A MIOCENE FLAMINGO FROM CALIFORNIA

By LOYE MILLER

The novitiate amateur in ornithology today takes great delight in listing his "firsts" among field acquaintances. And perhaps he is in a measure justified because it is the "first" that fixes the peg upon which he can hang all the subsequent and, we hope, oft-repeated contacts that eventually grow into real understanding.

The "first" has to come first in avian paleontology likewise and, sad to relate, that first may be restricted to a single bone or a mere fragment thereof. A single specimen from a single locality may seem to the bird watcher to be of little import in the over-all picture of ornithology. It does not sing. It has no charm of color or delicacy of shading in its plumage. There is no hint of sprightliness, no mastery of invisible air current, no influence on the farmer's crop or his insect competitor for that crop. It is nevertheless a thing of significance.

The science of avian paleontology has today reached a point where, despite the fascination of firsts, we are almost as eagerly looking for seconds, thirds, and fourths. What is more, we are finding them. Parts of the structure are beginning to take on a revealing shape. The subject of this report is a "second" for one genus and it is a "multiple" in the history of a highly specialized family—the birds we know today as the flamingos.

Alden H. Miller (1944) reported a new genus of primitive flamingo from the Lower Miocene of South Dakota, *Megapaloelodus connectens*. His diagnosis is unchallenged and his deductions are logical. The name chosen indicates great size as compared with *Paloelodus goliath* from the Oligocene of France (Milne-Edwards, 1867-1871:58). The specific name *connectens* indicates the describer's feeling that the species tends to bridge the gap between *Paloelodus* and *Phoenicopterus,* our only surviving genus of the family of the flamingos.

Only a small fragment of the tarsometatarsus and a badly crushed femur were taken from the South Dakota quarry (Flint Hill, Bennett County) which lies in the upper part of the so-called Rosebud Formation, correlated as late Arikaree. Now there comes in from Barstow, California, a tibial fragment of Upper Miocene age, separated in both time and space by a very sizable hiatus from the South Dakota specimens. But despite the fact that a different element of the skeleton is represented, the California specimen is here assigned to the species that was established for the South Dakota bird. Both authors who have studied remains of *Megapaloelodus* lean rather heavily upon a paraphrase of an old axiom: "Things that differ in the same way from the same thing do not differ from each other." The first author placed a tarsus and a femur in his newly established genus and species because of their comparable divergence from the Oligocene *Paloelodus* of France. The present author by similar reasoning and a similar comparison with the abundant French material assigns the California tibia to the species established for the South Dakota tarsus and femur.

The assignment is necessarily tentative in view of the wide separation of the two sources of material, but this course of action seems better than to establish entirely new taxonomic categories. It is true that certain characters of the California specimen seem to indicate higher specialization than either *Paloelodus* or *Phoenicopterus* and more complete representation may some day come to light with the result that revision may be demanded.

The California representation of *Megapaloelodus connectens* consists of the distal end of the tibiotarsus, no. 2303, and the distal end of the ulna, no. 2303A., Miller Collection, University of California, Los Angeles. It is derived from the Barstow Syncline, Upper Miocene. The specimens are the generous gift of Richard H. Tedford and Robert L. Shultz.

Tibiotarsus. After careful comparison with recent specimens of *Otis, Anhima, Cariama, Grus, Phoenicopterus* and a variety of other and more remote forms, the fossil was assigned to the family Phoenicopteridae although there were certain marked departures from the typical genus *Phoenicopterus*. Confirmation of that assignment came after a conference with Dr. Alden H. Miller and a study of Milne-Edwards' beautiful lithographs of the Oligocene *Paloelodus* of France (*op. cit.*).

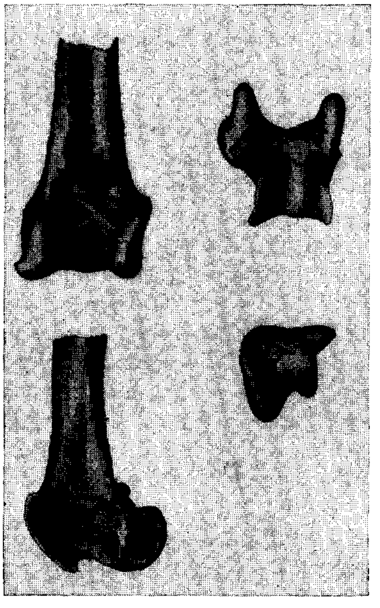

Fig. 16. *Megapaloelodus connectens* from Barstow, California. Natural size. Drawings by the author.
Upper left, left tibiotarsus, no. 2303, front view.
Upper right, tibiotarsus, end view.
Lower left, tibiotarsus, side view.
Lower right, right ulna, no. 2303A, end view.

