BOOK REVIEW

Dinosaur Isle in 101 Fossils (Isle of Wight Council 2021) Munt,M., Peaker,A., and Wilson T.

This book will appeal to all keen fossil collectors, locals and visitors alike. In a professional glossy format with 229 pages and abundant photographs of museum specimens, the three authors provide both a guidebook and updated geological history of the Island. Martin Munt and Alex Peaker are highly qualified and experienced palaeontologists at the museum, and Trudie Wilson is a professional palaeo-artist. They detail palaeo-environments from the earliest visible Cretaceous rocks through to the relatively recent Quaternary. They discuss the known or inferred lifestyle and ecology of the various fossil animals and plants. They include new data from seismic surveying, oil drilling, and analyses of tectonic plate movements have informed the reinterpretation of several significant local geological events. The authors have produced a most valuable visual guide; an excellent book despite some surprisingly ungrammatical sentences.

The sections of the book correspond to those of the museum displays: The Evolution of an Island, Wealden Landscape, Greensand Sea, Chalk Sea, Shark Sea, Last Paradise, Ice Age Wight, and Our Geological Heritage, so it enhances the museum experience. The very useful concluding section provides a stratigraphical column giving ages of the rock units, a short glossary of technical terms, and a bibliography. Most fossil photos are shown again in miniature with precise names, stratigraphic position and geographical location, thus providing some useful details omitted in the main text. There is also a brief history of the early museums on the Island, a summary of the legal position regarding fossil collection, and a short biography of the authors.

Unlike the arrangement of museum displays which take visitors progressively backwards in time to the spectacular dinosaurs, this account begins with the earliest rocks and fossils. It is the sequence normal in a geology book, showing how and why environments continually change into new configurations, with resulting changes in flora and fauna, and new species replace extinct forms.

The book starts by discussing the exotic clasts and fossils seen in the early Cretaceous record. Tectonic events on the Island throughout this period were influenced by an underlying ancient major fault system dating from the Variscan mountain-building episode, about 299 million years ago (Ma) in the Carboniferous. Wight was entirely terrestrial during the Wealden period, and the southern half of the Island was on the north side of a large, slowly subsiding land area called the Wessex Basin, bounded by these faults. Rivers flowing eastwards brought sediments and identifiable rock pebbles (clasts) from Devon and Dorset. Other streams came southwards from eroding uplands which existed across the northern half of the Island and beyond, bringing down sediments, clasts and fragments of older 'derived' fossils of Jurassic age which were redeposited in the new Basin sediments.

In 'The Wealden' from about 125 Ma. the book explores the braided meandering river systems of the Wessex Formation. Colour mottled mudstones and coniferous forests represent a seasonal climate of alternating hot and dry followed by cool and wet conditions. Trees like *Araucaria* and *Tempskya*, and iconic dinosaurs including *Iguanodon bernissartensis*, *Neovenator salerii*, *Eotyrannus lengi*, *Polacanthus foxii*, and the giant Sauropods, together with their coprolite 'dino-pats' and gastrolith 'stomach- stones' are illustrated. The book contains multiple photos of their bones and up-to-date details of classification and lifestyles.

Subsidence gradually changed the Wessex Basin geography to a broad estuary and eventually to a brackish lagoon inside a sandbar, now represented by the Barnes High Sandstone. This is the distinctive Vectis Formation which yields shark-fin spines from *Egertodonus bassanus*, storm-piled bivalve-shell coquina of *Filosina gregaria* which became thin limestone beds, and even occasional dinosaur foot-casts.

Eventually, seawater flooding into the lagoon produced the richly fossiliferous marine sediments of the Lower Greensand, beginning with the Atherfield Clay and progressing to the Monks Bay Member (formerly Carstone). There is a large variety of marine invertebrates to enthral collectors, and some terrestrial material that drifted out to sea including shipworm-bored logs and occasional dinosaur bones. Photographs highlight Island classics including the bivalve *Mulletia mulleti*, the trigonid *Eurotrigonia vectiana*, ammonite *Deshayesites deshayesi*, and partly 'unwound' heteromorphic ammonite *Australiceras gigas*. Coral colonies of *Holocystis elgans*, small lobsters *Mecochirus magnus*, flat spiral fossils of the tube worm *Rotularia polygonalis*, and the elegant common brachipod *Sellithyris sella*, are all well illustrated.

