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Title: Rebuilding Mr. Swales' plesiosaur

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Source: Evans, M. (1999). Rebuilding Mr. Swales' plesiosaur. *NSCG Newsletter*, *Issue 12*, 26 - 30.

URL: http://www.natsca.org/article/677

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vancement of Science (for 1841)
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Rebuilding Mr. Swales' plesiosaur.

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This is the story of the reconstruction, research and display of a relatively complete skeleton of the Middle Jurassic plesiosaur *Muraenosaurus leedsii*. It demonstrates the kind of results that can be obtained from apparently uninspiring beginnings.

Plesiosaurs are a group of extinct, secondarily aquatic reptiles that were a significant component of the marine fauna in the Mesozoic Era between 200 and 65 million years ago. The Oxford Clay Formation of the Peterborough area has been recognised since the end of the last century for the exceptional preservation and completeness of its vertebrate fauna (Leeds, 1956). Alfred Nicholson Leeds (1847-1917) of Eyebury near Peterborough assembled a well known collection of reptiles and fish, the majority of which is now in the Natural History Museum, London.

Specimen History

The specimen in question (LEICT G18.1996) was presented to the Leicester Town Museum in 1902 by Mr R. Swales, a shopkeeper from Peterborough. Swales had been donating fossils from the Oxford Clay and overlying Pleistocene deposits of the Peterborough area to the museum since 1896. It is worth noting that Swales was collecting at the same time as A. N. Leeds. The specimen was presented as a series of 89 lots, for example, accession 125/1902 is given as fragments of the skull, and the locality was given as "Oxford Clay, Peterborough".

There is no evidence of any previous work on the specimen such as old

glue or mends, or that the specimen has previously been on display. It is possible that it was displayed in the "open storage" style palaeontology gallery known to exist at the beginning of this century.

The project

This project began in December 1995, when Arthur Cruickshank, our Honorary Research Associate, assigned volunteer Richard Forrest to the task of reassembling the specimen. Richard wanted to learn about plesiosaur anatomy, and the best way to do that is through hands on experience. My own direct involvement started in January 1997, when Richard had other commitments, which curtailed his volunteering to a large extent.

By 1995, the specimen was in some 3000 pieces spread over a number of drawers in the geology store. All old labels from the drawers were retained and are now in the specimen's history file. The numbering system originally used on the specimen was rejected for two reasons. Firstly, it was impossible to say exactly which lot each piece would have originally belonged under, Secondly, the numbering system in use between 1902 and 1907 resulted in 35 parallel runs of accession numbers, one for each subsection of the museum's collections (Sizer, 1962). Codes, in this case Xw, were later assigned in order to differentiate the separate runs. All objects from this period need to be renumbered to bring them into line with the format used for the rest of the collections and the computerised documentation system. The specimen, previously known as 125-213Xw'02, is now G18.1996.

The elements of the skeleton were reassembled using HMG Paraloid B72 tube glue so all joints could be reversed with acetone if needed. The bone was in good condition, and so no consolidation was needed. Structural support was provided where needed with lengths of narrow dowel (actually sticks from cotton swabs) that were attached with Paraloid. Sand trays were used to support joints as the glue set.

Reconstructing the scene

As work progressed, it emerged that the specimen was remarkably complete, and the decision was made to display it for Science, Engineering and Technology Week (SET[7]) in March 1997. As we had a reasonably com-

plete specimen, we wanted to show the whole skeleton. There are two ways in which a skeleton can be displayed: an anatomical reconstruction or a taphonomic scenario. An anatomical reconstruction involves re-articulating the skeleton as if it was still surrounded by the soft tissues. The bones should to be relatively undistorted, and an armature or similar system is needed to support the separate elements. A taphonomic scenario recreates part of the process by which the dead organism becomes part of the fossil record (i.e. its taphonomy).

Although our bones were free of matrix and preserved "in the round", there were several instances of distortion where bones had been crushed on to each other. While this would be a disadvantage in an anatomical mount, it does allow us to recreate a taphonomic scenario. Current palaeontological collecting practices involve mapping the positions of skeletal elements *in situ*. However, in the case of the vast majority of historical specimens this information was never collected or has been lost. We decided to use the various taphonomic indicators and recreate the scene on the seabed near Peterborough 165 million years ago.

Marks showing where bones had been crushed onto each other or had been in contact were especially common around the limb girdles, and showed how the body had ruptured and collapsed. In the pelvic girdle, the sacral vertebrae lay, semi-articulated, on top of the ischia along with the sacral ribs. These elements were cemented together with harder matrix, preserving their positions. In the pectoral girdle, marks showed where the right scapula and coracoid had been crushed on top of the right humerus, which was folded underneath the body. The right radius was still cemented to the left coracoid with matrix, and confirmed this interpretation. This suggests that as the plesiosaur's dead body sank to the seafloor, the right forelimb touched down first. Other marks showed where ribs overlapped each other, and where the anterior trunk vertebrae had lain between the scapulae.

