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A NEW SPECIES OF CORMORANT FROM THE PLIOCENE OF MEXICO

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The occurrence of vertebrate fossils in deposits south of the small town of La Goleta, near Morelia, Michoacan, Mexico, was first discussed by Arellano and Azcon (1949) at the El Paso, Texas, meeting of the Geological Society of America. In 1950, the California Institute of Technology (CIT) collected in the La Goleta area, followed, five years later, by the Los Angeles County Museum (LACM). The material collected on both of these expeditions is now in the collections of the latter institution.

A brief discussion of the Michoacan beds, based on an unpublished report of the field party from California Institute of Technology is presented by Repenning (1962:554), who records the occurrence of the giant ground squirrel, *Paenemarmota*, in the Goleta fauna. Except for *Paenemarmota*, the only other generic or specific identifications from the fauna have been of horses assigned to *Nannipus* cf. *montezuma* and *Pliohippus osborni* (Arellano and Azcon, 1949). On the basis of the horses, the Goleta fauna has been placed in the Pliocene. A difference of opinion exists, however, as to whether it should be considered of Hemphillian (middle Pliocene) or early Blancan (late Pliocene) age (Repenning, 1962:554-555; and October, 1964, correspondence with the present writer from R. H. Tedford who takes the latter view).

Undescribed mammalian specimens representing mastodon, hyaenid, peccary, tapir, rabbit, rodent, antelope and camel are included in the fauna (Repenning, 1962:554-555). Only two avian bones occur, both representing a small cormorant of lesser size than the Recent *Phalacrocorax olivaceus*, known in the area today. Fortunately an almost complete coracoid is present, an element that is particularly diagnostic in the cormorants. More significant than the size difference from *P. olivaceus* are physical characters of the coracoid that serve to distinguish the fossil. The Goleta species is, therefore, here described as new to science:

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Figure 1. *Phalacrocorax goletensis*—new species, type coracoid, LACM 4632. A. Anterior view, B. Internal view, C. External view, D. Posterior view. Natural size. Photo by George Brauer, retouched by Pearl Hanback.

***Phalacrocorax goletensis*, new species**

Figure 1

Type: Nearly complete right coracoid, lacking only the sternocoracoidal process; LACM 4632, collected by R. H. Tedford and R. L. Shultz (CIT field party), summer, 1950.

Locality and age: CIT locality no. 505 (equivalent of LACM locality no. 1136); Morelia lacustrine basin, near La Goleta, and east of Morelia, state of Michoacan, Mexico; Goleta formation, in slightly consolidated sandstone approximately 10 feet below diatomite stratum; middle or late Pliocene (Hemphillian or early Blancan).

Diagnosis: Compared with coracoids of Recent cormorants, closest to *Phalacrocorax olivaceus*, but smaller (5 per cent shorter than minimum of four specimens of the Recent species, 13 per cent shorter than maximum); and further distinguished by (1) area from top of glenoid facet to tip of head relatively, as well as actually shorter, (2) posterior contour of head more abruptly rotated medially (see Fig. 1 D), with brachial tuberosity projected so as to produce an even more angular contour of the area as seen in external view (Fig. 1 C), (3) depression of neck equal in depth, but more circumscribed (pitlike), (4) anterior intermuscular line more lateral (external) in position (Fig. 1 A). See Table 1 for measurements and proportions.

Referred material: Distal end of left humerus, LACM 3166, from type locality; collected by L. C. Bessom (with LACM field party),

TABLE 1
Measurements of coracoid and humerus of
P. goletensis and *P. olivaceus*

	<i>P. goletensis</i>	<i>P. olivaceus</i> (4 specimens)	
CORACOID			
a. Length from head to internal sternal angle	47.7 mm.	50.0mm.	-53.7mm.
b. Distance from head to scapular facet (calipers placed under facet)	15.4	17.1	-18.0
c. Distance from top of glenoid facet to tip of head	8.1	9.1	- 9.9
d. Anteroposterior breadth immediately above procoracoid	7.1	7.3	- 7.5
e. Distance from anterior intermuscular line to internal sternal angle (measured along upper level of sternal facet)	9.5	7.5	- 8.3
Ratio of measurement c to measurement a above	16.9%	17.8%	-18.8%
Ratio of measurement e to measurement a above	20.0%	14.5%	-15.4%
HUMERUS			
a. Greatest breadth distal end	10.6 mm.	11.0mm.	-12.0mm.
b. Distal breadth across condyles only	8.9	9.4	-10.0
c. External depth distal end	7.4	8.1	- 8.8
d. Internal depth distal end	8.8	9.2	-10.0
Ratio of external to internal depth of distal end	84.0%	87.0%	-89.3%

May 6, 1955. Resembling humerus of *P. olivaceus* as distinguished from that of *P. pelagicus* in more rounded and more deeply depressed distal terminus of impression of brachialis anticus muscle; distinguished from *P. olivaceus* by relatively less depth of distal end, externally, and generally smaller size (4 to 13 per cent smaller in distal width). See Table 1.

