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Dismantling, painting and re-erection of an historical cast of the dinosaur *Iguanodon* in the Sedgwick Museum, Cambridge

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Abstract

A cast of the skeleton of the dinosaur Iguanodon has stood in the Sedgwick Museum since at least 1910, but has belonged to the University of Cambridge since 1896. Iguanodon was fundamental to the development of palaeontology in the UK and Europe, and in 2004 the Museum dismantled, cleaned, conserved and painted its skeleton, a task which had not been undertaken of over 30 years. The skeleton was painted to match the colour of the original bones as found in Belgium, and once re-erected elements of the skeleton not previously mounted were attached. New interpretation was added to the display and the skeleton now stands as central attractor and unrivalled educational resource in the Museum.

Introduction

On entering the Sedgwick Museum, visitors are greeted by the imposing figure of a full-size cast of a skeleton of the dinosaur *Iguanodon* (Fig. 1). The dinosaur is not only the first object noticed by visitors both young and old and often eliciting gasps of wonder, but has become iconic of the Museum. *Iguanodon* itself is important in the annals of palaeontology as one of the first extinct, giant terrestrial reptiles to be discovered and named and was one of the first dinosaurs to be recovered in its entirety and mounted in three-dimensions as though a living animal. Such was the fame of *Iguanodon* that casts were distributed across Europe. The skeleton has stood in the Sedgwick Museum since at least 1910, but has been in the University of Cambridge since 1896, and the history of its acquisition is explored here. In 2004, ongoing redevelopment of the Museum provided a once-in-a-lifetime opportunity to dismantle the skeleton and undertake much needed cleaning, conservation work where necessary and repainting.

The Sedgwick Museum and *Iguanodon*

The Sedgwick Museum is one of a number of museums within the University of Cambridge and is integrated into the Department of Earth Sciences. The Museum dates back to 1728 when John Woodward (1665-1727), a physick (medical doctor) and philosopher at Gresham College, bequeathed part of his collection of fossils (in the broad sense then employed), together with their catalogues, to the University of Cambridge. Woodward's bequeathment of two of cabinets of British fossils was accompanied by land whose income was to pay a lecturer to look after and show the collection to all who were interested (Price, 1989a). The University subsequently purchased the final two cabinets containing Woodward's collection of world fossils from his executors. Today, the Woodwardian collection is one of the oldest intact geological collections in its original cabinets in the world (Price, 1989a) and together with the original catalogues forms the nucleus of the present Sedgwick Museum collections.

Originally the Woodwardian collection was housed in a room off the old Arts School of the University,



Fig. 1 The Sedgwick Museum cast of *Iguanodon* in the gallery prior to restoration.

and the lecturer became known as the ‘Woodwardian Professor’. The most famous Woodwardian Professor was Adam Sedgwick (Anon., 1870), who raised money from the University and by public subscription to construct a purpose built museum in the 1842, which due to Woodward’s bequest was known as the Woodwardian Museum. Sedgwick massively increased the size of the collections, sometimes from his own pocket, and by the time of his death in 1879 space in the Museum was insufficient to house the ever growing collections. In 1904, under the direction of his successor, Professor Thomas McKenny Hughes (Anon., 1906), a new building, again largely paid for by public subscription, was erected as a memorial to Adam Sedgwick – this is the current museum that now bears Sedgwick’s name (Cowper Reed, 1903; Rickards and Price, 1985; Whyte, *et al.*, 2004).

Today, the Sedgwick Museum houses one of the great geological collections, containing upwards of one million objects. Specimens and collections of importance include those collected by Mary Anning (Price, 1986) and the eccentric Thomas Hawkins (Taylor, 1989, 2002; O’Connor, 2003), the John Watson building stone collection (Andrew, 1994), geological models by Thomas Sopwith (Turner and Dearman, 1979), palaeontological models by H. Neville Hutchinson (Hutchinson, 1917, 1922), vast collections of gaptolites (Rickards, 1999), local Cretaceous ‘coprolites’ (Ford and O’Connor, 2002) and Pleistocene vertebrates including the Barrington hippopotamus (Butler, 1994). Much of the holdings were catalogued by A.G. ‘Bertie’ Brighton (Price, 1989b) and the Sedgwick Museum had one of the earliest computerised museum catalogues (Rogers *et al.*, 1990).

