

NEW RECORDS AND A NEW SPECIES OF CHENDYTES,
AN EXTINCT GENUS OF DIVING GEESE

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The genus *Chendytes* was established with the description of *Chendytes lawi* from the Upper Pleistocene in Long Wharf Canyon, Santa Monica, California (Miller, 1925). This so-called "diving goose" is now known to occur in all Upper Pleistocene marine deposits on the mainland coast of southern California from which fossil birds have been reported. It is usually the first avian species found at these sites, and it always is the best represented. To date 61 specimens of *Chendytes* have been recorded from seven known Pleistocene localities, and fourteen are known from two sites said to be kitchen middens (Howard, 1949:24). To these may now be added another 82 specimens.

Table 1 lists by localities all the material now referred to *Chendytes*. The first seven localities are Upper Pleistocene in age. The Sexton Canyon site is recorded as Lower Pleistocene. The bones found in Palos Verdes in kitchen middens at Malaga Cove (Walker, 1951:27). As they were well mineralized, in contrast to associated skeletal material of living species of birds and mammals which lacked mineralization, it is probable that they were secondarily introduced (Woodring, Bramlette, and Kew, 1946:107-108). The new record for the same general locality, a well mineralized femur, was also found in a kitchen midden and collected and presented to the Los Angeles County Museum by the late Mr. James C. Marsh. The previously recorded (Howard, 1949:24) seven bones said to have come from kitchen middens on San Nicolás Island may have been mislabelled for all efforts to find the site on the island from which they could have been collected, have been fruitless. They are large and very well preserved, in contrast to the newly discovered (Miller, 1951:78) avian remains found *in situ* on San Nicolás. The latter, as will be discussed later, are of Lower Pleistocene age and represent a distinct, smaller species of *Chendytes*, heretofore undescribed.

Table 1

Occurrences of Individual Bones of *Chendytes* in Southern California

Localities	Previously recorded	Additions in coll. L.A.C.M.	Totals
Newport Bay, Orange Co.	16	7 (8?)	23 (24?)
San Pedro, Los Angeles Co.	19		19
Bixby Slough, Los Angeles Co.	1		1
Vermont and Sepulveda Blvds., Los Angeles Co.		1	1
Lomita, Los Angeles Co.		3	3
Playa del Rey, Los Angeles Co.	13	2	15
Santa Monica, Los Angeles Co.	4		4
Palos Verdes, Los Angeles Co.	7	1	8
Sexton Canyon, Ventura Co.	1		1
San Nicolás Island, Ventura Co.	7	67	74
"San Nicolás Island kitchen middens"	7		7
	—	—	—
Totals	75	81 (82?)	156 (157?)

DESCRIPTION OF NEWLY RECORDED UPPER PLEISTOCENE MATERIAL

The newly recorded material includes the following specimens of *Chendytes lawi* from Upper Pleistocene sites:

Newport Bay: 5 femora, 1 fragment of synsacrum, 1 incomplete humerus, 1 fragment of premaxilla (tentatively assigned).

Vermont and Sepulveda: 1 cervical vertebra.

Lomita: 1 incomplete coracoid and fragments of humerus and tibiotarsus.

Playa del Rey: 1 scapula, 1 tarsometatarsus.

Of these specimens the humerus from Newport Bay and the scapula from Playa del Rey add significant information concerning the wing of *Chendytes*; and the fragment of premaxilla is the first and only specimen to contribute even a meager idea of the skull. The coracoid from Lomita is better preserved than those previously recorded, but the characters are the same as described for the Newport Bay specimen (Howard, 1947).