Comparison is here made with the recent *Phoenicopterus ruber*. Front or ventral aspect (see fig. 16): The two bones are almost equal in size. The condyles appear much the same in both but the transverse profile of the notch between the condyles is different. In the fossil this transverse line is almost at right angles to the sagittal plane of the shaft, there being only a slight rise near the external condyle. In the Recent bird the inclination is in the opposite direction and the whole intercondylar profile is much more deeply notched, which means that the condyles of the living flamingo must fit into deeper cotylar basins in the tarsal head than in the fossil species.

The supratendinal bridge in the fossil overlies a larger tunnel with more rounded distal opening and a less oblique proximal border; the intercondylar tubercle is simpler, smaller, and is placed far over toward the external profile of the bone. The inner end of the supratendinal bridge is so depressed that it is separated from the inner border of the shaft by a distinct furrow. The intercondylar fossa is deeper and extends laterally until the inner condyle becomes excavated at the back side to a degree I have seen in no other bird. The significance of this character is difficult to postulate.

Unfortunately the shaft of the bone is broken off at a point about 15 mm. above the supratendinal bridge. Up to that point, however, it is more deeply and more abruptly furrowed; the internal ridge is sharp but the external ridge is gently rounded. Running up the shaft from the internal end of the bridge, is a very pronounced scar for the attachment of the internal end of the ligamentous bridge which overlies the osseous bridge. The outer end of this ligamentous bridge seems to have been anchored to the conical intercondylar tubercle since no other attachment is evident. In *Phoenicopterus, Grus,* and *Cariama* there is a definite, raised ridge for attachment of the external end of this ligament. The California fossil resembles the French *Paloelodus* in this respect.

Internal view: When viewed from this aspect, the fossil displays one of its most striking characters. The distal profile of the internal condyle in so many birds displays a fairly smooth curve from front to rear of the bone. Among the "straight-legged" forms which spend much of their time with the tibia and tarsus in almost perfect alignment, there is a tendency toward a flattening of this curve. In *Grus* there appears a barely perceptible indentation about midway of the curve; in *Cariama* the indentation is more marked but in the fossil specimen this character reaches an extreme such as is to be seen in no other group of birds. A deep, rounded notch in the profile is limited at its posterior border by a hook-like process fully two millimeters in length! This notch communicated with a well defined fossa on the terminal articular face of the bone, which is approached from the external side by a corresponding and only slightly less profound fossa.

A comparable notch is indicated on the external trochlear profile but unfortunately a slight local fracture has obliterated most of the corresponding process which seems to have existed there during the life of the individual. What may be the function of these notches is not quite certain; it may be to harbor powerful articular ligaments that would tend to strengthen the intratarsal joint when in the position of complete extension. As one of my colleagues suggested, "Perhaps it enabled the bird to lock the joint and sleep more securely in the standing position." There may be something to the idea. The two above-mentioned depressions are found in *Paloelodus* and *Phoenicopterus* but are not evident in *Cariama* or *Grus.*

Distal view: When viewed from this aspect, the fossil displays two characters which are not found in the Recent flamingo but which do appear in *Paloelodus* of France. The posterior intercondylar sulcus is divided into two parallel furrows by a low, rounded median ridge; *Grus* has this character to a slight degree and *Cariama* has but a suggestion of it. It is wanting in *Phoenicopterus.*

The second distinctive character results from a pronounced widening of the internal condyle at a point directly below the ligamental prominence. The effect of this lateral widening is greatly to increase the surface of contact between tibia and tarsus while the bird is standing erect. It gives the internal condyle a peculiar, inflated appearance when the tibia is viewed from the distal end. *Grus* has this expansion developed on the opposite condyle but it is less abruptly produced. *Phoenicopterus* does not show it on either condyle.

In size, the South Dakota tarsus and the California tibia are very nearly the same as the corresponding bones of a large male specimen of *Phoenicopterus antiquorum,* no. 1892, in the Miller Collection of Osteology at the University of California, Los Angeles.

	Flamingo no. 1892	South Dakota fossil
Tarsometatarsus (trochleae only)		
Maximum transverse diameter	21.0 mm.	21.3 mm.
Maximum sagittal diameter	19.7	22.5

	Flamingo no. 1892	California fossil
Tibiotarsus (distal end only)		
Maximum transverse diameter	17.4	17.0
Maximum sagittal diameter	19.7	18.8

Associated material.—The distal end of an ulna was taken from the same locality as the tibiotarsus here discussed and less than a yard removed therefrom. The specimen is not as well preserved as the tibia and displays less definite characters. It does seem to be phoenicopterid in its affinities, however, and the size would suggest that it might have come from the same individual. Further excavation at the site failed to uncover any other parts of the skeleton.

