A Replica of *Diplodocus*

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The present article is the story of how the replica of *Diplodocus carnegiei* Hatcher came to stand on the lawn of the Utah Field House of Natural History in Vernal.

Shortly after the turn of the century, a field party from the Carnegie Museum of Pittsburgh collected a large quantity of dinosaur material on Sheep Creek in the Medicine Bow country of Wyoming. These fossils, which were later to become one of the fine exhibits in the Dinosaur Hall at the Carnegie Museum in the shape of an impressive *Diplodocus* skeleton, created wide interest among the museums of many nations.

In view of this great interest by other institutions, Andrew Carnegie had executed molds of the entire skeleton of *Diplodocus,* from which he ordered ten plaster casts which he then gave to European, South American, and Mexican museums. The first of these, at the request of His Majesty King Edward VII, went to the British Museum (Natural History) on May 12, 1905.

After these initial activities, the molds were stored in the basement of the Carnegie Museum where, for more than forty years, they lay forgotten while acquiring a thick coat of famous Pittsburgh soot, a one-time by-product of the actual mills that had made their creation possible.

Some time after the completion of the Utah Field House of Natural History in the dinosaur country of northeastern Utah in the autumn of 1948, the Carnegie Museum, through the courtesy of Dr. J. LeRoy Kay, Curator of its Section of Vertebrate Paleontology, offered the molds to the Utah State Museum as a gift, if transportation could be provided. The Vernal Lions Club generously paid the freight charges, and, upon the arrival of the molds, the first steps in the resurrection of *Diplodocus* were begun. After some forty years of "dead" and dirty storage, a bath was imperative, and *Diplodocus* was given a thorough one with steam. Broken molds were repaired, and the whole lot was put in order for casting.

Prior to the actual casting, several experimental mixes were tried. A mixture of one part cement and three parts Aggra-lite[1] appeared to be the most suitable for our purpose. Because *Diplodocus,* when stretched out to full length would be seventy-six feet long and our exhibit halls are only fifty feet in length, we decided to place the skeleton out on the lawn. This choice posed the added problem of the hazards of changeable weather and temperatures which in our locality range from 100° Fahrenheit above zero to 40° below. Also we wanted as light a cast as possible. Aggra-lite seemed to be the answer.

We had already made more than a hundred casts of the approximately six hundred needed to complete the job, when Mr. Otto Buehner, president of the Otto Buehner Concrete Products Company of Salt Lake City, paid us a visit and became interested in our project. As the skeleton was to be exposed to severe extremes of weather, Mr. Buehner expressed some doubts about Aggra-lite as the best medium to use and suggested further study. He also kindly offered the experience of his workers and the facilities of his plant, if museum personnel would do the actual casting. We readily accepted the offer and proceeded to truck the molds out to Salt Lake City, where Grant Merrell, our preparator, did the casting of about three-quarters of the material that went to make up the complete skeleton. The other quarter of the casting required glue molds (of the more intricate skeletal parts) and was done at the museum in Vernal.

With the desirability of a lightweight cast constantly in mind, experimentation disclosed that a combination of cement and aragonite (a calcium carbonate) in the proportion of one to three was the most acceptable aggregate. For some of the larger "bones," in order to reduce weight, volcanic cinders were mixed with the aragonite, and the one to three proportion was used for the whole. Wire and steel reënforcing rods were inserted where needed. A cocoa-hued dry color was added to the batch, so that the finished product more nearly resembled fossil bone. Each cast was then covered with fiberglass to protect it from the destructive elements to which it would be exposed in the outdoor world.

In the process of fiberglassing the casts, it was discovered by Mr. Merrell that the fiberglass made an excellent mastic for cementing broken molds and casts together. In fact, it developed that as an adherent it was more effective and resistant than the usual bonding cements that were obtainable. Used with a small portion of the catalyst that comes with the fiberglass itself, it would set in a joint with such toughness that it became the strongest point in any material upon which it was used. (The Buehner people thereafter began using fiberglass cement to repair their Italian marble that had been broken in shipment or in construction, thereby

[1] Trade name for a lightweight product composed of volcanic pumice.

Fig. 1

saving thousands of dollars.) Here at the Utah State Museum, fiberglass has replaced virtually all other cements as a bonding agent, especially for large or heavy pieces. It is superior in the joining of wood, metal, stone, plaster, bone, or any combination of these, and it cannot be surpassed for use in the preparation of fossils. Fiberglass is sold under several trade names, including "Boat Resin," but a request for "fiberglass" is all that is necessary to secure the desired product. The catalyst, which can be purchased with it, is the secret of its superior qualities as a bonding agent. It is well to mix only a small quantity of fiberglass with the fixative at one time, as it sets rapidly and requires prompt use. The more catalyst that is used and the warmer the room temperature, the quicker the fiberglass sets. Experience will soon teach one how big a batch to make at one time and how strong to make it under given circumstances.

