REPORT

British Triassic palaeontology: literature supplement 42

Since the completion of the previous supplement on British Triassic palaeontology (*Mercian Geologist*, **19**, 285) the following works on or relating to the subject have appeared or come to the compiler's notice.

Atkinson, J. W. & Wignall, P. B. 2019. How quick was marine recovery after the end-Triassic mass extinction and what role did anoxia play? *Palaeogeography, Palaeoclimatology, Palaeoecology*, **528**, 99–119.

Atkinson, J. W. & Wignall, P. B. 2020. Body size trends and recovery amongst bivalves following the end-Triassic mass extinction. *Palaeogeography, Palaeoclimatology, Palaeoecology,* **538**: 109453, https://doi.org/10.1016/j.palaeo.2019.109453. 18 pp.

Atkinson, J. W., Wignall, P. B., Morton, J. D. & Aze, T. 2019. Body size changes in bivalves of the family Limidae in the aftermath of the end-Triassic mass extinction: the Brobdingnag effect. *Palaeontology*, **62**, 561–582.

Ballell, A., Moon, B. C., Porro, L. B., Benton, M. J. & Rayfield, E. J. 2019. Convergence and functional evolution of longirostry in crocodylomorphs. *Palaeontology*, **62**, 867–887.

Bennett, S. C. 2020. Reassessment of the Triassic archosauriform *Scleromochlus taylori*: neither runner nor biped, but hopper. *PeerJ*, **8**: e8418, DOI 10.7717/peerj.8418. 77 pp.

Bestwick, J., Unwin, D. M., Butler, R. J., Henderson, D. M. & Purnell, M. A. 2018. Pterosaur dietary hypotheses: a review of ideas and approaches. *Biological Reviews*, **93**, 2021–2048.

Cashmore, D. D. & Butler, R. J. 2019. Skeletal completeness of the non-avian theropod dinosaur fossil record. *Palaeontology*, **62**, 951–981.

Chure, D. J. & Engelmann, G. F. 2016. Fossil vertebrates in drill cores: a rare but surprisingly diverse record. *New Mexico Museum of Natural History & Science Bulletin*, **74**, 51–59.

Cubo, J. & Jalil, N.-E. 2019. Bone histology of *Azendohsaurus laaroussii*: implications for the evolution of thermometabolism in Archosauromorpha. *Paleobiology*, **45**, 317–330.

Dróżdż, D., 2018. Osteology of a forelimb of an aetosaur *Stagonolepis olenkae* (Archosauria: Pseudosuchia: Aetosauria) from the Krasiejów locality in Poland and its probable adaptations for a scratch-digging behavior. *PeerJ*, **6**: e5595, DOI 10.7717/peerj.5595. 28 pp.

Duffin, C. J. 2019. Charles Moore and the Late Triassic vertebrates: history and reassessment. *Geological Curator*, **11**, 143–160.

Fensome, R. A., Williams. G. L. & MacRae, R. A. 2019. The Lentin and Williams Index of Fossil Dinoflagellates 2019 Edition. *AASP Contributions Series*, **50**, 1173 pp.

Hoffman, D. K., Heckert, A. B. & Zanno, L. E. 2018. Under the armor: X-ray computed tomographic reconstruction of the internal skeleton of *Coahomasuchus chathamensis* (Archosauria: Aetosauria) from the Upper Triassic of North Carolina, USA, and a phylogenetic analysis of Aetosauria. *PeerJ*, **6**: e4368, DOI 10.7717/peerj.4368. 22 pp.

Hudgins, M. N., Uhen, M. D. & Hinnov, L. A. 2020. The evolution of respiratory systems in Theropoda and Paracrocodylomorpha, the end-Triassic extinction, and the role of Late Triassic atmospheric O_2 and CO_2. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **545**: 109638, https://doi.org/10.1016/j.palaeo.2020.109638. 15 pp.

Jäger, K. R. K., Gill, P. G., Corfe, I. & Martin, T. 2019. Occlusion and dental function of *Morganucodon* and *Megazostrodon*. *Journal of Vertebrate Paleontology*, **39**, DOI: 10.1080/02724634.2019.1635135. 21 pp.

Jin Meng, Fangyuan Mao, Gang Han, Xiao-Ting Zheng, Xiao-Li Wang & Yuanqing Wang 2020. A comparative study on auditory and hyoid bones of Jurassic euharamiyidans and contrasting evidence for mammalian middle ear evolution. *Journal of Anatomy*, **236**, 50–71.

