Dr. Theodore A. Hoch, on a case of acute anterior poliomyelitis in a youth, sixteen years old, who died in thirteen weeks after the onset of the disease. The clinical and post-mortem records of the case are given, and the microscopical examination is extensively illustrated. The article is to be continued. Following this, Dr. Paul Masoin, physician at the colony of Gheel, Belgium, reports and briefly discusses five cases of epileptiform attacks occurring in the course of dementia præcox among patients at the colony, comparing them with the other motor exteriorations of hebephreno catatonic subjects. Dr. Guy Hinsdale next presents the history of a remarkable case of paraplegia from fracture of the first, second and third dorsal vertebræ. The patient suffered seven other fractures in the accident, an explosion. A laminectomy was performed, removing the arches of the first, second, third and a part of the fourth dorsal vertebræ. Three years after the accident the patient is able to turn herself in bed, and to walk with assistance. Dr. M. A. Bliss reports a case of small round cell sarcoma of the spinal column, and Dr. G. L. Walton one of family atrophy of the peroneal type.

SPECIAL ARTICLES.

SKULL AND SKELETON OF THE SAUROPODOUS DINOSAURS, MOROSAURUS AND BRONTOSAURUS.

1. *Skull of Morosaurus.*

One of the most fortunate discoveries resulting from the American Museum excavations in the Bone Cabin Quarry deposits, in the Wyoming Jurassic, was the skull of *Morosaurus*. Hitherto our knowledge of the skull of the Sauropoda has been limited to the skull of *Diplodocus* and the posterior portion of the cranium of one specimen of *Morosaurus,* both described by Marsh.

The present specimen (Amer. Mus., No. 467) was traced by Dr. W. D. Matthew from a series of crushed cervical vertebræ. It was found in an extremely crushed condition and was restored with great skill and care by Mr. Adam Hermann, the preparator of the museum. In the region of the occiput some aid was gained from the specimen described by Marsh and from the posterior portion of another cranium also found in the Bone Cabin Quarry.

All three specimens exhibit a well-defined *parietal foramen* at the junction of the parietals, frontals and supraoccipitals. This foramen is smoothly lined with bone and leads directly down into the cerebral cavity. It is thus highly probable that it lodged a large pineal eye, an organ the existence of which was left problematical by Marsh.[1] In Marsh's drawing the parietal opening is indicated rather as a fontanelle than as a foramen.

The skull of *Morosaurus* differs from that of *Diplodocus* principally in the highly convex forehead or antorbital region, which is undoubtedly correlated with the difference in character of the great cropping teeth, which contrast widely with the slender, pencil-like teeth of *Diplodocus*. This skull shows these teeth in different stages of wear and of shedding or succession. Above, there are four premaxillary and eight maxillary teeth, decreasing in size as they extend toward the back of the jaw. From twelve to thirteen mandibular teeth are preserved. The deep, massive proportions of the premaxillaries, maxillaries and mandibular rami are also mechanically correlated with the insertion and powerful functions of these large teeth. It is evident, however, that the animal had no power of masticating its food, and that these anterior teeth served simply for prehensile purposes.

The anterior narial openings are very large and face forward and obliquely upward, rather than more directly upward, as in *Diplodocus*. The antorbital openings are correspondingly reduced. As restored, the orbits are enormous, but there is considerable deficiency of bone in the surrounding parts, so that the contours are not quite certain. From the superior aspect of the skull it is evident that both frontals and nasals were much longer than in *Diplodocus,* the latter bones sending forward median

[1] "There is no true pineal foramen, but in the skull here figured (Pl. II.) there is the small unossified tract mentioned above. In one specimen of *Morosaurus* a similar opening has been observed, but in other Sauropoda the parietal bones, even if thin, are complete."

bars uniting with the slender premaxillary processes. A striking feature is the large parietal foramen opening directly into the brain case, as above described. It is noteworthy that the occiput or back part of the skull has practically the same composition as that of the carnivorous dinosaurs, namely: (1) supraoccipitals bounding the parietal foramen posteriorly (this foramen is, however, absent in the carnivorous dinosaurs); (2) lateral parietal plates which hardly enter into the top of the cranial roof except to bound the parietal foramina at the sides; (3) the squamosals forming together with the paroccipital processes the infralateral portions of the occiput; (4) occipital condyles composed exclusively of the basioccipitals.

Correlated with the muscular insertions for the motions of the powerful neck we find two very powerful processes extending down from the basisphenoidal region, presenting a wide contrast to the comparatively slender processes observed in *Diplodocus*. The quadrates and pterygoids have substantially the same shape as in *Diplodocus;* the other bones of palate are not preserved. Of the bones of the jaw the dentaries, coronoids, articulars and angulars are well preserved, as shown in the drawing. The coronoids have a considerable upward extension, but nothing to compare with that seen in the Predentata since it is not necessary to provide for the insertion of muscles of mastication.

It is this skull which was mainly used in the mounted skeleton of *Brontosaurus* in the museum; only the anterior part of the skull of this animal being known.

