A NEW SEA DRAGON: FROM DISCOVERY TO DISPLAY

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Abstract

The discovery of a new ichthyosaur in 1992 in Somerset, the problems overcome in its conservation, and the production of a facsimile for display.

Keywords

Somerset coast, ichthyosaur, fossil preservation, Triassic

INTRODUCTION

Fossil reptiles have always excited palaeontologists, both young and old, and Somerset is well known for its fossil marine reptiles. This discovery is significant, not only because it adds to our knowledge of the species and their place in the history of the Somerset coast but because it emphasises the need to protect geological sites and bring the methodology used in preservation into public awareness.

Ichthyosaurs were first discovered in the Liassic shales and limestones of the South West. Their fossilised remains were studied by many early naturalists who visited this region from the early 17th to mid 19th centuries and they were variously interpreted as fish, lizards, and even 'sea-dragons' (Howe and Sharp 1981; McGowan 2001). They were in fact predatory, air-breathing marine reptiles, streamlined and powerful swimmers, that gave birth to live young. The last of these remarkable creatures died out at the end of the Cretaceous Period, some 90 million years ago, but the group first appeared in the Lower Triassic and for 150 million years they became a widespread and dominant reptile force, beautifully adapted to their marine realm.

Fossils are a key part of our natural heritage and form a major scientific, educational and recreational resource. They are fundamental to understanding the evolution of life and interpreting ancient sedimentary environments. Furthermore, they provide the basis for a relative geological timescale – a worldwide system of correlating sedimentary rocks. Geological collections are important. They are an irreplaceable part of our unique scientific and cultural heritage and a tremendous resource for future research. All finds of fossil vertebrates are considered rare and worthy of study and collecting, where possible. The opportunity to discover them in Somerset is confined to the rocks of the coast, a diminishing number of inland quarries, fissure infillings, and a small number of cave sites. The marine sediments of the Somerset coast offer the best opportunity to find such a creature. Here, the Upper Triassic and Lower Jurassic sediments accumulated on a shallow to moderately deep, open water shelf, in a sub-tropical climate. Organisms living in the sea and especially on the sea bed stand a much better chance of being fossilised than those living on dry land. Animals with shells or skeletons are more likely to be fossilised because their hard parts are much easier to preserve.

DISCOVERY

In 1992, a 1m long ichthyosaur, was found by geologist Peter Wayne while walking along the beach. His prompt and responsible action led to its rescue: he contacted the Somerset Environmental Records Centre (SERC) who telephoned English Nature (EN). The Somerset coast is largely privately owned and has been designated a Site of Special Scientific Interest (SSSI) by EN. It is managed for nature conservation (including the fossil resource) jointly by landowners, the Somerset County Museums Service (Museums Service), and EN. Following discovery, EN contacted the landowner and the Museums Service and a site inspection was made.

The responsible collecting of fossils is an accepted approach to the conservation management and sustainable development of our natural heritage. All parties agreed that it was in the public interest to attempt specimen recovery and the landowner was pleased to transfer the 'title of ownership' to the Museums Service – accession number TTNCM: 166/1992. The Museums Service organised the excavation and the team comprised staff from the museum, EN and SERC, the finder, landowner and some volunteers.

RESCUE EXCAVATION

The excavation plan was to extract the specimen on a single block of rock and remove it to the museum's laboratory in Taunton Castle. Limited photography and mapping was required since the outline of the reptile could be seen clearly. Part of the abdomen and tail was hidden by 0.8m of cliff overburden – this had to be removed.

The skeleton was found to be mineralised with calcite and pyrite. Iron pyrites is a mineral which can become unstable or 'reactive' and will decay rapidly, usually destroying the fossil it constitutes. Most of the fossil bone was highly mineralised with pyrite, indicating that after preparation from the rock, it would be wise to cast the specimen in resin as a safeguard. The skeleton was found to lie inclined within the sediment, crossing several bedding surfaces – the tail being situated *c.* 20mm above the snout.