Kalthoff, D. C., Schulz-Kornas, E., Corfe, I., Martin, T., McLoughlin, S. & Schultz, J. A. 2019. Complementary approaches to tooth wear analysis in Tritylodontidae (Synapsida, Mammaliamorpha) reveal a generalist diet. *PLOS ONE* **14**: e0220188,https://doi.org/10.1371/journal.pone.0220188. 24 pp.

Keeble, E. & Benton, M. J. 2020. Three-dimensional tomographic study of dermal armour from the tail of the Triassic aetosaur *Stagonolepis robertsoni*. *Scottish Journal of Geology*, **56**, 55–62.

King, B. & Beck, R. M. D. 2020. Tip dating supports novel resolutions of controversial relationships among early mammals. *Proceedings of the Royal Society of London*, **B 287**: 20200943, http://dx.doi.org/10.1098/rspb.2020.0943. 7 pp.

Langer, M. C., da Rosa, Á. A. S. & Montefeltro, F. C. 2017. *Supradapedon* revisited: geological explorations in the Triassic of southern Tanzania. *PeerJ*, **5**: e4038, DOI 10.7717/peerj.4038. 27 pp.

Lovegrove, J. 2019. Investigating the palaeotopography and variations in ecology of Rhaetian Bristol using the Westbury Formation bone bed. *Palaeontological Association N/L*, **102**, 85–88.

Mussini, G., Whiteside, D. I., Hildebrandt, C. & Benton., M. J. 2020. Anatomy of a Late Triassic Bristol fissure: Tytherington fissure 2. *Proceedings of the Geologists' Association*, **131**, 73–93.

Parker, W. G. 2018. Redescription of *Calyptosuchus* (*Stagonolepis*) *wellesi* (Archosauria Pseudosuchia: Aetosauria) from the Late Triassic of the southwestern United States with a discussion of genera in vertebrate paleontology. *PeerJ*, **6**: e4291, DOI 10.7717/peerj.4291. 47 pp.

Parker, W. G. 2018. Anatomical notes and discussion of the first described aetosaur *Stagonolepis robertsoni* (Archosauria: Suchia) from the Upper Triassic of Europe and the use of plesiomorphies in aetosaur biochronology. *PeerJ*, **6**: e5455, DOI 10.7717/peerj.5455. 31 pp.

Patrick, E. L., Whiteside, D. I. & Benton, M. J. 2019. A new crurotarsan archosaur from the Late Triassic of South Wales. *Journal of Vertebrate Paleontology*, **39**, DOI: 10.1080/02724634.2019.1645147. 18 pp.

Radley, J. D. & Coram, R. A. 2020. The earliest Laurasian unionoids? Freshwater bivalves from the Middle Triassic of Devon, southern UK. *Proceedings of the Geologists' Association*, **131**, 60–66.

Riding, J. B. 2020. Literature compilations in palynology are not simply tedious lists. *Palynology*, **44**, 1–3.

Riding, J. B., Scott, A. C. & Collinson, M. R. 2020. A biography and obituary of William G. Chaloner FRS (1928–2016). *Palynology*, **44**, 127–166.
Scheyer, T. M., Spiekman, S. N. F., Sues, H.-D., Ezcurra, M. D., Butler, R. J. & Jones, M. E. H. 2020. *Colobops*: a juvenile rhynchocephalian reptile (Lepidosauromorpha), not a diminutive archosauromorph with an unusually strong bite. *Royal Society Open Science*, **7**: 192179, http://dx.doi.org/10.1098/rsos.192179. 14 pp.
Simões, T. R., Vernygora, O., Caldwell, M. W. & Pierce, S. E. 2020. Megaevolutionary dynamics and the timing of evolutionary innovation in reptiles. *Nature Communications*, **11**: 3322, https://doi.org/10.1038/s41467-020-17190-9. 14 pp.
Sobral, G. & Müller, J. 2019. The braincase of *Mesosuchus browni* (Reptilia: Archosauromorpha) with information on the inner ear and description of a pneumatic sinus. *PeerJ*, **7**: e6798, DOI 10.7717/peej.6798. 28 pp.
Tihelka, E. 2019. New Mesozoic earwigs from England, with a catalogue of fossil Dermaptera. *Proceedings of the Geologists' Association*, **130**, 609–611.
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THE RECORD

Report of the Secretary

Our individual membership now stands at 138 together with 51 joint members, 0 student members and 25 institutional members. Five new members joined during the year. We regret to record the death of Dorothy Morrow, a member from the early days of the Society; former Secretary for many years and then President, she continued as a member, and up to the remarkable age of 101 maintained a keen interest in the Society.

