DUCKS, RAILS, AND LIMICOLINE WADERS (AVES: ANSERIFORMES, GRUIFORMES, CHARADRIIFORMES) FROM THE LOWERMOST OLIGOCENE OF BELGIUM

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ABSTRACT - A diverse avifauna is described from the lowermost Oligocene (MP 21) of the locality Boutersem near Bruxelles, Belgium. Remains of at least 13 avian taxa were distinguished and many are represented by more than one skeletal element. Coracoids of two anseriform taxa were identified, one of these is tentatively assigned to *Paracygnopterus* HARRISON & WALKER, 1979, the other is tentatively referred to *Romainvillia* LEBEDINSKY, 1927. Other anseriform bones are described but could not be assigned to one of the coracoids. The specimen referred to *Paracygnopterus* is the earliest certain record of the Anatidae and confirms the presence of this family in the lowermost Oligocene of Western Europe. Charadriiform birds are represented by at least four different species. Two of these are assigned to the new genus *Boutersemia* (*Boutersemia belgica* nov. gen. nov. sp., *Boutersemia parvula* nov. gen. nov. sp.). The genus *Boutersemia* is characterized by a large foramen vasculare distale on the tarsometatarsus and is tentatively assigned to the Glareolidae. Three species of rails (Gruiformes, Rallidae) were identified, two of which are classified in the new genus *Belgirallus* (*Belgirallus oligocaenus* nov. gen. nov. sp., *Belgirallus minutus* nov. gen. nov. sp.). The species of the genus *Belgirallus* are among the earliest substantial record of fossil Rallidae, and *Belgirallus minutus* is the smallest early Tertiary rail known so far. A fragmentary distal end of a tarsometatarsus has been assigned to the Pici and represents the earliest fossil record of this taxon. A distal end of an upper beak resembles that of recent Scolopacidae and Rostratulidae (Charadriiformes), but is much larger. Fragmentary tarsometatarsi of two large avian taxa probably belong to the Idiornithidae (Gruiformes) and Phoenicopteriformes. © 2001 Éditions scientifiques et médicales Elsevier SAS

KEYWORDS: FOSSIL BIRDS, LOWERMOST OLIGOCENE, BELGIUM, *BOUTERSEMIA* NOV. GEN., *BELGIRALLUS* NOV. GEN.

RÉSUMÉ - Une avifaune diversifiée est décrite de l'Oligocène basal (MP 21) de Boutersem près de Bruxelles, Belgique. Des restes d'au moins 13 taxons d'oiseaux ont été reconnus et la plupart de ceux-ci sont représentés par plus d'un élément du squelette. Les coracoïdes de deux taxons d'ansériformes ont été identifiés. L'un des deux est provisoirement rapporté à *Paracygnopterus* HARRISON & WALKER, 1979, l'autre à *Romainvillia* LEBEDINSKY, 1927. D'autres ossements d'ansériformes sont décrits, mais ils ne peuvent appartenir à aucun des taxons décrits sur la base des coracoïdes. Le spécimen rapproché de *Paracygnopterus* est le plus ancien représentant des Anatidae et confirme la présence de cette famille à l'Oligocène basal en Europe occidentale. Les oiseaux appartenant aux Charadriiformes sont représentés par, au moins, quatre espèces différentes. Pour deux d'entre elles, le nouveau genre *Boutersemia* nov. gen. a été créé (*Boutersemia belgica* nov. gen. nov. sp., *Boutersemia parvula* nov. gen. nov. sp.). Le genre *Boutersemia* est caractérisé par un grand foramen vasculare distale sur le tarsométatarse et est provisoirement rapporté aux Glareolidae. Sur les trois espèces de râles (Gruiformes, Rallidae) identifiées, deux sont incluses dans le nouveau genre *Belgirallus* (*Belgirallus oligocaenus* nov. gen. nov. sp., *Belgirallus minutus* nov. gen. nov. sp.). Les espèces du genre *Belgirallus* font partie des plus anciens représentants des Rallidae. *Belgirallus minutus* est actuellement le plus petit râle connu dans le Tertiaire inférieur. Un fragment distal de tarsométatarse a été attribué aux Pici; c'est le plus ancien représentant de ce taxon. Un fragment distal de la partie supérieure d'un bec ressemble à celui des Scolopacidae et Rostratulidae (Charadriiformes), bien que de plus grande taille. Des fragments de tarsométatarses de deux grands taxons d'oiseaux appartiennent probablement aux Idiornithidae (Gruiformes) et Phoenicopteriformes. © 2001 Éditions scientifiques et médicales Elsevier SAS

