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EARLY MIOCENE BIRDS OF DJEBEL ZELTEN, LIBYA

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Abstract. Early Miocene deposits of Djebel Zelten in Libya yielded two identifiable fragments of avian bones, which belong to a heron (*Zeltornis ginsburgi*) and a stork (*Palaeoephippiorhynchus edwardsi*). Both findings are of a considerable interest, because the Tertiary record of both of these families is exceedingly rare. Genus *Grallavis* Cheneval, 1984 was synonymized with *Palaeoephippiorhynchus* Lambrecht, 1930, and family Xenerodiopidae Rasmussen et al., 1987 was synonymized with Ardeidae Leach, 1820.

■ **Aves, Miocene, Libya.**

INTRODUCTION

Tertiary avian localities are not uncommon in North Africa (Rich 1974), but only three of them yielded reasonable amount of identifiable bones so far: the complex Fayum locality in Egypt (early Oligocene; Rasmussen et al. 1987), Beni Mellal in Morocco (middle Miocene, MN 7; Brunet 1961, 1971, Mayr 1998), and the complex locality Bled el Dourah in Tunisia (late Miocene, MN 9; Rich 1972, 1974). Below, avian remains from a fourth locality (Djebel Zelten in Libya) are described.

Djebel Zelten (also spelled Jabal Zaltan) is a desert hill in the province of Cyrenaica in NE Libya, ca. 150 km south of Surt Bay (ca. 28°30' N, 20°00' E). Its fossiliferous deposits were discovered in the 1950s by French paleontologists (see Arambourg et Magnier 1961). Using micromammals, the age of the deposits was estimated at Burdigalian, MN 3 (Savage 1967), although more recent data indicate that it can be slightly younger (MN 4; O. Fejfar, pers. communication). For a geological description of the locality see Magnier (1962) and Savage (1967).

Avian remains from Djebel Zelten were first mentioned by French paleontologists Arambourg et Magnier (1961, see also Rich 1974). Balouet (1981) described the only one avian bone from this locality, which he considered determinate, as a new genus and species of a heron. In 1983, Czech paleontologist Oldřich Fejfar continued excavations at the site, which resulted in the discovery of a second identifiable avian bone fragment, this time of a stork.

In describing age of the localities, Mammal Neogene zones (MN) of Mein (1990) and Steininger et al. (1996) are used. The material is deposited in the Muséum National d'Histoire Naturelle (MNHN) in Paris, France (*Zeltornis*), and in Fejfar's collection (OF) in Praha, Czech Republic (*Palaeoephippiorhynchus*).

SYSTEMATIC LIST

Order Ciconiiformes Bonaparte, 1854
Family Ardeidae Leach, 1820
Genus *Zeltornis* Balouet, 1981
Zeltornis ginsburgi Balouet, 1981
Zeltornis ginsburgi Balouet, 1981: 235, fig. 1–4.