Rising global temperatures and sea-levels at the end of the Lower Cretaceous brought a change in the marine sediments, first to Gault Clay and then to the Upper Greensand, both now comprising the Selborne Group. The book has illustrations of three ammonites, *Mortoniceras commune*, *Euhoplites* and *Hamites* and also the uncommon nautilus *Anglonautilus undulatus*. The latter represents a group which still lives today, unlike the ammonites. With greater depths came the Chalk Seas, beginning with extremely fossil-rich Glauconitic Marl, and then three further Marls. There were numerous ammonites, notably *Schloenbachia varians* and *Mantelliceras mantelli*, alongside the intriguing sponge *Exanthesis labrosus* and rare ichthyosaur marine reptile bones. Even deeper seas submerged the nearest land sources of sediment, and marls were replaced by brilliant white limestones, the White Chalk. originating from myriad minute, planktonic, calcium carbonate coccoliths. Unfortunately, alkaline Chalk ooze was poor at preserving ammonites and reptile bones. But there are distinctive echinoids including the sea urchins *Echinocorys scutata* and iconic *Micraster cortestudinarium*, the scallop *Spondylus spinosus*, bivalve *Mytiloides labiatus*, and squid-like bellemnite *Belemnitella mucronota*.

Sea-level fell in the Late Cretaceous, and combined with some local uplift, exposed the top of the White Chalk to erosion. Eventually in the Late Paleocene (Early Palaeogene), the potholed top of the White Chalk was covered in red terrestrial sediments, the Reading

formation. The authors provide a recently revised interpretation of topographic changes that occurred at this time. The Wessex Basin and Chalk had been gradually folding upwards for some time, but the eroded uplands north of ancient faults across the centre of the Island now began subsiding into what gradually became the Hampshire Basin, which extends from Sussex along the line of the modern Solent to Dorset. These changes were previously attributed to crustal compression from the south, where the African tectonic plate was pushing into the Eurasian plate along the Mediterranean. Instead, the uplift is now interpreted as increased buoyancy of the crust to the south-west due to a huge 'plume' of hot magma rising from very deep in the Earth's mantle. Further west it was producing the uplift, rifting and basaltic oceanic crust which created the new North Atlantic Ocean. Remnants of the plume continue to power volcanism in Iceland.

The Shark Sea developed in a deepening Hampshire Basin, and now the marine London Clay yields a rich variety of bivalves, gastropods and shark teeth. Beautiful fossils include bivalves such as the Pinna fan-shell renamed *Atrina affinis*, and *Bucardiomya margaritacea*, as well as the crab *Zanthropsis leachi*. Shallower warm sea deposits of the Bracklesham Group alternate with flint beach-pebbles, thin coals and the famous Alum Bay Plant Bed which includes leaves of the ginger plant *Aralia*. Marine beds provide teeth of shark like *Striatolamia macrota* and Eagle Ray tooth-plates, but fossils are less abundant than at the type locality in Sussex. There are *Turritella* snails, the cockle *Venericor planicosta*, and an impressive giant planktonic foram *Nummulites britannicus*. The Barton Group has elegant Scaphopod tusk-shells, *Antalis bartoniensis*.

A cooling global climate, after the Palaeocene-Eocene Thermal Maximum (PETM) at 55.5 Ma, produced the subtropical conditions of the Last Paradise, with Solent Group rocks of Late Eocene to Early Oligocene age. Uplift was now also affecting the Hampshire Basin, as shallow marine environments were replaced by fresh waters, interrupted by periodic incursions of brackish conditions. The Headon Hill Formation holds several important freshwater limestone beds and was followed by the wetland Bembridge Limestone and then the Bouldnor Formation. Cliffs from Alum Bay to Colwell give excellent vertical sections through near-horizontal Headon Beds located to the north of the Isle of Wight 'monocline', whereas at Whitecliff Bay the same beds are inclined (dip) steeply The featured fossils include bivalves *Polymesoda obovata* and the Colwell Venus, *Cordiopsis polytropa*, and an intricately colour-patterned *Neritina* gastropod *Pseudodostioa aperta*. Gastropods are quite diverse and include *Melanopsis fusiformis.* There are also vertebrates, the turtle *Rafetoides henrici* and pond tortoise *Emys*. Bembridge Limestone has abundant flattened-spiral freshwater Ramshorn snails, *Planorbis discus*, and the easily identified *Galba* now *Lymnaea longiscata*, great pond snails with lungs to breathe air. There is also a rare partial jawbone of the odd-toed ungulate mammal *Plagiolophus,* related to horses.

