



A ton of trouble: cleaning, conserving and mounting a large 300 million-year old giant clubmoss plant fossil from north Wales for display.

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Abstract

In 2004 a large and exceptionally well preserved Late Carboniferous giant clubmoss fossil comprising a tall trunk and broad *Stigmaria* root structure was discovered in a newly exposed fossil forest site in an old steel works at Brymbo near Wrexham, north Wales. Cleaning, conserving and safely mounting the whole fossil for exhibition in 2016 was not easy as the specimen was in 90 pieces, weighed about a ton and stood 2.25 m tall with a root span of 3.5 m. Also, as the specimen was to be displayed in various locations over time and would have to be dismantled and transported, a modular mount able to be easily assembled and dissembled was required. The mount was made in sections from welded steel lined with Plastazote foam, with robust lockable wheels underneath the main trunk. As the two uppermost sections of the trunk weighed approximately a quarter of a ton each, to reduce risk to the specimen and to people undertaking the mounting these sections were moulded so that painted casts could be mounted in their place.

Condition of the specimen

The specimen was in about 90 pieces including three heavy sections of trunk weighing around a quarter of a tonne each and many heavy sections of root each weighing up to about 20 kg. The pieces were dusty and dirty with bird and rodent droppings over their surfaces along with cobwebs and other detritus from a decade of storage in the old defunct steelworks building. Some of the surfaces of the fossil were flaky and friable and a number of pieces had fallen off or broken apart whilst the specimen was stored. Some repairs had been undertaken in the past and excess adhesive had flowed out of the repaired cracks. To remove the animal faeces that represented biohazards and to have clear surfaces for gluing sections together, all the surfaces had to be thoroughly cleaned with an adequate method to remove all the dirt and any unwanted matrix without causing any damage to the friable and flaky surfaces of the specimen which preserved superb detail under the dirt.



The fossil in situ, during excavation.