Material: proximal end of right coracoid; MNHN, uncatalogued.
Measurements (after Balouet 1981): maximum width and depth of head = 20.9 × 12.9 mm, maximum length of facies glenoidalis = 17.8 mm.
Comparison: Balouet (1981) detailed that *Zeltornis* is similar to night herons (subfamily Nycticoracinae sensu Payne and Risley 1976). Rasmussen et al. (1987) described a new heron-like genus and species *Xenerodiops mycter* from the early Oligocene of Fayum in Egypt. They found the holotypical rostrum of this species sufficiently aberrant from the Ardeidae, therefore they placed the bird in a new family Xenerodiopidae. Nevertheless, rostra tend to acquire "non-ardeid" shapes in the ardeid subfamily Nycticoracinae, where two of the three genera (*Nyctanassa* Stejneger, 1887 and *Cochlearius* Brisson, 1760) have highly modified, broad bills (Adams 1955, Cracraft 1967, Payne et Risley 1976). Moreover, large tricipital fossa on the paratypical humerus of *Xenerodiops mycter* resembles those in *Cochlearius*. In all, *Xenerodiops* seems to be another member of the Nycticoracinae, and Xenerodiopidae Rasmussen et al., 1987 should thus be merged with Ardeidae Leach, 1820. In size, *Xenerodiops mycter* is similar to *Zeltornis ginsburgi*. Diversity of very large night-herons in NE Africa in the mid-Tertiary could hardly be high, which opens the possibility that *Xenerodiops mycter* Rasmussen et al., 1987 is a synonym of *Zeltornis ginsburgi* Balouet, 1981. Nevertheless, direct comparisons are impossible, because the taxa were based on different bones. Taking into account also the difference in age (early Oligocene vs. early Miocene), I hesitate to do this action. *Nycticorax* sp., recorded by Rasmussen et al. (1987) from the early Oligocene of Fayum in Egypt was much smaller than either *Zeltornis ginsburgi* or *Xenerodiops mycter*, providing thus direct evidence for the existence of at least two night-herons in NE Africa in the early Oligocene.
Remarks: Confirmed record of the subfamily Nycticoracinae (sensu Payne et Risley 1976) is limited to *Xenerodiops mycter* and *Nycticorax* sp. from the early Oligocene of Fayum in Egypt (Rasmussen et al. 1987), and to *Zeltornis ginsburgi* from the early Miocene of Zelten in Libya (Balouet 1981). Several other ardeids were described from Oligocene and Miocene deposits of Europe and North America, but their affinbities within the family remain unknown (Brodkorb 1980, Olson 1985, Mlíkovský 2002).

Family Ciconiidae Sundevall, 1836
Genus *Palaeoephippiorhynchus* Lambrecht, 1930
Palaeoephippiorhynchus edwardsi (Lydekker, 1891b)
Propelargus (?) *edwardsi* Lydekker 1891b: 479.
Grallavis edwardsi (Lydekker): Cheneval 1984: 44 (new combination)
Palaeoephippiorhynchus edwardsi (Lydekker): Mlíkovský, this paper (new combination).

Material: proximal fragment of right humerus; OF, uncatalogued.
Measurementsv: Not meaningfully measurable. In size, the humerus fragment corresponds with the same element of the modern *Ephippiorhynchus asiaticus*.

Comparison: Border of the deltoid crest is not markedly deepened, in which character the fossil resembles the same element of modern representatives of the genera *Ephippiorhynchus* and *Mycteria*, and also the fossil genus *Grallavis* (see Cheneval 1984). It differs from *Mycteria* in the position of the insertion point of musculus latissimus dorsi posterior. This point is at the border of the pneumatic fossa in *Mycteria*, while in the fossil specimen, in *Grallavis* and in the modern representatives of *Ephippiorhynchus*, *Ciconia*, *Anastomus*, *Jabiru* and *Leptoptilos* it lays medio-distally from it. Impression of the proximal portion of musculus latissimus dorsi posterioris is not markedly inflated as in *Leptoptilos*, and agrees thus with all other modern stork genera and *Grallavis*. The Zelten specimen differs from the same element of all modern stork genera and agrees with that of *Grallavis* also in having exostoses in the proximal part of bicipital furrow. In size, the Zelten stork agrees with *Grallavis edwardsi* from the early Miocene (MN 2) of Saint-Gérand-le-Puy in France (see Cheneval 1984). In absence of morphological and mensural differences, and taking into account both stratigraphical and geographical proximity of the localities Djebel Zelten and Saint-Gérand-le-Puy, I identify here the Zelten stork as *Grallavis edwardsi* (LYDEKKER).

