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A MIDDLE EOCENE SHOREBIRD FROM CHINA

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Abstract. We describe a new species of shorebird, tentatively referred to the family Charadriidae, from the Huadian Formation (Middle Eocene) in Jilin Province, China. In general morphology the specimen closely matches that of an extant charadriid, and corresponds in size to the Killdeer (*Charadrius vociferus*). If correctly identified this is the oldest record of the Charadriidae. The Middle Eocene paleoenvironment of the Huadian region is thought to have resembled a subtropical swamp.

Key words: Charadriiformes, China, Huadian Formation, Jiliniornis huadianensis, *Middle Eocene, paleontology.*

Un Ave Playera de China del Eoceno Medio

Resumen. Describimos una nueva especie de ave playera, tentativamente clasificada como de la Familia Charadriidae, de la Formación Huadian (Eoceno Medio) en la Provincia de Jilin, China. En términos de morfología general, el ejemplar coincide mayormente con la morfología de un charádrido actual, y se asemeja en tamaño a *Charadrius vociferus*. Si la identificación es correcta, este representa el registro más antiguo para la Familia Charadriidae. El paleoambiente del Eoceno Medio de la región de Huadian se asemejaba probablemente a un pantano subtropical.

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Although charadriiform birds are not uncommon in the fossil record, only a few extant families have been reported from the Tertiary Period (Olson 1985), and none from its earliest epochs. The Late Cretaceous and Early Tertiary record of the order Charadriiformes is dominated by taxa referred to the extinct family Graculavidae (Olson 1985, Olson and Parris 1987, Boles 1999, Case and Tambussi 1999, Feduccia 1999, Hope 1999, Hope, in press). The graculavids lack certain anatomical characteristics in the humerus that are supposed to be derived in recent charadriiforms, for example a large second pneumatic fossa in the proximal

end and a well-developed dorsal supracondylar process, suggesting that the group represents an early branch in the charadriiform radiation (Feduccia 1999). However, the lack of well-preserved, articulated specimens has prevented an analysis of the precise systematic position of the Graculavidae, and the monophyly of this taxon remains to be verified (Hope 1999, Hope, in press).

Besides the graculavids, more derived (''higher'' sensu Olson 1985) charadriiforms are known from the Paleogene of France (Bessonat and Michaut 1973, *fide* Mayr 2000), Germany (Mayr 2000), and in the United States (Virginia; Olson 1999). These taxa, however, have not been conclusively referred to extant families of the order Charadriiformes. Tertiary paleospecies have been described of the following recent charadriiform families: Burhinidae, Haematopodidae, Recurvirostridae, Scolopacidae, Glareolidae, and Laridae.

Two other groups of birds with a suggested charadriiform affinity that have a Paleogene fossil record are the Presbyornithidae (an extinct group once suggested to be intermediate between shorebirds and ducks) and the Phoenicopteridae (flamingos; Olson 1985). However, neither of these families is now believed to be part of the order Charadriiformes. The Presbyornithidae has conclusively been shown to be an anseriform group (Ericson 1997, Livezey 1997), while a close relationship between flamingos and charadriiforms could not be corroborated by DNA-DNA hybridization data (Sibley and Ahlquist 1990), nor analyses of nucleotide sequences (van Tuinen et al. 2001).

Early Tertiary vertebrate fossils have been collected from oil shale and coal deposits at Huadian, Jilin Province, in northeastern China for more than 50 years (Wang and Li 1990). Beside birds, this formation has also yielded fossils of mammals, reptiles and fish. The age of the Huadian Formation has been variously interpreted. Recently, it was assumed to be of Late Eocene age based on the mammal fauna (Wang and Li 1990). However, the close resemblance between the fish fauna of the Huadian Formation and the Green River Formation of North America suggests a Middle Eocene age for the Huadian Formation (Zhou and Sun 1985, Chang and Chen 2000, Chang Mee-mann, pers. comm.). The Middle Eocene environment in the Huadian area has been characterized as a subtropical swamp forest (Wang and Li 1990), probably closely resembling that of the contemporary Green River Formation. In this paper we report on a bird specimen collected from the Huadian Formation by a field team from the Regional Geological Survey of the Jilin Province.

METHODS

The osteological terminology follows Baumel and Witmer (1993), with the Latin terms replaced by their English equivalents. The measurements were taken with a slide caliper to the nearest 0.1 mm. The specimen is stored at the Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing.

SYSTEMATIC PALEONTOLOGY

Order Charadriiformes Garrod, 1874
Family *cf.* Charadriidae Vigors, 1825
Jiliniornis nov. gen.

Type species. Jiliniornis huadianensis nov. sp.

