Geology Research

Lyme Museum publications

2010 Andrew, C., Howe, P., Paul, C. R. C. & Donovan, S. K. Fatally bitten ammonites from the Lower Lias of Lyme Regis, Dorset. *Proceedings of the Yorkshire Geological Society*, **58**: 81-94.

2011 Andrew, C., Howe, P., Paul, C. R. C. & Donovan, S. K. Epifaunal worm tubes on Lower Liassic ammonites from Dorset. *Proceedings of the Geologists' Association*. **122**: 34-46.

2011a Paul, C. R. C. Sutural variation in the ammonites *Oxynoticeras* and *Cheltonia* from the Lower Jurassic of Bishop's Cleeve, Gloucestershire, England and its significance for ammonite growth. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **309**, 201-214. doi:10.1016/j.palaeo.2011.05.045

2011b Paul, C. R. C. Dark bands on pyritic internal moulds of the Early Jurassic ammonites *Oxynoticeras* and *Cheltonia* from Gloucestershire, England: interpretation and significance to ammonite growth analysis. *Palaeontology*, 54, 1213-1221. doi: 10.1111/j.1475-4983.2011.01086.x

2012 Paul, C. R. C. and Simms, M. J. Epifauna on ammonites from the Lower Jurassic of the Severn basin, southern England, and their palaeoenvironmental and taphonomic significance. *Proceedings of the Geologists' Association*. **123**: 508-519. (doi:10.1016/j.pgeola.2011.11.008)

2012 Andrew, C., Howe, P. and Paul, C. R. C. The linguliform brachiopod *Discinisca* in the Lower Jurassic Charmouth Mudstone Formation of Dorset and the Alum Shale Member of Yorkshire. *Proceedings of the Yorkshire Geological Society*, **59**: 125-132.

2014a Paul, C. R. C. Did *Dactylioceras* eat fish? *Proceedings of the Yorkshire Geological Society* **60**, 9-17.

2014b Paul, C. R. C. Sutural asymmetry in the ammonites *Bifericeras* and *Leptonotoceras* from the Lower Jurassic of Bishop's Cleeve, Gloucestershire, England and its significance for ammonite life orientation. *Palaeogeography, Palaeoclimatology, Palaeoecology,* **418** (2015), 160-175. doi: 10.1016/j.palaeo.2014.11.005

2015 Andrew, C., Howe, P. and Paul, C. R. C. Fatally bitten ammonites from the Lower Liassic, 'Marston Marble', Somerset, UK. *Proceedings of the Geologists' Association*. **126**, 119-129. doi: 10.1016/j.pgeola.2014.10.006

In press

1. Andrew, C., Gale, A. S., Howe, P. and Paul, C. R. C. A new species of goniasterid starfish from chert in the Upper Greensand Formation (Lower Cretaceous: Albian) of Lyme Regis, Dorset, U.K. *Geoscience in South-West England*, 13.
2. Andrew, C., Howe, P. and Paul, C. R. C. Exceptionally preserved ammonites from the Charmouth Mudstone Formation (Lower Jurassic) and their significance for ammonite taphonomy. *Geoscience in South-West England*, 13.

3. Andrew, C., Howe, P. and Paul, C. R. C. Previously unreported spiny limid bivalves from the Blue Lias Formation (Lower Jurassic: Hettangian) of Lyme Regis, Dorset, UK. *Geoscience in South-West England*, 13.

Two of these papers involved international collaboration with Prof. S. K. Donovan, of the Naturalis Museum, Leiden, The Netherlands. A third involved collaboration with Dr M. J. Simms, Ulster Museum, Northern Ireland. One of the submitted articles involves description of a new species of Cretaceous fossil starfish, in collaboration with Professor A. S. Gale of Portsmouth University.

Themes

1. Fatally bitten ammonites. These are ammonites with a piece of the shell missing just in front of the last suture. The missing piece is interpreted as a ventral bite mark, which would have severed the muscles attaching the body to the shell, thus enabling a predator to remove the body more easily. To produce the bite marks the predator would have had to manipulate the shell considerably. Thus, we believe the predator was another cephalopod mollusc with suckered tentacles. Such damage was first reported by a German called Roll in 1935. Thereafter the next paper was published by three Dutch geologists in 2009. Our paper appeared in 2010. Since then interest has blossomed with papers and reports of similar damage by a Spaniard and two Japanese researchers. I have reviewed two papers on further English examples, one of which has been published. This damage is clearly very widespread, but had virtually been ignored before the present decade. In 2014 we submitted a second paper on bitten ammonites, this time as seen in cross-sections on the polished surfaces of a small block of the ‘Marston Marble’. This was published in 2015.