The bones were found to show two different preservational styles. Some areas were dark brown with a well-preserved surface while; others were buff-coloured with a slightly softer surface. In addition, traces of black material were found on the undersides of some of the caudal vertebrae.

This differential preservation is known to reflect the orientation of the bones on the seafloor (Martill, 1987). The buff bone projected up into the water column, while the dark brown bone was buried in soft sediment. The black material is the remains of soft tissues replaced by microorganism mats (Martill, 1987). Using these indicators, we could therefore orient the various skeletal elements with a fair degree of confidence. In certain areas, such as the neck, there was little information on bone contacts preserved, so we resorted to the anatomical arrangement of the elements.

Only the humerus was present from the left forelimb, and the distal end was missing, having been bitten off. What remained showed large tooth marks. The culprit was probably the large pliosaur *Liopleurodon ferox*, the top predator of the Oxford Clay Sea. The fact that the proximal part of the limb was still with the rest of the skeleton suggests the plesiosaur was attacked rather than scavenged. It seems that it escaped the predator, only to die later of its injury.

I concentrated on the skull fragments, and realised that the skull was more complete than we had thought at first. There was enough preserved to allow a reconstruction to be made. I constructed a simple mount out of acrylic sheet and rod, aluminium sculpting wire, and milliput epoxy putty to support the elements we had. Missing portions of bones were sculpted using milliput and wire, having first coated the bone surfaces with Paraloid to act as a separator.

The display and afterwards

The specimen was put on display for the SET weekend in March 1997 as planned. It was laid out in four flat topped display cases pushed together, and measured approximately 3.5 metres long. The bones were arranged according to the devised scenario using vermiculite as a soft base of a neutral colour. The display was staffed by Arthur, Richard and myself along with other Earth Science staff, and after the weekend, the display was put into a small vacant temporary exhibition gallery for a few weeks. The display has been dismantled, but the specimen has since been the focus of still more rebuilding and research. The bitten humerus has prompted Richard to undertake a study of the patterns of bite damage on plesiosaur limb bones. I have produced a new reconstruction of the skull of *Mu-*

raenosaurus leedsii based on this specimen (Evans, in press), and am now looking at other specimens to fill in the missing pieces.

Both Richard and I were volunteers when we undertook the rebuilding of Mr Swales' plesiosaur, and we had the luxury of spare time. Now I am employed by the Museum Service, and I doubt that I would be able to find the time to start it all over again. Volunteers are a valuable asset in this sort of long term, labour intensive project.

Epilogue: Redisplaying Mr. Swales' plesiosaur

1999 is the 150th anniversary of Leicester City Museums, with special events and a celebratory exhibition. The curatorial staff nominated objects for display, and I chose the *Muraenosaurus* skeleton. As the exhibition neared completion, we rebuilt Mr Swales' plesiosaur again. This time the bones were arranged and supported on plastazote, with grey gravel in-between substituting for the Oxford Clay substrate. The gravel was chosen, as it is more inert than the vermiculite used previously, and provides more contrast in colour with the bones. The exhibition will be up until the beginning of 2000, and I hope to have the plesiosaur, or part of it, in the new Evolution galleries in the future.

Acknowledgements

Thanks are due to John Martin, Arthur Cruickshank, and, of course, Richard Forrest for their input and hard work on the plesiosaur project.

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Conservation for Display - a designers perspective Conservation vs. Design or informed compromise

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Introduction

Museums provide a wealth of opportunities for designers. Each exhibition is different from the last, with diverse and fascinating stories to tell plus wonderful, awe-inspiring objects to reveal. It is a veritable Aladdin's cave, or is it? Are we placed in a straight jacket by the curators list of requirements? How does designing for museums and in particular the Natural Sciences affect the design process?

We need to look at the role of the museum and how the design team fits into this and importantly how the roles of the museum affect our ability to design successfully.

The definition of design according to Chambers dictionary is: To plan and arrange in an artistic manner. So why the need for designers in a museum environment? Because museums have a duty to display and explain the collections in their keeping. However, this isn't the only purpose of a museum. The main function of a museum is the collection and conservation of materials for posterity. The difficulty is that these two main functions of the museum are in direct conflict with one another. The ideal environment in order to maintain collections is that they should be kept in complete darkness with carefully controlled temperature and relative humidity without human interference. The ideal environment for the visitors is one in which they can view and understand the collections, in an environment that is comfortable yet stimulating, so that they feel involved in the experience. So displaying collections in the pitch dark and asking them to rest their lungs and stop breathing isn't going to draw the crowds in.

Role of the Designer

It is the role of the designer to assist the visitor in understanding the language of the objects and the story that they tell, by the physical arrangement and appearance of the exhibition, in a way that is stimulating and enjoyable whilst at the same time providing a secure environment for the ob-