# A NEW CORMORANT FROM THE MIOCENE OF CALIFORNIA

WITH TWO ILLUSTRATIONS

By LOYE MILLER

In June of the year 1928, Mr. Dan J. Poyer of Calabasas, California, placed in my hands two slabs of a fine grained shale, from his rock quarry, which contained the major portion of an avian skeleton very beautifully preserved. One slab was the property of Dr. Frederick Kellogg of Los Angeles, the other was presented by Mr. Poyer to the University of California at Los Angeles. The two specimens (figs. 58 and 59) represent the obverse and reverse of the same individual split along a bedding plane of the shale, and they are mutually supplementary.

Mr. Poyer's quarry is located near Calabasas, nw. ¼ of sec. 18, T. 1 N., R. 17 W., in what is designated as the Modelo formation by Kew, and considered to be of late Miocene or early Pliocene age. Accompanying the bird remains in the quarry are numerous fish remains of various sizes and some very beautiful specimens of marine algae. The matrix is of light grayish tone and the fossil is rich brownish or even black where the tarsal envelope, the foot webs, and the feathers have left their imprints recorded.

The bird is a totipalmate closely approximating the modern cormorants. In size it falls between the smaller *Phalacrocorax pelagicus* and the larger *Phalacrocorax penicillatus,* approaching closely an adult female specimen of the latter species. In a study of the osteological characters, however, there appear a number of points of divergence from the available specimens of recent species. For reception of the Miocene bird a new specific category is proposed as follows.

## **Phalacrocorax femoralis,** new species

Size slightly less than smallest *Phalacrocorax penicillatus,* from which it differs also in having longer and straighter femur, much shorter tibia, shorter and heavier tarsus, broader pelvis and smaller sternum.

*Sternum.*—One of the outstanding features of the species is the small size of the sternum in comparison with the pelvis. The latter element is fully as broad throughout the entire length so far as preserved, as in a medium sized *Phalacrocorax penicillatus,* yet the sternum is less than three-fourths (74%) as broad or as long. This difference is not such as to indicate a loss of the power of flight, and the coracoid, the humerus, and the wing primaries are well developed. Taken with the long femur and stocky tarsus, however, the suggestion is that flight was resorted to even less than with our modern cormorants. Possibly fishing excursions extended habitually less far from shore.

*Pelvis.*—The pelvis itself appears remarkably broad as compared with the modern cormorants. This feature obtains in the post-acetabular region as well as in the peculiar butterfly expansion of the iliac crests. Fortunately this latter characteristic region is perfectly preserved underneath the superimposed sternum. By sacrificing the right half of the sternum the ilium could be worked out with a dental tool under the microscope, leaving the left half of the sternum and its extreme right border intact. Both sternal and pelvic regions are decidedly cormorant-like. The entire ischial and pubic portions of the pelvis have been lost and the posterior extremity of the ilium can only be approximated, yet this approximation is felt to be fairly accurate.

With this small factor of uncertainty, the total length of the pelvis compared with that of the Brandt Cormorant is 83 per cent, while the width of the anterior expansion of the iliac region is 100 per cent and the width across the ischiatic foramen is 142 per cent. This latter ratio is not thought to be the result of post mortem crushing since there appears no distortion in the transverse section in this or in other parts of the skeleton. The pelvis of *Anhinga* displays this character of broadness, but otherwise the resemblance is more remote. The posterior half of the fossil pelvis is less gracefully formed, being more nearly rectilinear than that of either the cormorant or *Anhinga.*

