THE PLEISTOCENE STORKS OF CALIFORNIA

WITH ONE ILLUSTRATION

By LOYE MILLER

The first announcement of stork remains from the fossil beds of California was made over twenty years ago (Miller, 1910). The remains were most limited and all came from one horizon of Pleistocene age, the asphalt of Rancho La Brea. At that time the excavations at the asphalt pits were thought to be about completed and there was little prospect of further specimens coming to light. Since then, more than one hundred thousand bird bones have been taken from the same deposit, while several thousand more have been taken from the other two Pleistocene asphalt beds, at McKittrick and Carpinteria. With this remarkable assemblage of material an anomalous situation has arisen with regard to certain species that have survived to the present time, that is, we turn to the fossil material to learn the variability of the species. The combined museums of the world could not supply the worker with one hundred tarsi of the present-day California Condor, yet in one museum, we have many times that number of specimens from the Pleistocene deposits of the State.

The passerine birds and other small species of our contemporary fauna are represented in collections of cabinet skins by large series of individuals, but the osteologist is commonly expected to be content with an occasional skeleton or two. These are generally of the larger species and too often they are mounted or ligamental skeletons which serve as a mere source of irritation or a "cup of Tantalus", for all minute characters are concealed under ligamentous tissue.

During the early study of California storks, one specimen each of *Ciconia alba, Euxenura maguari* (of authors = *E. galeata*), *Mycteria americana,* and *Jabiru mycteria* were available, and the fossil material was entirely too limited to give adequate indications of variability. Today, the situation is but little improved as to Recent skeletons, but Pleistocene material, though still comparatively rare, has become sufficiently abundant to make a re-survey of the situation warrantable. Comparative material was loaned by the American Museum of Natural History and by the United States National Museum. The Pleistocene storks at the Los Angeles Museum, the California Institute of Technology, the Museum of Natural History at Santa Barbara, and the Museum of Paleontology at Berkeley were all made available for study. To these several institutions and their courteous curators the author extends sincere thanks.

Genera Represented.—With the exception of the single lower mandible of *Mycteria americana* (now lost) in the collection of the Los Angeles High School, all the fossil storks examined from the California Pleistocene are here classified in one genus of one variable species. On several earlier occasions there have been two genera and species recorded (Miller, 1910 and 1925), the distinction being based upon size and upon certain osteological variations, both of which distinctions have fallen to the ground with the increase of our Pleistocene collections. This material differs from all living American storks and is included in the species *Ciconia maltha* originally described from Rancho La Brea. Discussion of the original generic assignment included the following statement: "The generic distinction between *Euxenura* and *Ciconia* is based largely on external features, and even these features are considered by some students to exhibit insufficient differences to warrant recognition of the separate genus *Euxenura.* Conceding that the differences between existing forms are of generic value, the form under discussion would not agree with either genus and

