CURATION OF FOSSIL VERTEBRATES

by A. W. GENTRY

ABSTRACT. Fossil vertebrates are characterized curatorially by their size disparities and their multi-boned skeletons. A curator has to find sufficient space for the large specimens and to maintain a systematic or stratigraphical sequence in the collections. Public display and the use of annexes or outstations are two options for solving or sidestepping the over-all space problem. Fossil vertebrates are best stored on lower floors, separately from offices, in labelled or numbered cupboards which allow flexibility in the fitting of wooden drawers or shelves. Heavy specimens should be catalogued, but not always repaired, then placed with their labels visible, well apart from one another, on low shelves, supported as necessary on plastic or rubber foam or wooden pallets. The new storage for fossil vertebrates at the British Museum (Natural History) is described briefly.

SOME vertebrates may be extremely large, others, even close relatives of the giants, may be much smaller. All of them, whatever their size, have more than one bone in their bodies. Thus the curatorial characteristics of fossil vertebrates include wide disparities in size between different species and between different elements of the same species. Mammals, for example, have more than 200 bones in their bodies, and thousands or millions of years after their deaths a curator may have to deal with a range of fossils from complete skeletons to bone fragments. The problems are firstly to find space for the material, and secondly to maintain a sequence in the collection in the face of the size disparities. Whether the curator adopts a stratigraphical (or geographical) arrangement of sites or a systematic arrangement of species, he is confronted with accommodation difficulties: for example, either there are micromammals and mastodons from the same site, or limb bones of giraffes to be stored with their incisors. Very often an order is accepted or imposed on the collection which is neither stratigraphical nor systematic, e.g. small fossils in the curator's own room, larger pieces and unprepared material in the basement.

PRACTICAL OPTIONS FOR STORAGE

Public display and outstations

Two possible locations for fossils offer solutions or means of sidestepping the space part of the vertebrate curator's problem. One is to put as much material as possible on public display. Present-day emphasis on imaginative and striking presentations of rather few objects limits the scope for this option. However, if it can be accomplished it usually carries with it some advantages such as the material being carefully prepared, protected behind glass, identified and labelled, and available to all visitors (although perhaps with some difficulty to the research scientist). Most importantly, space in the main storage area is released for other uses.

The second option is to put the material in an outstation or ancillary storeroom remote from the main museum building. The use of an outstation arises because there is always pressure on museum working space. More offices or an expanded education service may be called for, or perhaps an expansion of the collections themselves takes

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place. In these circumstances an ancillary storeroom seems an obvious or is even an inescapable answer. The principal difficulty with outstations arises at this point. Every curator knows that there are some prize items in his collections and these he will definitely not allow to go to an outstation. It follows logically that other material which he will allow to go, must be of lower importance. In other words a division of the collection into first- and second-class parts, which formerly had no more than a misty existence in the curator's mind, has now been made manifest. It is hard to prevent material in an outstation coming to be regarded as junk, and this is dangerous because in museum history one generation's junk can become posterity's crock of gold. Large vertebrate material is particularly likely to be added to that sent to an outstation because it releases the maximum amount of space in the main museum building in exchange for the loss of the lowest possible number of species or specimens.

A number of other problems arise with outstations. Since the outstation is to be only for storage, with the stress on 'only', the curator has difficulty in justifying expenditure on it. Maintenance of more or less stable levels of temperature and humidity will be more difficult than in a building which is regularly occupied by public or staff. Dust will be more of a problem, and so will security. If any curation has to be done the curator will have to decide whether to take the necessary equipment to the outstation or to bring the collection back temporarily to the museum. The final problem will come in later years when the outstation itself has to be changed and the curator of the day is asked the question 'Do you really need these collections?'.

Vertebrates as part of the main storage

The main subject for this contribution is to outline some of the requirements for a storeroom for fossil vertebrates, given their curatorial characteristics as specified above.