Humerus.—One specimen of humerus (L.A.C.M. no. 2030) was collected at Newport Bay in 1946 (Howard, 1947:77). Owing to its poor preservation, it was difficult to distinguish between degeneration of the element and erosion, and only a few characteristics were described. The second specimen (L.A.C.M. no. 2455), now recorded, was collected by Mr. and Mrs. Robert Zava of Laguna Beach and presented to the Los Angeles Museum in 1952. This specimen represents the proximal two-thirds of the element and, although the head and bicipital crest are incomplete, it is in a much better state of preservation than the first. The following characters, some of which were suggested in the first specimen, may be noted: (1) deltoid crest a heavy ridge rather than a flared crest; ridge swings abruptly onto the palmar face of the bone below the external tuberosity; (2) bone narrows sharply below external tuberosity; (3) bicipital furrow irregularly margined and limited in distal extent by position of deltoid crest; (4) pectoral attachment on external tuberosity long, narrow and smooth-surfaced, lacking the rugosity which accompanies firm muscle attachment in the scoters; (5) pneumatic fossa small and circular, with overhanging internal tuberosity; (6) area below fossa slightly depressed, smooth, and lacking evidence of surface for attachment of supraspinatus muscle. The fragment of humerus from Lomita adds no further information.

Scapula.—This odd-shaped little bone (L.A.C.M. no. 2006) was collected near Playa del Rey with the other avian material reported earlier (Howard, 1936), but it was not identified. Only recently, and in comparison with other specimens to be discussed later in this paper, was its identity recognized. Characters are as follows: (1) proximal end only slightly flared, and the articular surface nearly straight and with little definition of the coracoidal articulation; (2) acromial area broken but apparently greatly reduced; (3) glenoid facet concave, bordered externally by slight ridge followed by an ovoid depression; (4) shaft relatively deep, lacking blade-like quality of normal anatid scapula. Breadth 3.7 mm., depth 2.4 mm.; same measurements in *Melanitta perspicillata*, 4.5 mm. and 2.2 mm., respectively.

Premaxilla.—The fragment of premaxilla (L.A.C.M. no. 2059) consists only of a portion of the tip with the nasal process. There is no evidence of sutures with bordering nasals, but the slight flare and the descent of the bordering contours of the nasal process posteriorly indicate that the nasals must have been present and fused to the nasal process of the premaxilla. Although the bordering contours of the tip of the beak are lacking, the presence of perforations characteristic of the anterior margin of the mandible in the scoters suggests that there has been very little broken away anteriorly. The depth and breadth of the beak cannot be estimated. The meager information afforded by this fragment is as follows: (1) texture of bone heavy; (2) length of tip approximately equal to length of nasal process (27.9 mm.); (3) nasal process very broad (8.0 mm. at narrowest point); (4) convexity of tip moderate. In general the specimen suggests a relatively short, heavy beak with the nasal process broader than in any known anseriform.

SAN NICOLÁS ISLAND MATERIAL

The new site on San Nicolás Island has yielded the most significant assemblage of bones of *Chendytes* so far known. This occurrence was brought to light in 1950 by Rob-

ert and Kenneth Norris, then graduate students at the University of California, who were engaged in making a geological survey of the island. The fossiliferous deposits were discovered in a narrow canyon on the north side of the island, and in the course of brief examination of the beds, seven avian bone fragments were collected. These were soon identified by Loye Miller as *Chendytes* (Miller, 1951:78). Dr. Miller informed the Los Angeles County Museum and arrangements were made for a field party to accompany the Norrises to the site. Accordingly, from November 9 to 12, 1950, Leonard Bessom and William Reeder of the Museum carefully examined the area with the following results.

Three outcrops of bone-bearing matrix were found within a radius of about 170 yards in gullies running into a large canyon to the west of the Navy camp. The outcrops are apparently all part of the same marine terrace deposit laid down under shallow littoral conditions according to Robert Norris (oral communication). The deposits varied in depth from 2 to 7 feet, in some places being exposed directly on the surface, in others lying beneath several feet of over-burden.

Bird bones were numerous in each outcrop but were poorly preserved. A few bones of marine mammals and some fish also were encountered, and numerous badly fragmented specimens of invertebrates were found. The best preserved of the mollusks have been analyzed by George Kanakoff. According to him this assemblage corresponds to the cold water fauna of Lower Pleistocene deposits on the mainland, such as those found at Hilltop Quarry in the San Pedro section.

The matrix graded from a slightly cemented coquina to a more firmly cemented white calcareous grit. The bones in the looser matrix were badly broken and worn; those in the white limey matrix were better preserved, but the cementing agent of the matrix adhered so firmly to them that it was difficult to extract the bones without damaging their contours.