MOTS-CLÉS: OISEAUX FOSSILES, OLIGOCÈNE BASAL, BELGIQUE, *BOUTERSEMIA* NOV. GEN., *BELGIRALLUS* NOV. GEN.

ZUSAMMENFASSUNG - Eine formenreiche Avifauna wird aus dem untersten Oligozän (MP 21) von Boutersem bei Brüssel, Belgien, beschrieben. Reste von mindestens 13 Vogeltaxa wurden unterschieden und viele davon sind durch mehr als ein Skelettelement vertreten. Coracoide von zwei anseriformen Taxa wurden identifiziert, eines davon wurde unter Vorbehalt zur Gattung *Paracygnopterus* HARRISON & WALKER, 1979 gestellt, das andere unter Vorbehalt zur Gattung *Romainvillia* LEBEDINSKY, 1927. Andere anseriforme Knochen werden beschrieben, konnten aber nicht einem der beiden Coracoide zugeordnet werden. Das Exemplar, das zu *Paracygnopterus* gestellt wurde, ist der früheste sichere Nachweis der Anatidae und bestätigt das Vorkommen dieser Familie im untersten Oligozän Westeuropas. Charadriiforme Vögel sind durch mindestens vier verschiedene Arten vertreten. Zwei davon wurden in die neue Gattung *Boutersemia* (*Boutersemia belgica* nov. gen. nov. sp., *Boutersemia parvula* nov. gen. nov. sp.)

gestellt. Die Gattung *Boutersemia* ist durch ein großes Foramen vasculare distale am Tarsometatarsus charakterisiert und wird unter Vorbehalt zu den Glareolidae gestellt. Drei Arten von Rallen (Gruiformes, Rallidae) wurden identifiziert, zwei davon wurden in die neue Gattung *Belgirallus* (*Belgirallus oligocaenus* nov. gen. nov. sp., *Belgirallus minutus* nov. gen. nov. sp.) gestellt. Die Arten der Gattung *Belgirallus* gehören zu den frühesten Nachweisen der Rallidae und *Belgirallus minutus* ist die kleinste bisher aus dem Frühtertiär bekannte Ralle. Ein fragmentarisches distales Ende eines Tarsometatarsus wurde zu den Pici gestellt und stellt den ältesten fossilen Nachweis dieses Taxons dar. Ein distales Ende eines Oberschnabels ähnelt dem der rezenten Scolopacidae und Rostratulidae (Charadriiformes), ist aber viel größer. Fragmentarische Tarsometatarsi von zwei großen Vogeltaxa gehören wahrscheinlich zu den Idiornithidae (Gruiformes) und Phoenicopteriformes. © 2001 Éditions scientifiques et médicales Elsevier SAS

SCHLÜSSELWÖRTER: FOSSILE VÖGEL, UNTERSTES OLIGOZÄN, BELGIEN, *BOUTERSEMIA* NOV. GEN., *BELGIRALLUS* NOV. GEN.

