although there is only one remaining species of rhynchocephalians, the New Zealand tuatara, the global distribution of their fossils in the Early Jurassic indicate that they achieved their maximum diversity during that time. Fossils of squamate reptiles first appeared in Middle Jurassic aged rocks although the earliest common ancestor of squamates probably during the Early Jurassic.

Here are a couple examples of Jurassic reptile fossils.

Homaeosaurus, a Rhynchocephalian

Figure 4 - *Homaeosaurus maximiliani*
Credit: Ghedoghedo, Creative Commons Attribution-Share Alike 3.0 Unported license

Homaeosaurus is a genera of rhynchocephalian lizard from the Late Jurassic of Western Europe. Christian Erich Hermann von Meyer was the first to describe *Homaeosaurus* from fossils found in the Solnhofen Limestone, a lagerstätte formation in Bavaria. There are three identified species of the *Homaeosaurus* genus: *H. maximiliani*, *H. major* and *H. solnhofensis*.

From its fossils, *Homaeosaurus* was a small predator, apparently living by hunting insects and other creatures. *Homaeosaurus* fossils are very similar to the modern tuatara and is likely representative of the ancestors of the modern reptile.

Eichstaettisaurus - a Squamate Reptile

One of the oldest fossil of a squamate reptile was of *Eichstaettisaurus*. Ferdinand Broili first identified *Eichstaettisaurus* in fossils from the Late Jurassic Solnhofen Limestone. There are two species of the *Eichstaettisaurus* genus: *E. schroederi* from the Late Jurassic and *E. gouldi* from the

Early Cretaceous. *Eichstaettisaurus* resembles modern geckos and probably had a similar lifestyle.

Figure 5 - *Eichstaettisaurus schroederi*
Credit: Ghedoghedo, Creative Commons Attribution-Share Alike 3.0 Unported license

Pterosaurs

Although they are often seen as flying dinosaurs, pterosaurs were actually another kind of reptile. (Birds are flying dinosaurs!) While they originated in the Late Triassic, quite a few families of pterosaurs appeared and diversified in the Jurassic: the Rhamphorhynchidae which first appeared in the Early Jurassic; Anurognathids and Pterodactyloidea which first appeared in the Middle Jurassic, and Ctenochasmatids, found in rocks from the Late Jurassic.

Rhamphorhynchus

Georg zu Münster found the first fossil of *Rhamphorhynchus* in 1825 and it originally called it *Pterodactylus longicaudus*. Later, Christian Erich Hermann von Meyer proposed the genus *Rhamphorhynchus* for *Pterodactylus* and related fossils. In 1995, a review by pterosaur researcher Chris Bennett established the current organization of the genus and its species. Three species of the genus *Rhamphorhynchus* are currently recognised: *R. muensteri, R. longicaudus*, and *R. etchesi*.

The best fossils of *Rhamphorhynchus* fossils were found in the Late Jurassic Solnhofen Limestone. Other examples of *Rhamphorhynchus* have been found in the Kimmeridge Clay in the United Kingdom and in Jurassic rocks from Spain and Tanzania.

The fossils of *Rhamphorhynchus* show a flying reptile with needle like teeth. Some fossils show the remains of fish and cephalopods in their abdominal cavities, so we can surmise that it ate

fish. The exceptional preservation of *Rhamphorhynchus* in the fossils recovered from the Solnhofen Limestone allowed for a deep analysis of its lifestyle and life cycle.

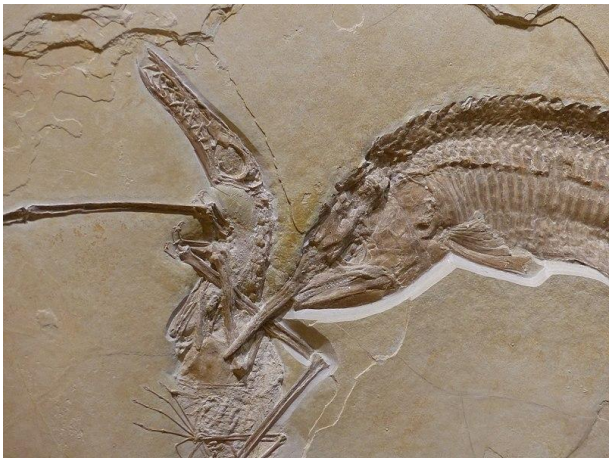


Figure 6 - *Rhamphorhynchus* Fossil
Credit: Christian Reinboth, Creative Commons Attribution-Share Alike 4.0 International license