With the return of the "bones" to Vernal, the work of assembling the nearly six hundred cast pieces into anatomical units was begun by museum personnel which consisted of Mrs. Untermann, staff scientist and technician, Mr. Merrell, and the present writer. A limited amount of literature

Fig. 1. Members of the staff of the Utah Field House of Natural History assembling Diplodocus *casts.*

Fig. 2. Diplodocus *laid out in the workshop for a trial fitting.*

Fig. 3. Beginning the outside work. The first "bones" are placed in position.

Fig. 2

Fig. 3

was the only guide available for this "do-it-yourself" dinosaur-assembling project, which has since passed critical examination by experts. Originally, each plaster mold, from which the casts were made, had an identifying number, but with age and use most of the numbers were obliterated and thus were of little help in the assembling process. A working knowledge of vertebrate anatomy and common sense proved far more helpful than reliance upon a vague numbering system.

Each cast piece was drilled and fastened to its adjoining member with a steel rod and bonded with fiberglass. The entire skeleton was assembled and laid out in the workshop so that we could be certain that all bones were present and in the right place. Some smaller and lighter pieces, such as cervicals and the skull, were fastened together in the shop and later assembled in place, outdoors, as a single unit.

With the inside work completed, the crew moved its activities outdoors onto the museum lawn. The cement base was laid, and the supporting steel stanchions and iron framework were set. A chain-link fence, a gift of the Vernal Lions Club, was erected around the work area for protection. Then the actual placing of the skeleton of *Diplodocus* was begun. The heavy pelvis was first placed on its central stanchion. The hind legs and feet were attached next, their proper position was determined, and they were welded into place. The dorsal vertebrae were then welded to the pelvis and to one another. A total of one hundred and three vertebrae, from the head to the tip of tail, were laid in place in their iron cradle. Front legs and feet were fastened in position, followed by the ribs. The

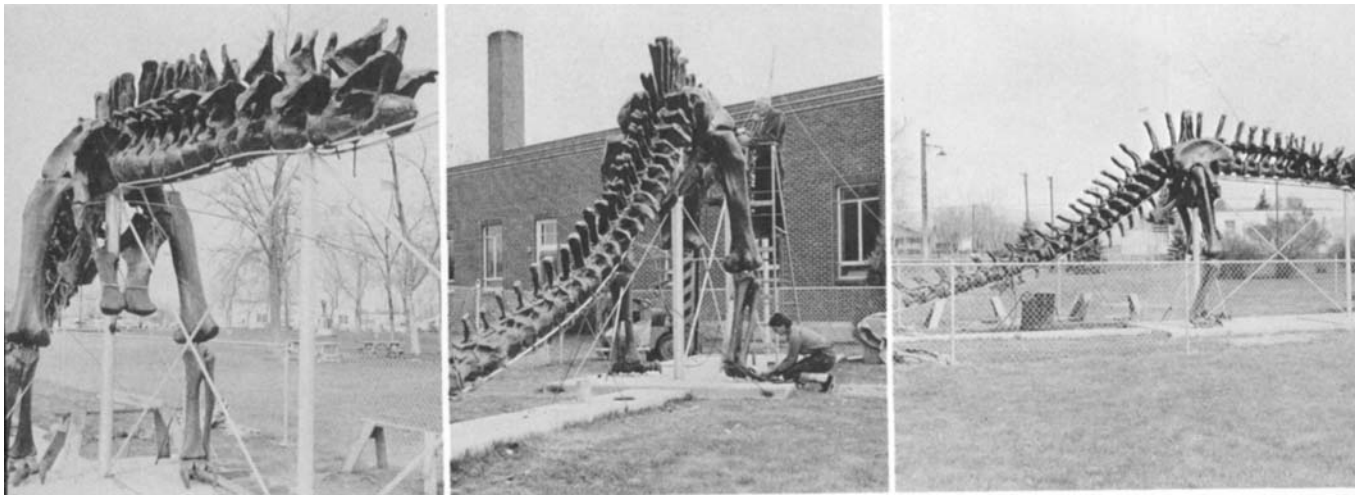

Fig. 4

skull, which rises twenty-one feet above the ground, was the last to be attached. The seventy-six-foot long skeleton was guyed with iron rods which have enabled it to withstand seventy-mile per hour gales that have uprooted trees in the neighborhood. A "Hyster," which is a mechanical lumber loader, was used to lift the heavy casts into place.