INTRODUCTION

The avian remains described in this study were collected during three days of field work by one of the authors (RS) in September 1999 at the locality Boutersem, ca. 30 km east of Bruxelles, Belgium. The site was a shallow cutting at km 29.650 along motorway E 40, temporarily exposed during the HST (= Hoge Snelheidstrein or High Speed Train) railway construction (Fig. 1). The vertebrate bed occurs at the base of a fluvio-lacustrine complex, known as the Boutersem Member and formerly included in the Upper or Continental Tongrian. In this area it unconformably overlies the Upper Eocene glauconitic Neerrepen Sands. A multidisciplinary palaeontological and stratigraphical study of the Boutersem railway cutting is in progress (Steurbaut et al. in prep.). The thickness and lithological composition of the vertebrate bed are highly variable. Locally it thickens up to 30 cm and consists of four distinct layers, in descending order: a pinkish shell-bed, often indurated (5 to 10 cm), greenish clayey sands with crushed, partially decalcified shells (5 to 10 cm), a dark-green clay without shells (2 to 3 cm) and greenish shelly sands with reddish discontinuous bands (10 to 15 cm). Sometimes, the basal green sands and the overlying green clay are not touching, but are separated by a 2 to 3 cm thick pinkish shell bed.

Apart from birds, the vertebrate bed yielded abundant remains of fishes, amphibians, reptiles (turtles, lizards, snakes, very few crocodiles) and mammals (mainly small insectivores and rodents). Several rodents, including at least one theridomyid (see Vianey-Liaud 1972), one cricetid (Freudenthal 1988) and six glirid species (Vianey-Liaud 1994) from the Boutersem HST section are known from the Hoogbutsel level, discovered by Glibert & de Heinzelin (1952). The similarity of the rodent assemblages suggests that both vertebrate levels are coeval and, according to the well-dated Hoogbutsel level, are attributable to the Early Oligocene reference level MP 21 (BiochroM'97 1997), positioned at about 33 mya (Legendre & Lévêque 1997). Some amphibian vertebrae have been found in association, but since the sediments have been screen washed, most of the material consists of isolated bones.

In this study, only those specimens from the avian material have been included, which could be reliably identified. This includes virtually all of the small species which are represented by adequate material.

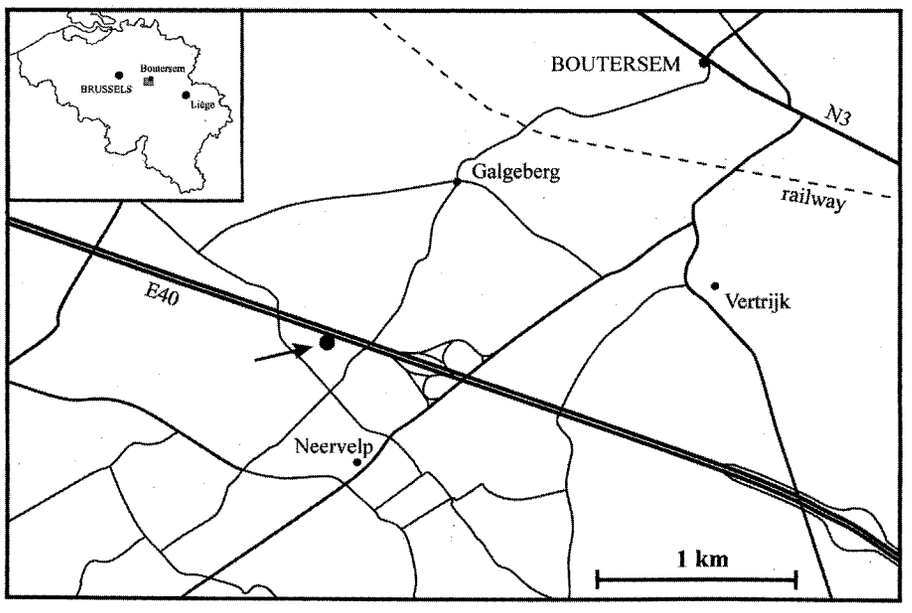

FIGURE 1 - Location of the Boutersem site. The arrow indicates the position of the exposure. *Situation du gisement de Boutersem. La flèche indique la position du talus.*

MATERIAL AND METHODS

The types and all fossil specimens figured in this study are deposited in the Institut Royal des Sciences Naturelles de Bruxelles, Belgium (IRScNB); a few additional specimens are in the collection of R. Smith. The osteological terminology follows Baumel & Witmer (1993), if not indicated otherwise. All dimensions are in millimeters; comparisons with recent bird skeletons are largely based on the specimens in the collection of the Forschungsinstitut Senckenberg, Frankfurt/M., Germany.

