A NEW PLIOCENE STORK FROM NEBRASKA

By

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During 1956 Dr. Charles G. Sibley, visiting the University of Nebraska campus, borrowed from the Nebraska State Museum a number of avian fossils in that collection, with the intent of studying them. Subsequently Dr. Sibley gave me permission to undertake identification of the fossils, which included specimens from the Oligocene to the Pleistocene of Nebraska. Through the kindness of Dr. C. B. Schultz of the Nebraska State Museum and Dr. Sibley, I have been able to borrow these fossils for continuation of my investigations at the U. S. National Museum. One of them, a distal tibiotarsus, proves to represent a new genus and species of stork, which is herein described and compared with fossil and extant storks.

Family CICONIIDAE

Subfamily Ciconiinae

DISSOURODES, new genus

Diagnosis.—*Dissourodes* is most similar to the modern genus *Dissoura* Cabanis 1850, but distal tendinal groove opening in direct contact with deepest part of intercondylar fossa, not separated from it by a ridge between that opening and the intercondylar tubercle (as it is in *Dissoura*). Internal condyle distally angles toward the opening of the tendinal groove in *Dissourodes*. *Dissourodes* is much larger than *Dissoura episcopus*. Other characteristics of the genus are those given below for the type species *Dissourodes milleri*.

DISSOURODES MILLERI, new species (fig. 1)

Holotype.—Distal 162 mm. of left tibiotarsus, Nebraska State Museum No. 5780. The distal 135 mm. of the tibiotarsus is complete except for some surface abrasion, slight wear at various edges, and a missing intercondylar tubercle. The proximal portion of the bone is broken diagonally for 27 mm. This distal tibiotarsus represents an estimated 40 to 50 percent of the original bone. The fossil was collected on July 18, 1930, by Paul McGrew and Phillip Harper at a quarry four miles southeast of Valentine, Cherry County, Nebraska, SEC. 17, T. 33N, R. 27 W. It comes from Cr-12 in the Valentine formation of the Ogallala group, assigned to the Lower Pliocene (possibly upper Miocene). The tibiotarsus is fully fossilized and sandy brown in color. A cast of the bone is present in the U. S. National Museum.

Diagnosis.—The fossil tibiotarsus is massive, with a rather small condylar head for its shaft diameter. It is characterized by: having a narrow condylar head with a very narrow posterior border of its articulating surface; its narrow intercondylar groove; its very short, papilla-like, external ligamental process; its pronounced internal ligamental prominence; the lack of a definite notch between the intercondylar tubercle and external condyle; and its low, oval distal opening of the tendinal groove.

Measurements: Measurements and their ratios for the fossil are given in Table 1 (see p. 11).

Etymology: The generic name *Dissourodes* reflects the similarity between the fossil tibiotarsus and that of the modern *Dissoura episcopus.* It is a pleasure to name this species in honor of Dr. Loye H. Miller, who has contributed greatly to our knowledge of fossil birds.

COMPARISON WITH OTHER FOSSIL STORKS

The fossil tibiotarsus has been compared with descriptions and figures of *Propelargus edwardsi, Amphipelargus majori, Ciconia maltha, Xenorhynchopsis tibialis* and *X. minor,* for which distal tibiotarsi are known.

The following are the known fossil storks from the late Tertiary (mostly taken from Brodkorb, 1963):

Miocene	Pliocene	Pleistocene
Ibis milne-edwardsi—France	*Amphipelargus majori*—Greece	*Ciconia maltha*—U. S.
Pelargopappus magnus—France	*Ciconia gaudryi*—Greece	*Xenorhynchus nanus*—Australia
Propelargus edwardsi—France	*Leptoptilos falconeri*—India	*Xenorhynchopsis tibialis*—Australia

Miocene	Pliocene	Pleistocene
Propelargus olseni—Florida	*Leptoptilos pliocenicus*—Russia	*Xenorhynchopsis minor*—Australia
		Leptoptilos titan—Java
		Mycteria wetmorei—U. S.
		Pelargosteon tothi—Rumania
		Palaeopelargus nobilis—Australia
		Prociconia lydekkeri—Brazil

The fossil will be compared below with *Ibis, Leptoptilos, Ciconia* and *Mycteria. Amphipelargus major* (Lydekker, 1891) of the Lower Pliocene from the island of Samos is larger than the present fossil species, and has markedly different tibiotarsal features. Its distal articulating surface projects laterally due to expansion of the anterior inner condyle. This results also in a much wider intercondylar groove than in *Dissourodes milleri,* which shows no notable lateral expansion. The latter also exhibits a much broader supratendinal bridge and an oval, rather than round, distal tendinal groove opening. *Amphipelargus* too differs from *Dissourodes* in possessing a deeper posterior intercondylar sulcus.