Indoor Meetings

Once again Ian Sutton is to be thanked for organising the spring 2019 and autumn/winter 2019–20 lecture programmes which covered a varied range of topics, as detailed below. These were held on Saturday evenings at the lecture theatre in the Sir Clive Granger Building at Nottingham University's main campus. The Society is indebted to the School of Geography at the University for sponsoring our lectures and for the use of their excellent facilities. Peter Beastall applied his technological know-how in overseeing the operation of the audio-visual equipment.

Following the 2019 AGM on 9 March, Dean R. Lomax, Visiting Scientist at Manchester University, delivered a superbly illustrated lecture on **Incredible Ichthyosaurs – a decade studying Jurassic 'Sea Dragons'**. More than 100 species of ichthyosaur have been found across the globe, with thousands of specimens from the UK. Most British specimens are from the Jurassic Coast, Dorset, and from quarries in Somerset, and by far the most common British ichthyosaur genus is *Ichthyosaurus*. Over the past decade Palaeontologist Dean Lomax has dedicated much of his academic career to studying ichthyosaurs by examining specimens held in museums across the world. This has resulted in the discovery of a new species (*Ichthyosaurus anningae*, named in honour of Mary Anning), some incredibly rare specimens, and other finds that are new to science, including a newly-identified giant ichthyosaur from the Westbury Mudstone Formation (latest Triassic) of Lilstock, Somerset.

The subject of the April lecture, **Derbyshire Blue John revisited** was chosen to coincide with the publication by the Society of a new, up-dated and improved edition of the definitive book on Derbyshire Blue John, written 20 years ago by Trevor Ford (reviewed in the 2019 issue of *Mercian Geologist*). Blue John fluorite is one of the few minerals that can be claimed as unique to Britain. The banded purple and yellow colouring of the material extracted from Treak Cliff at Castleton cannot be matched by fluorite that is known from anywhere else in the world. The reason for its rarity lies in the unusual geology of the reef limestone of Treak Cliff. When cut and worked into ornaments or jewellery, Blue John is beautiful. Tony Waltham gave an overview of Blue John, its mining and its uses as a decorative stone, highlighting some of the changes in our understanding of the geology and history of Blue John. Noel Worley then described the geological features at Treak Cliff, which is probably the most accessible example of mineralized hypogenic karst in the South Pennine Orefield, and explained how the geological conditions influenced the formation of the distinctive colour banding of Blue John fluorite.

Sea floor minerals exploration was the focus of **Into the abyss: exploring the mineral potential of Earth's final frontier**, a lecture given in October by Paul Lusty, Principal Economic Geologist at the British Geological Survey. Growing demand for mineral raw materials, coupled with the increasing challenges of land-based mining and geopolitics, will motivate the search for alternative sources of mineral supply, pushing resource development into frontier environments. A resource frontier currently attracting significant attention is the ocean floor, which covers more than two-thirds of the planet's surface and hosts a diverse spectrum of geological environments, geomorphological features and ecosystems. Metal resources on the seafloor have been known for more than a century and it is speculated that the seafloor may contain a metal endowment proportionate to its area.

Extensive areas of ocean floor are now licensed for exploration and some deep-ocean mining projects are scheduled to commence operation in the next few years. As a consequence, deep-ocean mining has moved from a distant possibility to a reality that could make an important contribution to metal supply and economic growth. Despite this optimism, there is a requirement for enhanced mineral exploration models, improved resource assessment, more robust economic evaluation, and the development of cost-effective exploration strategies and techniques. This presentation explored these issues in the context of two case studies. The first considered the Trans-Atlantic Geotraverse hydrothermal field, located at the Mid-Atlantic Ridge, which is known for its seafloor massive sulfide deposits. The second case study examined the mineral resource potential of ferromanganese crusts, which develop on seamounts in the deep-ocean. These deposits can be highly enriched in 'critical' metals required for high-technology and green energy applications.

The minerals theme continued in November with **Minerals of the English Midlands** given by Roy Starkey. He provided an overview of some of the fascinating stories associated with the mines, quarries and minerals of the English Midlands, illustrated by images taken especially for a recently published book of the same title (reviewed *Mercian Geologist* 2019).

The mineral wealth of the English Midlands has been exploited for centuries. Lead, copper, zinc, and to a lesser extent silver, have all been worked. Deposits of coal, iron ore and limestone powered the Industrial Revolution, providing raw materials for such visionaries as Sir Richard Arkwright, Matthew Boulton, James Watt, William Murdoch and Josiah Wedgwood.

The area has produced a wide range of interesting mineral specimens. Examples of these are to be found in local and regional museum collections, and especially at the Natural History Museum in London. However, such was the importance of Britain in the development of mineralogy as a science that specimens from the English Midlands are to be seen in collections all over the world.