2. *Mounted Skeleton of Brontosaurus.*

The mounting of *Brontosaurus* has occupied the museum staff more or less continuously since the discovery of the skeleton by Mr. Granger and Mr. Grant, of the American Museum expedition, in 1897. In 1898 and 1899 the excavation was completed, and a little more than two thirds of the entire skeleton was recovered. The chief missing parts are the skull, the three anterior cervicals, the fore limbs of both sides from the shoulder down, the upper portions of the sacrum, the hind limb of one side, and the terminal portion of the tail. The restoration of the skull is largely conjectural from that of *Morosaurus* above described, and the missing parts of the limbs are restored from the famous specimen in the Yale Museum, the type of Marsh's *Brontosaurus excelsus*. The terminal portion of the tail is completed from another individual in the American Museum of Natural History.

The special features of the skeleton are its large size, the absence of crushing of the bones, and the completeness of the ribs. The mounting represents not only prolonged work of difficult restoration under the supervision of the head preparator, Mr. Hermann, but very careful anatomical studies, in which Messrs. Granger, Matthew and Gidley materially assisted the writer. Messrs. Granger and Matthew especially made a complete restoration of the muscles of the shoulder girdle and fore limb prior to the placing of these elements, which was an extremely difficult matter. The manus represents the single-clawed condition, resulting from comparison with the feet of many Sauropoda. The chief measurements of the skeleton are:

	Ft.	In.
Length over all, from head to tip of tail	66	8
Length of vertebral column	64	4
Length of neck	16	10
Length of tail	31	4
Length of longest rib	6	9
Length of hind limb including foot.	10	7
Length of fore limb including foot.	8	6
Depth of body from lower end of pubis to top of posterior dorsal spine	8	7
Length of head as restored	2	4

It is interesting to compare these measurements with those of a fully grown 'sulphur bottom' whale, carefully measured by Mr. F. A. Lucas, and reproduced at the St. Louis Exposition. This animal, a male, measured 74 feet, 8 inches, from the notch of the flukes to the tip of the nose. The approximate weight of the bones was 17,920 pounds. The entire animal was estimated at not far from 63 tons. We observe that while the body of the whale

is longer than that of *Brontosaurus,* the absence of limbs in the whale would reduce the water displacement and weight.

Several new features are brought out in relation to the proportions of *Brontosaurus.* While a number of terminal vertebræ are undoubtedly missing, the tail is less elongate and massive than was supposed by the writer at one time. There is no evidence that it served for the support of the body, nor was the fin development for propulsion in water so great as in *Diplodocus.* A second point of interest is that the sacrum, while the center for motion, was not certainly the highest point in the body, as at one time supposed by the writer. The center of the vertebræ arch upward in front of the sacrum, and while the neural spines rapidly subside, the highest point appears to have been about the middle of the back; unless, indeed, the fore limbs were very much more flexed than appear in the present mount.

There is still room for wide differences of opinion as regards the habits and means of locomotion of these gigantic animals. Some hold the opinion that the limbs were far more flexed at the knee and elbow than they are in the present mount. that on land at least the animal had rather the attitude of the alligator, and that only while submerged beneath the water were the limbs straightened for the purposes of walking along the bottom, the claws serving to keep the feet from slipping in the mud.

H. F. O.

THE DRUMMING OF THE DRUM-FISHES (SCIÆNIDÆ).

It is rather remarkable that so common a function as the drumming of fishes should have remained so long misunderstood; that so much speculation should have been indulged in regarding a phenomenon so easily investigated in most parts of the world; and that a conspicuous specialized drumming muscle should have been either overlooked or ignored by ichthyologists.

For several years, as opportunity was afforded, I have been studying the peculiar drumming sounds made by those fishes in which this function is so strikingly developed that it has determined the family name, the inquiries being in continuation of some observations and experiments on the squeteague (*Cynoscion regalis*) carried on by Professor R. W. Tower, at Woods Hole, in 1901 and 1902, and noted by me in the Report of the U. S. Fish Commissioner for 1902 (page 137).

The diverse notions prevailing among modern writers on fishes may be seen from the following quotations from a few standard works.

Günther, in 'An Introduction to the Study of Fishes' (1880), makes only a single reference to drumming, and that a highly edifying one in connection with *Pogonias cromis:*

> These drumming sounds are frequently noticed by persons in vessels lying at anchor on the coasts of the United States. It is still a matter of uncertainty by what means the drum produces the sounds. Some naturalists believe that it is caused by the clapping together of the pharyngeal teeth, which are very large molar teeth. However, if it be true that the sounds are accompanied by a tremulous motion of the vessel, it seems more probable that they are produced by the fishes beating their tails against the bottom of the vessel in order to get rid of the parasites with which that part of their body is infested.

Jordan and Evermann, in their admirable 'American Food and Game Fishes' (1902), reassert what was stated in their 'Fishes of North and Middle America' (1898), namely, that the peculiar noise is 'supposed to be produced by forcing air from the air-bladder into one of the lateral horns.'

Boulenger, in the section on fishes in volume VII. of the Cambridge Natural History[1] (1904), discusses 'sound-producing organs' at some length, but appears to be unaware of the special mechanism existing in the drum-fishes. He cites several ways in which sounds are produced through the agency of muscles connected with the air-bladder, and copies from Sörensen[2] a diagram of the air-bladder and 'musculo-tendinous extensions from muscles of the body-wall' of a croaker (*Micropogon*

[1] Reviewed by Dr. Theodore Gill in Science, April 28, 1905.

[2] *Journal of Anatomy and Physiology,* Vol. XXIX., 1895.