The short-lived marine incursion which eroded the top of the Bembridge Limestone left saltwater fossils in the base of the Bouldnor Formation. Around 35 Ma was about the time when the break-up of a southern super-continent called Gondwana was reaching completion. Open oceans expanded between Antarctica and nearby continents and produced a circum-polar current, cutting Antarctica off from all tropical warm-water currents. Huge ice sheets began to grow there, slowly lowering sea-level and contributing to prolonged global climatic cooling.

On Wight, freshwater and terrestrial sediments soon covered the marine beds in the Gurnard Member (formerly Bembridge Marls), with many molluscs, plants and some vertebrates. The internationally famous Bembridge Insect Bed, a very fine-grained limestone with exquisitely preserved spiders, ants, wasps, dragonflies, grasshoppers, beetles and flies was laid down. The book's photographs show the termite *Mastotermes anglicus* and the water- spider *Vectaraneus yulei* named after expert local collector Andy Yule. The Gurnard beds also have *Sabal major* fan- palm leaves, *Typhus* rushes, and cypress conifers from seasonally flooded forests. Fossilized seeds include those of water-soldier *Stratiotes websteri* and waterlily *Sabrena chandlerae*. These no doubt helped to conceal the predatory *Alligator hantoniensis*, renamed *Diplocynodon.*

Accelerated global cooling resulted in the loss of archaic mammals and a notable change of plant fossils preserved in the clays and ironstones of the Hamstead beds. A reconstructed jaw of the pig-sized cloven-hoofed artiodactyl called *Bothridion velaunus* looks impressive. Freshwater to brackish sediments of the Cranmore beds, with the estuarine swimming crab *Portunus vectis*, took the Bouldnor Formation through late Eocene into early Oligocene times, ending at 28.1 Ma.

Then nothing. Erosion has removed whatever sediments were deposited after the early Oligocene right through to the Quaternary (Pleistocene) Ice Ages. Enigmatic non-fossiliferous Quaternary river gravels of uncertain age but possibly dating back to 2.59 Ma, lie unconformably across various Island downs. Numerous glacial episodes occurred, separated by warm and even hot inter-glacials. Whenever polar ice accumulations caused low sea-levels, a large Solent River flowed around the east end of the Wight peninsula (later Island) and turned west to join European rivers in the valley that became the English Channel. Gravels and muddy sediments along the tributaries and floodplains of that Solent River preserved important mammal fossils. Fossils from these interglacial beds of Ipswichian age, about 100,000 years BP, are now exposed on the foreshore near Newtown and may match the well- known fauna under Trafalgar Square in London. They include bones, teeth and horns, notably of *Bison priscus*, the elephant *Palaeoloxodon antiquus*, mammoth *Mammuthus primigenus*, and *Hippopotamus amphibus*.

The great variety of animals and plants from Cretaceous to modern times described in this book is the awesome geological heritage of the Island.

If the Island fossils inspire you to seek more knowledge about changing global environments in ancient times, useful books include: Peter Ward and Joe Kirschvink 'A New History of Life' (Bloomsbury 2015), David Beerling 'The Emerald Planet – How Plants Changed Earth's History' (Oxford UP 2007), Andrew Scott 'Burning Planet – The Story of Fire Through Time' (Oxford UP 2018) and, with more technical details, Tim Lenton and Andrew Watson 'Revolutions That Made The Earth' (Oxford UP 2007), Tim Flannery 'Europe the First 100 Million Years' (Penguin 2019).

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