SYSTEMATICS

ANSERIFORMES (Wagler, 1831)
ANSERES Wagler, 1831
ANATIDAE Leach, 1820

cf. *Paracygnopterus* HARRISON & WALKER, 1979, species indeterminate
Fig. 2.1-2

Referred specimen - Almost complete right coracoid (IRScNB Av 33; Fig. 2.1-2).

Dimensions - Length from angulus medialis to tip of processus acrocoracoideus, 35.0; distance from center of cotyla scapularis to tip of processus acrocoracoideus, 10.8; minimum width of shaft, 4.4.

Description and comparison - The specimen exhibits the characteristic morphology of the anseriform coracoid. The cotyla scapularis is deeply excavated and nearly circular, and the impressio ligamenti acrocoracohumeralis is a deep groove. The impressio musculi sternocoracoidei on the extremitas sternalis bears several distinct transversal striae of muscle scars, which is a derived feature of anseriform birds (these striae also occur in few other avian taxa, e.g. the Threskiornithidae, which however otherwise trenchantly differ in the morphology of the coracoid).

Only few early Tertiary anseriform birds have been described so far (see below) and judging from the illustrations and descriptions in Harrison & Walker (1979), both in size and morphology the coracoid IRScNB Av 33 most closely resembles the corresponding bone of *Paracygnopterus scotti* from the early Oligocene Hamstead Beds of the Isle of Wight, England (MP 21-23, according to Mlíkovský 1996a). Compared to recent Anatidae, it has similar overall proportions to the coracoid of the Common Shelduck, *Tadorna tadorna*; in swans and geese (Anserinae) this bone is stouter, in typical ducks (Anatinae) it usually is more elongated. Although most of the facies articularis clavicularis is broken, the remaining part indicates that it was deeply undercut by the sulcus musculi supracoracoidei. Contrary to the Anserinae, there are no pneumatic foramina below the facies articularis clavicularis. The sulcus ligamenti (terminology after Ballmann 1969) is shallow, similar for example to the recent genus *Dendrocygna*. The processus procoracoideus appears to have been short, although its tip is broken. A foramen nervi supracoracoidei is absent but there is a distinct incisura nervi supracoracoidei at the medial margin of the shaft which is present in many recent Anserinae, but absent in Anatinae and Dendrocygninae (whistling-ducks); in the species from Belgium this incisura is longer than in *Paracygnopterus scotti* (3.0 vs. 1.3 mm). A foramen nervi supracoracoidei occurs in the basal anseriform taxa Anhimidae, Anseranatidae, Presbyornithidae, *Anatalavis*, *Romainvillia*, and *Petropluvialis* (see below), and according to Livezey (1986) its absence is a derived feature of the Anatidae. On the medial margin of the bone, above the angulus medialis, there is a small notch which is also present in many recent Anatidae (e.g., *T. tadorna*). The medial part of the facies articularis sternalis extends broadly on the ventral side of the extremitas sternalis.

Another anseriform coracoid from the type locality of *Paracygnopterus scotti*, which was assigned to *Palaeopapia eous* (HARRISON & WALKER, 1976) by Harrison & Walker (1979), differs from specimen IRScNB Av 33 in the farther medially protruding angulus medialis of the extremitas sternalis (see discussion below for further comments on *Palaeopapia eous*).

Family inc. sed.

cf. *Romainvillia* LEBEDINSKY, 1927, species indeterminate
Fig. 2.3-4

Referred specimen - Extremitas omalis of left coracoid (IRScNB Av 34; Fig. 2.3-4).

Dimensions - Length as preserved, 23.0; distance from center of cotyla scapularis to tip of processus acrocoracoideus, 9.2 [8.5 in *Romainvillia stehlini*, according to Lebedinsky 1927]; minimum width of shaft, 4.2.