An ammonite (*Asteroceras*) with a bite out of the shell (top right) scale bar = 1 cm

2. Hitch-hiking worms. Numerous local ammonites have worm tubes on them that were clearly alive while the ammonites were alive since in several cases the worm tube was eventually overgrown by the ammonite. During their growth the worm tubes migrate to a mid ventral position on the ammonite and the worm tube aperture maintains a position about 90 degrees behind the ammonite aperture. We have shown that this position was ideal for the worm as the swimming ammonite created currents that enhanced the worms food-gathering capacity. It was harmful to the ammonites, however, as those with attached worm tubes died at smaller sizes than identical ammonites without attached worm tubes. Occasionally, some of the larger species of ammonite were involved and they often survived the attachment of the worms, but became distorted as they grew over the worm tubes. Hitch-hiking worms attachéd to ammonites were also first reported by two German geologists separately in 1932 and 1934. There is also a short note in Dutch recording the occurrence of hitch-hiking worms on the Jurassic Coast. As far as we are aware our paper is only the fourth on this topic and, so far, has not stimulated other research. However, we hope to consider how the additional weight of the worm tubes affected the ability of the ammonites to float in seawater. A poster was presented at the 3rd International Palaeontological Conference in London in 2010.

A pyritized ammonite (*Promicroceras*) with a worm tube that emerges from beneath the ammonite's aperture. Scale bar = 1 cm.

3. Sutural variation in Liassic ammonites. This topic involved a large collection of pyritized ammonites from the Lias at Bishop's Cleeve, Gloucestershire. Two forms, which may be male and female of the same species, showed great variation in the number of sutures per whorl of the shell and the angle at which the septa grew. The variation was very considerable, but similar in both forms, thus tending to confirm that they were closely related, possibly sexual dimorphs.

Variation in suture spacing in the ammonite *Cheltonia*.

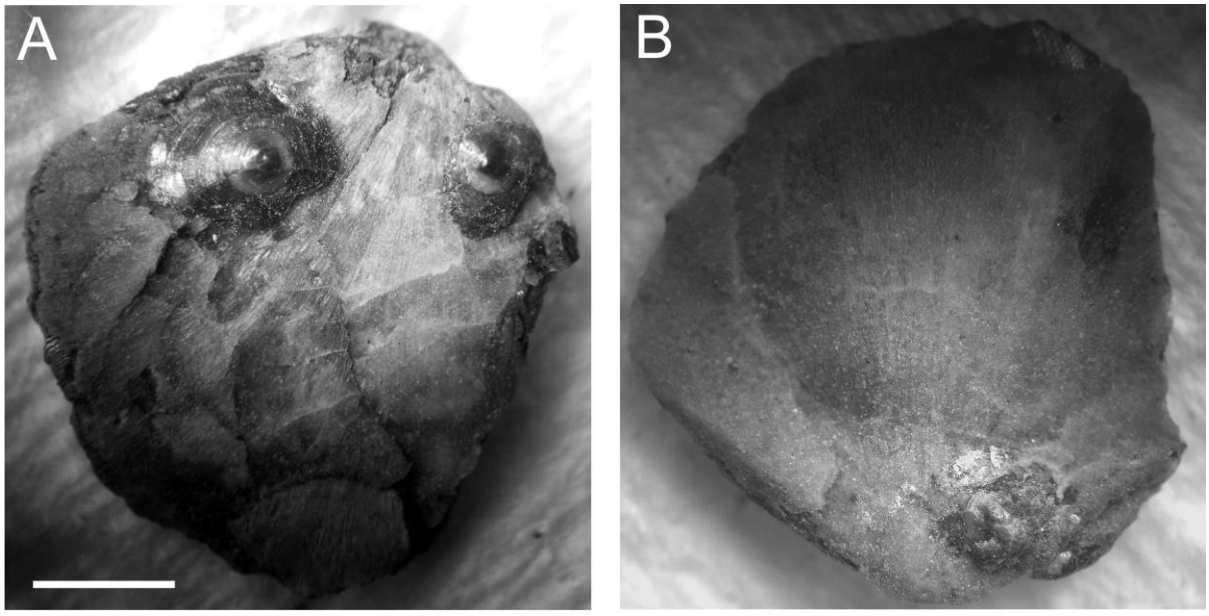
4. The second type of variation seen in three other forms involved the sutures becoming asymmetrical with the siphuncle, which is normally mid-ventral in position, migrating as much as 93 degrees to one or other side. I suggested that this resulted from the ammonites not being vertical in the water, due to the attachment of fouling organisms, possibly seaweeds. Sutural asymmetry has been frequently reported in the ammonite literature in the past, but never in such extreme frequency (95 % of one species had asymmetrical sutures), nor has there been any previous attempt to explain it other than as due to aberrant growth or the result of accidental injury.

An ammonite with an offset siphuncle (v) in the middle of the ammonite's right side instead of at the periphery where it normally is. Scale bar = 1 mm

5. Preservation history of ammonites. As a spinoff from the Bishop's Cleeve research Dr Michael Simms (Ulster Museum) and I discussed the organisms that attached to ammonite shells after they fell to the sea floor. We showed that some ammonites must have been exposed on the sea floor for at least four years, as four size classes of bivalves were attached to them, and that there was a prevailing current direction at the time. Another spinoff was the discovery on freshly exposed pyritic ammonites of repeated dark bands, which indicated the position of former apertures. Thus, although these ammonites showed no other sign of periodic growth, they must have stopped growing repeatedly to produce the dark bands. In modern *Nautilus* the production of a dark band indicates that the shell is fully grown. However, *Nautilus* does not produce repeated dark bands.