Of 77 identifiable bird bones recovered in these deposits on San Nicolás Island, 74 are referable to *Chendytes*. The characteristic leg elements are most abundant. But included also are seven humeri, three ulnae, two coracoids and three scapulae. These wing and pectoral girdle elements represent 26 per cent of the total number of *Chendytes* bones collected. At the Newport and Playa del Rey localities the ratio of known wing elements to the total number of *Chendytes* specimens is only 15 per cent. In view of the fact that none of the San Nicolás Island material is well preserved, the large representation of wing bones is especially significant.

Comparison of the island bones with those from the Upper Pleistocene deposits of the mainland reveals certain notable differences, particularly in the wing elements, which show less degeneration than those of *Chendytes lawi*. A new species of *Chendytes* is, therefore, here delineated and named in honor of Dr. Loye Miller, author of the genus.

Chendytes milleri, new species

Holotype.—Right humerus, L. A. Co. Mus. no. 2364, lacking bicipital area and internal tuberosity, and with contours of distal end eroded; collected by Leonard Bessom and William Reeder, November, 1950.

Paratypes.—Left femur, L. A. Co. Mus. no. 2378, nearly complete; ulna, L. A. Co. Mus. no. 2387, with distal end chipped; scapula, L. A. Co. Mus. no. 2386.

Locality and age.—Los Angeles County Museum locality no. 1085; top of bluff on north side of San Nicolás Island, S 47° W of Coney Point; altitude approximately 400 feet. Lower Pleistocene.

Description of holotype.—Deltoid crest of humerus weak, relatively longer than in living scoters and curving around onto palmar surface of shaft; less sharply curved than in *Chendytes lawi*, however, and shaft narrows less abruptly below the external tuberosity. Less fragile in appearance than