Iguanodon

Iguanodon has pre-eminent importance in the early history of palaeontology in the UK and Europe, and was one of the first giant-sized land-living reptiles to be recognised as such (Mantell, 1825). It was one of the three animals (with *Hylaeosaurus* and *Scelidosaurus*) originally designated by Richard Owen as ‘Dinosauria’ (Owen, 1842; Desmond, 1979). At the time relatively little was known of the skeleton of *Iguanodon*, although it became iconic of the new sciences of geology and palaeontology (Cadbury, 2000). More complete remains were found in 1834 allowing the animal to be reconstructed as a giant lizard (Norman, 1993), and in 1854 a model of *Iguanodon* was constructed as a three-dimensional sculpture in a rhinoceros-like pose (famously with the thumb spike as a nose horn) in the Crystal Palace gardens, Sydenham, south London following the Great Exhibition of 1851 (Owen, 1854; McCarthy, 1995).

The fame of *Iguanodon* was enhanced between 1878 and 1881 by the discovery of 39 skeletons in a coal mine close to the town of Bernissart in south-west Belgium (Norman, 1987). These skeletons, many of which were beautifully preserved and some substantially complete, were carefully collected and sent to the Musée Royal d’Histoire Naturelle de Belgique (now the Institut Royal des Sciences Naturelles de Belgique). They provided, for the first time, dinosaur skeletons that could be mounted complete and in three-dimensions. Thus, *Iguanodon* was first mounted in the early 1880’s in a bird- or kangaroo-like pose (Norman, 1985), and appeared to give firm evidence that dinosaurs were bipedal, rather than lizard- or rhinoceros-like. However, although *Iguanodon* has long been shown as standing upright (e.g. Swinton, 1973), subsequent research indicates that this traditional pose is inaccurate and that adult individuals of *Iguanodon* were probably most frequently quadrupedal (Norman, 1980; 1986; Wright, 1999).

The Sedgwick Museum *Iguanodon*

The Sedgwick Museum *Iguanodon* is a cast of one of the most complete of the Belgian specimens. The original skeleton was discovered in 1878 at a depth of 356 metres in the Bernissart mine, and was first published on in 1883. The original is housed in the Royal Museum of Natural History in Brussels, and the Sedgwick Museum specimen is one of a number of casts of this animal on display in Museums around the country; others casts can be found in the Natural History Museum, London (Woodward, 1895), and the Oxford University Museum, Oxford.

The cast of *Iguanodon* is of great importance to the Sedgwick Museum, as one of the first and most striking objects seen by visitors entering the galleries. Indeed, so important was *Iguanodon* that representations of the dinosaur appear on the outside of the building (Figs. 2a, b), and are carved onto the book ends of the Museum (now Department) library (Fig. 2c). Indeed *Iguanodon* has become iconic of the Sedgwick Museum and is incorporated, in stylised form, into the institutions logo (Fig. 3.). However, although phenomenally important to the Museum, *Iguanodon* was not part of the Sedgwick collections, when the current building was opened by King Edward VII on 1st March 1904 (Whyte, *et al.*, 2004). So how did the cast of *Iguanodon* come to be in Cambridge, some 300 km from its site of discovery at Bernissart, and arrive in the Sedgwick Museum? The story of the acquisition of *Iguanodon* by the university and its transfer to the Sedg-

wick Museum can be reconstructed from letters available from the University Museum of Zoology Cambridge 'histories' records (<http://www.zoo.cam.ac.uk/museum/ccmainpage.html> accessed: 14 February 2008).