1. Fossil vertebrates are best stored on lower floors or in basements to avoid problems with excessive weight loading of floors and lifts. The curator may need professional advice on these matters, and he might also have to consider whether basements would be too damp for some fossils. Ideally there should not be steps or slight differences of floor level on any one storey. They are a potential source of inconvenience, if not danger, when fossils are being moved about.

2. A separate or discrete storeroom is better than a store which is simply an extension of staff accommodation. The storeroom can be kept locked so that the curator has more control over the safety of the collections within. The exclusion of dust and perhaps light is beneficial to the fossils (see item 3, below). A dark storeroom placed centrally rather than peripherally in a large building will give greater protection from seasonal and diurnal fluctuations in temperature and relative humidity.

3. It is better to install cupboards in the storeroom than to have open shelves.

(*a*) They are more secure in that their contents are less accessible to interference from casual passers-by.

(*b*) They are dark so that minimal undesirable photochemical reactions of preservatives or glues on the fossils take place, there is little fading of labels, and no excessive heating under direct sunlight.

(*c*) They give more protection from dust, and dust is a danger because it is often greasy; it obscures and stains old writing and labels, it obscures bone sutures, and it is an inconvenience when the fossils are handled.

(*d*) Temperature and relative humidity are more constant within the enclosed space of a cupboard than around open shelves.

(*e*) Any emergency operations which become necessary to restore desired levels of temperature and relative humidity are more easily undertaken within the confines of a cupboard than in an open storeroom (Howie, this volume).

Against these advantages of cupboards are the disadvantages that cupboards are more expensive than shelves, that their bases have to be scribed (precisely shaped to fit the floor surface beneath) to ensure that doors and drawers do not subsequently jam, and that fewer specimens can be housed in a storeroom with cupboards than in one with open shelving.

4. For storage of large vertebrates the choice of shelving and drawer material usually lies between wood or metal, and wood is certainly the best. Among its advantages are the following:

(*a*) It transmits vibrations poorly, such as may arise from throbbing machinery or near-by traffic, and over a sufficiently long period such vibrations can be harmful to fossils.

(*b*) Wood is hygroscopic and therefore acts as a useful buffer against changes in relative humidity, i.e. it will absorb and release water vapour during wetter and drier conditions respectively and thus give additional protection to sensitive fossils (Howie, this volume).

(*c*) Large areas of shelving are possible without the need for numerous bracing bars, and this may be very useful indeed with large specimens.

(*d*) Wood is less noisy to work with than metal.

(*e*) It doesn't suddenly alter its plane of rest by tension changes when a heavy fossil is laid on an adjacent area as may happen with metal. Hence fossils on wood are jolted less often.

(*f*) Wood is softer than metal and is thus less likely to damage fossils with which it comes into contact.

Against all these advantages of wood as a shelving material is the disadvantage that it has become very expensive in recent years.

5. Whether cupboards or open shelves are used, a degree of flexibility should be built into the system if it is to be suitable for large vertebrates. A minimum requirement would be the facility for setting shelves at varying vertical intervals.

6. When the time comes to move fossil vertebrate material into the storeroom, heavy specimens should not be placed on high shelves. It is difficult to lift or manhandle them up to the shelf or down again, and the operation is hazardous for both fossils and staff. If space is available at high levels and the curatorial sequence can be so arranged, a useful item for storage there is deer antlers. Antlers are a frequent problem in collections, and while they are large, irregularly shaped, and often fragile, they are not enormously heavy. Those of later Pleistocene age are often not fully fossilized and, if not leached, are a little less likely to fall apart during handling. Incomplete specimens may be put on high shelves; complete frontlets or heads which are only partly fossilized can be mounted on walls. It is advisable to check beforehand that the wall is capable of bearing the specimen, and that the specimen has no massive fractures held only by ancient glue instead of metal braces.