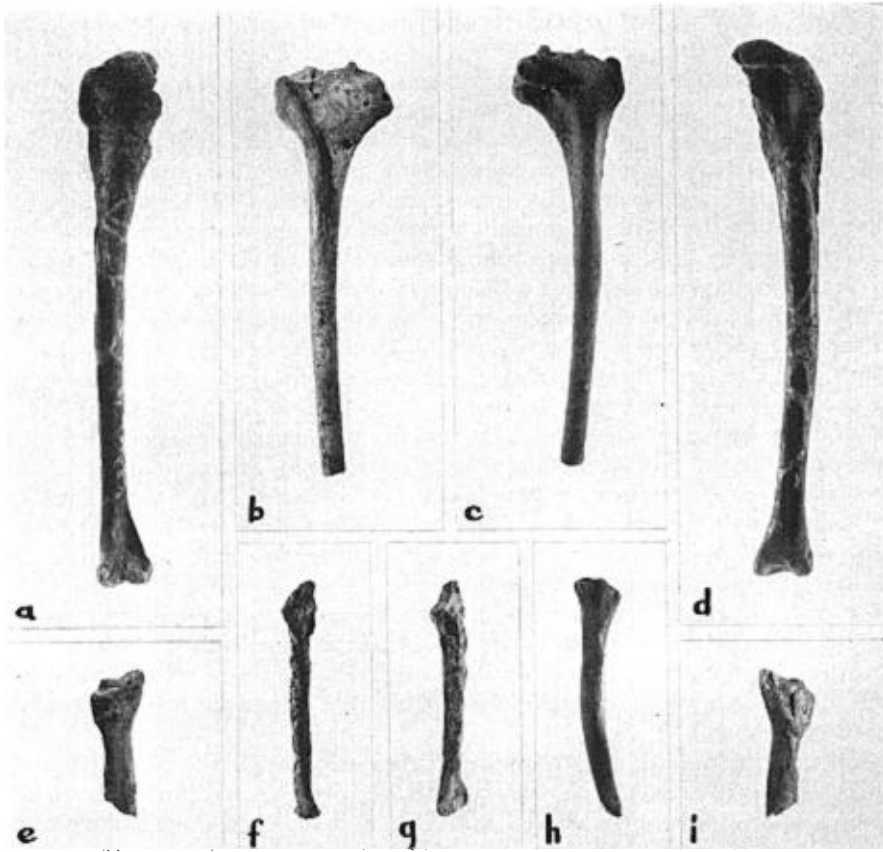


Fig. 1. Wing elements of *Chendytes*; a and d, *Chendytes milleri*, type humerus, L.A.C.M. no. 2364, palmar and anconal views; b and c, *C. lawi*, humerus, L.A.C.M. no. 2455, palmar and anconal views; e and i, *C. milleri*, paratype scapula L.A.C.M. no. 2386, ventral and dorsal views; f and g, *C. milleri*, paratype ulna, L.A.C.M. no. 2387, radial and internal views; h, *C. lawi*, scapula, L.A.C.M. no. 2006, dorsal view; all $\times 1$.

in *Chendytes lawi*, with shaft slightly greater in diameter. Pectoral attachment long. Distal end relatively narrow; impression of brachialis anticus muscle lying along internal margin and deeply incised; this area incomplete in *C. lawi* but impression of brachialis anticus appears to occupy the same position as in *C. milleri*, although it is shallower. Measurements are: length, approximately 69.7 mm.; breadth of shaft below external tuberosity, 5.5 mm.; breadth of shaft at middle, 4.4 mm.; depth of shaft at middle, 4.4 mm.

Description of paratypes.—Femur scoter-like but longer and stouter than in living *Melanitta fusca deglandi* or *M. perspicillata*. Length about 85 per cent of average for *Chendytes lawi*. Compared in detail with *C. lawi*, the following characters are notable: (1) shorter, stockier bone, with straighter lines especially toward the proximal end; (2) obturator ridge on line with external condyle, straighter and forming sharper angle between posterior face of bone and trochanteric area than in *lawi*; in the latter the proximal part of the femur inclines toward internal side so that obturator ridge is in line with popliteal fossa; (3) anterior border of trochanter relatively straight; this contour more rounded in *C. lawi*; (4) popliteal area small, the bordering ridge (internally) thin and sharp.

Ulna tiny, straight, approximately 32 mm. long. Impression of brachialis anticus deeply incised, corresponding to deeply cut impression at distal end of humerus. Distal end with prominent carpal

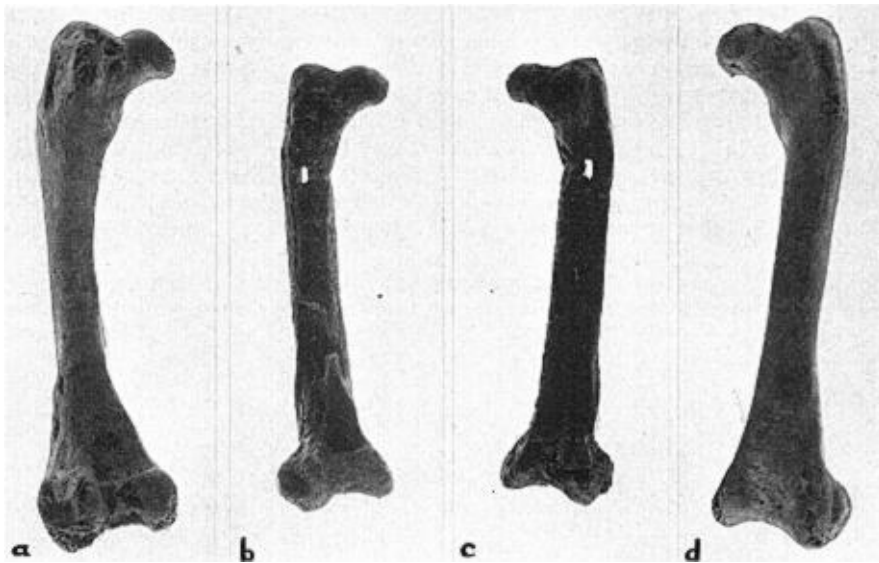


Fig. 2. Femora of *Chendytes*; a and d, *C. lawi*, L.A.C.M. no. 2015, posterior and anterior views; b and c, *C. milleri*, paratype, L.A.C.M. no. 2378, posterior and anterior views; all $\times 1$.

tuberosity, suggestive of that in *Melanitta*, but proportionately larger and more distally placed. Trochlea smoothly rounded, with crests not sharply defined. The ulna of *C. lawi* is as yet undiscovered.