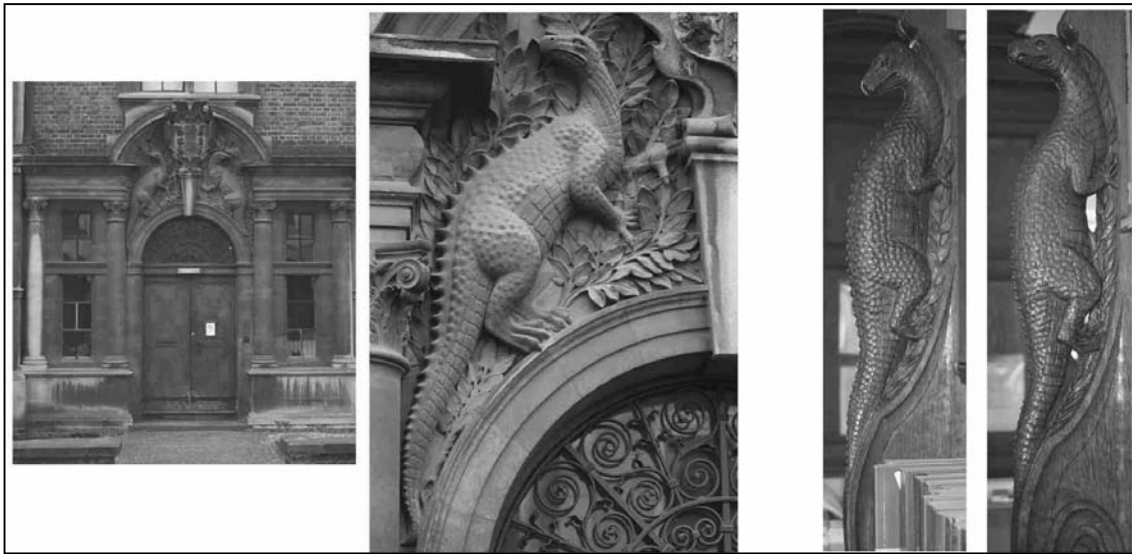


Fig. 2. *Iguanodon* as represented in the Sedgwick Museum building (a) the Downing Street doorway showing *Iguanodon* above the door to the left and (b) enlarged, (c) two *Iguanodon* carvings (of four) in the Department of Earth Sciences library.

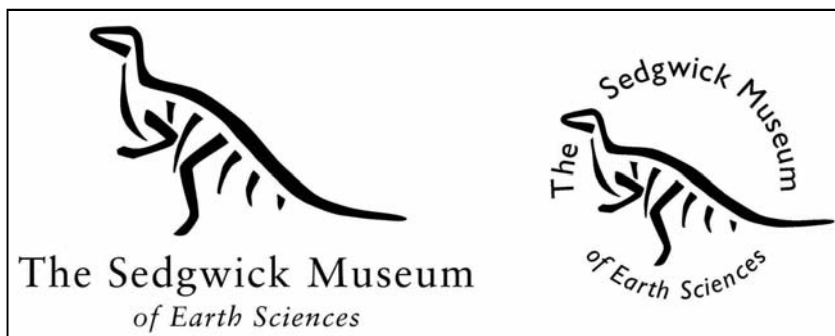


Fig. 3. Two versions of the Sedgwick Museum logo incorporating a stylised version of the *Iguanodon*.

History of the Sedgwick Museum Cast

Following application by Sir John Kirk, British plenipotentiary to the 1889-90 African slave trade conference in Brussels (McMullen, 2004), the University of Cambridge was promised, in February 1896, the donation of a cast of the skeleton of *Iguanodon* by the King Leopold II of Belgium. The casts were prepared and carefully packed in the Musée Royal d'Histoire Naturelle de Belgique and were ready for shipping on 15th July of that year. The specimen was sent on July 17th in eight boxes and insured for 4000 francs. The shipment was made by Mr Auguste Bulcke & Co. via Antwerp and Harwich, the latter being the closest port to Cambridge. In addition to the casts, the boxes contained the metal armature to support the bones, and instructions for assembling the skeleton. The specimen arrived safely on 24th July with 'minimal damage', and the skeleton was mounted by 13th August. A notice of the arrival of the skeleton was made in the Cambridge University Reporter on the 6th October, and on 15th of that month a Grace was passed by the Senate (the University's ruling council of scholars) authorising Charles Smith, the then Vice-Chancellor of the University, to convey the thanks to the King of the Belgians. A report of the presentation of the casts to the Museum of Zoology indicates the skeleton was accompanied by 'supplementary casts of the skull, lower jaw, ilium (one of the bones of the pelvis) and some other bones' (Harmer, 1896: 202); these additional casts are housed in the University Museum of Zoology (registered numbers R.5257, R5258 and T679).