A survey of the immediate area was conducted to establish the stratigraphy and to gather any related materials. In particular, fossil ammonites were collected from the surrounding strata to establish the age of the ichthyosaur:

Middle *Arietites bucklandi* Biozone, Lower Sinemurian.

Kilve Shales, Lower Lias, Lower Jurassic.

No additional parts of the skeleton were found during a careful examination of the site and of the spoil made during the excavation.

An abrasive wheel cutter was used to make a large trench around the specimen and wedges were carefully, but firmly, inserted well beneath it. The aim was to separate the slab of rock containing the specimen in its entirety from the underlying rock. However, during the process part of the tail was broken and the loose piece was taped in place throughout the excavation. Also, two cracks appeared on one side of the slab, running from the edge of the slab into the specimen.

The slab separated relatively easily from the substratum and was gently lifted on to a previously prepared base-board covered with a 12mm thick sheet Plastozote, closed-cell foam. The slab with the base-board was then placed on a wooden carrying frame with handles and secured with webbing straps. This simple device enabled the heavy specimen to be carried with relative ease across the uneven, stony beach. In the museum's laboratory the entire slab and board were completely submerged in a large sink and flushed continuously with fresh water for three days in order to remove as much sea salt as possible before starting remedial conservation treatment. The specimens were allowed to air-dry for about a week prior to treating the cracks and exposed friable bone with Paraloid B72. This was a holding operation while the specimen was in storage awaiting further preparation. It was sad that, due to insufficient funding the specimen remained in store until the millennium – a period of 8 years!

THE MILLENNIUM COMMISSION

During 2001 I was awarded funding by the Millennium Commission under its Sharing Museum Skills in-service training programme and was seconded to the Natural History Museum to prepare and conserve the ichthyosaur for public access – a process which took five weeks. This involved carefully developing the fossil bone from the rock matrix, making a mould from which to cast a copy which was then painted to resemble the original. Figure 1 shows the specimen in the laboratory at Taunton Castle with the skeleton partially visible.

PREPARATION AND CONSOLIDATION OF EXPOSED BONE

The Palaeontology Conservation Unit (PCU) of the Natural History Museum is world-famous for its work on fossil and mineral specimens – a national centre of excellence.

A 'dust box' was specially constructed from *Cardex* corrugated plastic and made air-tight by sealing with tape. Vacuum cleaners were attached to the box so that dust would be continuously extracted during cleaning of the specimen. Access ports were cut through a replaceable, transparent *Melanex* cover. The box now provided an efficient and safe environment in which to work. Figure 2 shows the dust box under construction. The dust box was opened flat when the mallet and chisel or the air pen were used. Protective glasses, mask, dust extractor, and hand-held vacuum cleaner were used to minimise risks to health and keep the work face clean. The work bench provided access from both sides, greatly reducing the need to rotate the heavy specimen during preparation, moulding and casting.

Parts of the skeleton had been exposed by coastal erosion and these were prepared first using a portable air abrasive unit – fully removing all matrix from these areas. Sodium bicarbonate abrasive powder (50 micron) was used because it was found to provide adequate abrasion rate whilst minimising damage to the finely detailed surface of the bone. As the fragile bone was exposed its surface was sealed with Butvar B98 consolidant in Propan-2-ol [(CH_3) 2 CHOH]. In order to assist the up-take of Butvar by bone and matrix the surface of the specimen was first flooded with solvent.

The bulk of the matrix was removed using a combination of an electrically powered diamond circular saw, a small mallet, and tungsten-tipped chisels. A number of strips, *c*. 100mm wide, were prepared across the specimen in order to determine the relative positions of the fossil elements within the rock. Two series of parallel cuts were made with the saw to a depth of *c*. 5mm, *c*. 20mm apart at an angle of 120 degrees to each other, forming a diamond pattern. Firm blows to the chisel on the obtuse angle of each diamond resulted in the clean removal of matrix while imparting minimal stress to the block.