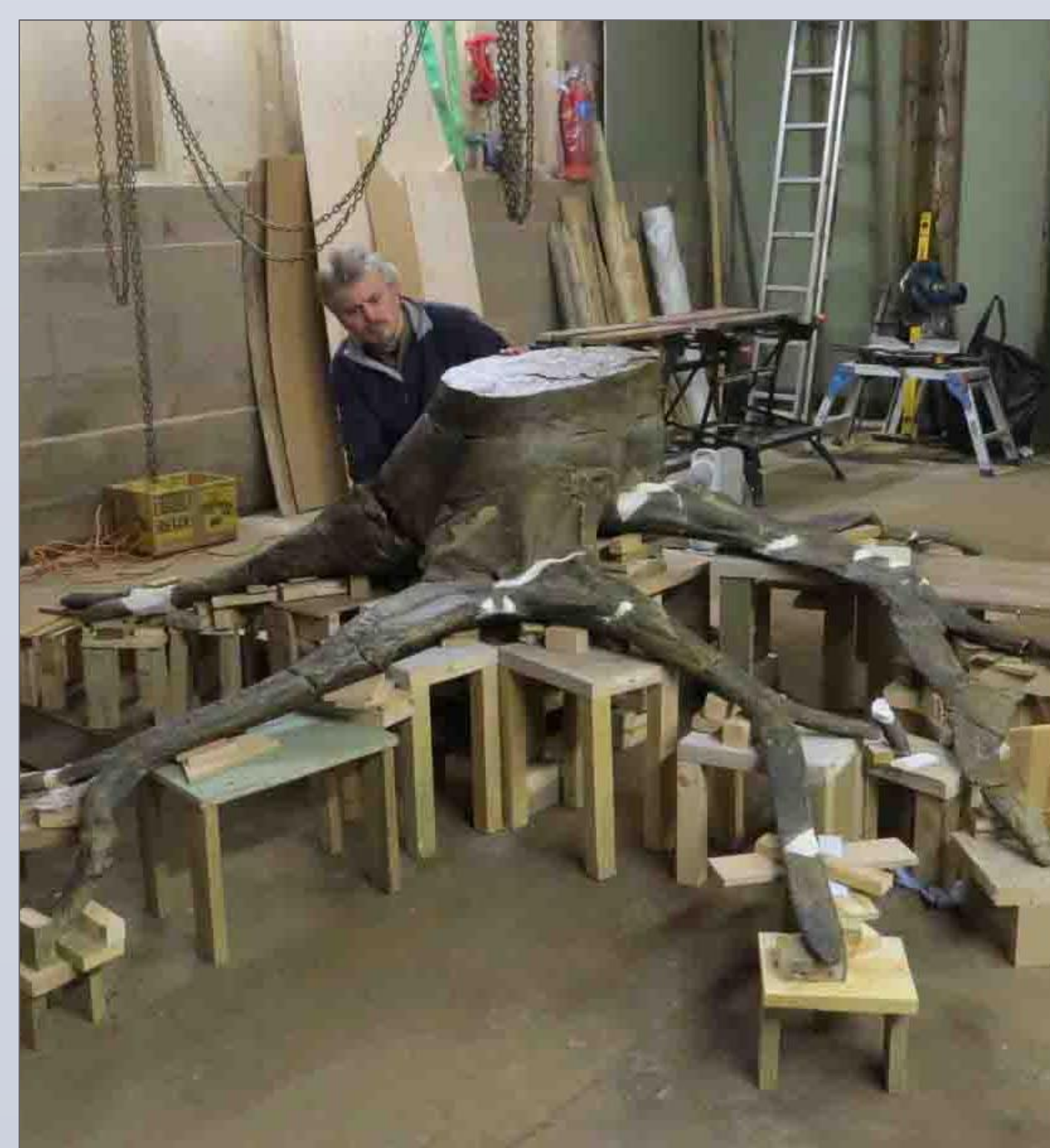


Above left: the proximal portion of the rear root (showing bird droppings etc) before cleaning and consolidation (left) and after cleaning and consolidation (right). Above right: Middle section of the trunk before cleaning (left) and after cleaning and consolidation, on the sturdy permanent bespoke pallet (right).

Cleaning and conservation of the specimen

All cleaning and conservation work undertaken on this specimen was as gentle, non-invasive and reversible as possible. Initially, to remove the dirt, dust and detritus from the surfaces of the specimen a soft wide artist's brush was used alongside a vacuum cleaner with gauze taped over the end (to prevent the loss of small pieces). Stubborn areas of dirt, dried bird excrement for instance, required stiffer brushes and occasionally were cleaned with an airabrasive unit utilising compressed air which when necessary was lightly laced with sodium bicarbonate powder. In turn, this powder was removed with compressed air, vacuum cleaner and soft brushes. Some excess matrix was removed with scalpels.

The surfaces of the fossil were quite flaky and friable. Therefore once each section was cleaned a consolidant (Paraloid B72 in acetone at about 5%) was applied by brush to strengthen the surface, give long-term protection and to bring back the natural colour of the fossil which had become quite grey (see above). The smaller segments of *Stigmaria* root could then be adhered back together where appropriate to form sections that were not so big and heavy that they would break under their own weight nor were too difficult to lift. Where small sections of the fossil were missing, such as between breaks, gaps were filled with plaster of paris (see image below) which was painted with artists' acrylic paints to match the fossil.