Scapula resembles *Melanitta perspicillata* in general, but slightly narrower with reduced acromion and less prominent and less well defined glenoid facet. Outer margin of glenoid facet straighter, the surface less inflated, even depressed near its posterior tip; roughened area between glenoid facet and small acromion. Compared with *C. lawi*, broader proximally but relatively flatter, with more inflated glenoid facet, better defined coracoidal articulation, and suggestion of flare on external edge of shaft.

Measurements of Paratypes

	Length	Breadth proximal end	Breadth distal end	Breadth of shaft	Depth of shaft
Femur	59.4	13.0	15.0	7.0	8.1
Ulna	31.4	5.0	2.7	3.2
Scapula	8.3	2.4

Referred material.—Sixty-three specimens in the Los Angeles County Museum collection and six in the Loye Miller material at the University of California at Los Angeles (Miller, 1951:78, recorded seven specimens, but only six are present in the material kindly loaned by the University of California at Los Angeles). Included are fragmentary specimens of 16 tibiotarsi, 10 tarsometatarsi, 18 femora, 1 fibula, 6 humeri, 2 ulnae, 2 coracoids, 2 scapulae, 8 vertebrae, 2 phalanges, a partial pelvis, and a fragment of synsacrum. All are incomplete and considerably eroded. Several lack diagnostic characters and are referred to *C. milleri* on the basis of general similarity to *Chendytes*, as there is no reason to suspect the presence of more than one species of the genus at the Lower Pleistocene locality.

Among the femora referred to *C. milleri* are specimens that are larger and others smaller than the paratype femur. It is suggested that the variation in size possibly results in overlap of maximum *C. milleri* with minimum *C. lawi*. Characters described for the paratype appear to obtain in the referred specimens in which erosion has not destroyed the contours.

All the tibiotarsi are badly eroded and none is complete. Distinctions from *C. lawi* should, therefore, be considered tentative: (1) proximal end of shaft more convex posteriorly than in *C. lawi*; (2) external cnemial crest projects more gradually anteriorly and is less steeply inclined upward; (3) fibular crest more abruptly thrust outward from shaft distally than proximally; crest seems more evenly flared in *C. lawi*. All of the specimens in the Loye Miller collection are tibiotarsi.

The length of the tarsometatarsus can be taken on only one specimen (L.A.C.M. no. 2373) and is 58.2 mm. This is greater than in *Melanitta fusca deglandi* but is nearly 5 mm. shorter than the smallest *C. lawi*. The contours are badly eroded so that other distinctions from *C. lawi*, if present, are not observable. Other fragments suggest greater breadth than this specimen, indicating a range upward in size.

The referred humeri reveal the same characters of the deltoid crest and shaft noted in the type. Three specimens show the median crest and internal tuberosity; the contour of the bicipital crest is

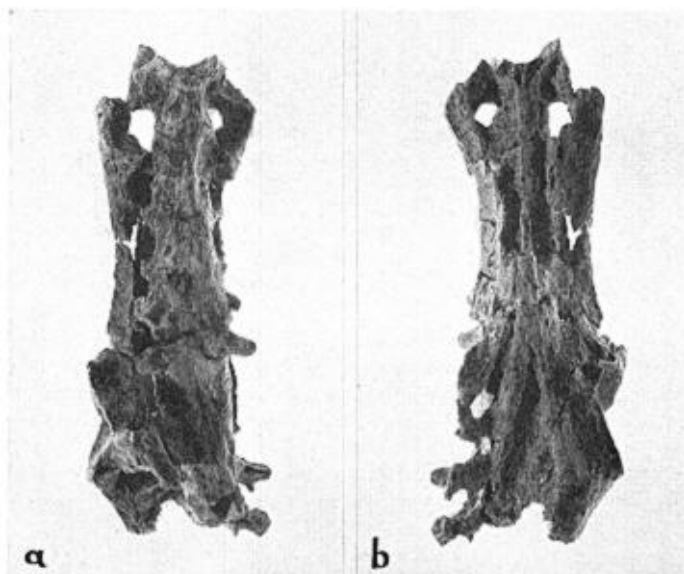


Fig. 3. Pelvis and synsacrum of *Chendytes milleri*, L.A.C.M. no. 2395; a, ventral view; b, dorsal view; $\times 1$.

incomplete in all. The median crest is apparently longer than in *C. lawi* and the internal tuberosity is slightly inclined over the pneumatic foramen, although less so than in *C. lawi*.