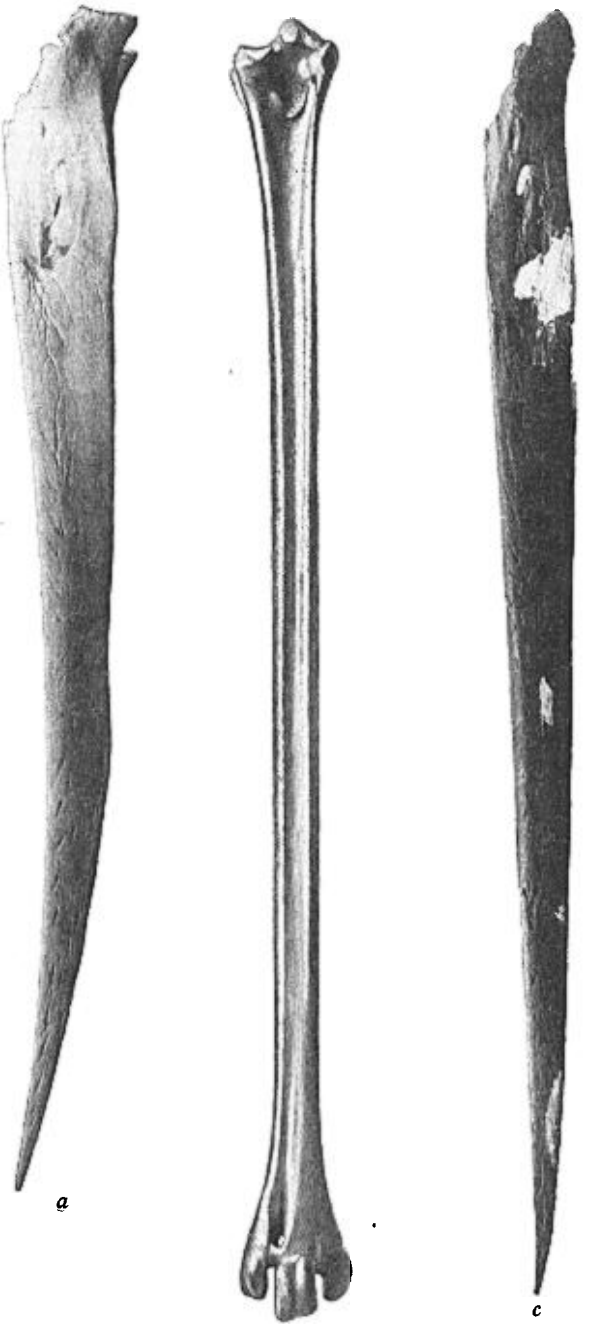

Fig. 23. *a*, MANDIBLE OF *Jabiru mycteria* (Recent).
b, TARSOMETATARSUS OF *Ciconia maltha* (fossil).
c, MANDIBLE OF *Ciconia maltha* (fossil).
Drawing by Mr. J. L. Ridgway.
Photographs by Dr. R. B. Cowles.
All figures to same scale, approximately 5/9.

a new genus would be necessary. While there is little question that, were the asphalt stork restored to us in its entirety, it would likely exhibit characters sufficient for its generic distinction, yet for the sake of simplicity it is referred, in the absence of those superficial characters, to the genus *Ciconia*."

The opinion might be advanced that it is unlikely that the genus *Ciconia* should occur in both eastern and western hemispheres and hence *Euxenura* should be used to designate the New World stork. This argument should be given small consideration in the light of such cosmopolitan, related genera as *Ardea*, *Egretta*, *Butorides*, *Botaurus*, and *Nycticorax*. Wetmore (1928 and 1931) records *Jabiru mycteria* from subfossil remains from Cuba and as true fossils from Pleistocene deposits in Florida. He also assigns *Jabiru weillsi* Sellards to the surviving species *Jabiru mycteria*. It is quite proper then to expect the California deposits to yield representatives of the same genus. Thus far they have failed to appear.

Comparison of *Euxenura* with *Jabiru*.—*Euxenura maguari* and *Jabiru mycteria* differ notably in size when the limited Recent material is compared. *Jabiru* is much the heavier bird in body mass and relative strength of the limbs. Comparison of the several characteristics of the skeleton shows differences as listed below.

1. *Tarsus*. Viewed from in front, the tarsus of *Euxenura* has a broad, rather shallow excavation in the region of the papilla of the tibialis anticus. This area is narrower and deeper in *Jabiru*. The shaft of the bone is much narrower in *Euxenura* even though the head is just equal to that of *Jabiru*. The effect is of a more positive "flaring out" at the proximal end. With the exception of one juvenile bird, the Pleistocene specimens resemble *Euxenura* more than *Jabiru*.

2. The intercotylar tuberosity is blunter and less deeply undercut on the external side in *Euxenura*.

3. Seen from the outer side the head is far less in diameter as measured through either the hypotarsal ridges or from the bottom of the furrow between them.

4. Seen from the rear, the hypotarsal ridges are much closer together and the outer instead of the inner is the longer. There is, just above the hypotarsus, a deep pit separating the hypotarsus from the cotylar area. This pit is practically wanting in *Jabiru*.