Xenorhynchopsis of the Australian Pleistocene (De Vis, 1906) differs from *Dissourodes* in the proportionally greater width of the distal end of the tibiotarsus. The condyles are more broadly spaced with a broader intercondylar groove than in *Dissourodes.* The distal opening for the tendinal groove is round and not oval, as in the present species. The major feature of *Xenorhynchopsis* is the presence of a small subpyriform projection at the base of the tubercle lying between the condyles at the distal end of the supratendinal bridge. Unfortunately, the tubercle is broken off near its base in the fossil Nebraska tibiotarsus, but other differences mentioned make it unlikely that *Xenorhynchopsis* is closely related to *Dissourodes milleri.*

The genus *Propelargus* was described by Lydekker (1891) for an Oligocene (or Eocene) and a Miocene species, *P. cayluxensis* and *P. edwardsi,* respectively. A tibiotarsus possibly of the latter species (Lydekker, op. cit., p. 65) was not figured and the description given does not permit detailed comparison with the fossil tibiotarsus. Lambrecht (1933, pp. 318-320) accumulated one complete and four partial distal tibiotarsi assigned to *P. edwardsi,* but the complete one may represent a juvenile bird. Lambrecht's photograph (p. 319) is not clear, but the tibiotarsus represented shows general resemblance to that of *Dissourodes milleri.* The latter appears to have a more massive shaft, a more pronounced internal ligamental prominence, and an oval rather than round distal opening of the tendinal groove, when compared with the tibiotarsus illustrated by Lambrecht. These differences, the question of identity and age of *Propelargus* tibiotarsi, and occurrence of that genus in French Oligocene to Miocene deposits, seem to preclude its congeneric relationship with *D. milleri.*

The other fossil storks not previously discussed are not represented by tibiotarsi, except for certain species of Recent genera which will be discussed below. *Palaeopelargus nobilis* (De Vis, 1891) was described from metacarpal fragments and appears much larger than *D. milleri* (larger even than *Xenorhynchus*). *Prociconia lydekkeri,* from Pleistocene cave deposits in Brazil, is based on distal tarsometatarsi. It appears to represent a species the size of *Leptoptilos* (sp.), but little can be said about its affinities until we learn more about it. *Pelargopappus* is comprised of three species from the Oligocene (possibly also Eocene) and Miocene of France, and the material includes no tibiotarsi, except for a proximal tibiotarsus of *P. magnus.* The species of *Pelargopappus* were the size of *Cinonia ciconia* (*P. magnus*) or smaller. According to Lydekker (1891, p. 68) *Pelargopappus magnus* shows similarities to *Ibis. Palaeoephippiorhynchus dietrichi,* an Oligocene stork from North Africa, is not represented by tibiotarsal material. It is apparently closely related to *Ephippiorhynchus* (Lambrecht, 1933, pp. 325-326), a stork approximating species of *Leptoptilos* in size (see discussion of modern forms below). *Ciconiopsis antarctica* was an Argentine Oligocene form and is known only from a metacarpus. Kretzoi (1962) has recently described *Pelargosteon tothi* from the Pleistocene of Rumania. This form was between *Ciconia* (sp.) and *Leptoptilos* (sp.) in size, but no tibiotarsal material is yet available from it.

The tibiotarsus of *Dissourodes milleri* appears to differ considerably from fossil storks represented by tibiotarsal material. Perhaps the greatest need in paleoornithology is for comparative osteological studies of modern (and fossil) species, with emphasis on correlating modifications of elements within individual structural complexes and among related structural complexes. Such studies are essential to enable some evaluation of the biology of fossil forms, as well as to enable us better to establish their relationships. The differences between the fossil form and other represented tibiotarsal material are sufficient to warrant generic distinction for this species. Similarities with fossil species not represented by tibiotarsi remain to be demonstrated.