The distal end of the ulna is better preserved in referred specimen no. 2389 than in the paratype. The prominence of the carpal tuberosity and its distal position are notable, as indicated in the description of the paratype. The distal trochleae are smoothly rounded with the crests not sharply defined. Referred specimen no. 2388, an incomplete proximal end, shows the deep incision of the impression of the brachialis anticus muscle as in the paratype ulna.

The coracoid is shorter and more slender than in *Melanitta perspicillata*, narrowing markedly just below the procoracoid. The head is flattened and inclined forward more than in living *Melanitta*. Compared with *C. lawi*, the procoracoid is narrower laterally but deeper anteroposteriorly and it juts out less abruptly from the shaft.

The scapulae show the same characters described for the paratype scapula, and no. 2393 clearly shows a broadening or flaring of the external border of the shaft about 10 mm. posterior to the coracoidal articulation; this is suggested but broken in the paratype.

About three-fourths of a synsacrum are present with portions of the ilia attached; the acetabulum and antitrochanter of the right side are present with small fragments of ischium and pubis below.

The pelvis is similar to that in *Melanitta* although it is larger and proportionately narrower through the ilia; *C. lawi* has wide ilia, more as in *Melanitta*. At the junction of the ilia to the dorsal spine of the synsacrum, *C. milleri* shows perforations between the ilia and the spine as in *Melanitta*; the area is solid in *C. lawi*. As in *C. lawi* the centrum of the anteriormost synsacral vertebra is relatively broader than in *Melanitta*.

Six cervical and two lumbar vertebrae resemble those of *Melanitta* except for generally larger size and greater sturdiness.

Beyond the fact that the fibula and phalanges are scoter-like but larger, nothing can be said of them, as they are badly eroded specimens.

Table 2

Comparison of Measurements in Millimeters of Bones of <i>Chendytes milleri</i> and <i>Chendytes lawi</i>		
	<i>C. milleri</i>	<i>C. lawi</i>
Scapula		
Breadth articular end	7.2-8.3	6.8
Depth shaft	2.1-2.4	2.4
Coracoid		
Anteroposterior depth of shaft below procoracoid	3.7-3.8	3.3*-3.7
Breadth of shaft below procoracoid	4.1*	4.7-5.3
Height: posterior rim scapular facet to head	12.3	14.1-14.6
Humerus		
Length	69.7	70.0 (approx.)
Breadth proximal end from external tuberosity to internal tuberosity	13.3-14.6	14.3
Breadth of shaft below external tuberosity	5.5-5.9	4.8
Pelvis and synsacrum		
Distance: 1st synsacral vertebra to junction of ilia dorsally	39.3	46.2-61.0
Breadth centrum of 1st synsacral vertebra	7.5	6.7-7.5
Femur		
Length	59.4	65.7-76.4
Breadth proximal end	13.0-13.4	14.0-17.0
Breadth distal end	13.5-15.0	16.3-18.2
Tibiotarsus		
Breadth proximal end	10.8-13.0	14.8-15.5
Breadth distal end	12.2-13.5	13.3-14.1
Tarsometatarsus		
Length	58.2	63.0-66.0
Breadth across trochleae 3 and 4	10.6	11.4-13.5

* Two specimens have the same measurement.

DISCUSSION

Distinction between the two known species of *Chendytes* is chiefly concerned with the degree of their loss of flight. *C. milleri* appears to represent a developmental stage between a flying, scoter-like ancestor and the flightless *C. lawi*. As previously noted (Howard, 1949:25), the femur and humerus of *lawi* are approximately equal in length (ratio of humerus to femur, 100 per cent), whereas in living scoters the humerus is twice as long as the femur (200 per cent). *C. milleri* occupies a position between these two but is closer to *lawi*, with a ratio of humerus to femur of 117 per cent.

