ford have had a somewhat more natural environment, having spent the winter in a submerged crate. They are hardy, voracious and seem to thrive.

The plans for the second year were based on the successes and failures of the first, and it was thought best to take advantage of the favorable environmental conditions at Wickford, to discontinue the work elsewhere, and to put all the energy into devising some economical contrivance for keeping the water so agitated that the fry would not and could not settle to the bottom.

After many experiments, a relatively simple and inexpensive device was adopted. Several bags of scrim about three feet in diameter and four in depth were so suspended in the pool of the floating laboratory that the current could not change their general shape or cause them to collapse. In each bag was placed a dasher, the blades of which in rotation would constantly lift the water through the mesh at the bottom of the bag and urge it with obviously less velocity through the pores of the vertical walls. The dashers were kept in motion by means of a small gasolene engine, the motor apparatus as a whole having a striking resemblance to the aerating equipment of a second-class restaurant. The scrim bags looked like so many vertical cylinders. We found that when the mechanism was in actual operation the current in rising through the bottom of the bag brought with it large numbers of pelagic animals, while the reduced current of the water passing through the greater expanse of the vertical walls was not sufficient to carry this living material out of the bags; thus the apparatus sufficed not only for keeping the fry and artificial food from the bottom, but it also provided the fry with living natural food. To Mr. George H. Sherwood is due the credit of devising and installing this aerating and feed apparatus.

In practice it was found that the eggs stripped from the abdomen of the female would hatch in these scrim enclosures under much more favorable conditions than in McDonald jars. Indeed, I am inclined to believe that a far higher percentage of eggs would hatch in these bags than in the McDonald jars, and I am sure that the young are in a much more healthy condition than when hatched by the older method. Even a superficial examination of the young that have spent some hours in the trituration of the McDonald jars will show that a large proportion of them have the appendages broken, bent or indented.

The number of fry that were available for the purpose of experimentation during the first season was considerably less than in 1900, and the period of experimental work was also materially reduced. Nevertheless, Dr. Mead, who had the work immediately in charge, reports that by actual count in no case was the number of lobsters that reached the fourth stage less than 16 per cent. of the number of fry originally placed in the enclosure. In a few cases it was above 40 per cent. and in at least one case it was as high as 54 per cent. In previous years no experiments had yielded more than a fraction of one per cent. The total number of lobsters raised to the fourth stage during the season of 1901 (in the twelve cylinders) was a little more than nine thousand.

Encouraged by these results, the United States Commission of Fish and Fisheries is now planning to equip one or more stations with the aerating, hatching and brooding apparatus above described, and to actually test the feasibility of raising large numbers of fry to the fourth stage, and I feel convinced that the liberation of large numbers of these more hardy young will result in the restocking of our depleted waters.

H. C. BUMPUS.
AMERICAN MUSEUM OF NATURAL HISTORY.

ON THE STRUCTURE OF THE MANUS IN BRONTOSAURUS.

During the past season, while engaged in collecting vertebrate fossils for the Carnegie Museum, Mr. Charles W. Gilmore had the good fortune to discover in the Jurassic exposures on Sheep Creek, in Albany Co., Wyo., a very considerable portion of the skeleton of *Brontosaurus*.

This skeleton was very carefully taken up by Mr. Gilmore and has been received at the museum. Among the more important parts secured was a nearly complete fore limb and foot with the different elements for the most part still retained in their normal position, making it possible for the first time to definitely determine most of the more important points regarding the structure of the manus in this genus of the Sauropoda.

The entire limb and foot were taken up in two sections, in one of which was the humerus, while the other contained the radius, ulna, and such portions of the manus as were preserved, consisting of the supposed scapholunar, the complete series of metacarpals, the five proximal phalanges, and the ungual of the first digit. All these elements when found, except the scapholunar, lay in approximately their normal positions, with reference to each other, and thanks to the skill and care of Mr. Gilmore, they were so taken up and packed that their original positions had not been disturbed when the limb and foot were unpacked in the laboratory.

The radius, ulna and manus have already been partially freed from the matrix by Mr. Gilmore, and throw considerable light upon the structure of the latter.

The limb when found lay with the palmar side up. The proximal end of the radius lay in the radial groove on the anterior surface of the ulna, these bones still articulating with the distal end of the humerus. Lying between and upon the palmar side, near the distal end of the radius and ulna, was a large flat bone presenting on one side a gentle but regularly convex surface, and on the other two flat, subequal surfaces separated by a low ridge. This bone I have interpreted as the scapholunar, and it seems to be the only carpal element retained in the Brontosaur manus.

Metacarpals I., II., III., IV., V. were in regular order at the distal extremity of the radius and ulna, though the first and fifth were closely applied to the external lateral surfaces of the distal ends of the radius and ulna, indicating that in life they articulated directly with these bones, perhaps through the intermedium of heavy cartilaginous pads, while the three median metacarpals were a little more removed in order to accommodate the scapholunar mentioned above.