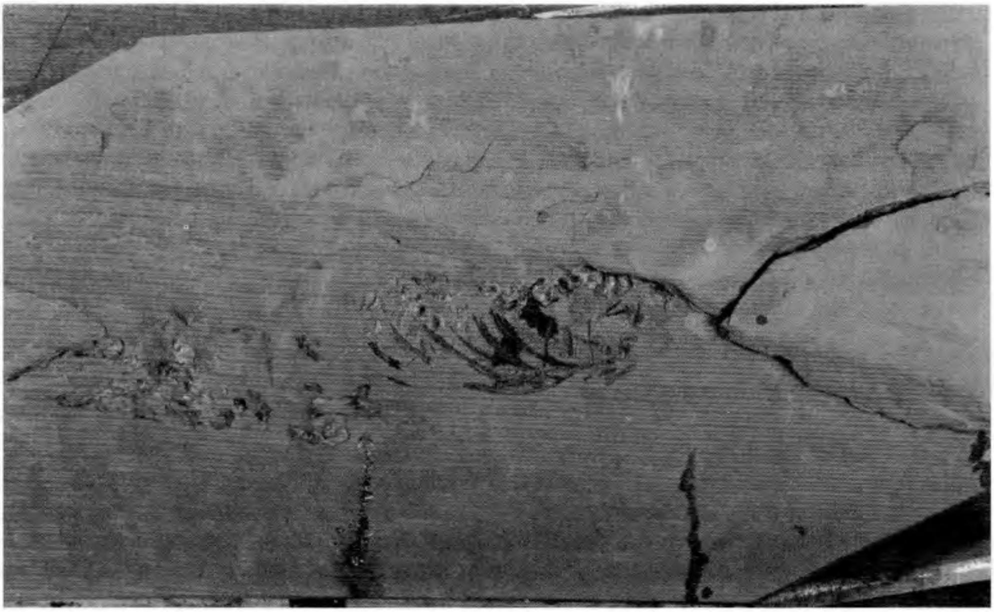

Fig. 1 Ichthyosaur in the laboratory at Taunton Castle. After thorough washing with fresh water to remove as much salt as possible it was allowed to air-dry for about a week. Cracks and exposed friable bone were then consolidated with Paraloid B72.

