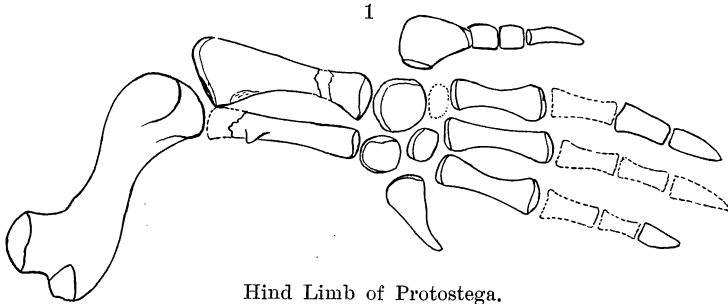


ART. XXII.—*On the Hind Limb of Protostega*; by S. W. WILLISTON.

ALTHOUGH the structure of those huge Cretaceous turtles, *Protostega* and *Archelon*, has been, for the most part, determined in recent years through the researches of Baur, Hay, Case and Wieland, little has hitherto been discovered concerning the limbs, aside from the humerus and femur. In examining the material of *Protostega* in the University of Kansas museum recently, I found a nearly complete hind limb collected by Mr. Charles Sternberg in the Kansas chalk two years ago. This is of so much interest that I give herewith a brief description and outline figure of it. The species is, I

Hind Limb of *Protostega*.

suppose, *P. gigas*, though I do not feel certain. Among the various specimens of this genus I have examined there is a great difference in size, a character of doubtful value for specific separation, as well as distinct differences in the shape of the limb bones. The present specimen, for instance, is among the largest discovered in the Kansas chalk, and has the femur much more slender than in the specimen figured by Case (*Journal of Morphology*, June, 1897, pl. vi, f. 18).

The specimen had been, for the most part, washed from its matrix, and the original relation of the different bones lost, but since only the posterior part of the skeleton is present they all clearly belong to the hind limb. The bones of the fore limb, moreover, are all much larger than those of the hind. Some of the phalanges were lost and probably one of the tarsals. In the figure I have arranged the bones as they would seem to belong, though very likely some of the metatarsals and phalanges had different positions in the living skeleton.

For a review of the discussion as to the systematic position of *Protostega*, the reader is referred to the paper by Professor

Case cited above. The relationships to *Chelone* and *Thalassochelys* pointed out by Baur, Hay and Case receive additional confirmation from the structure of the limb, as will be seen in the accompanying figure. The leg, while broader and more powerful, is not essentially different in structure from that of *Thalassochelys*, and it would seem that there could hardly be longer a question as to the relationship of these forms,—*Protostega* and *Archelon*, at least,—to the Cheloniidae.

The characters separating *Archelon* Wieland from *Protostega* Cope, while not very important, would seem sufficient. Nevertheless, one can derive little justification from the different geological horizons in which the forms are found. The relations between the Niobrara and Fort Pierre vertebrates are for the most part very close. I have recognized in both horizons *Tylosaurus*, *Platecarpus* and *Mosasaurus* (*Clidastes*), as well as *Pteranodon* and *Hesperornis*, all very typical of the Niobrara deposits, and the existence of *Claosaurus* has been recently affirmed in the Fort Pierre. On lithological grounds, there is nothing separating the two groups of deposits, and I protest against the names Colorado and Montana, as perpetuating a wrong impression. On paleontological and lithological grounds there would be much better reasons for uniting the Niobrara with the Fort Pierre than with the Fort Benton.

Description.—The head of the femur is large, and, in life, evidently nearly hemispherical. The neck is very stout, placed at nearly right angles to the axis of the shaft and is but slightly constricted. The trochanter is large, and stout, with a large, triangular, roughened area on the posterior side for muscular attachment. The smaller trochanter is indicated by a small tuberosity. The shaft is much constricted and curved, with its convexity dorsal; it is nearly cylindrical at its middle part. The condyles are large and stout, the inner more massive than the outer one; their articular surface looks nearly backward. The tibia is much expanded superiorly, and has its articular surface at an angle of about 45° with the axis of the shaft. On its posterior surface, and margin, a little below the angle there is a strong muscular rugosity. The shaft is much narrowed below, and is again moderately expanded for the distal articulation.

The fibula is elongated and narrow, of nearly uniform width, except at the upper extremity. This portion of the bone is wanting in the specimen but that portion preserved indicates a moderate expansion superiorly. On the posterior surface, opposite the roughening of the tibia, there is a strong rugosity, produced into an angular tubercle, for muscular attachment.

Three tarsal bones are preserved, and there was probably

one more not recovered. They are all rounded and flattened. The largest, apparently the tibiale, shows a thickened cartilaginous border on three sides, elsewhere thinned. The next larger tarsal, probably the fibulare, is somewhat thicker, and has the thickened cartilaginous surface encompassing nearly the border. The third bone, the smallest, and probably belonging in the distal row, is a more thickened nodular bone, oval in shape with one side much thickened for cartilage.

The metatarsal of the first toe is a thin, broad, hatchet-shaped bone, with a proximal thickened articular border for union with the tarsus, a smaller distal surface for phalangeal articulation, a thickened, concave inner border and a strongly convex, thin, outer border.

The three metatarsals belonging to the second, third and fourth toes are moderately slender, with the extremities moderately expanded. Their relative positions I cannot give positively, but I have arranged them in the figure as they would seem to belong. They differ only a little in length; two of them have one border nearly straight, the other concave, while the shortest and stoutest has both borders markedly concave. The fifth metatarsal bears no phalanges. It is a slender, triangular bone flattened proximally, where it articulates with the tarsus; curved, cylindrical and pointed distally. It evidently was much divaricated in life.

The phalanges of the first toe were three in number, the first two short, thickened, with a concave proximal and convex distal extremity. The unguis phalanx I believe to be the slender pointed one of the three preserved. The other unguis phalanges preserved, two in number, were less slender, one much smaller than the other. One other phalanx is known, a rather short and but little constricted bone, apparently belonging in the second row.

Measurements.

Length of femur.....	360 ^{mm}
diameter of head.....	95
diameter of shaft.....	60
Length of tibia (somewhat approximate).....	270
Greatest diameters of tarsals.....	90, 65, 55
Length first metatarsal.....	110
Length fifth metatarsal.....	130
Lengths second, third and fourth metatarsals..	140, 155, 170

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