7. It is often curatorially preferable not to repair a large bone if it has only a simple break, and this facilitates its examination. Plastic or rubber foams or moulded polystyrene (Rixon 1976, p. 272) can be used to protect the underside of heavy but delicate specimens. Plastic foams based on polyethers are best for not sticking to the specimens they support; latex foams may need tissue papers placed beneath the specimen to prevent sticking. It is wise to use only foams which have flame retardants among their additives. Really heavy specimens should be given support with wooden

pallets to avoid dangers from an approach to point loading on the floor or cupboard base.

8. If the storage provided for a collection is not too cramped, it is useful to leave handling space between large specimens so that any one of them on a shelf can be moved without risk of damage to the others. There should also be space to manœuvre large specimens in the adjacent gangways or corridors.

9. It is easy to overlook the need for cataloguing or registering large specimens. They tend to be known individually to one generation of curators, but without the benefit of catalogue entries their provenances can become a matter of legend to future generations. A curator approaching retirement can well ask himself whether material he excavated, or those items with which he has become most familiar over the years, have in fact been catalogued. It seems to be agreed that several bones known to come from one individual should be given a single catalogue number—with suffixes if desirable. In this way their association is made explicit to the worker at the shelves and this association is given a chance of surviving a move of the collection from one storage area to another.

10. It is helpful if labels on large specimens are visible without having to move the specimens on the shelf in order to see which is which.

11. Cupboard doors should be numbered or labelled to identify them. Labels are best, but a pitfall here is to have frequent changes of storage location resulting in messy and incomprehensible label alterations which are intended to be temporary, but somehow last a long time.

12. Material on open shelves can be shielded by curtains. Transparent polythene or PVC (polyvinyl chloride) sheeting may well be used in dry storerooms, in which case it can be split into horizontally oriented sheets, each providing shelter for no more than a pair of shelves in a vertical sequence. This avoids coping with the weight of immense sheets of plastic hanging from high levels and allows more convenient access to the shelves in the middle and upper ranges. Such sheeting can also be a cover for material on cupboard tops, but it may show a tendency to settle around upstanding projections of the objects beneath it. Before introducing large quantities of plastic sheeting into a storeroom, the curator should check on the fire and smoke risks involved. He might also consider deleterious effects on air circulation if the storeroom is more damp than it should be.

13. If there is much demand to see large specimens, then it will be convenient to provide visitors' working space near by.