Another large stork, *Palaeoephippiorhynchus dietrichi* LAMBRECHT, 1930, was described on the basis of a nearly complete brain case and a partial mandible from the early Oligocene of Qasr Qarun in Egypt. Later, distal end of a tibiotarsus was found in the nearby and similarly aged Quarry M (Rasmussen et al. 1987). All the elements were said to be very similar to those of modern *Ephippiorhynchus* storks, which applies also to *Grallavis edwardsi* (CHENEVAL 1984) and the Zelten specimen. In size, *Palaeoephippiorhynchus* is similar to *Grallavis edwardsi*. No differences between the crania of *Palaeoephippiorhynchus dietrichi* and *Grallavis edwardsi* were mentioned by Cheneval (1984). Hence, I synonymize here *Grallavis* CHENEVAL, 1984 (type species: *Propelargus edwardsi* LYDEKKER) with *Palaeoephippiorhynchus* LAMBRECHT, 1930. The species should thus bear the name *Palaeoephippiorhynchus edwardsi* (LYDEKKER 1891b), new combination. On the other hand, I hesitate to synonymize here *Palaeoephippiorhynchus dietrichi* LAMBRECHT, 1930 with *Palaeoephippiorhynchus edwardsi* LYDEKKER, 1891b, because of the differences in their age (early Oligocene vs. early Miocene). The possibility, that these two species are identical, should nevertheless be kept in mind.

Palaeoephippiorhynchus edwardsi was a large stork of the size of the modern *Ephippiorhynchus asiaticus*, being morphologically quite similar to modern *Ephippiorhynchus* storks, but with shorter hind limbs. In the latter character it resembled modern *Leptoptilos* storks (see Cheneval 1984). So far, this species has been recorded from the early Miocene of Libya (this paper), and France (Lydekker 1891b, Cheneval 1984, Mlíkovský 2002) only.

Comparative material: Humeri of *Mycteria americana* LINNAEUS, 1758, *Anastomus oscitans* (BODDAERT, 1783), *A. lamelligerus* TEMMINCK, 1823, *Ciconia ciconia* (LINNAEUS, 1758), *C. maguari* (GMELIN, 1789), *C. episcopus* (BODDAERT, 1783), *C. nigra* (LINNAEUS, 1758), *C. abdimii* LICHTENSTEIN, 1823, *Ephippiorhynchus asiaticus* (LATHAM, 1790), *E. senegalensis* (SHAW, 1800), *Jabiru mycteria* (LICHTENSTEIN, 1819), *Leptoptilos javanicus* (HORSFIELD, 1821), *L. crumeniferus* (LESSON, 1831), and *L. dubius* (GMELIN, 1789), i.e. representatives of all modern genera and 14 of 17 modern species recognized by Kahl (1972).

Remarks: The earliest known stork is *Palaeoephippiorhynchus dietrichi* LAMBRECHT, 1930 from the early Oligocene of Fayum in Egypt (Lambrecht 1930, Rasmussen et al.

1987). Next oldest records are *Palaeoephippiorhynchus edwardsi* LYDEKKER, 1891b from the early Miocene (MN 2) of Saint-Gérand-le-Puy in France (Lydekker 1891b, Cheneval 1984) and the early Miocene (MN 3–4) of Djebel Zelten in Libya (this paper), *"Cygnus" bilinicus* LAUBE, 1909 from the early Miocene (MN 3) of Břešťany in the Czech Republic (Mlíkovský et Švec 1989), *Ciconia minor* HARRISON, 1980 from the early Miocene of Rusinga Insland in Kenya (Harrison 1980) and *"Propelargus" olseni* BRODKORB, 1963b from the early Miocene (Hawthorne Formation) of Tallahassee in Florida (Brodkorb 1963b). Taxonomic position of these storks within the family is not well known (with the exception of *Palaeoephippiorhynchus*). "*Cygnus*" *bilinicus* was based on totally flattened bone fragments, which cannot be identified within the family (Mlíkovský et Švec 1989). The generic position of *Ciconia minor* should be reevaluated. *Propelargus olseni* cannot belong to this genus, because its type species (*Propelargus cayluxensis* LYDEKKER, 1891a) is not a stork (see below), and its position within the family Ciconiidae awaits clarification.

