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### Moving Large Articulated Skeletons

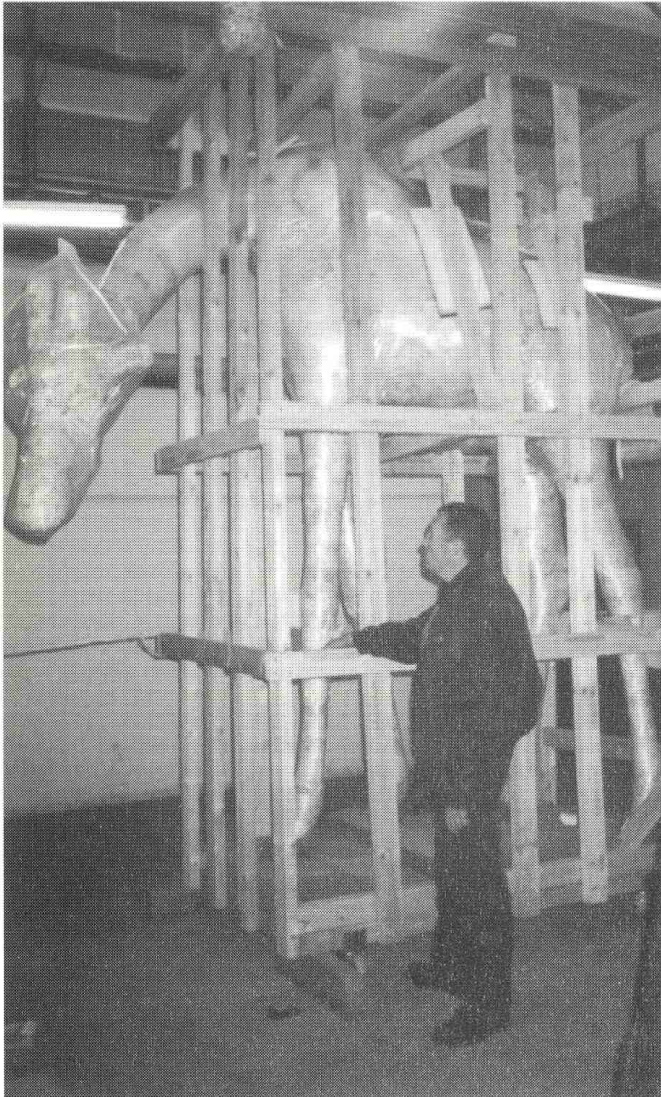
In the current climate of building projects and ever-changing gallery displays, all museums eventually have the problem of moving collections, either internally or to off-site storage facilities. The skills required to move collections, whether large in numbers of specimens or large in terms of the size of individual objects, is rarely present in-house. External contractors will be required in many cases.

We have a Museum Services Division with a dedicated team of operatives experienced in the handling and transport of museum collections. We understand the museum ethos and we believe in solving problems in conjunction with curators and conservators, to ensure the safety of collections. The need to protect specimens and provide a sealed environment to minimise changes during movement, are central to the way we work.

I'd like to talk to you today about how we move specimens, the problems that occur and some of the ways we have developed to overcome them I will be concentrating on a number of moves which we have undertaken here in the Natural History Museum.

When faced with moving specimens like the articulated skeletons of fully-grown elephant and giraffe, the first question to be asked is 'can this be moved complete or does it need to be sectioned?' The answer to this question is always 'is there enough room to physically and safely move the specimen from A to B?' Assuming a complete physical move cannot be achieved, the next stage is to stay the construction of the specimen from the point of view of its constructor. If you study the method of securing the joints, it becomes apparent which parts can be easily separated and which, if possible, should be left intact. Our policy has been to section a specimen as little as possible to minimise disruption to the specimen.

We were recently tasked to relocate six articulated elephant skeletons from this museum to a new storage facility. These specimens have been in store for many years and building work, principally ducting and fire-door systems, had severely reduced the available headroom. Therefore, the specimens needed to be sectioned prior to removal.



Most large land mammal skeletons section in three major areas – skull, rib cage and limbs. Our experience has taught us to section along these lines. Our first step is always to remove the vulnerable scapulae. These are almost always connected with steel pins and just require lifting off. Using a genie lift, we then remove the skull. This is usually bolted to the steel bar which runs through the vertebrae. The next stage is to secure the skeleton to the lifting tackle via this central supporting bar. The weight of the specimen is then held by the lifting mechanism and the limbs can be detached. These are usually secured by steel pins which are easily removed.