COMPARISON OF THE FOSSIL WITH LIVING STORKS AND THEIR FOSSIL CONGENERS

The following specimens were used in comparison with the fossil tibiotarsus: *Mycteria americana*, 10; *Euxenura galatea*, 2; *Dissoura episcopus*, 3; *Xenorhynchus asiaticus*, 1; *Anastomus lamelligerus*, 1; *Ibis cinereus*, 2; *Ephippiorhynchus senegalensis*, 1; *Ciconia ciconia ciconia*, 4; *C. c. boyceiana*, 1; *C. nigra*, 2; *Jabiru mycteria*, 10; *Leptoptilos dubius*, 2; *L. javanicus*, 2; *Sphenorhynchus abdimii*, 1. These species represent all genera listed by Peters (1931). Among living storks *Dissourodes milleri* shows some major similarities with *Dissoura episcopus, Jabiru mycteria, Ciconia ciconia* and *C. nigra*, and *Euxenura galatea*.

The tibiotarsus of *Dissourodes* differs rather strikingly from *Xenorhynchus asiaticus* in proportions of the condylar head of the bone. In the latter species the head of the bone is deep and narrow, with little evidence of lateral displacement of the inner condyle. The intercondylar groove is proportionally narrower, and the external ligamental process is much more elongate than that of *D. milleri*. A fossil species, *Xenorhynchus nanus* (De Vis, 1888), is more like *Dissourodes* but is peculiar in the great size of its tendinal groove. The two mycteriine genera, *Mycteria* and *Ibis* (*cinereus*) have the condylar heads of their tibiotarsi shaped generally like *Xenorhynchus* and so differ in a similar manner from the fossil. Their intercondylar grooves are peculiar in being V-shaped anteriorly but sharply shifting to a U-shape near the base of the groove. The distal tendinal groove opening is circular, not oval, in these genera, the species are much smaller than *Dissourodes milleri*, and the latter's tibiotarsus is generally much more massive. *Anastomus lamelligerus* differs from the fossil in many respects including its differently shaped intercondylar notch and shallow anterior condyles, longer supratendinal bridge, round distal opening of the tendinal groove, much more rounded posterior articulating face of the condylar head, and its much smaller size and less massive structure.

Modern species of *Leptoptilos* differ in tibiotarsal conformation from *Dissourodes*. The shaft in the latter is proportionally more massive in relation to the size of its condylar head, although representing a species smaller than those of modern *Leptoptilos*. Fossil species of this genus include *falconeri* (Lydekker, 1884), *titan* (Wetmore, 1940), and *pliocenicus* (Zubareva, 1948). Of these only *falconeri* is represented by a tibiotarsus that generally agrees with *Leptoptilos* and is quite different from that of *D. milleri.* The supratendinal bridge is shorter in the latter, and the distal opening of the tendinal groove is oval rather than round. The posterior portion of the condylar articulating surface is much broader in *Leptoptilos.* The intercondylar groove is similar in shape in both but broader in *Leptoptilos.* The external ligamental process is ridge-like in *Leptoptilos* and longer, not short and papilla-like. The inner lateral bulge is different in configuration in *Leptoptilos.* Finally, the posterior tip of the inner condylar edge is pointed and sharply angled in the fossil, while it is gently rounded in *Leptoptilos.* These differences are considerable and indicate that that genus is not closely related to *Dissourodes.*

The fossil tibiotarsus is similar in size to that of *Ephippiorhynchus senegalensis,* and its shaft is similar in shape. However, the latter has a very narrow and deep condylar head very unlike that of the fossil. Similarities between *Ephippiorhynchus* and *Dissourodes* include: a narrow intercondylar groove; an unnotched ridge between the intercondylar tubercle and the external condyle; an oval distal opening of the tendinal groove; and, a papilla-like external ligamental process. However, the tibiotarsus of *Ephippiorhynchus* is distinctive in several features, particularly in having a large process flaring anteriorly and laterally from a position beside the proximal opening of the tendinal groove. *Dissourodes* lacks such a process and has a shorter external ligamental process and a more oval distal opening of the tendinal groove. These and other minor configurational differences preclude the fossil being included within *Ephippiorhynchus.*