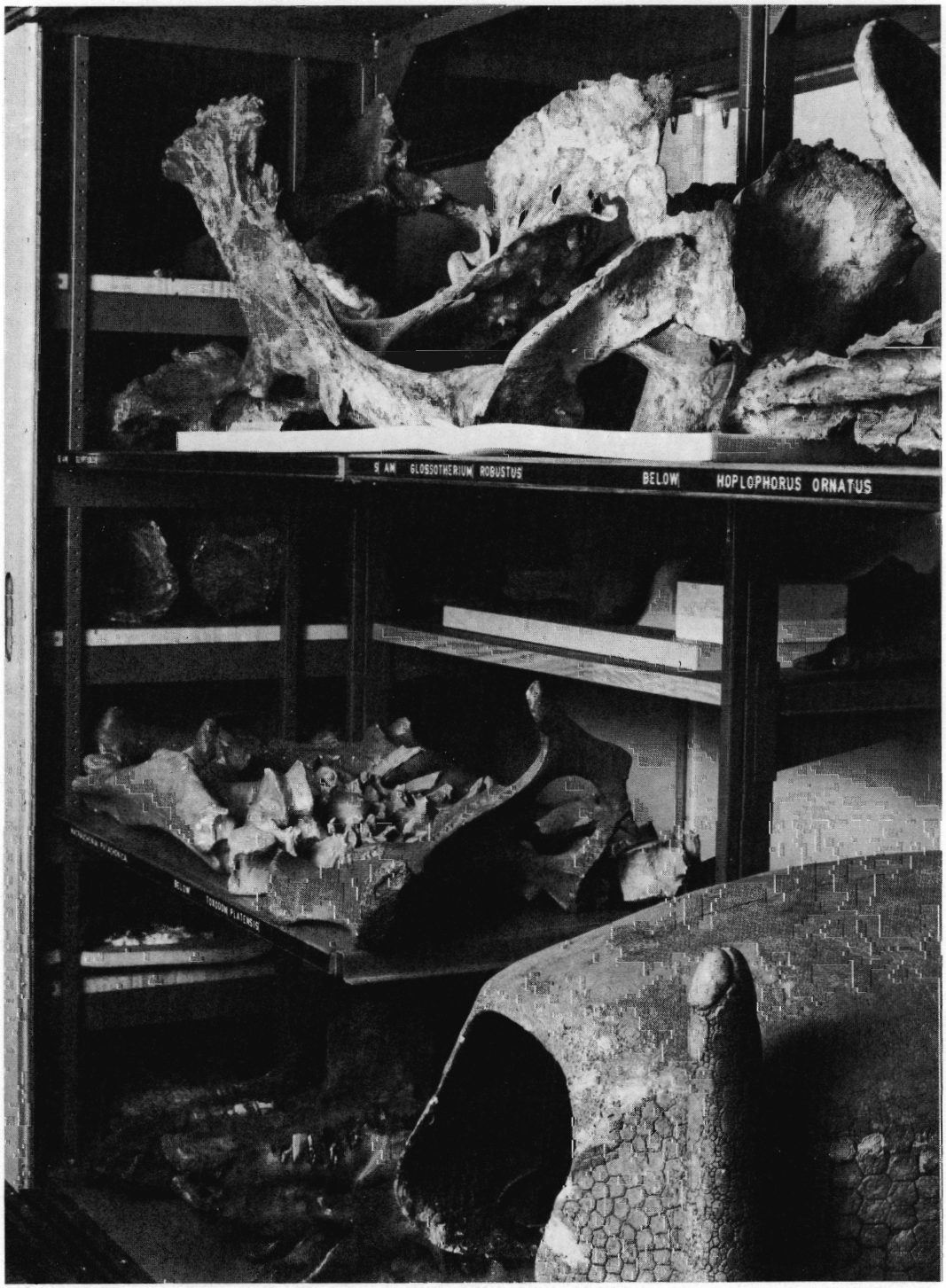
STORAGE OF FOSSIL VERTEBRATES AT THE BRITISH MUSEUM (NATURAL HISTORY)

In 1976–1977 the Palaeontology Department of the British Museum (Natural History) moved into a new building (Ball, this volume). In this building vertebrates are stored on the lower floors: reptiles in parts of the basement and sub-basement, mammals on the ground floor, fish on the first floor, and more reptiles on the second floor.

Flexible storage in the form of a modular system of cupboard units has been installed. Each unit is about 210 cm high by 120 cm wide by 70 cm deep, front to back.

TEXT-FIG. 1 (*above*). Cupboard fitted with drawers of 120 mm external depth. One of the steel runners for support of the drawers can also be seen.

TEXT-FIG. 2 (*below*). Large slabs stored vertically on wooden pallets. The supporting steel framework and horizontal rollers are also visible.



TEXT-FIG. 3. Cupboards fitted with shelves.

They are assembled in double-ranked rows, each row having a structural framework of vertical and horizontal spines built of heavy-gauge hollow steel. Available fittings for the cupboards include wooden drawers, drawer shelves, shelves, and roller units (text-figs. 1–4), and this versatility is a major step towards allowing an ordered arrangement of fossils of disparate size and weight. The cupboards can be loaded with fossils to maximum weights between 580 and 690 kg net (roughly 1300 lb), depending on their internal fittings. Beneath the visible cupboard floors are softwood cross wedges screwed together as a sub-frame support. They allow a heavy load to be spread over a large area, and make it unnecessary for the cupboards to have their bases scribed during erection.