The *Iguanodon* was temporarily placed in the lecture room of Comparative Anatomy. Edouard Dupont of the Brussels Museum indicated that the label accompanying the specimen should state: 'the specimen was supplied by the Museum in Brussels and donated by the King of Belgium' (letter dated 16th July 1896) or

'*Iguanodon Bernissartensis* Boulenger. Cretaceous. The *Iguanodon* of Bernissart, found in 1878 and mounted 1883. Donated by the Trustees of the Museum in Brussels' (letter of 24th July 1896). Dupont also indicated that various papers regarding the specimen would be sent to Cambridge. The historical display label currently associated with the cast is a composite of this information (Fig. 4), although it is not known when this was written. However, by November 1909, the zoological lecture rooms were to be rearranged, and a lantern installed. It was acknowledged that the Zoology Museum did not have enough space for *Iguanodon* and it was suggested that Professor Thomas McKenny Hughes (Anon., 1906), then Woodwardian Professor of Geology, might like to place the specimen in the Sedgwick Museum. Funds were found to dismantle the *Iguanodon* in Zoology (by the same man who had erected it 13 years earlier) and during the Christmas vacation of 1909-10 McKenny Hughes paid to have the specimen transported over the road to the Sedgwick. There is no record of *Iguanodon* having been moved since its erection in the Sedgwick Museum, although the skeleton had been dismantled and painted during the 1960's (M. Dorling and R. Long, pers. com., 2004).



Fig. 4. The historical label currently associated with *Iguanodon*. Note the difference in wording from that suggested at the time of acquisition of the skele-

Restoration of *Iguanodon*

In 2004, the opportunity to restore and repaint the *Iguanodon* presented itself due to redevelopment of the Museum funded by the Museums, Libraries and Archives Council's 'Designation Challenge Fund'. Funding was granted to replace the aging flooring (acquired from the Queen Mary liner) and to refurbish the Museum's electrical supply. This work required the *Iguanodon* and several display cases to be moved and offered a rare opportunity to dismantle, clean, restore and repaint the dinosaur. Remounting the skeleton in a more modern pose, or simply turning the head so as to face visitors upon entry to the Museum was considered, but it was decided that the animal should remain in its original, bipedal, mount for historical reasons and to act as a learning aid showing the nature of changing scientific thought.

Pre-restoration condition assessment

Prior to commencement of restoration, the *Iguanodon* skeleton was fully assessed. The dinosaur was on open display and situated very close to the main entrance of the Museum. The skeleton was 10.1 m (33 feet) long and 4.7 m (15 feet 6 inches) high and mounted on the original metal armature manufactured at the same time as the cast in Brussels. The armature was mounted on a low wooden plinth incorporating interpretative displays. The skeleton was cast in plaster of Paris, containing low levels of straw and other impurities, with an internal steel armature. Each of the major elements of the skeleton retained the stamp of the museum in Brussels impressed into the cast.

The skeleton was found to be, with very few exceptions, generally sound. The skeleton itself had been cast as a series of more than 130 separate elements, either single bones or as small units of conjoined bones, which were 'cradled' by the mount, rather than fixed to it. None of the individual elements were bolted directly to the armature or to each other. The feet were mounted in cast 'boots' to keep the individual bones in articulation, and the ischia (the posterior pelvic bones) were mounted in two detachable mounts, bolted to the main armature. The ischia, as with the original skeleton and other casts, had been mounted reversed with the left ischium on the right side of the body and vice versa. Several elements of the skeleton, including the left right side of the pelvis and the hyoids (bones from under the chin) were not mounted with the skeleton.

The skeleton had last been repainted during the 1960's (Fig. 5), and the existing colour was as a result of that work. At that time, a pale brown had been selected for the skeleton, however when tested in the gallery

the colour was considered too light and it was repainted a darker shade. Upon re-erection, the new colour, although giving better definition to the bones, had the unfortunate effect of periodically giving a purple tinge to the skeleton under the natural lighting conditions then in the gallery (Mike Dorling, pers. com., 2004). In addition, it became clear that, although dusted at low level, the higher elements had not been cleaned regularly, and the skeleton as a whole was in need of both cleaning and repainting. Clearly dismantling, moving, repainting and re-erecting this specimen would be a major undertaking.

Movement of the specimen and the surrounding display cases required the Museum to be shut. The work was carefully planned and programmed during the University summer teaching pause to permit use of the nearby laboratories; this also avoided clashes with school groups and other pre-planned visits. As the cast had not been dismantled or repainted for more than 30 years, no one in the museum knew for sure how to dismantle the skeleton. However, the Director of the Museum (Dr David Norman) was familiar with the mount, as he had worked extensively on *Iguanodon* and had handled and dismantled several of the original skeletons as part of his postgraduate research.