5. Viewed along the axis from the proximal end, *Euxenura* is again seen to have a much less robust tarsus. The cotylae have a much shorter sagittal diameter in relation to the transverse dimension.

6. At the distal end, the tarsus is much smaller, the entire foot is narrower, the trochleae are smaller and the inner toe is set farther back throwing the three trochleae into a more strongly curved arc.

7. *Tibiotarsus*. Viewed from the proximal end, the tibia of *Euxenura* seems to have more rugged contours, depressions are more sharply marked, and crests rise more abruptly. The outer cnemial crest is thrown farther to the fibular side, and the whole articular area is broader in relation to its sagittal diameter.

8. As in the tarsus, the shaft is more slender though but slightly shorter.

9. At the distal end the width increases to equal that of *Jabiru*. The condyles are smaller in diameter but are separated from each other by a broader intercondylar groove.

10. The tubercle above the osseous bridge is sharper and lies practically on the median line instead of toward the fibular side.

11. The outer attachment of the ligamentous band over the flexor tendons is placed farther up the shaft.

12. The pit into which the intercotylar tubercle of the tarsus fits during articulation is less circular in both species than it is in *Ciconia alba*; it is expanded to the inner side and encroaches upon the inner condyle in *Euxenura*, thus offering a superficial resemblance to *Grus*.

13. In size there is greater disparity between the extremes of available *Euxenura* than there is between the largest *Euxenura* and the one available *Jabiru*.

On the basis of the above comparison of distal leg bones in Recent storks, the fossil specimens have been carefully scrutinized. All tarsi and tibiae fall into one group showing affinity with *Euxenura* and not with *Jabiru*. The only character showing notable diversity is the (1) and (2) combination, a character which may depend upon age of the individual. Actual size of the fossils varies greatly, extending well beyond the Recent *Jabiru*.

Femur. In *Euxenura* the linea aspera is simpler and lies nearer the inner profile of the shaft, the entire bone is more slender, the pneumatic foramen on the proximo-anterior area is placed higher up under the trochanter and the pattern of the muscle scars is variable.

In all the fossil femora examined, relationship appears closer to *Euxenura* though the length ranges above that of *Jabiru*.

Anterior Limb Bones. Only fragments of the humerus have been collected. Insofar as they are preserved, these parts resemble *Euxenura* though they are as large as *Jabiru*.

The carpometacarpus is extremely long and slender. The radio-ulnar diameter of the greater digit is less than in *Jabiru*, and the maximum transverse over-all dimension of the bone is less though the length may reach 13.3% in excess. The wing, like the leg, seems to point to the species as a slender limbed bird in comparison with the living *Jabiru*.

The coracoids of the fossil birds run slightly less than *Jabiru*, but not so much so as one would expect from a study of the limb elements.

Furcula. A marked difference appears among the American storks in the way in which the furcula is attached to the sternal carina. *Jabiru* shows a pedunculate furcular process of some 6 mm. length and definitely reflexed toward the carinal apex. *Euxenura* makes contact with the carina by a broad tabular facet which is not at all pedunculate. All fossil stork furculae examined have the character of *Euxenura* in this contact. Other parts of the furcula are not available for study owing to method of preparation of the loaned material.

Mandible. Fortunately an almost perfect lower mandible of this interesting fossil stork is preserved in the collection at the California Institute of Technology.

The right articular region is the only part lacking, and the left articulation is but slightly fractured. The specimen differs from *Jabiru* in being quite appreciably longer (8.8%), but with a much shorter symphysis. The fossil mandible has a total length of 355.4 mm., with a symphysis of 106.5 mm. (30%). In *Jabiru* the total length is 326.6 mm. and the symphysis is 152 (46%).

Euxenura has a beak length of 288 mm., with a symphysis of 109.8 (38%). *Ciconia alba*, with a beak length of 217 mm. and a symphysis of 64 mm. (29%), shows closest approximation to the fossil mandible.