Several other Oligocene and early Miocene storks were listed in earlier catalogues (Lambrecht 1933, Brodkorb 1963a), but their restudy led to their removal from the family. *Pelargopsis stehlini* GAILLARD, 1908, and *Pelargopsis trouessarti* GAILLARD, 1908 from the undated (late Eocene to late Oligocene – see Rémy et al. 1987, Mourer-Chauviré 1996) deposits of the phosphorites of Quercy in France and *Pelargopsis magnus* MILNE-EDWARDS, 1867 from the early Miocene (MN 2) of Saint-Gérand-le-Puy in France were all reidentified as sagittariid raptors (Mourer-Chauviré et Cheneval 1983). *Propelargus cayluxensis* LYDEKKER, 1891a, also from the undated (late Eocene to late Oligocene) phosphorites of Quercy, was later transferred in the Cariamidae (Mourer-Chauviré 1983). *Ciconiopsis antarctica* AMEGHINO, 1899 from the early Oligocene (Deseado Formation) of Patagonia (exact locality unknown) in Argentina was removed from the Ciconiidae (Tonni et Tambussi 1986), but its affinities have not yet been clarified.

Both oldest storks, for which the taxonomic position has been adequately determined (*Palaeoephippiorhynchus edwardsi* and *Palaeoephippiorhynchus dietrichi*) belong to the Leptoptilini sensu Kahl (1972). Intrafamily phylogeny of the Ciconiidae has not been resolved yet (cf. Kahl 1972, Wood 1984), but the fossil record indicates that *Ephippiorhynchus*-like storks were ancestral within the family.

Aves incertae sedis

M a t e r i a l: Unknown, probably eggshell fragments. Arambourg et Magnier (1961) listed an "aepyornithide (*Psammornis*?)" from Djebel Zelten, without stating which remains were found. Neither Rich (1974) nor I were able to locate the material. The genus *Psammornis* was based solely on large eggshell fragments from northern Africa (see below), which makes it probable that Arambourg et Magnier's identification was based on eggshell fragments as well.

R e m a r k s: *Psammornis* was described by Andrews (1911) on the basis of eggshell fragments from Touggourt in Algeria, which he believed to be Eocene in age. Subsequently, eggshell fragments from a variety of North African sites, including those in Libya (Moltoni 1928), were assigned to *Psammornis* (Rich 1974, Sauer et Sauer 1978). The eggshells were believed to have aepyornithine patterns, but Sauer (1969, 1972) showed that all the specimens came from surface dune deposits and are thus probably Quaternary in age, belonging to *Struthio* LINNAEUS, 1758. Michajlov et Kuročkin (1988)

restudied much of this material, concluding that these eggshells form two groups, both of which are morphologically similar to *Struthio* eggshells. In addition, Rothe (1964, Sauer et Rothe 1972) reported that aepyornithid eggshells were found in the late Miocene deposits of Lanzarote, eastern Canary Islands, but they seem to belong to giant seabirds from the family Pelagornithidae s.l. (García Talavera 1990 sub Odontopterygiformes). The eggshells (?) from Djebel Zelten cannot be identified even to the order until they are rediscovered and restudied.

DISCUSSION

Early Miocene avian localities are common in Europe (Mlíkovský 1996a,b, 2002), but only two such localities were reported from Africa: Rusinga Island in Kenya (Harrison 1979), and Djebel Zelten in Libya. In general, the avifauna of Djebel Zelten resembles early Miocene localities of Europe (see Mlíkovský 1996b, 2002), and also the early Oligocene complex locality Fayum in Egypt (see Olson et Rasmussen 1986, Rasmussen et al. 1987). It might be of some interest from the zoogeographical point of view, that herons from the subfamily Nycticoracinae were found in both North African localities, but not yet in any Tertiary site of Europe (Mlíkovský 1996b, 2002).

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