Minerals such as phosgenite, matlockite and mottranite are recognised as having been first described from the English Midlands. Although the glory days of mining are long gone, quarrying operations, especially in Derbyshire, Gloucestershire, Leicestershire and Shropshire mean that fresh exposures are constantly being created, and new mineralogical discoveries continue to be made today. Thanks to the efforts of miners, mineral dealers and collectors over the past few hundred years, interesting and beautiful specimens have been preserved for us to enjoy today.

Permafrost through geological time was the subject of a lecture by Prof. Peter Worsley (University of Reading) in December. Permafrost (perennially frozen ground) is a product of below-0°C temperatures in earth materials for a period of at least two years. The ground is not necessarily completely frozen since it is possible for included water to have a freezing point several degrees below 0°C. Permafrost is not permanent, since both natural and anthropogenic climatic changes may result in temperatures rising above 0°C. Permafrost is associated with the growth of ground ice which may take several forms. In this lecture Peter Worsley focused on the growth and decay of those forms that develop as a result of thermal contraction processes related to the annual cycle of temperature change. These are ice-wedges and sand wedges (including intermediate forms); and the sedimentary structures created by the casting processes which follow climatic amelioration.

Modern analogue studies of permafrost have been undertaken on Banks Island, NWT, Canada. At a latitude of 71° N, the permafrost is regarded as continuous and may approach 500 m in thickness. The mean annual temperature is about minus 12°. In permafrost terrains sub-surface exposures are normally rare but occasionally rapid coastal erosion exposes sections through the top part of the permafrost. Examples were examined and the implications for the interpretation of the UK Pleistocene were discussed. In the *Mercian Geologist* 53 years ago, the speaker presented evidence for several phases of permafrost development in east Cheshire and thereby assembled an early UK palaeopermafrost stratigraphy. A recent enquiry from Dutch geologists has led to the field examination of structures in Sweden which were thought to be evidence of palaeopermafrost in Precambrian rocks. The reasons for doubting the link to permafrost were discussed.

The lecture for January 2020, given by Dr Elsa Panciroli (University of Oxford), was on **Middle Jurassic mammals and other fossils of the Isle of Skye, Scotland**. Discoveries of Middle Jurassic (Bathonian) fossils on Skye more than forty years ago were the first of their kind in Scotland. Since then, outcrops of the Kilmaluag Formation in particular have become some of the most productive sites for Middle Jurassic microvertebrate fossils in the UK, yielding multiple small vertebrates including early mammals and salamanders. In the last decade, fieldwork led by researchers from National Museums Scotland and the University of Oxford has led to new and significant discoveries, suggesting Skye is of international significance for small vertebrate remains.

The Kilmaluag Formation on Skye represents a predominantly freshwater environment, not unlike the Florida Everglades today. This depositional setting preserves some of the most complete Jurassic mammal skeletons outside China. Unlike similar-aged sites in England, or Late Jurassic sites in Portugal and North America, microvertebrate fossils from the Kilmaluag Formation are most often recovered as associated skeletons, or skeletal elements. Study of these specimens is made possible through micro-CT and synchrotron scanning, technologies that are revolutionising palaeontological research. The mammals from the Kilmaluag Formation provide new insights to early mammal diversity, anatomy and ecology. This internationally significant fossil material will add much-needed detail to our increasingly vivid picture of the rich ecosystems of the Middle Jurassic.

For his President's Evening in February, Mike Allen elected to invite Dr Simon Drake, Research Associate at Birkbeck College, University of London to give a talk on **Ignimbrites and associated rocks from the Palaeocene Isle of Skye, NW Scotland, and Ordovician Upper Borrowdale Volcanic Group, English Lake District**. The talk covered an introduction to ignimbrites (also called ash-flow tuffs) and how they can be identified and classified (*a la* Branney & Kokelaar 1992: A reappraisal of ignimbrite emplacement, *Bulletin of Volcanology*, **54**, 504–520). Recreation of eruption dynamics and ignimbrite deposition were covered. Examples were described with reference to Palaeocene volcanics from the Isle of Skye, and Ordovician volcanics from the Upper Borrowdale Volcanic Group of the Coniston area in the English Lake District. Reference was also made to 275 ka pyroclastic rocks from Tenerife in the Canary Islands. The speaker was particularly excited by an opportunity to study the similarities and contrasts between ignimbrites and the recently discovered Palaeocene-aged meteoritic ejecta blanket on Skye.