Dismantling

The Museum was cleared of surrounding display cases, and the existing interpretation dismantled from the plinth and stored. Elements of the cast were labelled with a unique number using tie on tags, and the skeleton photographed as we went along. The feet were dismantled first, as the most accessible elements and to check the procedure for the larger elements. With a system of work in place the head was the next dismantled, which required erection of a scaffolding tower (Fig. 6), and careful thought as to safe methods of working at height. The skull was found to consist of two pieces held together by a locking pin, which greatly facilitated removal and handling. The neck and cervical ribs were then removed, followed by the shoulder blades, arms and hands. The dorsal ribs were removed next and the backbone down to the pelvis. The loose pelvic elements and the legs were disassembled, and then the tail working from the tip forwards, until the elements were 'locked' on by the weight of the block containing the sacrum (pelvis plus sacral vertebrae) above. The pelvic block was the largest and most difficult element to remove, but fortunately could be reached from ground level as it took six people to lift it safely off the mount, thereby allowing the

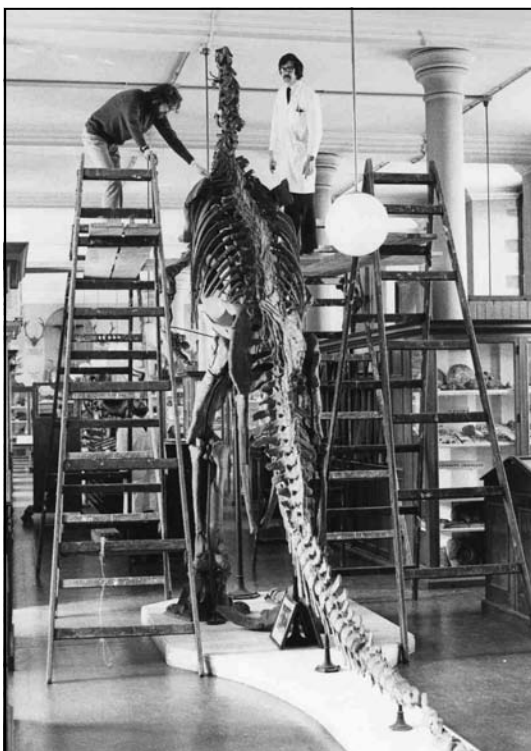


Fig. 5. Work being undertaken on *Iguanodon* during the 1960's by Mike Dorling (left) and Rod Long (right); exact date of the photograph unknown. Note the head has been removed and the unattached right ilium on the plinth between the feet.



Fig. 6. Scaffolding tower erected around *Iguanodon* to safely access high level elements of the skeleton (compare to fig. 5). Note the missing foot bones revealing the 'boots' in which the elements were housed.

remainder of the tail to be removed. The armature now had an artistic, almost ethereal beauty about it – a skeletal reminder of the skeleton we had just dismantled.

With the cast removed, the wooden plinth, with the steel armature still attached, was split along an existing dividing line and moved along the gallery to allow the new flooring to be laid. Beneath the plinth were discovered chalk marks indicating the position of the ‘boots’ for the feet, and the positions of the bases of the armature. These were presumably workman’s marks dating back to 1909-10 when the skeleton was first erected in the Museum. However, it proved impossible to preserve these chalk marks, although a photographic record was kept.

Cleaning, repairs and painting

Once the *Iguanodon* specimen had been dismantled it was laid out in a nearby teaching laboratory, which necessitated transporting the cast upstairs. The benches were covered with inert Plastazote foam and each element cleaned and assessed for damage. Cleaning involved removal of the considerable quantity of dust that had accumulated over the years of being on open display. Brushing and swabbing using sponges dampened with distilled water, and immediately drying it, removed most of the accumulated grime. Use of water was kept to a minimum to keep the cast as dry as possible thereby minimising ingress of water reducing risk to the plaster and preventing corrosion of the internal metal armature. Stubborn areas dirt or stains were removed using a small amount of biodegradable plant based ‘Ecover’ detergent.