The modern *Sphenorhynchus abdimii* is much smaller than the species represented by the fossil. There are a number of general similarities between tibiotarsi of the two forms, including: the similarly shaped distal opening of the tendinal groove, the agreement between the two in length and shape of the papilla-like external ligamental process, and the unnotched condition of the ridge between the intercondylar tubercle and the external condyle. Although the distal opening of the tendinal groove is oval in both *Dissourodes* and *Sphenorhynchus,* that of the fossil does not angle laterally and proximally as in *Sphenorhynchus.* The margin of the posterior articulating surface is narrower in the fossil tibiotarsus. The posterior intercondylar sulcus is deeper in the fossil and situated more toward the inner side, while that of *Sphenorhynchus* resembles *Ciconia* in being shallower and located more centrally. *Sphenorhynchus* exhibits a groove lacking in *Dissourodes,* between the internal ligamental prominence and the anterior face of the internal condyle of its tibiotarsi. Finally the shape of the interior intercondylar fossa of the fossil tibiotarsus is quite different from that of *Sphenorhynchus.* This is chiefly due to the raised area, including the supratendinal bridge and intercondylar tubercle, angling toward the inside of the shaft and *distally* in the fossil tibiotarsus, and toward the inside and *proximally* in *Sphenorhynchus.* These differences are sufficient to preclude very close relationship between *Dissourodes milleri* and *Sphenorhynchus abdimii.*

Euxenura galatea approximates the fossil in size of the distal end of its tibiotarsus. The fossil is much more massive than *Euxenura;* indeed the fossil tibiotarsus may be described as having its shaft about the size of *Jabiru,* with a condylar head the size of *Euxenura.* Howard (1942, p. 200) pointed out the ridgelike nature of the external ligamental process in *Euxenura* and *Ciconia* (including the fossil *C. maltha*), in contrast to the papilla found in *Jabiru.* The fossil tibiotarsus resembles that of *Jabiru* (and also *Dissoura episcopus*) in this respect. The fossil tibiotarsus further differs from *Euxenura* in its relatively narrower condyles (both anteriorly and posteriorly), its narrower intercondylar groove (*Euxenura's* is broad, as in *Ciconia*), in having its intercondylar tubercle connected by an unnotched ridge with the external condyle, and in its longer supratendinal bridge. The distal opening of the tendinal groove is similarly placed in both, although shaped more elliptically in the fossil tibiotarsus. Finally, *Euxenura* agrees with *Jabiru* and *Ciconia* (including *C. maltha*) in having the anterior end of the external trochlea broad and barely indented by the intercondylar depression, rather than narrower and indented as in *Dissoura* and *Dissourodes.*

The fossil tibiotarsus is larger than those of living *Ciconia* species but is approached in size by the fossil *Ciconia maltha* (Miller, 1910). *Dissourodes milleri* differs significantly from *Ciconia* in a number of ways, chief among which are: its narrower intercondylar groove; indentation and narrowing of its anterior external condylar head; its distal tendinal groove opening is oval, not round; the intercondylar tubercle of the fossil tibiotarsus is connected by an unnotched, rather than a deeply notched ridge with the external trochlea; its internal ligamental process is papilla-like, not a long ridge as in *Ciconia;* its condylar head is relatively deeper; its more pronounced internal ligamental prominence; and, its internal condylar edge is more flaring posteriorly than in *Ciconia,* causing the posterior intercondylar sulcus to be displaced medially (as in *Jabiru, Euxenura* and *Dissoura*). The fossil resembles *Ciconia* in having a relatively deep and narrow condylar head.

The massiveness of the fossil tibiotarsus is responsible for some of its similarities with *Jabiru mycteria.* Both have a pronounced internal ligamental prominence, a papilla-like external ligamental process, an unnotched connection between the intercondylar tubercle and external condyle and a flaring margin of the posterior internal condyle. The intercondylar groove, although similar in shape in *Dissourodes* and *Jabiru,* is relatively narrower in the former than in any specimen of *Jabiru* examined. The fossil tibiotarsus has a narrower posterior condylar head than *Jabiru,* and its external ligamental process does not extend as far proximally. The distal opening of the fossil's tendinal groove is oval, not round in shape, and it is not connected by a ridge with the intercondylar tubercle, as in *Jabiru.* Also, *Jabiru* lacks (or has only vaguely present) a process on the supratendinal bridge below the distal opening of the tendinal groove; this process in *Dissourodes milleri* produces a notch above the anterior internal condyle (visible from the internal side).