Description and comparison - The fragmentary coracoid IRScNB Av 34 is of about the same size as specimen IRScNB Av 33 (cf. *Paracygnopterus*), and also resembles the latter in its general shape. However, it differs in that the facies articularis clavicularis is not undercut by the sulcus musculi supracoracoidei and in that there is a small foramen nervi supracoracoidei near to the medial margin of the shaft; the sulcus ligamenti is deeper, the entire extremitas omalis somewhat smaller in relative size. Specimen IRScNB Av 34 compares best with the coracoid of *Romainvillia stehlini* from the Upper Eocene (MP 20, according to Mourer-Chauviré 1996) of France, which according to Lebedinsky (1927:5) also exhibits a small foramen nervi supracoracoidei ('la présence chez notre fossile d'un trou sous-claviculaire, bien que très petit, constitue un caractère sans analogue chez les Anseriformes proprement dits'). The specimen from Boutersem further corresponds to *R. stehlini* in the shape of its unusually short processus acrocoracoideus. In *Petropluvialis simplex* HARRISON & WALKER, 1976 from the Upper Eocene of England (see below), there is also a small foramen nervi supracoracoidei but in this species the processus acrocoracoideus is more elongate, and the facies articularis clavicularis is undercut by the sulcus musculi supracoracoidei.

Genus and species indeterminate
Fig. 2.5-16

Referred specimens - Incomplete left quadratum (IRScNB Av 35; Fig. 2.5-6); fragmentary cranial part of sternum (IRScNB Av