To avoid completely dismantling the skeleton, we then cut through the two one inch thick bars that provide the upright supports. The risen section of the specimen, which includes the rib cage, can then be secured in a purpose-built crate. A specimen may be reduced to six manageable sections, which can be easily and safely moved.

This method was used to section the six elephant skeletons. On arrival at the store, the specimens were reassembled. The only destructive part of the operation, cutting the steel supports, was repaired using inch and a half tubular-steel sleeving.

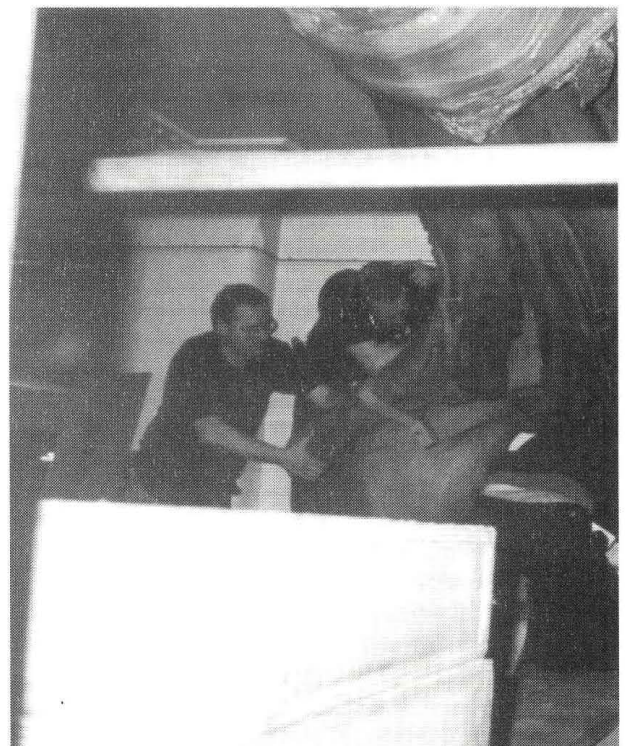
At the same time, it was also necessary to move an articulated giraffe skeleton which stands approximately 16 feet high. The specimen is in excellent condition but, unfortunately, the framework supporting it had begun to deteriorate, to the extent that it needed temporary supplementary supports.

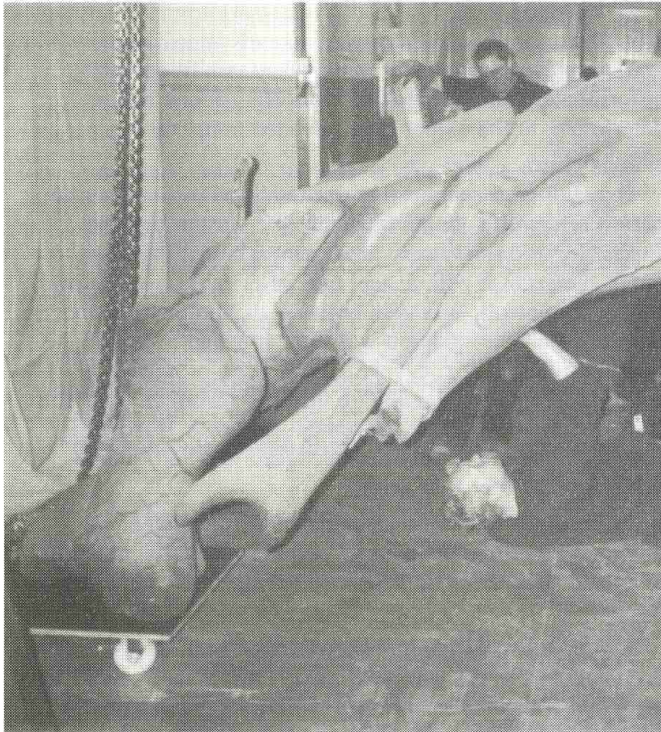
The skull and neck of the giraffe had to be detached to permit removal from the museum. We cut through the supporting rod, low down, at a point which allowed us to repair the section with a steel tube after relocation. A long timber framework was then built-up around the remainder of the skeleton. The skeleton was then attached to this frame, principally using its legs which had been protected in advance. We were then able to turn the specimen over onto its front and place it on movement skates. A 16-foot high specimen had effectively been reduced to a very manageable 6'8" high, 10-foot long case.