The proximal phalanges of all the digits were present and nearly in their normal positions with relation to their respective metacarpals. That of digit I. was in contact with its metacarpal, but shifted from its normal position so that its external lateral surface was opposed to the distal end of the metacarpal, with its proximal articular surface turned inward toward the median axis of the foot, and the distal outward. The proximal phalanx of digit II. was in position at the extremity of metacarpal II., but very much flexed, so that its longitudinal axis lay almost at right angles to that of metacarpal II. It is much the larger and stronger of the series of proximal phalanges, and has the distal articular surface deeply grooved for the keel of the second phalanx. The first phalanx of digit III. is much smaller than that of the second, and presents distally a small, but well-formed and slightly grooved, surface for the articulation of the succeeding phalanx. It (the first) was found in its proper position at the extremity of metacarpal III., and there was on the palmar side, interposed between it and that bone, a small rounded sesamoid. The proximal phalanx of the fourth digit was in position articulated with metacarpal IV. It is the smallest of the series and presents distally an ill-defined articular surface. That of digit V. lay at the extremity of its metacarpal, but with its external lateral surface opposed to the distal end of the latter. This phalanx is slightly larger than the corresponding one of digit IV., but its distal extremity scarcely shows any trace of an articular surface for a succeeding phalanx. These were the only phalanges found with this foot except the ungual of the first digit, which lay in its normal position with reference to that of the first phalanx as the latter has been described above, except that it was turned on its side and had been moved slightly backward, and lay with its articular surface abutting against the external border of the distal articular surface of the first phalanx and the external lateral surface of metacarpal I.

There was a slight vertical displacement in the carpal region, so that the distal ends of the radius and ulna were a little lower than the metacarpals. Metacarpals I. and V. lay in such position with reference to II., III. and IV. as to indicate that the proximal ends of these bones were arranged in the arc of a circle, and not horizontally.

From the above brief description it will readily appear that the Sauropod manus in *Brontosaurus* at least was like the pes, arranged on the entaxomic plan, and not mesaxomic as Professor Osborn was led to believe from a study of the abundant but isolated material in the collections of the American Museum of Natural History.

This foot and limb will be more fully described and adequately illustrated in the coming number of the *Annals* of this Museum.

J. B. HATCHER.

CARNEGIE MUSEUM,
December 2, 1901.

GOLDFISH AS DESTROYERS OF MOSQUITO LARVÆ.

IN Professor L. O. Howard's recent excellent volume on 'Mosquitoes,' etc. (p. 161), reference is made to a reported employment of 'carp' as destroyers of mosquito larvæ and doubt is expressed as to the facts in the following words:

"It was stated a number of years ago in *Insect Life*, that mosquitoes were at one time very abundant on the Riviera in South Europe, and that one of the English residents found that they breed abundantly in the water tanks, and introduced carp into the tanks for the purpose of destroying the larvæ. It is said that this was done with success, but the well-known food-habits of the carp seem to indicate that there is something wrong with the story. If top-minnows or sticklebacks had been introduced, however, the story would have been perfectly credible, and it points to the practical use of fish under many conditions."

An examination of *Insect Life* (Vol. IV., p. 223) and also of *Nature* (Vol. XLIV., 1891, p. 591)—the original source of the statement in question—fails to reveal the precise species of 'carp' here referred to, but if, as seems likely, it was the common goldfish, *Carassius auratus*, I happen to be in a position to confirm the general truth of the story.

About six years ago at my home in Belmont, near Boston, Massachusetts, I constructed a small artificial pond in which to grow water-lilies and other aquatic plants, and also to breed, if possible, some varieties of goldfish—though the latter object was a secondary consideration. The advisability of making this pond had been somewhat questioned on account of its close proximity to my house and the fact that such ponds are likely to become excellent places for the propagation of mosquitoes. Nevertheless, the plan was carried out and the pond was stocked with goldfish taken from natural ponds in the vicinity where they had been living and breeding, to my personal knowledge, for a number of years.

The aquatic garden has proved a success and the goldfish have meantime thriven and multiplied. Moreover, no mosquitoes attributable to the pond have appeared and I have been unable to find any larvæ in it, although I have searched repeatedly and diligently for them. I have always believed that the absence of mosquito larvæ from this pond was due to the presence of the goldfish, and I have so stated in a paper 'On the Drainage, Reclamation and Sanitary Improvement of Certain Marsh Lands in the Vicinity of Boston' in the *Technology Quarterly*, XIV., 69 (March, 1901), as follows: "In the water [of this pond] are hundreds of goldfish that feed upon the larvæ of mosquitoes and serve to keep this insect pest in check."

On observing the statement referred to in Professor Howard's book I determined to make careful observations, to settle the point in dispute. Within fifty feet of the pond in question stands a large tank which for a long time last summer was filled with rain water. Here I found constantly large numbers of mosquito larvæ, of both *Culex* and *Anopheles*. Between this tank and the pond runs a cool brook, fed by a spring. Here also I found abundant mosquito larvæ, those of *Anopheles* being more prevalent than those of *Culex*. Reflecting upon this fact it seemed more probable than ever that the goldfish were holding the mosquitoes in check in the artificial pond while in the brook the insects were breeding in comparative safety.

To test the correctness of my theories I took from the pond a small goldfish about three inches long and placed it in an aquarium where it could, if it would, feed upon mosquito larvæ and still be under careful observation. The result was as I had anticipated. On the first day, owing perhaps to the change of environment,