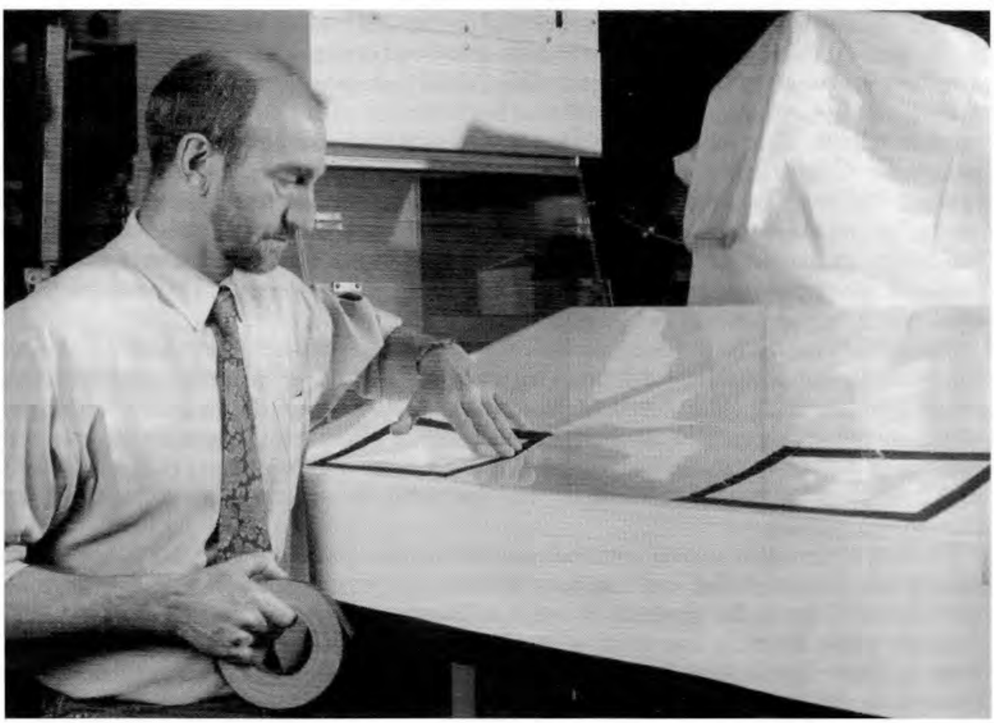

Fig. 2 Dennis Parsons constructing the dust box within which the specimen was prepared

Gradually, the right anterior fin, rib cage, and part of the vertebral column were revealed. The specimen appeared to be lying on its back with its limbs extended, having been crushed dorso-ventrally but with lateral surfaces distorted – left lateral over right. The jaw had twisted exposing the teeth. Most of the ribs and cranium had undergone a fine-scale fracturing as the composite skeleton was crushed during compaction of the sedimentary envelope. Some teeth had also been broken. The ribs were particularly delicate structures to prepare. They were often hollow and proved to be very fragile: they frequently burst open when touched by the powder-jet. The rib cage developed as a collapsed, three-dimensional bony mesh. All exposed bone was consolidated as development proceeded. Figures 3 and 4 illustrate the structures revealed by cleaning. Cling-film was used to protect previously developed areas from an unnecessary build-up of dust, thereby reducing the amount of post-operative cleaning.

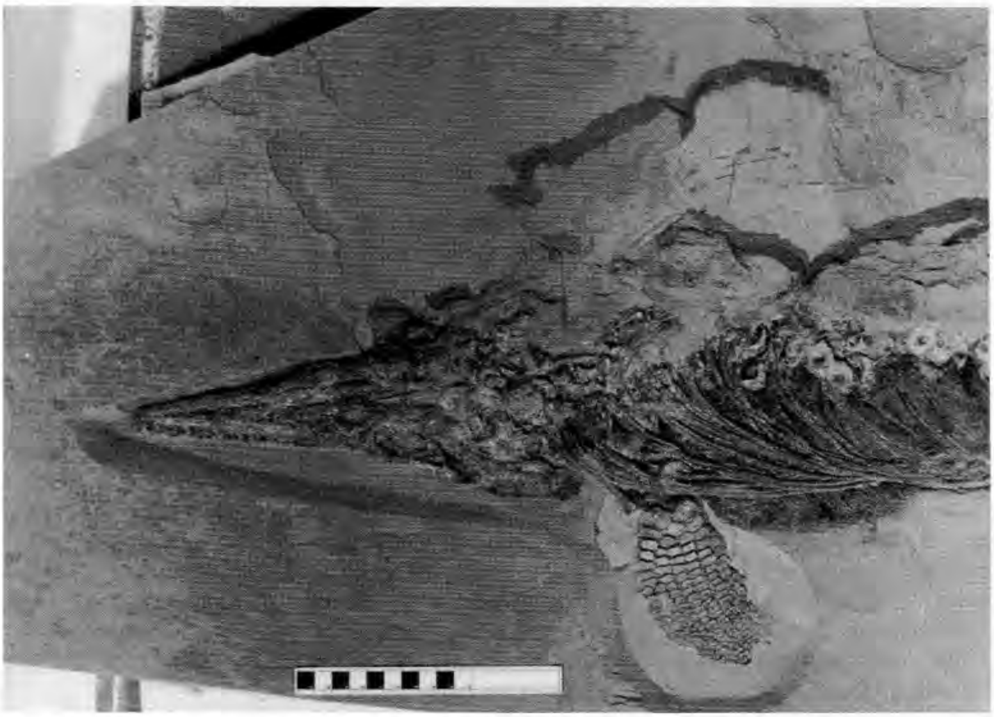

Fig. 3 Under preparation; the cranium, thorax and right fore fin have been exposed. The specimen is orientated ventral surface uppermost and the jaw has twisted exposing the teeth. Many of these delicate structures were difficult to locate and prepare without imparting damage