Sinomacrops, an Anurognathid Pterosaur

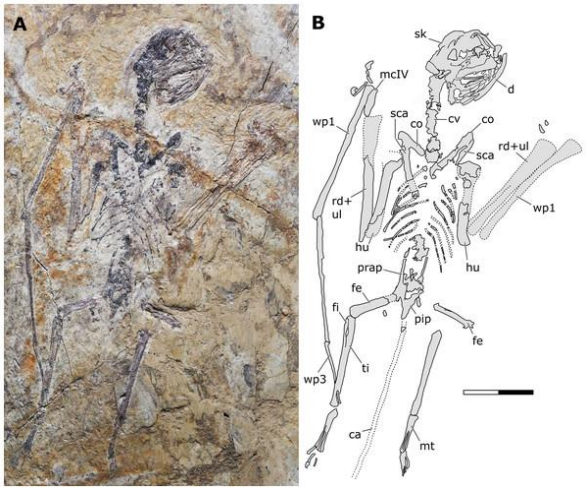


Figure 7 - *Sinomacrops*
Credit: Xuefang Wei *et al* 2021, Creative Commons Attribution-Share Alike 4.0 International license

Sinomacrops was an anurognathid pterosaur whose fossils were found in rocks from the Middle-Late Jurassic. A team of researchers (Xuefang Wei, Rodrigo Vargas Pêgas, Caizhi Shen, Yanfang Guo, Waisum Ma, Deyu Sun, and Xuanyu Zhou) first described the pterosaur *Sinomacrops* in 2021. There is only one identified species of the *Sinomacrops* genus*: S. bondei*.

The research team found the fossils of *Sinomacrops* in the Middle-Late Jurassic Tiaojishan Formation in Hebei Province, China, another lagerstätte. Volcanic rocks make up the Tiaojishan Formation: mostly varieties of trachyandesite and ignimbrite together with sedimentary tuff,

tuffaceous conglomerate and tuffaceous sandstone.

Figure 8 - Life Restoration of *Sinomacrops*
Credit: Xuefang Wei *et al* 2021, Creative Commons Attribution-Share Alike 4.0 International license

Pterodactylus

Figure 9 - *Pterodactylus antiquus* specimen, showing both part and counterpart
Credit: Ryan Somma, Creative Commons Attribution-Share Alike 2.0 Generic license

A Pterodactyloid pterosaur from the Late Jurassic, *Pterodactylus* was the first flying reptile fossil described in scientific literature . The Italian scientist Cosimo Alessandro Collini was the first to describe *Pterodactylus* in 1784 from fossils found in the Solnhofen Limestone of Bavaria. At the time, Collini was the curator of "curiosities" for the palace of Charles Theodore, Elector of Bavaria at Mannheim and he wasn't sure exactly what he had found. In 1812, Samuel Thomas von Sömmerring was the first to describe the fossil as the remains of a flying reptile. Georges Cuvier and Constantine Samuel Rafinesque each independently coined the term *Pterodactylus* and Richard Lydekker established *Pterodactylus antiquus* as the type species of the genus *Pterodactylus*. In addition to *P. antiquus*, two other species were proposed for the genus: *P.*

kochi and *P. scolopaciceps*, however paleontologists have assigned these to *Diopecephalus kochi* and *Aerodactylus scolopaciceps*. As they say on social media "it's complicated".

Figure 10 - Reconstruction of *Pterodactylus*
Credit: Matthew Martyniuk, Creative Commons Attribution-Share Alike 4.0 International license

There are around 30 fossil specimens of *Pterodactylus* showing a variety of developmental stages. The teeth in the fossils show small and needle like teeth, suggesting a diet of small animals and especially invertebrates.

Jurassic Amphibians

The ancestors of modern amphibians, Lissamphibia, including frogs (Anura), salamanders (Salamandroidea) and caecilians (Gymnophiona) all diversified during the Jurassic. Let's look at a couple of examples.