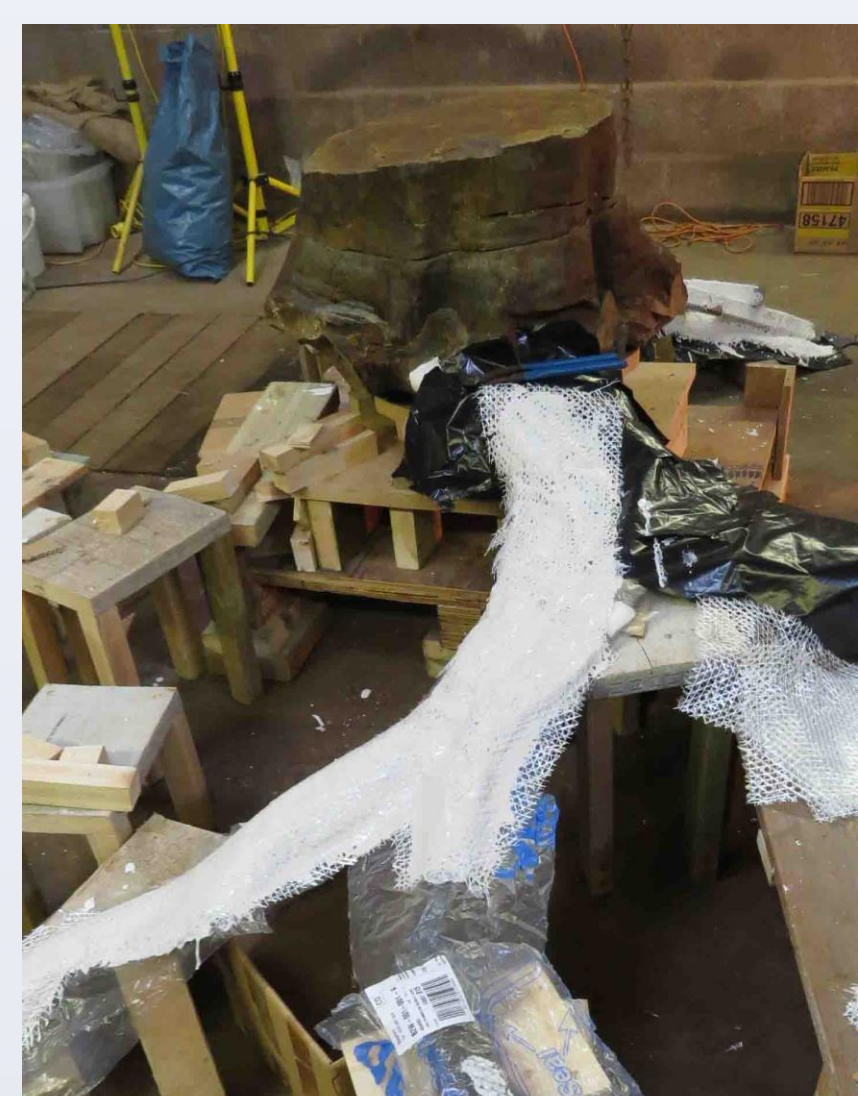


Making the metal mount

The combined weight of the main sections of the trunk was 0.8 tonnes, with each of the three sections weighing about a quarter of a tonne. Therefore the central piece of metalwork that the trunk was to be mounted on was designed to safely accommodate at least 1 tonne. The metal mountwork required to support the roots and the trunk for display had to be modular so that the specimen could be dismantled and re-assembled in sections for transport, display or storage. The design had to ensure that no single section was too heavy to move but also that there would be a choice of which roots could go on display, depending on the space available at any future location i.e. one or more root could be left in storage.

Although it weighed over a quarter of a tonne, the lowermost section of the trunk against which the roots would be positioned had to be easily manoeuvrable so that it could be placed exactly where required on display or in storage. It therefore had to be on sturdy lockable wheels (see image to right).

To make suitable mounts for the root sections, metal 'cradles' had to be made for the underside of each portion. However, this was impossible to achieve whilst the roots were in their correct orientation. The pieces had to be turned upside-down whilst maintaining their exact three-dimensional relationships with one another.



Multiple splints were added to each jacket as required, screwing wooden batons to one another and securing them in place with more Jesmonite resin and glass fibre. As each jacket was completed it was carefully removed, turned upside-down and the pieces of the root laid within the jacket in their correct association and position (above right). The steel brackets could now be made for the underside of each section of root. Foil was placed between the metal brackets and the fossil to protect the specimen from the heat of welding. The welding was undertaken in short bursts so that the metal did not get too hot and damage the fossil and also to avoid the chances of the metal distorting due to overheating.

Moulding sections of the trunk to make casts

The middle and upper sections of the trunk were so heavy that they presented serious health and safety issues if they were placed on top of one another and on top of the lowermost section of the trunk as well as risking damaging the lowermost section in the process. Therefore the decision was taken to make moulds of these two sections to produce painted casts. However, due to the size and weight of the fossils and the fragility of the middle section which had been extensively consolidated and repaired, even making the moulds presented a significant challenge. The specimens had already been cleaned, consolidated and placed on Plastazote foam on sturdy bespoke permanent pallets. To prepare them for the moulding process more consolidant was applied to ensure the surfaces were well protected. Gaps were filled with reversible water soluble putty (polyethylene glycol 4000, glycerol, water and precipitated chalk). Two-part moulds could then be made from silicone wacker rubber with rigid portions made with Jesmonite acrylic resin. The two large casts were made from Jesmonite resin and glass fibre which was coloured with artists' acrylic paints (right).