As has been suggested above, the fossil tibiotarsus most closely agrees with that of *Dissoura episcopus.* The shape of the distal end (viewed end-on) is identical in the two, including the shape of the flaring posterior internal condylar surface, the shape and width of the intercondylar groove, and the relatively narrow posterior margin. The external ligamental process is papilla-like and about equally short in both. The distal opening of the tendinal groove is elliptical in both, and the ridge between the intercondylar tubercle and the external condyle lacks a notch. Although the fossil represents a much larger species, the thickness of the distal shaft and size of the trochlear head are comparable in the two forms. Other similarities include the shape of the condylar margins, depth of the condyles, configuration of the internal ligamental prominence and the angle of the tendinal groove. There are two noteworthy differences between *Dissoura* and the fossil. There is in *Dissoura* a ridge between the distal tendinal groove opening and the intercondylar tubercle. This ridge seems to separate the opening from the rest of the intercondylar fossa. The fossil lacks this ridge and the opening is in direct contact with the deepest part of the fossa. Also, tibiotarsi of the two forms differ in the configuration of the intercondylar fossa. In *Dissoura* the internal condyle distal to the distal opening of the tendinal groove is more laterally angled. In *Dissourodes* the condyle angles more toward the opening of the tendinal groove, thus reducing the extent of the fossa between the condyle and the opening.

The fossil tibiotarsus thus represents a species related to the modern, paleotropical wooly-necked stork (*Dissoura episcopus*), and probably also the jabiru (*Jabiru mycteria*). While similar to *Dissoura, Dissourodes* differs in several respects noted above and in its much larger size and slightly more massive tibiotarsus. Its resemblances to *Jabiru* and its occurrence in the New World warrant generic recognition for this fossil form.

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SUMMARY

A fossil tibiotarsus from the Lower Pliocene of Nebraska proves to be a new genus and species of fossil stork, *Dissourodes milleri.* This form differs from all (sufficiently known) fossil and modern storks, but shares many features with *Dissoura episcopus* and also *Jabiru mycteria.* Several differences in the condylar head of the tibiotarsus distinguish it from these two storks.