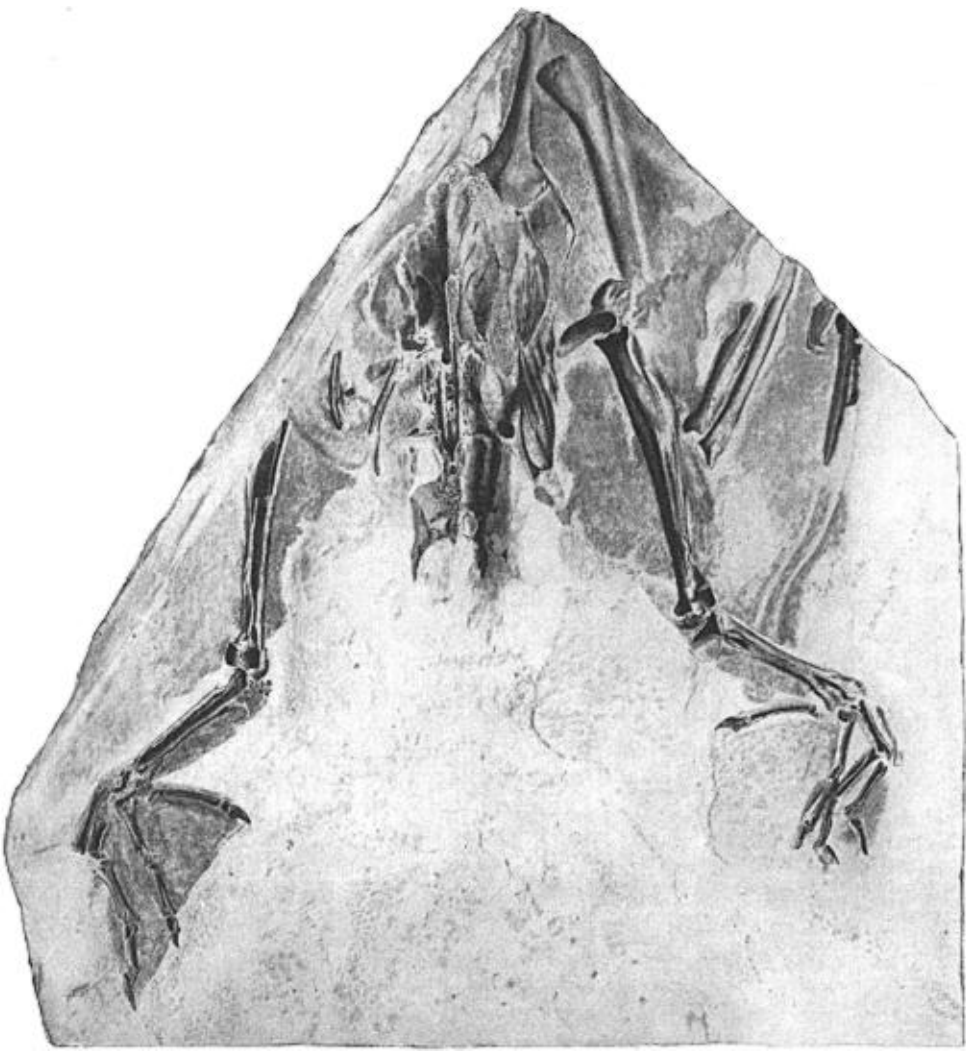

Fig. 58. SLAB CONTAINING PART OF SKELETON OF *Phalacrocorax femoralis*, NEW SPECIES.

*Foot.*—The foot is decidedly cormorant-like so far as preserved. The long hind toe included within the web, the deep tarsal sheath, and the very prominent hypotarsus extending down the tarsal shaft in broadly curved profile are characteristic. Unfortunately the outer toe is not preserved in either foot, but toes I, II, and III stand in the following length ratios: 100, 118, 206.

In the Brandt Cormorant, the corresponging parts stand in the ratios of 100, 145, 217; in the Farallon Cormorant, 100, 147, 189. There seems to be a marked brevity of the second toe in the Miocene bird.