The specimen (figure 16) differs from the Recent flamingos and cranes in its very large carpal tuberosity which is flattened on its radial side, is set off on its distal side by a deeper, more rounded notch, and is located in a more proximal position. No traces of papillae for the secondaries are evident along the shaft. Their absence may, however, be the result of post-mortem deterioration.

The Barstow locality has been the scene of paleontologic "hunting" for a period in excess of forty years. Both professionals and amateurs have represented a variety of interests from the serious studies by large universities and museums to the casual wanderings of tourists and of enlisted men from a nearby military base. It remained for a pair of enthusiastic young amateurs, Richard Tedford and Robert Shultz, to discover and partly explore the first lacustrine bird-bearing locality, sandwiched as a broad, thin lens between thick layers of the general tuffaceous accumulation that makes up the main mass of the Barstow Syncline.

I quote from Tedford's notes as follows:

Locality V492. Middle of SE¼, NW¼, Sec. 15, T 11 N. R2W. San Bernardino base line and meridian, Searles Lake Quadrangle.

The lacustrine lens here described is exposed in the south limb of the Barstow Syncline near the west end of the exposure and is composed of finely weathering buff to grayish-brown clays interbedded with calcareous layers of one to three inches thickness, the calcareous layers being confined to the lower two thirds of the section. Freshwater gastropods and land mammals were found only in the upper one-third of the section consisting of pure clay and varying from one half to one foot in thickness . . . . The lacustrine beds are traceable for about 900 ft. along their exposed edge which extends in an approximately east and west direction . . . . and are about four feet in thickness. Associated mammals include *Merychippus, Hypohippus, Procamelus, Merycodus,* mastodont, *Tomarctus.*

In a paper describing *Phoenicopterus stocki* from the Pliocene of Chihuahua (L. Miller, 1944) the following suggestion was made. "The African bird is especially abundant about the bitter waters of the African plateau country. *P. ruber* is partial to those 'half islands' in the Carribean area, where water and mud are scarcely differentiated, and to the saline crater lakes of the Galápagos Islands. The Chilean bird finds in the semi-desert of Argentina, Chile, and Patagonia, the same salt-pan environment . . . . Is it not justifiable therefore to postulate a comparable environment in Pliocene time at the Rincón locality of Chihuahua?"

Chapman (1908:153) states that a large factor in the diet of the flamingo on the Bahama swash is a small mollusk *Cerithium,* the shells of which are completely reduced by the bird's digestive processes. It has even been intimated by him that the shells constitute a vital factor in the normal metabolism of the flamingos. Associated with *Megapaloelodus* in the lacustrine matrix at Barstow there occur the abundant shells of small snail-like mollusks of two or three species not yet precisely determined. Merriam (1919: 450) mentions *Planorbis, Limnaea,* and *Anodonta* in his tabulation of the fauna but does not designate the exact locality from which they were obtained. His only comment is that "the section in the Barstow syncline consists in large part of volcanic materials with beds of clay and shale at some horizons. The deposits are evidently partly of terrestrial and partly of lacustrine origin. At rare horizons, remains of fresh water mollusca including *Planorbis* and *Anodonta*(?) are abundant. In other beds scattered and weathered bones, representing a large tortoise and numerous mammals belonging to the open plains type probably indicate accumulation on dry land." It would seem that we are here dealing with one of these lacustrine lenses in the greater subaerial accumulation. It was apparently a small, shallow and ephemeral body of water in which sedimentation took place, for the lens is thin and it diminishes gradually to its margins. It is overlaid by the same type of rock as that upon which it rests. Whether or not its waters were entirely fresh is not known, but careful search revealed no deposits of gypsum, borax or soluble salts. The presence of calcareous layers interbedded with the clays would, however, suggest cycles of time greater than annual cycles during which the lake waters were highly concentrated. More soluble matter may have been leached away during subsequent geologic periods. It is possible therefore that the Miocene lake may have contained salts not preserved to us in Recent time. On the other hand, Merriam postulates a more abundant rainfall than is normal in Barstow today. In the Lower Pliocene beds (Ricardo) to the westward there occur the petrified stems of palms and of broad-leaved trees (*Robinia*). Furthermore, imprints of palm leaves were found at Barstow by Tedford and Shultz. Quite certainly the present mountain barrier which cuts off the moisture laden winds from the south coastal area was either much lower or even non-existent. Still the area was pretty well removed from the sea and there is no assurance that there did not occur at times the bitter lake environment that seems to attract the modern flamingos.

Megapaloelodus, although presumably less specialized in beak structure than *Phoenicopterus,* would thus fit well into the picture that the imagination reconstructs of the Miocene landscape at Barstow.

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