Prosalirus

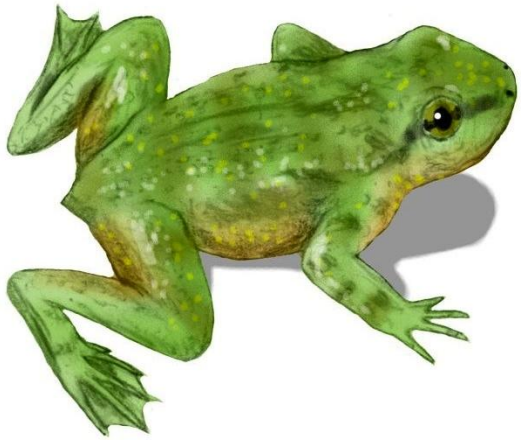


Figure 11 - Reconstruction of *Prosalirus bitis*
Credit: Nobu Tamura, Creative Commons Attribution-Share Alike 3.0 Unported license

Recognized as the earliest true frog, *Prosalirus*, fossils of the frog were found in rocks from the Early Jurassic. In 1981, Farish Jenkins found the first fossil of *Prosalirus* in the Kayenta Formation of Arizona. There are only three specimens of *Prosalirus* and the only species in the genus is the type species: *Prosalirus bitis*.

Karaurus

Figure 12 - *Karaurus sharovi*
Credit: Ghedoghedo, Creative Commons Attribution-Share Alike 4.0 International license

One the stem species of salamanders, *Karaurus*, its fossils were found in Middle to Late Jurassic rocks. Mikhail F. Ivakhnenko discovered *Karaurus* in claystones of the Karabastau Formation of Kazakhstan. There is only one species of the *Karaurus* genus: *K. sharovi*.

The fossils of *Karaurus* show a small amphibian, around 20 cm long, with teeth that were suitable for a diet of small insects, worms and crustaceans.

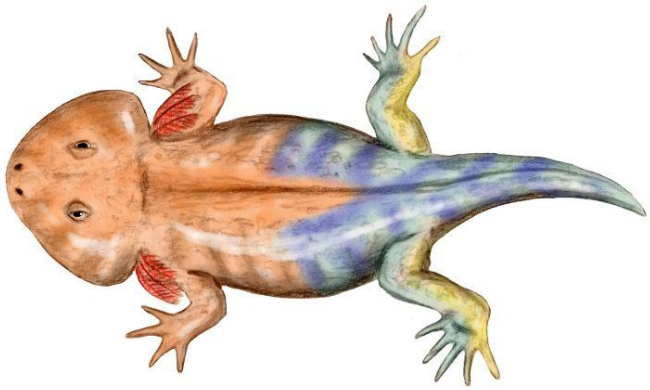


Figure 13 - Reconstruction of *Karaurus*
Credit: Nobu Tamura, Creative Commons Attribution-Share Alike 3.0 Unported license

Jurassic Insects and Arachnids

Insects and arachnids appear to have weathered the End Triassic Extinction and flourished during the Jurassic, providing food for many of the vertebrates listed above. Here are a couple of examples from the fossil record.

Orthophlebiidae

Figure 14 - Orthophlebiidae from China
Credit: Yan-jie Zhang et al, 2021, Creative Commons Attribution-Share Alike 4.0 International license

Orthophlebiidae are family of scorpionflys that lived from the Triassic to Cretaceous. A team of researchers (Yan-jie Zhang, Peter J. M. Shih, Jun-you Wang, Maria E. McNamara, Chungkun Shih, Dong Ren & Tai-ping Gao) found the fossils in Figure 14 in the Middle Jurassic Jiulongshan Formation of Inner Mongolia, China. The Jiulongshan Formation is another of these amazing formations that show exceptionally good preservation of fossils, in this case within sediments deposited within deltaic and lacustrine environments.

Mongolarachne jurassica

An extinct spider, *Mongolarachne jurassica* is a big spider from the Jurassic that may be an ancestor, or is related to the ancestors, of modern orb-weaving spiders. The fossils show a spider with a total body length of approximately 24.6 mm with front legs that are 56.5 mm long.

Only two fossils of *Mongolarachne jurassica* have been found, one female and the other male. Figure 15 shows these two specimens, with the male specimen on the left and the female on the right.

Figure 15 - *Mongolarachne jurassica*
Credit: Paul A. Selden, Creative Commons Attribution-Share Alike 3.0 Unported license

A team of researchers (Paul A. Selden, ChungKun Shih, and Dong Ren) first described *Mongolarachne jurassica* in a 2013 paper. Originally named as *Nephila jurassica*, the team found the fossil in the Jiulongshan Formation from Inner Mongolia, China.

Standard Caveat

The purpose of my weblog postings is to spark people's curiosity in geology. Don't entirely believe me until you've done your own research and checked the evidence. If I have sparked your curiosity in the subject of this posting, follow up with some of the links provided here. If you want to, go out into the field and examine some rocks on your own with the help of a good field guide. Follow the evidence and make up your own mind.

In science, the only authority is the evidence.