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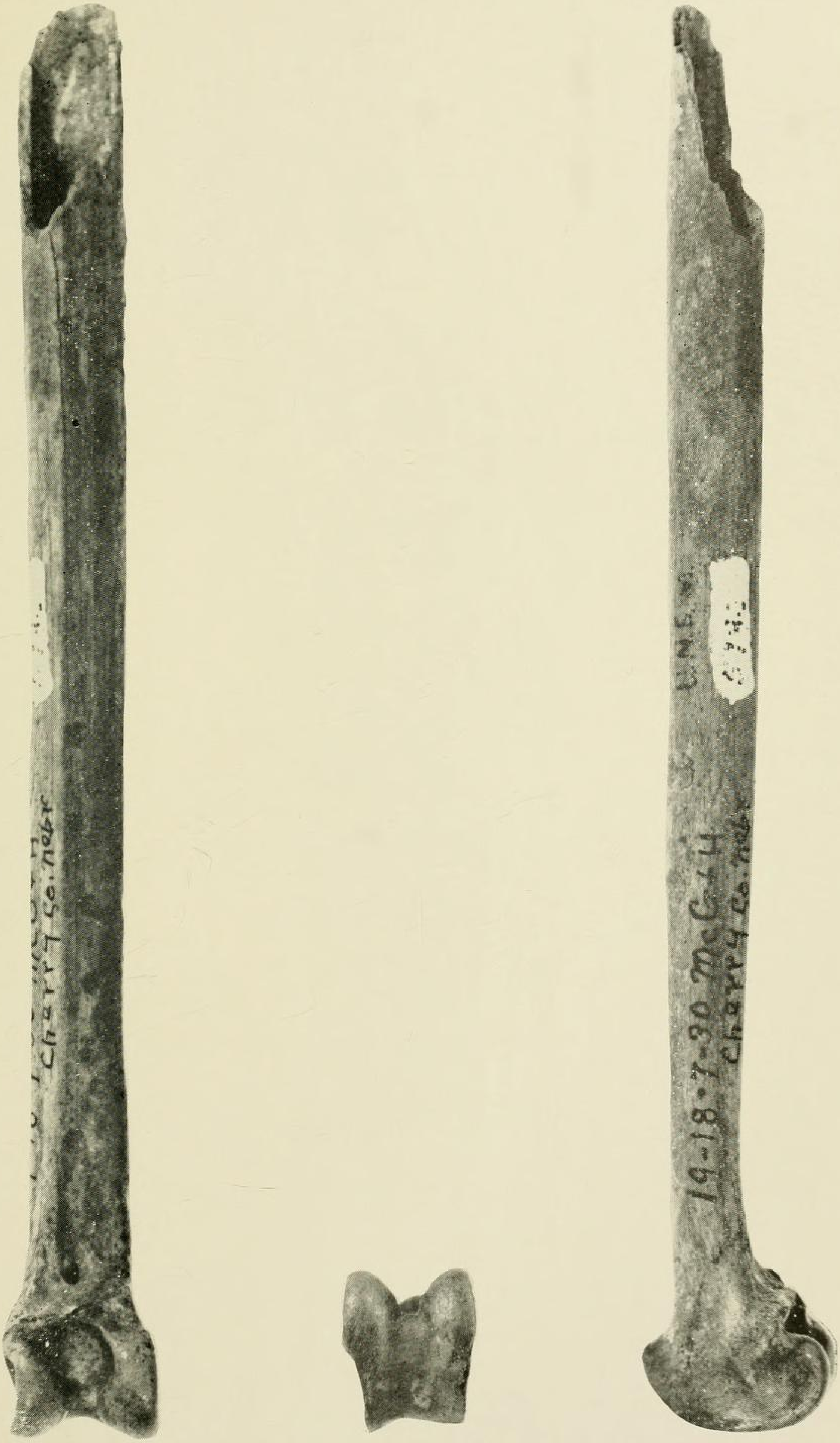
TABLE 1

Measurements of *Dissourodes milleri* tibiotarsus

1. Antero-posterior shaft diameter just above external ligamental process. 10.3 mm.
2. Antero-posterior shaft diameter 5 cm. above proximal base of (curvature of) external condyle. 9.4 mm.
3. Antero-posterior shaft diameter 10 cm. above proximal base of (curvature of) external condyle. 10.0 mm.
4. Greatest antero-posterior condylar distance. 21.2 mm.
5. Distance from proximal base of external ligamental process to distal end of the external condyle. 18.5 mm.
6. Distance from proximal base of external ligamental process to proximal base of (curvature of) external condyle. 4.2 mm.
7. Greatest distance across condyles at distal end of tibiotarsus. 16.7 mm.
8. Distance across condyles at internal ligamental prominence. 16.3 mm.
9. Lateral shaft diameter at level of proximal base of external ligamental process. 13.7 mm.
10. Lateral shaft diameter 5 cm. above posterior proximal end of condylar articulating surface. 10.6 mm.
11. Lateral shaft diameter 10 cm. above posterior proximal end of condylar articulating surface. 11.5 mm.
12. Distance across condylar articulating surface at line marking its posterior proximal end. 10.3 mm.
13. Distance across condyles at their anterior ends. 15.6 mm.
14. Distance across anterior intercondylar groove (taken within 1 mm. of bottom of groove). 2.5 mm.
15. Distance from distal opening of tendinal groove to distal, lateral edge of external condyle. 15.4 mm.
16. Distance across supratendinal bridge. 4.8 mm.
17. Distance from a point on the inner (medial) shaft surface at the level of the proximal edge of the supratendinal bridge, to the distal end of the internal condyle. 18.1 mm.
18. Distance across *flat* anterior shaft surface 5 cm. above proximal edge of supratendinal bridge. 8.9 mm.



Three views of the left tibiotarsus of *Dissourodes milleri*, gen. et sp. nov. From the left, the views are of: (a) the anterior face of the bone; (b) the distal end of the bone, and (c) its inner surface. About $1\frac{1}{4}$ natural size.