Display

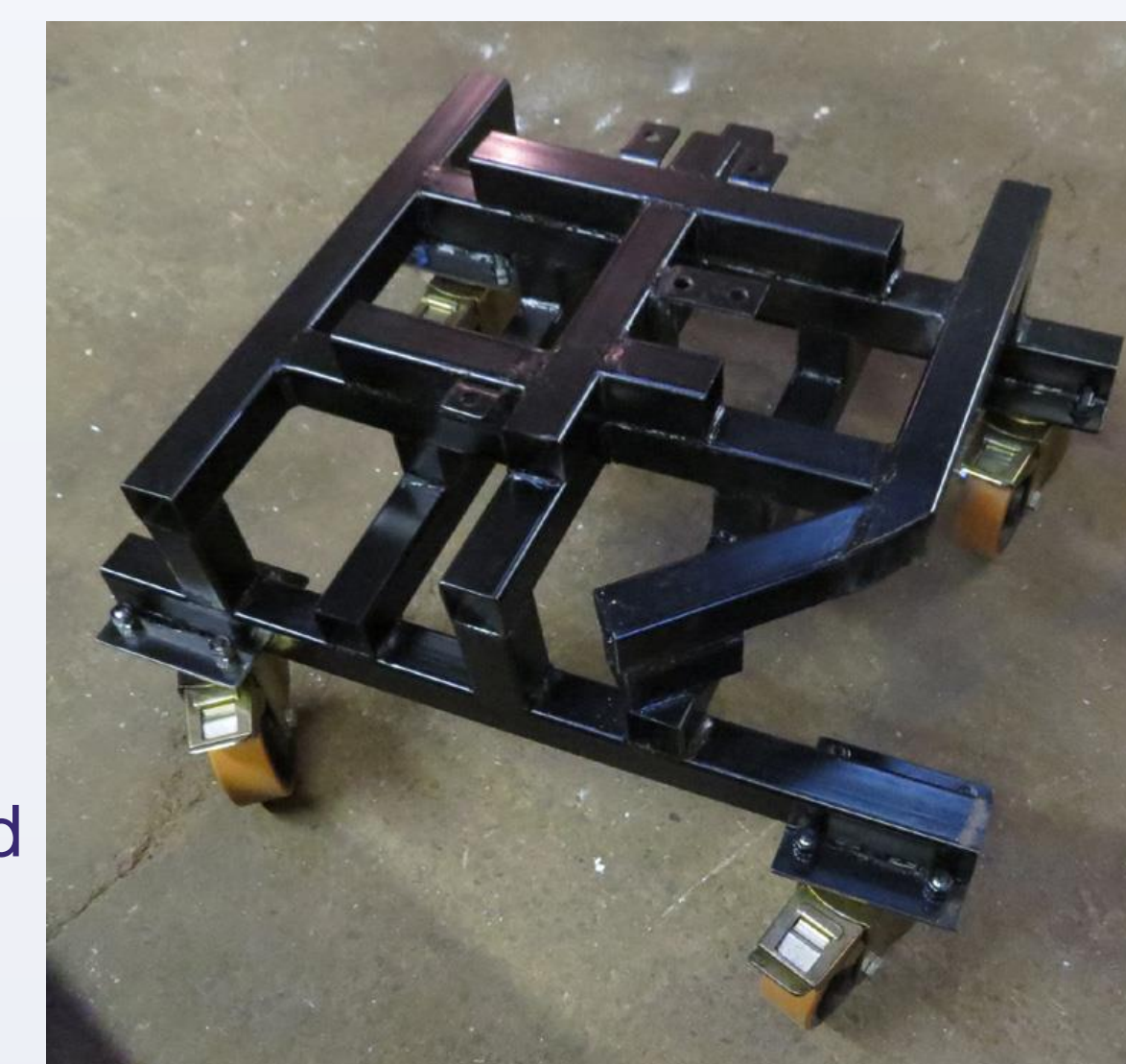
The fossil and its mount were disassembled, carefully packed up and transported to Wrexham Museum. It was installed in January 2016 as the star specimen in a six-month exhibition entitled 'Swamp Land: Brymbo 300 Million Years Ago' telling the story of the fossil forest. The two heavy sections of trunk were displayed on their pallets behind the mounted root system and the cast of the trunk (see top right image beside the title). The final destination of the specimen is intended to be a permanent display at the Brymbo Heritage site itself but in the interim the specimen is currently stored in Cardiff where it may also be put on display temporarily.

Conclusions

Large Carboniferous *Stigmaria* root systems associated with trunks are rare and few are on display. This specimen has proved to be a popular exhibit in Wrexham. The mounting system is strong but not too intrusive. The brackets supporting the roots have the appearance of rootlets that would have existed in life. It is fitting that the structure is created from steel, the material made for over a century on the heritage site where the fossil was discovered.

Acknowledgements

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Therefore a temporary bespoke resin cradle had to be made for each root that could correctly maintain its exact three-dimensional shape when turned over the other way. Sections of plastic sheet were draped over the top sides of every root, then Jesmonite acrylic resin (AC100) and glass fibre were applied in layers to build up a thick sturdy jacket (see image to far left).