After relocation and rebuilding of the specimen, we prepared and fitted new lateral and rear supports, in addition to a head support, which allowed the specimen to stand freely.

Articulated sea mammal skeletons present unique problems in storage and movement. Due of their shape, they are usually suspended for display or storage purposes. A dolphin is relatively easy to move but when we were contracted to move an 18-foot elephant seal, a longer-term solution was required. An inexpensive open wooden frame on wheels proved a good solution to the problem.

The skeleton was sealed with acid-free tissue and bubble-wrap and then braced within the frame with tape. In the new facility the skeleton was unwrapped and left suspended in its frame. This could be easily moved within the store and made the specimen readily available for curatorial and study purposes.





A recent challenge involved a long-time resident in this museum's osteology department – the skull from a bowhead whale which weighed approximately 2 tonnes. Deterioration in the supporting framework necessitated its removal to a safer area. Initial problems related to the space beneath the specimens. This space contained storage cupboards and a partition. The partition was easily removed but unfortunately, the cabinets could not be moved at this time. Our task, therefore, was to move the specimen forward 2 feet and then lower it to the floor prior to removal.

Our first task was to remove the mandibles. We then erected a staging underneath the specimen. This staging was designed to allow us to move the specimen forward the required 2 feet. The rear of the specimen was raised 6 inches and landed on movement skates.

The front of the skull was then raised and landed on its movement skate. The specimen was, at this point, secured to two block and tackles, front and rear, as a safety measure. The skull was then moved slowly forward until it was clear of the storage cabinets.

The specimen was then raised slightly on the two tackles and inspected for any structural weaknesses before proceeding. When we were satisfied that the skull was stable, the staging was removed. The skull was then gently lowered to the ground.

The front of the skull was secured on a mobile frame and an inspection was made to decide, in conjunction with the curators, where the skull could be sectioned to facilitate removal. A previous break along the line of a suture was identified and agreed as the best option.

Using the blocks and tackles, the skull was successfully sectioned, removed from the museum and transported to the new storage facility.

When the decision was made to relocate two type-specimen mounted giraffe skins, one mounted in an upright

position, the other mounted with its head and neck bent forward, my assertion some months earlier that they could be, moved complete focused my mind on the accompanying problems.

The problems were immense. Physical removal, physical protection, environmental protection, time-frame problems, the list was growing. We set about formulating a plan, stage by stage.

After thoroughly measuring the specimens, we studied all possible exit routes. The specimens were stored in the basement, so we started there. Construction work over a period of years, consisting of trunking, fire-doors etc., ruled out any route from the basement to the rear of the building. This left us one option – through the trapdoor into the main hall and then out through the main entrance.

Having established our route, we undertook to protect and secure the specimens for removal. Firstly we completely covered the specimens in acid-free tissue because they were travelling on an open vehicle we needed to protect them from pollution and possible infestation. A covering of bubble-wrap afforded some protection against temperature and humidity changes. Finally, the specimens were completely shrink-wrapped. This effectively sealed them against inclement weather and infestation.

The specimens were then encased in strong timber frames. This allowed us to move and turn them without fear of damage. Finally, because of our exit route, the removal timings had to revolve around museum opening times. Our plan was to bring the two specimens into the main hall starting at 19:00 one evening. We then planned to remove and deliver the upright specimen that night. We planned to remove the smaller specimen the next morning, starting at 6:00 with completion by 9:30 to allow the museum to open at 10:00 as usual.

The upright giraffe was moved up from the basement via the trapdoor using an overhead hoist. Once the specimen was clear of the trapdoor we manoeuvred it over onto hardstanding in the main hall. The second giraffe was then brought up into the hallway. Using the overhead crane, we then turned the largest specimen onto its back, manoeuvred it to the doorway and then with the assistance of a crane we slowly cantilevered it out of the building. The larger specimen was then loaded onto the vehicle. It needed to be loaded in such a way that the overall height of the vehicle and specimen was less than 16'2" to avoid low bridges on the journey.

The next morning, we began the most difficult part of the operation. This was to remove the smaller giraffe, which had its head and neck mounted bending forward. We needed to turn this specimen 180 degrees to allow us to feed the head through the doorway, connect our crane to the framework and then slowly inch the specimen out of the doorway. We elected to do this difficult task last because it could be completed in daylight. Long sighs of relief all round when it was successfully loaded onto the vehicle.

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