In all species examined the upward curvature of the mandible is almost entirely accomplished in the symphysial portion. The greatest degree of upturn is seen in *Jabiru*, the least degree in *Ciconia alba*, and an intermediate degree in *Euxenura*.

The fossil ramus displays a curve intermediate between *Euxenura* and *Ciconia alba*. The total length exceeds that of any other specimen examined.

The accompanying table of measurements is taken from Recent specimens as listed: *Euxenura maguari*, U. S. Nat. Mus., no. 49041, male; U. S. Nat. Mus. no. 19940; the author's collection, no. 204. *Jabiru mycteria*, Am. Mus. Nat. Hist., no. 2931.

Pleistocene material comes from Rancho La Brea and McKittrick localities and is drawn from the collections of the University of California, the Los Angeles Museum, and the California Institute of Technology.

TABLE OF MEASUREMENTS OF STORKS, RECENT AND PLEISTOCENE

All diameters in millimeters		*Ciconia maltha*			*Euxenura maguari*, 204	*Euxenura maguari*, 19940	*Euxenura maguari*, 49041	*Jabiru mycteria*, 2931
		Minimum	Maximum	Mean				
Tarsus	Total length (2 specimens)	307	314	310.5	267	247	230	302
	Transverse diameter through trochleae (10 specimens)	24.4	26.3	25.4	24.5	22.2	21.8	25.7
	Transverse diameter through cotylae	23	25.7	24.8	23.9	21.5	20	23.8
Tibia	Total length	....	....	....	311	283	274	351
	Sagittal diameter through condyles (12 specimens)	23.2	25.4	24.8	22.5	21	20.5	24.7
	Transverse diameter through condyles (12 specimens)	19	20.8	19.9	19.4	18	17.3	19.1
Humerus	Total length	....	....	....	224	220	212	257
	Maximum diameter, distal end	....	....	....	34.6	32.1	32.1	40
	Maximum diameter, proximal end (one specimen)	....	....	51.5	44.9	42.9	41.4	52.5
Carpus	Extreme length metacarpal II (3 specimens)	138	150	139	120.7	116	112	132.8
Coracoid	Maximum length	....	....	....	98.8	93.7	....	115
	Maximum basal width (3 specimens)	106	113	109.5	37	35.5	....	42.7
Beak	Length from nasofrontal suture	....	....	....	246	....	194	287
Mandible	Length over all (1 specimen)	....	....	355	288	....	225	326
	Length of symphysis (1 specimen)	....	....	106	110	....	....	152
	Maximum depth (1 specimen)	....	....	25.2	20.7	....	18	29.7

Conclusions.—Stork remains occur in three Pleistocene asphalt deposits of California: Rancho La Brea, McKittrick, and Carpinteria.

Their relative abundance is greatest at McKittrick.

With the exception of a single fragment now lost, all specimens are assigned to a single species, *Ciconia maltha*.

This species is quite constant in all characteristics except size. The range of size variation includes both the Jabiru and the Maguari Stork, extending beyond them at either end of the scale.

The species has less dorsal curvature of the mandible than any other American stork.

It was longer limbed but more slenderly built than either the Jabiru or the Maguari Stork.

BIBLIOGRAPHY

Miller, L. H.
1910. Wading Birds from the Quaternary Asphalt Beds of Rancho La Brea. Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 5, no. 30, pp. 439-448.
1925. Avifauna of the McKittrick Pleistocene. Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, no. 9, pp. 307-326.
1925. The Birds of Rancho La Brea. Carnegie Inst. Washington, Publ. no. 349, pp. 63-106.
1931. Pleistocene Birds from the Carpinteria Asphalt of California. Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 20, no. 10, pp. 361-374.

Wetmore, A.
1928. Bones of Birds from the Ciego Montero Deposit of Cuba. Am. Mus. Novitates, no. 301, pp. 1-5.
1931. The Avifauna of the Pleistocene in Florida. Smithsonian Misc. Coll., vol. 85, no. 2, pp. 1-41.

University of California at Los Angeles, May 10, 1932.