Parts of three years were consumed on the dinosaur project, with a total working time of eighteen months. The cost of the completed skeleton was $10,000, most of which was accounted for in salary. The actual material cost only a few hundred dollars.

Because human "erosion" is one of the factors that every museum must deal with, we placed signs at all vantage points which read as follows: "Warning!!! High Voltage. Stay Outside Fence! This Skeleton has been Charged with High Voltage Electricity!" The museum staff is too small to carry the extra load of protection, but this warning has had the proper psychological effect, and *Diplodocus* is still intact.

People ask the funniest questions! Although the label on *Diplodocus* plainly states that the skeleton is an authentic cement replica, some persons ask, "Are those bones real?" We reply that they are made of cement. "Well, where did you dig him up?" At this point you are a little hard put to give a satisfactory answer.

Several museums in the United States and from lands as distant as

Fig. 4. Stages in the assembling of skeleton. Fig. 5. The completed replica.

Japan and Italy have expressed a desire to acquire the molds and cast a *Diplodocus* of their own from either plaster or some of the newer synthetics. To date no museum has apparently been able to make satisfactory arrangements for the acquisition of the molds and the casting of a skeleton. We still have the molds in Vernal, and any museum, anywhere, is welcome to them just for hauling them off. We make only one requirement and that is that after the casting is completed the new owner makes the molds available to other institutions free. We shall be happy to hear from any interested persons. Transportation requires only a large truck, with a bed twenty feet long, a beam of eight to ten feet, and a depth of five feet, to haul all the molds.

The *Diplodocus* on the lawn of the Utah Field House is the eleventh replica to be cast from the molds and, as far as we know, the only one cast in cement for outdoor display as a skeleton.

Does anyone wish to cast the twelfth?

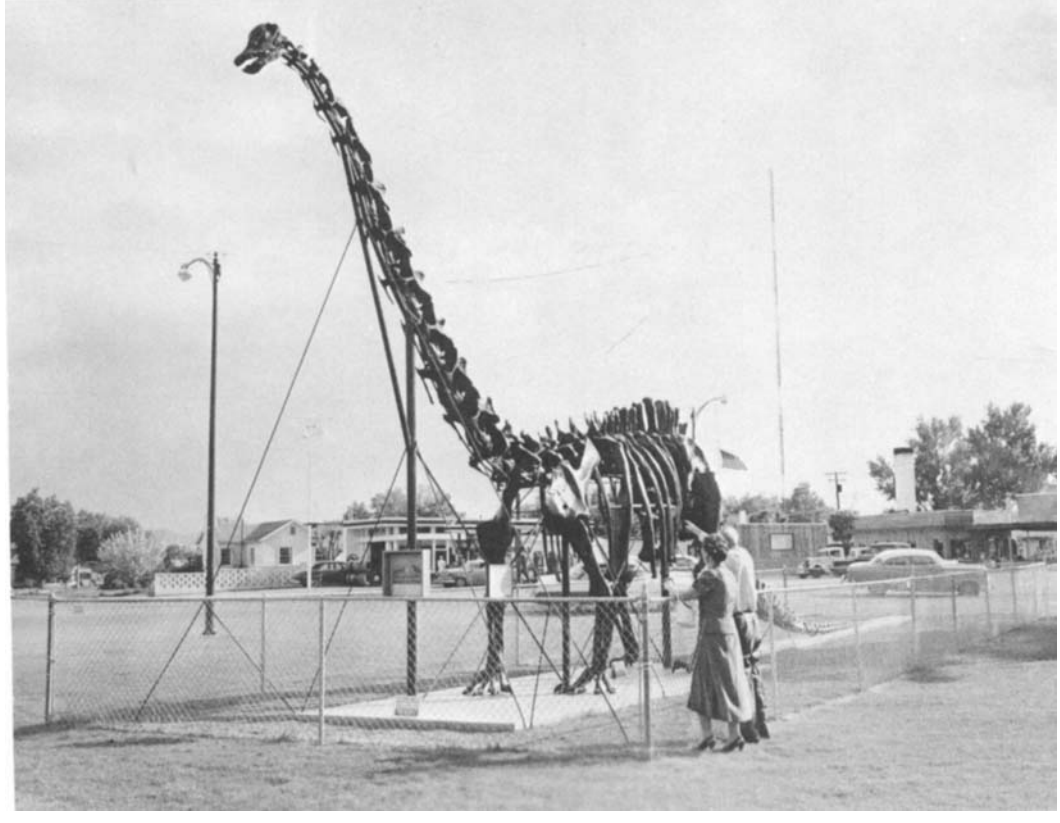

Fig. 5