

ART. XXVII.—*An American Jurassic Frog*; by ROY L. MOODIE.

THE remains of Amphibia between the close of the Triassic and the opening of the Tertiary are among the rarest if not the rarest of fossil vertebrates. One can almost count on the fingers of one hand the species of Amphibia known in the post-Triassic, pre-Tertiary times. These are: *Hylæobatrachus croyii* Dollo of the Belgian Wealden; *Scapherpeton excisum* Cope, *S. favosum* Cope, *S. laticolle* Cope, *S. tectum* Cope; *Hemitrypus jordanianus* Cope, all from the upper Cretaceous (Laramie) of Montana, and Canada. So far as I know, other amphibian remains have not been described elsewhere from the formations mentioned.

Professor Marsh, in 1887, referred to some amphibian bones from the Como Beds\* of Wyoming, calling attention to the previous mention of the species. † Again, in discussing the fauna of the Denver Basin, ‡ he mentioned the amphibian where he says: "A batrachian (*Eobatrachus agilis*) and a peculiar fish (*Ceratodus güntheri*) have likewise been found in this horizon." The material has not been fully described, since all Professor Marsh's mention of them in 1887 is as follows: "More recently, various bones of small anourous amphibians (*Eobatrachus agilis*) have been found, the first detected in any Mesozoic formation."

Thus it is that, up to the present, the *Eobatrachus agilis* of Marsh has been a *nomen nudum*, and the discovery has been discredited. Recently through the kindness of Professors Schuchert and Lull of Yale University I have been permitted to examine the remains referred to by Professor Marsh, and find on examination that they are undoubted remains of Salientia, and of the modern type. There is no distinction, so far as I am able to observe by the most careful comparisons, between this *Jurassic frog* and the frogs and toads which are around us to-day. This is the more remarkable on account of the great age of the species. The Salientia have been suggested in the Pennsylvanian by *Pelion lyelli* Wyman, from the Coal Measures of Ohio, and attention has been directed to the salientian characters of the species by various writers. No intermediate forms are known and both the Jurassic and the Carboniferous forms are far too indefinite for any conclusions to be based on them as to phylogenetic descent. The transition took place in the Permian or late Pennsylvanian since this species *Eobatrachus agilis* Marsh has every identical character of the modern Salientia. The origin of the Salientia, like that of nearly all of

\* This Journal (3), xxxiii, p. 328, 1887.

† Proc. Brit. Assn. Science, Aberdeen Meeting, 1885, p. 1033.

‡ Monograph U. S. G. S., xxvii, p. 508, 1897.

our great vertebrate groups, is still involved in mystery. The mystery is so great that it leads some to doubt the validity of the theory of evolution by gradual development. No distinct ancestral forms are known for any of the Amphibia save the Caudata. Smith Woodward has made the same statement in regard to the fishes and has emphasized the importance of the Mutation theory of DeVries as the paleontological record has thus far been read. The record is however still imperfect.

The present specimens seem to indicate a bufonid nature for the species. In fact I think we will be safe in locating the species in the family Bufonidæ and possibly even in the genus *Bufo*. It is entirely too soon for the species to be certainly placed in *Bufo*, since such a determination will have to await future discoveries of more complete material, especially of the pectoral girdle and the skull.

The reasons for placing the species in the Bufonidæ are simply on account of the well-developed condition of the lower end of the humerus and its apparently calcified condition. This is hardly more than an inference but it is an inference which has long been justified in Paleontology. Certainly the ulno-radial articular end of the humerus of *Eobatrachus agilis* is not the same as that of the modern *Rana pipiens*, or *Rana catesbiana* and it does resemble the epiphysial structures of calcified cartilage described by Parsons for some of the toads.

The specimens represent two individuals and by the following parts: One specimen, a lower end of a left humerus, somewhat smaller than the type; the other or *type* humerus; the lower end of a tibio-fibula; the entire left (?) femur; the entire right ilium, all, apparently, of a single individual excepting the humerus first referred to, which indicates a second frog though possibly of the same species. All of the specimens are from Quarry 9 of the Como Bluff in Wyoming.

The *humerus* (No. 1862 Yale University Museum) of the *type* as above stated is represented by the lower end only, this portion measuring 6<sup>mm</sup> in length, by 2<sup>mm</sup> in distal width, by slightly more than one half a millimeter in shaft diameter. The well-developed characters of the bone indicate a bufonid nature for the species as indicated above. The head, that is, the ulno-radial articular surface, is as distinctly marked as in all modern Salientia with which I am acquainted. The ball is apparently capped with calcified cartilage. Above the ball is a distinct pit for muscular attachments, precisely as in modern frogs. The shaft is quite slender and nearly circular.

The *ilium* (No. 1568 Yale University Museum) is quite peculiar and will possibly be sufficiently characteristic to sustain the validity of Professor Marsh's genus, *Eobatrachus*. The element is of the right side. It measures 10<sup>mm</sup> in greatest length, by 3<sup>mm</sup> in greatest width, by 2<sup>mm</sup> in greatest thickness on the articular surface. The element is a slender rod, like the

modern salientian ilium, with the anterior end greatly narrowed and pointed; the pointed portion occupying one and one half millimeters. The shaft of the ilium is flattened laterally. It expands in width from a little less than one-half a millimeter to slightly more than three millimeters. The articular surface is marked by four pits which are the broken surfaces indicating the firm union of the elements of the pelvic girdle. The element is greatly thickened posteriorly, with a slightly developed, posterior, dorsal crest.

The *femur* (No. 1862 Yale University Museum) is quite distinctly amphibian of the salientian type. It is a slender rod of bone from which the epiphyses have been lost, leaving in their place pits occupying the ends of the bone; indicating the slight development of the endochondrium, as in all Amphibia. The lower end of the femur is divided into two surfaces by an imperfect partition, much as in modern frogs. The upper end is peculiar in having a well-developed crest which, in life, was undoubtedly capped by a large amount of cartilage. In the fossil state it has been preserved as a spine. The femur measures 12<sup>mm</sup> in length, by 3<sup>mm</sup> in distal width, by 1<sup>mm</sup> in diameter of shaft, by 2.5<sup>mm</sup> in proximal width.

The *tibio-fibula* (No. 1394 Yale University Museum) is represented by a portion of the lower end including 8<sup>mm</sup> of the element. Its characters are so clearly those of the modern Salientia that a description is hardly necessary. The lower end is divided by grooves, one on either side, indicating the previous separation of the tibial and fibular elements, thus plainly showing that the frogs have had a long pre-Jurassic history.

The *humerus* of the other individual (No. 1863 The Yale University Museum) is similar to the one described for the *type*, though somewhat smaller. Like the *type* there is only the lower half preserved, measuring but slightly more than 4<sup>mm</sup>.

The *Jurassic Frog* thus indicated by these imperfect remains was an animal about the size of *Bufo debilis* Girard of southwestern Kansas, and Texas; though possibly shorter in its bodily proportions as indicated by the short ilium.

The above description will indicate, without a doubt, that the *Eobatrachus agilis* of Marsh is the *oldest known frog*. It is hardly necessary to figure these imperfect remains since the above description has been written with the skeletons of several species of Salientia at hand and the comparisons are so exact, the characters so identical and the frog skeleton has been figured so many times that it hardly seems necessary. The specimens are in Yale Museum, where they may be seen at any time by anyone interested in a more direct generic and specific comparison. This has not been attempted in this short account chiefly on account of the lack of skeletal material of *Eobatrachus agilis* and on account of the lack of sufficient recent skeletal material.