During preparation the carbonised envelope of what may be preserved skin became clearer – all skeletal elements seeming to lie within. Also at this stage, numerous very tiny (up to 1.5mm) discs became visible primarily in the area of the abdominal cavity. These proved to be the vertebrae of a small fish – evidence of the reptile's last meal!

The presence of a left anterior fin was indicated by a significant upward drape of the matrix. However, even though more matrix was removed than expected, the structure remained hidden. Eventually, the fin was located and found to be curiously folded.

Periodically, the specimen was examined using a microscope to ensure damage was not being done to the bone's surface – especially important in areas of fine detail. The rock layers were not well-cemented and coarse mechanical preparation tended to loosen parts of the skeleton

Fig. 4 Partly prepared ichthyosaur. As preparation progressed, the delicate three-dimensional skeleton was consolidated in order to prevent 'data loss'. Here the rear half of the body has still to be exposed.

lying at different levels, e.g. sections of vertebra lying within different layers became separated. These areas had to be consolidated with Butvar 98 or supported with a temporary splint of surgical gauze impregnated with polyethylene glycol wax (PEG) to prevent their loss during development.

Repeated consolidation was necessary as more of the skeleton was exposed, especially where the delicate bone was three-dimensional. A 20ml syringe was used to slowly inject a very weak solution of Butvar 98 (in isopropanol) into the specimen's cracks, crevices and hollow bones. Some areas were temporarily lifted by the injection process, e.g. the last 120mm of the tail and its matrix separated from the main slab as Butvar 98 was infused. A sandbag on tissue paper was placed on the tail to press it back into position as the solvent evaporated. Repetition of this process resulted in the tail being firmly glued in place. The specimen was weighted where necessary and left to dry overnight.

This preparation presented an almost complete skeleton with little evidence of post-mortem disturbance.

MOULD PRODUCTION

A mixture of BJKS dough[1], Butvar 98 in isopropanol and additional sepiolite powder was used to fill the area around the tail ready for mould production. When dry it was lightly sanded to resemble the surrounding rock and later painted to match the specimen. The entire surface, slab and specimen, was then cleaned thoroughly with industrial methylated spirits.

A water-soluble putty made from PEG and French chalk was used to gap-fill delicate areas where mould-rubber might damage the specimen, i.e. hundreds of tiny holes, hollow ribs and areas of undercut, and a supporting ring of Plasticine was fashioned around the edge of the slab to limit the flow of silicone rubber while forming the mould.

[1] BJKS dough – Butvar 98, jute fibre, kaolin and sepiolite clays.

The silicone rubber used for moulding will adhere to rock, bone and filler, so care was taken to ensure the mould would detach freely without damaging the specimen's surface. A barrier was used to separate the specimen from the mould – a thin coat of Butvar was painted over the surface. Additionally, a very thin layer of polyvinyl alcohol was applied to further enhance the separation of mould from specimen. To prevent silicone from adhering to the Plasticine its surface was painted with Teepol.

The silicone rubber and its catalyst were mixed in a fume cupboard and the mould was produced from three mixes. A softener was added to the first mix to alleviate potential damage to the fragile surface when the mould was removed. The rubber was carefully and thinly applied to the surface of the specimen with a medium-sized, soft brush, taking care not to cause significant pooling – it has a high creep factor and runs freely into small holes and crevices. Air bubbles were removed by stroking the surface with a brush. The second mix was made with a thickener and applied immediately over the first. The mould was left to cure for about five hours before the application of a third layer to strengthen it and increase its resistance to tearing on removal from the specimen and to prolong its working life. The area over the skeleton, especially the raised parts of the vertebra, cranium and odd ribs were given special attention to make sure they were completely covered, as were the edges and corners of the slab.