Examination of the characteristics of the wing elements of the two species presents a similar picture. In both species the flattened furcular facet and the flat profile of the upper end of the coracoid, with reduced acromion of the scapula, suggest a narrow, slit-like triosseal canal. This would have provided reduced leverage for the muscles that raised the wings. In *lawi* the acromion of the scapula is reduced to a greater degree than

in *milleri*. Furthermore, the entire area that forms the socket for the humerus exhibits more marked weakness in *lawi*; the coracoidal articulation of the scapula, which is ball-like in the scoters and even in *milleri*, is almost imperceptible in *lawi*, and the glenoid facet of the coracoid is very narrow. The size of this facet cannot be determined in *milleri*. Although many areas of muscle attachment are too badly eroded to show the degree of muscle development, the crest of the humerus which bore the most important propelling muscle of the wing, the pectoralis major, is significantly revealing. In both species of *Chendytes*, it is little more than a roughened ridge, lacking the flare and wide area for muscle attachment found in the scoters and indicating lack of propelling power. In *lawi* the area shows even more marked degeneration than in *milleri* by reason of the sharp twist of the ridge and the accompanying pinching in of the shaft of the bone.

The ulna is not known in *lawi*. In *milleri* it is so small that it measures less than half the length of the humerus (43 per cent). In the scoters, the ulnar length is 87 per cent of that of the humerus. The area for attachment of the brachialis anticus muscle is narrow and deeply incised on both the ulna and the distal end of the humerus. This suggests a strength of flexure of the forearm, rather out of keeping with the minute size of the ulna, unless it indicates that the wing was held in a tightly flexed position. There is no evidence of equally strong extensor muscles. A portion of the impression of the brachialis anticus is present in one specimen of humerus of *lawi*. Although less deeply incised than in *milleri*, it shows greater depression than in the scoters.

The smooth contours of the distal trochlea of the ulna of *milleri* suggest very little delineation of characteristic contours on the carpometacarpus. The carpometacarpus may have been very small; possibly in *lawi* it was lacking entirely.

Because the deposits on San Nicolás Island from which *Chendytes milleri* were recovered are Lower Pleistocene in age, it is suggested that the species *milleri* represents an evolutionary stage in the development of the Upper Pleistocene *lawi*. Previous to the discovery of *milleri*, all but one specimen of *Chendytes* had been recovered from Upper Pleistocene strata. The single Lower Pleistocene specimen, a tarsometatarsus from Sexton Canyon, Ventura County, is recorded as *Chendytes lawi*. As noted earlier, no real distinctions between *milleri* and *lawi* can be drawn on the basis of the eroded fragments of tarsometatarsi of *milleri* available, except that the one measurable bone (58.2 mm. in length) is about 5 mm. shorter than the minimum for *lawi*. Other specimens, however, suggest an upward size range and a possible intergrading with minimum individuals of *lawi*, as indicated also in the femur. The Sexton Canyon bone measures 63.7 mm. in length, which falls within the range of *lawi*, near the minimum. Without better evidence of distinction, we are faced with the possibility that *milleri* and *lawi* are indistinguishable in this element, except for range in size, and, therefore, that the Sexton Canyon bone may as well be *milleri* as *lawi*. On the other hand, the possibility remains that *Chendytes lawi* did exist on the mainland in the Lower as well as the Upper Pleistocene, leaving the claim of *Chendytes milleri* to status as an evolutionary ancestral stage somewhat insecurely supported. It may be said, however, that *milleri* fulfills all the necessary structural qualifications for such a position.

SUMMARY

Fifteen additional specimens of *Chendytes lawi* are recorded from the Upper Pleistocene of southern California. Of these, three (a first scapula for the species, a second humerus, and a tentatively assigned premaxilla) give additional information concerning the species.

A new species, *Chendytes milleri*, is described from the Lower Pleistocene of San Nicolás Island. Wing elements are fairly well represented for this species, including the first record of the ulna for the genus *Chendytes*.

Chendytes milleri shows less degeneration of the wing than does *lawi* and it is suggested that the earlier species may represent an evolutionary stage in the development of *lawi*.

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