Diagnosis. As noted by others (Hope, in press) charadriiform birds are difficult to diagnose based on their general osteology, and this is also true for the humerus. A charadriiform affinity for *Jiliniornis* is indicated by the possession of a dorsal tricipital fossa and a well-developed supracondylar process. The former character differentiates it from all members of the Anatidae, Presbyornithidae, and Phoenicopteridae. While procellariiform birds also possess a shallow dorsal tricipital fossa and a well-developed supracondylar process, *Jiliniornis* lacks the unique torsion of the humerus of these birds. Furthermore, the supracondylar process (when present) protrudes less far cranially in charadriiform birds, than in the procellariforms. The proportions and general appearance of the bone closely resemble that of a recent charadriid or scolopacid bird.

Etymology. Named after the province where the type species was discovered.

Remarks. Jiliniornis huadianensis exhibit osteological features (a distinctly concave caudal surface of the deltoid crest; the absence of a bony ridge in the capital groove; a well-developed dorsal supracondylar process; a nonpneumatized ventral tricipital fossa; and a distinctly triangular deltopectoral crest) that, when taken individually, are either primitive within the order Charadriiformes, or occur also outside the family Charadriidae. However, in combination they are found in no other extant taxon than the Charadriidae (*cf.* Strauch 1978). This leads us to tentatively place *Jiliniornis* in the Charadriidae, although we recognize the possibility that the humerus of *Jiliniornis* exhibits the plesiomorphic morphology for a group of birds to which the Charadriidae belong. It differs from all extant representatives of the Charadriidae by having the humeral head not caudally undercut, the dorsal tricipital fossa shallow and poorly developed, and the proximal end of the caudal margin of the shaft less pronounced.

Jiliniornis huadianensis nov. sp.

Holotype. Complete right humerus exposed mainly in a caudal aspect (Fig. 1); Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, Beijing, IVPP V.8323.

Type locality and horizon. Huadian, Jilin Province, China. Huadian Formation (Middle Eocene). Coordinates: 43°00′N, 126°40′E.

Etymology. Named after the locality in Jilin Province where it was found.

Diagnosis. Same as for the genus.

Description and comparison. Unlike in extant members of the Charadriidae the humerus has the dorsal tricipital fossa shallow and poorly developed, while the ventral is well developed. The humeral head is rather small and rounded, but not caudally undercut. The dorsal tubercle is elevated from the shaft and has a marked scar for the attachment of the supracoracoideus muscle. The ventral tubercle is poorly preserved but may be less prominent than in modern charadriids. The in-

FIGURE 1. The holotype, a right humerus, of *Jiliniornis huadianensis* nov. sp. (IVPP V.8323). The bone (still in matrix) was collected from the Huadian Formation (Middle Eocene), at Huadian, Jilin Province, China. The scale bar is 1 cm.

cisura capitis is smooth as in charadriids, and lacks the bony ridge diagnostic of scolopacid taxa. The cranial surface of the humerus can be observed only at the proximal end, but it is not well preserved. A transversal ligamental groove is present although we cannot determine how deep it is. The deltoid crest is well developed and markedly dorsocaudally protruding, which gives it the triangular shape typical of many extant charadriids. The caudal surface of the deltoid crest is distinctly concave as in other charadriids, and not convex as in, for example, glareolids and scolopacids. At the proximal end of the bone, the caudal margin of the shaft is not as pronounced as in many charadriids. In this character it most closely resembles the condition in *Charadrius morinellus*. The dorsal supracondylar process is well developed and closer to the shaft than in many noncharadriid taxa. The dorsal groove for the tricipital tendon is deep, like in many charadriiforms, while the olecranial fossa is shallow. The ventral epicondyle is not well preserved, but it does not seem to have projected very much distally.

Measurements (mm). Length 35, width of proximal end 10, depth of caput 3, length of crista pectoralis 8, least width of corpus 3, height of the dorsal supracondylar process (from distal end) 6, and width of distal end 6.

Remarks. Given that the familial allocation of *Jiliniornis huadianensis* is correct, it is arguably the oldest described fossil of an extant group of the order Charadriiformes. Even though molecular data suggest that the shorebirds evolved by the Late Cretaceous (van Tuinen and Hedges 2001), only one Tertiary species has reliably been referred to the family Charadriidae (Olson 1985, Olson and Rasmussen 2001). The observation that extant charadriiform families originated prior to the Middle Eocene is consistent with calculations based on molecular-clock estimates that many extant orders and families of birds evolved during the Cretaceous (Cooper and Penny 1997, van Tuinen and Hedges 2001, Ericson et al. 2002).

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