PRODUCTION OF THE SUPPORTING JACKET FOR THE MOULD

With the mould still in place, a thin layer of petroleum jelly was smeared over its exposed surface and cling film applied as a separator. The petroleum jelly helps the separator adhere closely to the mould's surface prior to the application of a glass-fibre or Jesmonite support jacket. The jacket holds the thin mould in shape during the casting process and while it remains in store. The rubber is thought to become dimensionally unstable over time therefore firm, conforming support is important.

Jesmonite is an acrylic compound. A three-layer jacket was constructed, the main body of which contained glass fibre matting cut into 6-8 inch (150–200mm) squares. Once set, areas of sharp surface material were carefully removed and the jacket was further strengthened by the addition of a 1 inch (25mm) diameter hollow, square profile, glass fibre strut which was placed on the long axis of the specimen and cemented in place with Jesmonite-soaked sheets of glass fibre matting.

WEIGHT REDUCTION AND MAKING THE SUPPORTING JACKET FOR THE SPECIMEN

The specimen, mould and jacket were temporarily secured to the base-board using non-slip plastic ties and the assembly inverted to rest on sandbags arranged to support it evenly. The aim of inverting the specimen was to position it so that excess matrix could be removed, reducing its weight and therefore the risk of damage from awkward handling in the future.

The thickness of the slab was reduced by 25mm to a flat, natural bedding surface. At this stage it was possible to see that the Paraloid B72 which had been applied to the one major transverse crack on the upper surface of the slab, had penetrated deep enough to cement the two halves together. It was still functioning well eight years and many hammer blows later!

The supporting jacket for the specimen was made from epoxy resin, strengthened with Kevlar – a woven synthetic fabric of great strength. A separator was laid over the base of the slab so the jacket could be removed in the future. Additionally, two parallel glass fibre supporting struts, extending the full length of the specimen, were fixed to the back of the jacket using Kevlar and resin straps.

CASTING AND PAINTING

The specimen was inverted to rest on the struts of the supporting jacket and the Jesmonite mould jacket removed. Very gently, the rubber mould was peeled back from the specimen, carefully washed and dried and replaced in its supporting jacket ready for use in casting. It was lightly dusted with fine talc to ease the removal of the cast.

The cast was constructed from a two-part Araldite resin. First, a thin layer was carefully applied by brush, ensuring good, even coverage; working the resin into crevices and hollows. The second coat was added about five hours later as the first became tacky; this was thicker but evenly applied and extended up the shallow sides of the mould in order to impart strength to the finished cast. The addition of dyes to the resin produced a uniform grey colour, similar to the slab of Lower Lias shale and therefore reducing the amount of painting necessary.

The cast was painted to resemble the specimen using acrylic paints. They were applied to the specimen using artists' brushes and to the matrix around it with a large brush and pad made from Plastozote. The latter helped to reproduce the slightly mottled appearance of the shale in which the fossil had originally been found.

CONCLUSIONS

The successful preservation and mounting of the new ichthyosaur cast is of considerable educational interest. The experience gained from the whole partnership employed in the project will be valuable in the future conservation of similar fossils in Somerset. In particular participants in the project learnt that is was valuable to:

Collaborate with the landowner and English Nature to extract the specimen in a recognised and responsible manner – the site is protected by law and appropriate procedures must be followed in order to collect material.

Conduct its own excavation, preparation, conservation and casting.

Collect and record a broad range of information in association with the specimen.

Disseminate information about the find to museums including the British Museum (Natural History), Local Record Centres, to responsible countryside bodies, palaeontologists, and readers of this august journal!

ACKNOWLEDGEMENTS

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About the Author

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