Field Excursions

Together with members of the North Staffordshire Group of the Geologists' Association (NSGGA) the field trip season started in April with a challenging visit to **Mam Tor** to look at Carboniferous outcrops and the well-known landslip. Unfortunately, due to adverse weather this part of the visit had to be abandoned for safety reasons. The second part of the planned visit involved a tour of **Treak Cliff Cavern** to view the Blue John veins in-situ as well as the excellent cave formations. Being underground the cavern, a well-appointed show cave with a gift shop, displays and refreshments, brought welcome relief from the weather.

In May we marked the **Centenary of the first UK oil discovery at Hardstoft, Derbyshire** led by Tim Pharaoh and Tim Colman. The morning was spent at the Oilwell Nursery at Hardstoft near Tibshelf, which is the site of the first discovery of oil in the UK on 27 May 1919. We learned the reasons behind the search for UK oil at the time and why Hardstoft was selected as one of the drilling sites. We then travelled to Kelham Hall, between Southwell and Newark, to visit the museum dedicated to the WW2 Eakring oil and early North Sea gas discoveries, and to hear Kevin Topham talk about his involvement in the early offshore exploration, including the Sea Gem disaster, in which he was personally involved.

In June, members of EMGS joined a weekend organised by the Yorkshire Geological Society centred around the **Brassington Tertiary pocket deposits of Derbyshire**. Saturday saw an afternoon of talks on the Geology and Geomorphology of the Pocket Deposits, held at the British Geological Survey, Keyworth. Sunday was spent examining the deposits exposed in old workings at Brassington, led by Jim Riding. The onshore UK is not well known for Miocene sediments (there is a major hiatus between the Oligocene and the Pliocene in southeast England) and the Brassington Formation is the best example of sediments in karstic fills which survived Late Neogene and Quaternary erosion. The Brassington Tertiary (Miocene) sand, clay and gravel deposits infill karstic cavities in dolomitised Carboniferous Limestone. This excursion essentially repeated an earlier EMGS field trip led by Jim Riding and Peter Jones in 2016, for an account of which see *Mercian Geologist*, **19** (1), 55.

Because of the interest shown by members, and in the view of the limited number of places available, two evening visits to the **Goodluck lead mine** at Bonsall, both led by Paul Chandler (Peak District Mines Historical Society), were made in June and September. This old Peak District lead mine has been conserved by a dedicated group of mining history enthusiasts.

In July very good weather favoured a weekend tour of **Anglesey**, led by Ian Stimpson of Keele University. Among the varied delights were rare Precambrian blueschists, Gwna Group mélange (?Precambrian–Cambrian), South Stack Group (Cambrian–Ordovician), Carboniferous Limestone and associated Quaternary palaeokarst, Devonian fluvial sandstones, and the spectacular Parys Mountain (Ordovician–Silurian) opencast copper mine and precipitation ponds.

A very thorough and informative visit to **Bantycock opencast gypsum mine** at New Balderton, near Newark, was made in September. This was led by Adam Garbutt, Mine Technical Engineer of Saint-Gobain Formula who operate the quarry. This is a large operation which exposes not only the Triassic Branscombe Mudstone Formation in which the several seams of worked gypsum are found, but also the overlying Penarth Group (Triassic) including the base of the Barnstone Member (Jurassic). The party was given ample opportunity to examine the full sequence exposed at various levels in the quarry, and to collect fossils in particular from the Westbury Mudstone Formation.

More detailed reports of some of these visits will be found elsewhere in this issue. Our thanks go to Tim Colman for his organisation of the Society's field excursion programme, and to the leaders for their time and expertise.

Circular

As usual we must thank Sue Miles for continuing to edit the Society's *Circular*, which is issued six time a year.

Publications

Tony Waltham has now handed over the role of Editor of the *Mercian Geologist* to David Bate, although Tony's experience and expertise will continue to be available to the new editor along with that of the editorial team.

March 2019 saw the publication of a third edition of the late Trevor Ford's *Derbyshire Blue John*, edited by Tony Waltham and Noel Worley and published by the Society in association with Treak Cliff Cavern. It has been a great success, with half the printing costs already recouped.

Website

Our thanks go to Rob Townsend who continues to update the Society's website.

Council

Council met on six occasions during the year to discuss the smooth running of the Society. Lectures, field trips and financial matters formed the majority of the business, together this year with determining the logistics for the distribution of the Blue John book. Council was given a presentation by Andrea Snelling concerning the digitization of Nottinghamshire's RIGS. The results are now available on the Nottingham City website. The Society's publicity stand was manned at an event at New Walk Museum in Leicester.

Janet Slatter