Discussion: The five Recent North American cormorants that were compared with the Pliocene fossil fall into two groups on the basis of shape of the neck and head area of the coracoid, and position of the anterior intermuscular line (with minor variations within

each group). In group 1, *P. olivaceus*, *P. auritus*, and *P. carbo*, the lower edge of the furcular facet terminates posteriorly well above the glenoid facet and projects in the area of the brachial tuberosity so as to produce an angular posterior contour of the neck and head area as viewed externally; in group 2, *P. pelagicus* and *P. penicillatus*, the furcular facet terminates lower (nearer the glenoid facet) and there is little (*P. penicillatus*) or no (*P. pelagicus*) angularity of posterior contour. The anterior intermuscular line is more medially placed in group 1 than in group 2. The fossil, *P. goletensis*, is closer to group 1 in the characters of the head and neck, but closer to group 2 in the position of the intermuscular line.

Nineteen fossil cormorants have been previously described from tertiary and quaternary deposits of various geographic areas (see Brodkorb, 1963:250-254). Thirteen of these were notably larger than *P. goletensis*. From four of the smaller species (*P. miocaenus* and *P. littoralis* from the Miocene of France, *P. destefani* from the Pliocene of Italy, and *P. vetustus* from the Pleistocene of South Australia), *P. goletensis* is distinguished by the medial curvature of the anterior intermuscular line as it meets the sternal facet. In the four above-named species, the line is either straighter or more externally directed (see Lambrecht, 1933:290-298).

Through the courtesy of Dr. J. A. Shotwell of the Museum of Natural History, University of Oregon, I have been able to examine the type tarsometatarsus and referred lower end of coracoid of *P. leptopus* Brodkorb (1961:170-172) and the middle and lower Pliocene (respectively) of Oregon. These bones, though representing a relatively small cormorant, are larger than comparable elements of *P. olivaceus*. Calipered measurements are difficult to make on the Oregon coracoid; not only is the upper end lacking, but the bone is broken through the sternocoracoidal process and sternal facet so that the point of distal termination of the anterior intermuscular line cannot be determined. Bone-to-bone comparisons indicate close size agreement with large individuals of *P. pelagicus* that are 20 per cent longer than the type of *P. goletensis*. Shaft dimensions at the narrowest part preserved in the coracoid of *P. leptopus* are 4.4 x 5.8 mm. At an estimated similar location on the type of *P. goletensis* (point of greatest anteroposterior bend), the dimensions are 3.5 x 4.6 mm. More significant than the size difference is the character of the internal angle of the sternal end and the development of the upper lip of the sternal facet. In *P. leptopus* the sternal angle is blunt, and the lip of the facet is large, both in lateral and posterior extent. In *P. goletensis* the sternal angle is sharper, and the lip of the facet is

relatively, as well as actually smaller. In this latter character, the Mexican fossil resembles *P. olivaceus*, whereas *P. leptopus* is closer to *P. pelagicus*.

P. pampeanus, from the Pleistocene (Pampean formation) of Argentina, may be within the size range of *P. goletensis*. It is known only from the type, a proximal end of humerus described (Moreno and Mercerat, 1891:35) as being slightly smaller than this element of "*P. brasiliensis*" (= *P. olivaceus*). No measurements are given, and the two views of the bone that are illustrated (*Ibid.*: pl. xviii, figs. 8-8a) do not agree in size. Neither view, however, shows the specimen to be of lesser dimensions than the minimum humerus of *P. olivaceus* now available for comparison (Univ. Calif. Mus. Vert. Zool. no 126084, a femal from Mexico). The description of the type of *P. pampeanus* specifies slight distinctions from *P. olivaceus*, which are difficult to evaluate. In several instances, the four specimens of *P. olivaceus* now at hand show a variability that seems to include the characters referred to *P. pampeanus*. No direct comparison can be made between the humeri of *P. pampeanus* and *P. goletensis*; the type of the former is a proximal end, the referred specimen of the latter is a distal end. In view of the fact that the South American Pampean formation is considered to be of latest Pleistocene (Rancholabrean) age (Stirton, 1953:606), whereas the Goleta formation is, at most, late Pliocene (an age difference of at least a million years), I believe it wiser to name the Mexican fossil as a separate species rather than to allocate it, even tentatively, to *P. pampeanus*. It seems likely that *P. pampeanus* bore closer relationship to the living *P. olivaceus* (geologically separated by some 15,000-30,000 years) than to the earlier *P. goletensis*. Either, or both of the fossils may have been in the ancestral line to *P. olivaceus*.

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