In the process of quarrying the stone, both tarsus and tibia were split longi-

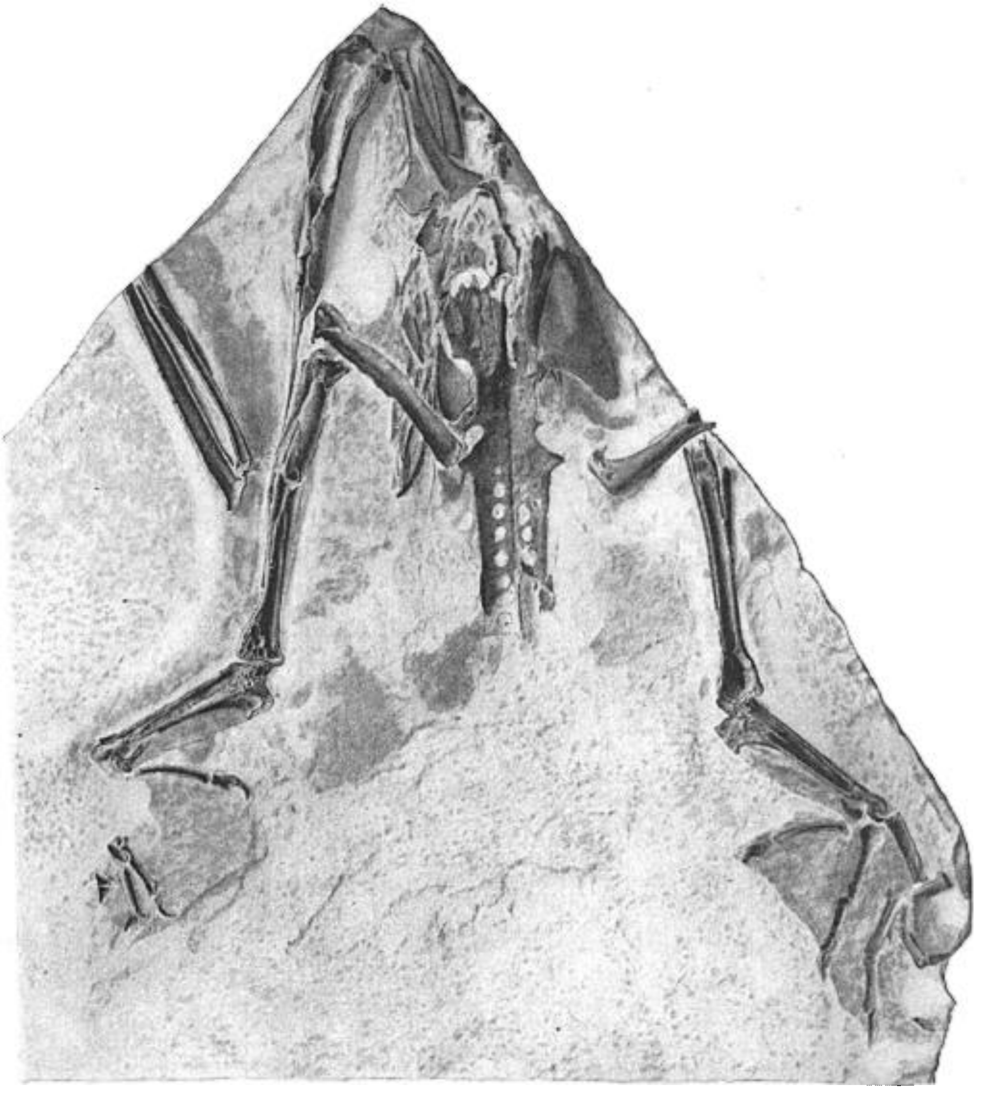

Fig. 59. SLAB CONTAINING REVERSE OF SKELETON, THE OBVERSE OF WHICH IS SHOWN IN FIGURE 58.

tudinally; thus all except the grosser characters were destroyed. The left femur is preserved for over half its length and the right is again seen in longitudinal section. Both show a lack of curvature that is sharply in contrast with the Recent cormorants. The intermuscular lines on the posterior surface of the proximal portion are practically identical in the two species.

An excellent imprint of the patella is available in the Kellogg slab. The part differs markedly from the true cormorants in being much broader but not so high, the effect being much like that of the broad cnemial crest of a shearwater and quite in contrast with the high pyramidal patella of a cormorant.

*Humerus.*—The right humerus is sufficiently well preserved to show the family characters of the proximal region including the low deltoid crest, the sharp angle at the insertion of the pectoralis minor, the depression at the proximal extremity of the bicipital furrow, and the general rectilinear effect of the deltoid profile of the entire bone. The distal end is almost entirely obscured by being tucked under the knee. The total length, however, is determinable, and it almost coincides in this dimension with *Phalacrocorax penicillatus*. In view of the stronger pelvis and weaker sternum, this well developed humerus is of interest.

The remaining segments of the wing are not preserved to sufficient extent to be distinctive in any way.

*Coracoid.*—There is a close approximation in size of the coracoid with that of *Phalacrocorax penicillatus,* but positive differences appear in the contours both of the base and of the head of the bone. The central profile as the bone is viewed from the ventral aspect, is less concave basally and more concave toward the head, the latter point being due to more pronounced clavicular facet, the former to a shorter base of contact with the sternum. Again, this sternal facet is placed at a more acute angle with the shaft of the coracoid, and lies more nearly under the main axis of the bone.

The total effect of these profiles is a coracoid that is more symmetrical with respect to the main axis of the bone.

TABLE OF MEASUREMENTS

| | Calabasas Cormorant | Farallon Cormorant |
|---|---|---|
| Tarsus—Length | 56.5 mm. | 64.5 mm. |
| Depth hypotarsus | 16.5 | 17. |
| Depth shaft | 6.7 | 5.6 |
| Tibia—Length | 93. | 162. |
| Across condyles | 14. | 12.5 |
| Shaft width | 6.3 | 7. |
| Femur—Length | 56.5 | 57.2 |
| Head | 15.5 | 15. |
| Shaft | 7.9 | 7.6 |
| Humerus—Length | 136.2 | 145.2 |
| Shaft | 8.2 | 7.7 |
| Head | 22. | 22. |
| Sternum—Length median line | 59.3 | 72.6 |
| Length lateral line | 56.5 | 68. |
| Width posterior end | 56. | 52.3 |
| Coracoid—Width base | 27.5 | 26.5 |
| Sternal facet | | 20. |
| Pelvis—Width across acetabula | 31. | 33.6 |
| Width across ischia | 22. | 44.5 |
| Hind toe—Total length | 32.7 | 38. |
| First joint | 21.3 | |
| Inner toe—Total length | 48.8 | 51. |
| Middle toe—Total length | 69. | 66. |