Two stacks of drawers can be fitted in each cupboard, and the drawers can be of 60, 90, or 120 mm external depth (text-fig. 1). The drawers have grooves along their outer sides to enable them to slide on steel runners at vertical intervals of 60 or 90 mm. The steel runners support the drawers and also have the important function of preventing them tipping up when they are withdrawn from the stack.

Drawer shelves are stronger than drawers, but have the same horizontal dimensions and are used to store the occasional larger and heavier item in the middle of a series of drawers.

Shelves stretch across the complete horizontal area of a cupboard, so that each one has an area equal to that of two drawers, i.e. about 1·7 square metres. They can be spaced as closely as 30 cm vertically, and are intended to take large specimens like elephant mandibles or wild ox skulls. Each shelf is constructed of laminboard nearly 3 cm thick; the laminboard consists of a single layer of softwood strips laid along the long axis of the shelf with their grain parallel, each strip glued to its neighbours and the whole being flanked top and bottom by a thin wooden envelope about 1 mm thick. The front of each shelf is fitted with a plastic slot to take labelling made up from individual pre-printed letters. Cupboards with shelves (text-fig. 3) can be

TEXT-FIG. 4. Limb bones of the extinct rhinoceros *Paraceratherium* stored in a cupboard without any internal fittings.

interspersed among cupboards with drawers and so bring large and small fossils from the same collection into proximity. If specimens are sufficiently large and deep, they can each occupy a whole cupboard (text-fig. 4).

Roller units are used for large slabs consisting of complete or partial skeletons in matrix (text-fig. 2), the matrix being enclosed in square or rectangular wooden frames. These slabs are stored vertically, but a number of them would be too heavy for a shelf and would also lead to a waste of space because of their differing heights. Therefore some cupboards have been fitted with an extra steel framework supporting occasional narrow sets of horizontal rollers on which are mounted wooden pallets, on which in turn stand the slabs. Trolleys are being constructed which can be wheeled to the cupboards and enable slabs to be taken off the horizontal rollers with safety.

It can be seen from these brief remarks that the new building and its fittings allow a much better integration of the collections than has been possible hitherto. Standards of curation are rising accordingly, and this improvement should be maintained for some time to come.

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The rationalized storage system at the British Museum (Natural History) is covered by Crown Copyright. Further details of its design and construction can be obtained by writing to the Department of the Environment, Property Services Agency, Supplies Division, Museums Group, Southbridge House, Southwark Bridge Road, London SE1 9HQ.

REFERENCE

RIXON, A. E. 1976. *Fossil animal remains: their preparation and conservation.* viii + 304 pp., Athlone Press, London.

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DISCUSSION

P. J. Lawrance. How does the BM(NH) store large, fragile specimens such as mammoth tusks?

A. W. Gentry. For some years the mammoth tusks have been lying together in one place—the floor of a disused public showcase. They are going to be moved to an outstation, but because some of them are only partly fossilized we have asked that they should go to a storeroom which we hope will have correct humidity and temperature control to overcome the obvious dangers to partly fossilized ivory from variations of such factors. You probably know that ivory is a particularly sensitive material.

W. D. I. Rolfe. With regard to the point regarding the hanging of skulls of giant Irish deer, I suggest that the mandibles should be removed. In the Hunterian Museum we have had one hanging on the wall since 1870, in typical Victorian mode. When a visiting research worker wanted to measure the specimen recently

we discovered that the weight of the skull with antlers had caused all the lower teeth to have impact fractures —they were not quite pressure-welded but all the dentition of the specimen was ruined. If one hangs a specimen in this way one must ensure that the load is taken off the bearing surface.

V. Burns. Would the use of polythene to cover trays or specimens result in a moisture problem due to the lack of air circulation, with consequent deterioration of specimens?

A. W. Gentry. It has not come within my personal experience, but it sounds as if it could be a likely hazard. The only safe precaution would be frequent inspection and extreme care in removing the polythene. Moreover, before introducing large quantities of polythene, the implications regarding fire hazards must be considered.

F. M. P. Howie. As long as there is adequate circulation of air around specimens there should be no problem.