MODERN METHODS OF EXCAVATING, PREPARING AND MOUNTING FOSSIL SKELETONS

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The work of collecting and preparing fossil bones is so well known in the museums of America that it is not my intention to explain in detail how to take up bones in the field and to prepare them in the laboratory. Some of the most modern methods adopted in the American Museum of Natural History may, however, be of interest.

FIELD WORK

Too much emphasis can hardly be laid upon the proper treatment of bones in the field, because very crumbly but precious specimens may be saved by proper treatment, while, on the other hand, good specimens may be ruined by wrong treatment.

Up to recent years collectors in the field have used almost exclusively gum arabic for saturating soft bones in order to harden them, and while practical for very porous bones it does not penetrate sufficiently into less porous ones, so that they become hardened on the outside only, remaining crumbly inside. Another disadvantage is that gum will absorb moisture and loses its binding properties in damp weather. Shellac will penetrate the bones much more thoroughly than gum, and when sufficiently dry will leave them much harder and absolutely waterproof. For the last three or four seasons our collectors have used a solution of shellac in place of gum arabic with very good results; and this can be recommended for any field work wherever the fossils are porous and badly preserved. Brown shellac is better as it dissolves more easily and it is stronger, and should be used

wherever practicable, but for light-colored bones white shellac is preferable, as it will not discolor the bones.

PREPARING BONES IN THE LABORATORY

Bones treated in the field with a solution of shellac usually arrive in the laboratory in better preservation than those treated with gum or glue-water, and much less care is necessary to prevent wetting in freeing them from the matrix or burlap cover. Numerous methods are employed to remove the matrix from the bones, according to the condition of the specimens. While a good-sized chisel is practical on a large and well-preserved specimen, small and delicate bones may be freed more securely with so-called harness awls of different sizes, bent and hardened to suit as a gouge and as a scratcher for softer matrix. Wherever the system of pneumatic chisels can be introduced it may be of great importance, especially for lighter chiseling of not too hard rock; it works very rapidly and with less injury to the specimens, as I had opportunity to observe in the Field Museum of Natural History at Chicago.

I have found in my experience that a moderately strong solution of gum arabic used with alabaster plaster is a good and very practicable cement with which to fasten pieces together and is the best cement for all ordinary bones. When used in the right proportions it holds very well, at least as well as the expensive cements, so much advertised. I find that the best and most substantial plaster for restoration work is made by mixing the plaster in a solution of yellow dextrine which can be easily dissolved in boiling water. The dextrine solution should not be too strong; the right strength is indicated when the solution is of a light coffee color. Too much dextrine causes the plaster to crack when dry.

So-called plasterine or modelling clay furnishes a very good material for moulds for rough casting. In this work the bones are slightly coated with glycerine and pressed in both halves of the clay mould in such a way that they

can be lifted out without changing the shape of the mould. The two halves are then placed together properly and filled with plaster, which makes a fairly accurate cast. In many cases I have made the casts larger than the objects by moving the specimen to and fro in the mould to enlarge the cavity. When modelling missing bones much time is saved by casting a bone in this manner and then modifying the form to suit, with knife and awl, instead of modelling the missing bones in clay.

Mounting of Skeletons

The mounting of fossil skeletons is a problem which can not be explained in a general way. Every skeleton has to be treated according to its size, shape, and condition. Skeletons from the size of a cat up to that of a large dog, to be mounted free, can be supported with light soft steel, so that the mounting shows very little. In case the vertebræ are not to be made detachable for study purposes, a flat rod may be run through the neural canal, which makes the neatest mount.

Limbs and ribs supported with flat soft steel, fitted close to the bones, look very well and the mounting is very inconspicuous. All soft bones may be bored and fastened to the supports by screws or pins; harder bones by means of very small flat bands, fitted around the bones and fastened on the main supports with pins or screws.

I may mention another method which I have introduced in the American Museum that may prove to be valuable for other museums. Skeletons which are soft enough, so that the bones can be bored, can be mounted so that every bone is easily detached in the following manner: The back-bone may be supported by a soft steel rod (flat or half round) running under the vertebral column. Fittings to slide over the rod can be cast in bronze without great expense. Each fitting has a pin fastened to it which runs into the centrum of the vertebra, holding it firmly. Pins made stationary by being fastened in the supporting rod do not answer as in many cases it is impossible to get

the individual vertebræ in or out of the column without moving the adjacent vertebræ and pins. After the limbs have been temporarily set up and the flat or half round steel fitted flush to the bones, holes may be bored in the supports and in the bones at the proper places and brass tubes inserted and fastened in the bones with a mixture of shellac and whitening, which holds them very firm. Before the tubes are inserted a thread should be cut inside the tube to which the supports can be screwed very securely. This makes the bones easily detachable. This method is desirable for all skeletons with soft bones, small or large, and especially large skeletons, such as the Mammoth or Mastodon, can be mounted with comparatively few rods or uprights. I can not recommend any style of iron or steel for all purposes as that largely is a matter of individual taste. I myself prefer half round, soft iron for all large skeletons to be fitted along the bones. For very small skeletons, small flat steel is preferable. The so-called channel iron makes good rib supports for all larger skeletons, as there is in the channel a suitable place for the nuts of the screws.

A very practical tool to use in mounting skeletons, especially larger ones, is the "electric drill." It can be attached to any electric light block, and is a great labor-saving tool, which I can recommend very highly. We have one in use in our laboratory which weighs eight pounds; it cuts a $\frac{1}{4}$-inch hole, can be handled very easily, and can be used to drill holes in any bone or iron without taking them out of place.

Another new feature of importance is the over-head rail or trolley system. As installed in our laboratory, a comparatively heavy rail is fastened to the ceiling, on which trolleys with hoisting blocks attached can be rolled very freely to and fro. Skeletons suspended by these blocks can easily be raised or lowered, or moved from one end of the room to the other. This system is of great importance for economy in mounting very large skeletons. To suspend small skeletons while in operation we use

steel rods screwed to tripods of different sizes for uprights with a horizontal bar fastened by means of clamps, which allow it to be moved up and down. This is a simple apparatus and is very useful for suspending skeletons of not too large dimensions.

To dispense with most of the plumbers' fittings in mounting skeletons we have introduced during the past few years a mode of splitting steel at the end, to act as braces and in other ways, opened and flattened and screwed to the uprights and other supports. This perhaps takes a little more time than to use so-called plumbers' fittings, but it appears as an entirely different style of mounting.

Wherever electric power is available labor-saving machines can be installed, such as drilling machines for heavy work, rotary saws for splitting and cutting steel and brass, small turning lathe attachment for corborundum wheels, and rotary diamond saws for large section cutting. All these appliances just mentioned we have attached to one large lathe run by a one-horse power motor, although a little stronger motor may be recommended. A small gas-blast furnace with a one third or one half horse power motor for the blower makes a sufficiently strong forge to heat a two-inch steel bar and we find this in our laboratory indispensable.

During later years we have introduced numerous other convenient tools, but it would take too long to mention them all here.