*Discussion.*—The entire assemblage of fossils, both plant and animal, would indicate accumulation in quiet water, free from any appreciable disturbance by wave or tidal current. The many marine algae seem to be "floated out" as carefully as the collector of "sea mosses" floats them out upon his mounts. Tidal currents or strong wind ripples tend to roll such drift into knots or windrows. The nearly normal association of parts in all fish and bird skeletons uncovered indicates a similar lack of any marked disturbance.

*Matrix.*—The matrix is extremely fine grained and homogeneous, splitting into thin lamellae. Under the microscope, there appear the tests of diatoms and fine spicules of sponges. Samples were subjected to chemical and optical analysis by a capable geology student, Miss Mary Kathryn McGee, who made a special search for foraminifera. Her report is as follows:

The rock at first glance, appears to be an ordinary siliceous shale. Fresh surfaces are cream colored and the rock splits fairly evenly along well defined bedding planes. Weathered surfaces are pitted and give the impression of a secondary deposit covering the fresh rock. As a whole, it is only slightly stained by iron oxide.

On closer examination, however, the freshly cleft rock is seen to possess a number of odd characters. The surface is marked by numerous minute knob-like areas, with corresponding depressions between, giving the impression of an imperfectly formed oolite. Moreover, fresh surfaces, on minute examination, possess a pearly lustre that gives them a polished appearance.

Microscopic examination of thin sections shows the rock to be composed principally of calcite, diatom frustules, and siliceous sponge spicules. A few patches of secondary quartz are also present. In all the slides examined, only one recognizable foraminifer could be found. This was of the genus *Bolivina.* No other faunal forms are present.

There was no indication whatever of oolitic structure in the sections, but there is very evident accumulation of the calcite in fairly definite zones about many diatoms, as well as a filling of the tests by the same mineral. I believe that the peculiar knob-like appearance of the rock surfaces is to be explained by this accumulation of calcite about the diatom frustules. Moreover it is more logical to believe that this accumulation is a secondary phenomenon rather than a primary oolitic type of accretion upon the frustules at the time of their deposition. That is, the calcite, which probably was deposited originally in the form of aragonite, aided by subsequent consolidation of the sediment, has migrated during the process of recrystallization and has filled the once empty tests. The mode of precipitation of the calcite is doubtful, although it could have been due to bacterial activity.

Chemical analysis of a sample shows the rock to contain about 9.8 per cent alumina. This is probably in the form of kaolin and represents a fine silty deposit in relatively quiet water some distance from shore. The rock has evidently undergone sufficient regional metamorphism to change at least a portion of the kaolin to kaolinite and this would account for the pearly lustre.

The rock, then, is an argillaceous-diatomaceous shale with considerable lime content which represents an original deposit concurrent with the accumulation of the diatoms and sponge spicules. The material probably represents a relatively shallow inland sea deposit rather than an estuarine one, as indicated by the presence of the sponges.

Judging from the locality from which it was taken, it undoubtedly belongs to one of the more siliceous members of the Modelo series. The formation that outcrops in this vicinity, according to Kew (U.S.G.S. Bull. no. 753, 1923), is one which has been correlated with the Modelo formation of Santa Clara valley.

The accumulation at Calabasas differs from that at Lompoc in being a hard oölitic limestone with smaller admixture of diatomaceous silica instead of the light, siliceous shale, almost a pure diatom accumulation, that we find at Lompoc. The two deposits are similar in their fine grain and thin lamination, in their freedom from detrital material, and in the undisturbed condition of their contained fossils.

Both must have accumulated in land-locked, quiet basins free from the contribution of any large stream. The Calabasas matrix may have been laid down at a slightly later period geologically.

The bird here newly named differs from the surviving cormorants by characters that are not found in the genus *Phalacrocorax,* but they are held to be not of great significance, and to establish a new superspecific category at present would result in a monotypic genus, the thought of which is not attractive to the present writer, who holds that the genus should indicate relationship by being inclusive and that the species as groups should emphasize differences. Especially does this view appeal to one handling the extinct forms where the record is so discontinuous that the monotypic genus would be the rule were we to adhere closely to the standards of the extreme systematist in modern ornithology. Should additional and related material be found at some future time, the establishment of a new genus might become advisable.

*University of California at Los Angeles, May 18, 1929.*