Some areas of the skeleton had sustained damage, which required repair, either whilst on open display, or during dismantling. These were mostly bony processes which had been chipped or damaged over the years, but the right femur had sustained considerable prior damage. The cast was repaired using plaster of Paris to be as sympathetic as possible to the original materials. The femur in particular required reconstruction of areas where the internal armature had flexed and broken off large flakes of plaster. Large areas of damage were repaired using buffered neutral pH archivists Polyvinyl acetate (PVA) adhesive and Paraloid B72 in acetone for small flakes. PVA was chosen for the larger areas as its flexibility was considered more appropriate. During setting, the joints were tied with acid free tape to allow the repairs to set firmly.

Painting

The decision was made to repaint the cast so as to match, as closely as possible, the colour of the original bones – a rich, dark chocolate-brown, with reconstructed elements painted black to match the original coaly matrix. This had the added advantage that the new paint scheme would be darker than the existing, allowing minimal application of paint, thereby retaining important surface detail. Under the direction of David Norman, who had worked extensively with the original material (Norman 1980, 1986), and supplemented by photographic references, suitable colours were selected. Initially a simple two colour paint scheme was attempted, but this left the bones appearing rather flat and featureless, both to the naked eye and when photographed. As the specimen was to be a key centre point to the gallery a decision was taken to laboriously hand paint the entire skeleton using a ‘dry brushing’ technique, mixing the colours on the cast, highlighting raised areas and applying a darker tone for depressions.

Acrylic paints were selected for their flexibility, an important factor with a large object made of composite materials. Additionally, acrylics can be applied without diluting or mixing, enabling application of the different colours in a consistent manner; this was particularly important over substantial areas and as a large team were involved in the painting process. Liquitex paints were selected as high-quality acrylics with good resistance to fading, ensuring longevity of colour under gallery lighting (Fig. 7). The colours selected were: Ivory Black, Mars Black, Burnt Sienna, Burnt Umber and Red Oxide. The paints were applied with 25 mm hog bristle brushes using a stippling action. The base colours were predominantly a mixture of Ivory Black and Mars Black, the next dominant colours were Burnt Sienna and Burnt Umber with highlighting applied using Red Oxide. The result was a much more realistic appearance to the cast than the original attempts, but extended the time required to paint the skeleton from the original estimate of two weeks to almost two months.

Whilst the skeleton was being restored and repainted, the mount was inspected for damage and itself repainted. The cradle for the skull was removed for ease of access, and the remainder of the armature painted *in situ*. The plinth was cleaned, ready for repainting once the skeleton had been re-erected – this could not be done earlier as we would need to walk over the plinth to re-erect the skeleton. Once the new flooring was in place, the plinth was repositioned approximately one metre forward of its original position, to provide greater impact for visitors. The armature was made safe and the Museum reopened to visitors.

Re-erection and display

Erecting the newly painted skeleton of *Iguanodon* was a challenge. It was important to minimise damage to the paint scheme during re-erection and, as the Museum was open to the public, had to be undertaken in carefully planned stages. However, dismantling the skeleton had provided important insights as to how the dinosaur had been mounted, aided by the fact that this was the way in which the skeleton had been erected originally. Re-mounting took place in the following order: tail; feet and lower legs; pelvic block; upper legs and the remainder of the pelvis; backbone; ribs; shoulder girdle, arms and hands; neck and finally the head. The Museum was kept open, and the local press invited, for the 'topping off ceremony' as the skull was gently placed in position. This resulted in valuable media coverage and in a number of visits to the Museum to see the newly refurbished *Iguanodon*.

Once the skeleton was completely erected, a local engineering company was approached to produce a new armature for the previously unmounted right ilium and to realign the incorrectly positioned ischia of the pelvis. The ilium had not been attached to the skeleton before, and thus needed a new mount; the ischia had to be reversed and correctly placed. It is believed this is the only cast of *Iguanodon* fully mounted in this way. In addition, new displays were written and produced to accompany the refurbished skeleton. The plinth was painted and landscaped, and a new interpretive background installed. Never-before-seen models of *Iguanodon* from the Museum's collections were added to the plinth, together with a fossil footprint and the historical label originally associated with the specimen retained. The up-to-date interpretation, landscaping and models now form an integral display at the entrance of the Museum, and the skeleton is regularly admired by visitors, and is well used for undergraduate teaching.



Fig. 7. Liquitex acrylic paints and brush used for painting the *Iguanodon* skeleton. Utilising small brushes (here just 10 mm across) took considerable time to but permitted resulted in high-quality finish.

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