An ammonite that has overgrown an encrusting oyster (arrow) attached on its right hand side. Scale bar = 1 mm.

6. The occurrence of a rare brachiopod, *Discinisca*. Prior to our paper only three specimens of *Discinisca* had been reported from the local Lias. We documented several additional occurrences attached to ammonites and other brachiopod shells. We also added information about the morphology of the hidden valve, which lies closest to the surface of attachment and is usually hidden from view. Since then, further local occurrences of *Discinisca* have been discovered. It is apparently nothing like so rare as it seemed, but has been overlooked because it is so small.



Two views of opposite sides of a rhynchonellid brachiopod with three specimens of *Discinisca* attached. Scale bar = 1 mm.

7. Food of ammonites. I have reported on a specimen of the ammonite *Dactylioceras* from Yorkshire, which has numerous fish scales and a short section of fish backbone preserved in the inferred position of the stomach and crop, respectively. A possible explanation for these occurrences is that the ammonite ate fish, either as a predator or scavenger. Clear evidence of ammonite food is only rarely preserved in fossils.

Close up view of fish scales and three articulated vertebrae found within the ammonite *Dactylioceras* approximately where the crop may have been. Scale bar = 1 mm.

Current research

Two talks were presented at the Ussher Society annual meeting in Paignton in Jan. 2015. One concerned unusually preserved ammonites with a thin veneer of iridescent shell material remaining attached to the shell. The veneer is confined to the rear part of the body chamber and suggests there was a difference in shell structure in this part of the shell. Why the rear of the body chamber should differ from the rest of the shell is currently unexplained, although it may mark the limit of the ammonite's mantle cavity.

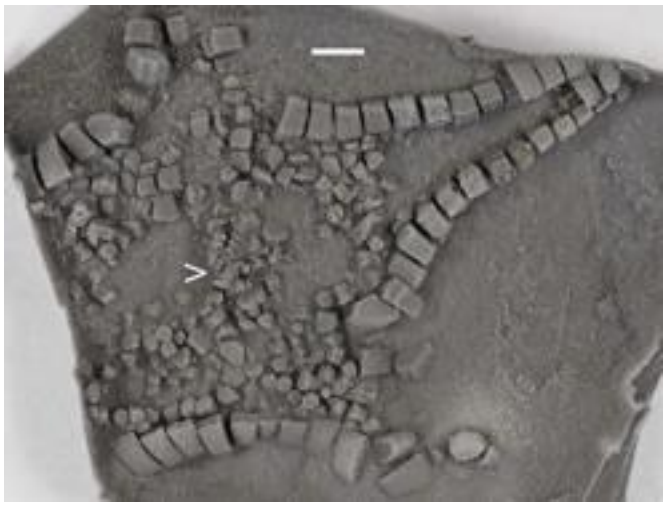
An iridescent ammonite with a gently sloping front margin to the iridescent veneer. Arrow indicates last suture. Scale bar = 5 mm.

The second talk concerned new records of possibly three species of spiny limid bivalve molluscs from the local Blue Lias Formation and an articulated starfish from Cretaceous chert in the Upper Greensand Formation. Despite Lyme's fame as a source of fossils the bivalves have never been reported to occur here in the geological literature. Specimens in the Geological Survey collections were acquired in 1860-64 and 1878, respectively, and apparently represent two species. So the bivalves have been known to occur here for a very long time, but no-one has actually recorded their occurrence. We have found additional specimens of a third species recently and have attempted to document the exact beds from which they came.

The spiny limid bivave *Ctenostreon*, which has not previously been reported from the Blue Lias of Lyme Regis. Chisel haft is 13 mm across.

A second unexpected occurrence involved a new species of articulated starfish from the Cretaceous chert in the Lower Greensand Formation to be named *Nymphaster lymensis*. This is the oldest known species of Nymphaster. However, the main interest is how such a delicate fossil managed to get preserved in a shallow, high-

energy deposit such as the Lower Greensand. Modern starfish start to disintegrate within hours to days of death. Other articulated examples of related starfish are preserved in the Chalk, which was deposited in a very low energy environment. Our starfish must have been buried permanently and not subsequently disturbed within a few days of death at the most.



Silatex cast of the articulated starfish from the Chert beds on the Upper greensand, Church Cliffs, Lyme Regis. Scale bar = 5 mm. The arrow points to the mouth angle plates.

These talks form the basis of three papers that have been accepted by the journal ‘Geosciences in SW England’, published by the Ussher Society.

Finally, it is worth pointing out that much of the fossil material for the research documented above has been collected by Paddy Howe and Chris Andrew during fossil walks. The fossil walks not only provide entertainment and education for the participants, but the continual gathering of material inevitably turns up rarities or other significant finds that contribute to scientific research. The published research has involved the Museum acquiring about 170 specimens, including slabs with many individual fossils preserved in them. About half contributed free by Paddy and Chris.

Professor C. R. C. Paul