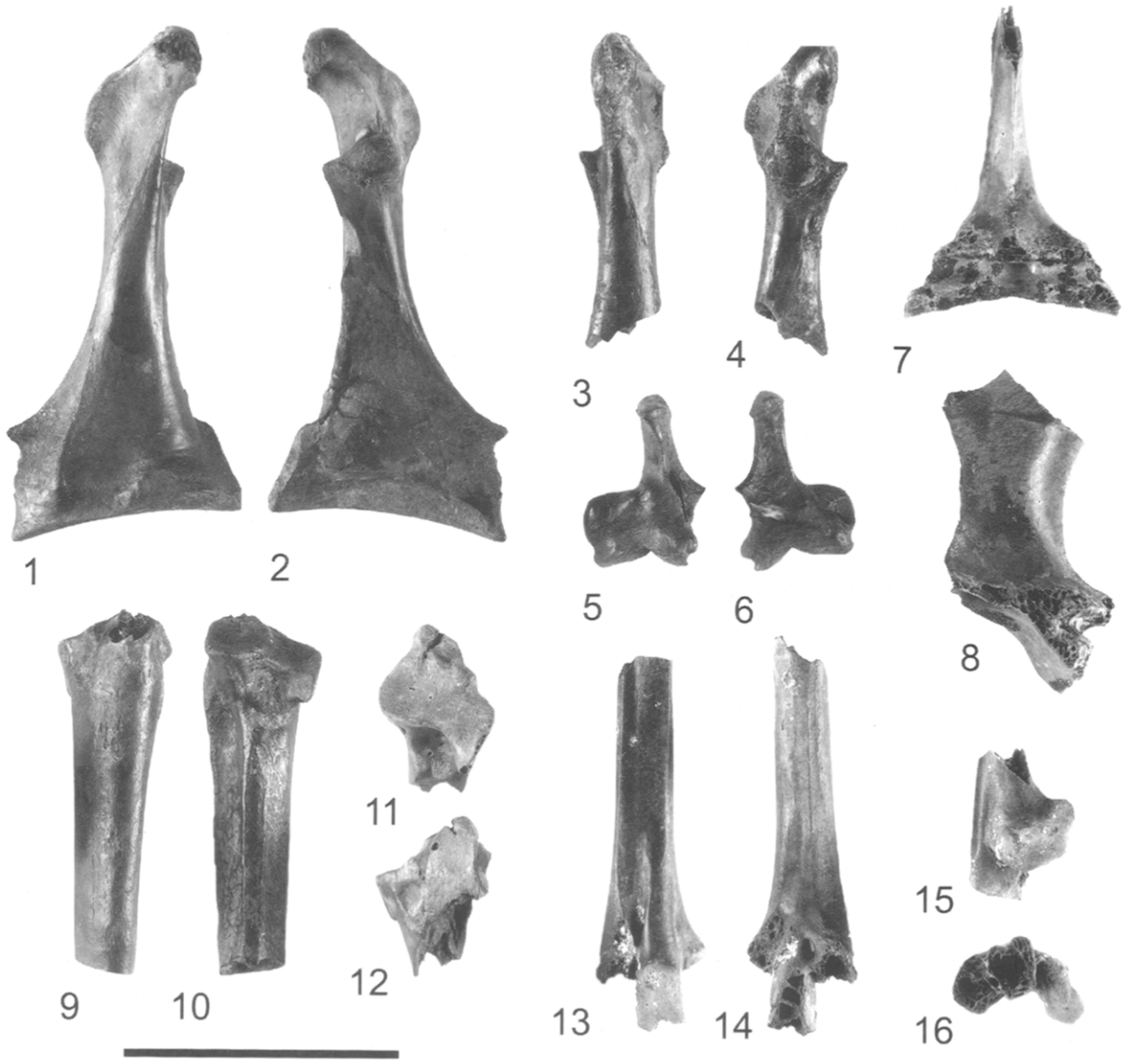

FIGURE 2 - Anseriform birds from Boutersem. cf. *Paracygnopterus* HARRISON & WALKER, 1979, species indeterminate, almost complete right coracoid (IRScNB Av 33). **1**, ventral side; **2**, dorsal side. cf. *Romainvillia* LEBEDINSKY, 1927, species indeterminate, extremitas omalis of left coracoid (IRScNB Av 34); **3**, ventral side; **4**, dorsal side. Anseriformes, genus and species indeterminate: incomplete left quadratum (IRScNB Av 35); **5**, medial side; **6**, lateral side; fragmentary cranial part of sternum (IRScNB Av 36); **7**, cranial view; **8**, lateral view; proximal end of left ulna (IRScNB Av 37); **9**, caudal side; **10**, cranial side; proximal end of left ulna (IRScNB Av 38); **11**, cranial side; **12**, caudal side; distal end of right tarsometatarsus (IRScNB Av 39); **13**, dorsal side; **14**, plantar side; distal end of right tarsometatarsus (IRScNB Av 40); **15**, medial view; **16**, distal view. Scale bar equals 20 mm. *Ansériformes de Boutersem. cf.* Paracygnopterus *HARRISON & WALKER, 1979, espèce indéterminée, coracoïde droit presque complet (IRScNB Av 33).* ***1****, face ventrale;* ***2****, face dorsale. cf.* Romainvillia *LEBEDINSKY, 1927, espèce indéterminée, partie dorsale du coracoïde gauche (IRScNB Av 34),* ***3****. face ventrale;* ***4****, face dorsale. Ansériformes, genre et espèce indéterminés: quadratum gauche incomplet (IRScNB Av 35),* ***5****, face médiale;* ***6****, face latérale; partie crâniale fragmentaire du sternum (IRScNB Av 36);* ***7****, vue crâniale;* ***8****, vue latérale; ulna gauche proximale (IRScNB Av 37);* ***9****, face caudale;* ***10****, face crâniale; ulna gauche proximale (IRScNB Av 38);* ***11****, face crâniale;* ***12****, face caudale; tarsométatarse droit distal (IRScNB Av 39);* ***13****, face dorsale;* ***14****, face palmaire; tarsométatarse droit distal (IRScNB Av 40); 15, vue médiale;* ***16****, vue distale. L'échelle représente une longueur de 20 mm.*

36; Fig. 2.7-8); two proximal ends of left ulnae (IRScNB Av 37, IRScNB Av 38; Fig. 2.9-12); two distal ends of right tarsometatarsi (IRScNB Av 39, IRScNB Av 40; Fig. 2.13-16).

Dimensions - Tarsometatarsus (IRScNB Av 39), length as preserved, 28.5; minimum width of shaft, 4.1; width of trochlea metatarsi III, 3.6. Quadratum (IRScNB Av 35), distance from tip of processus oticus to tip of condylus medialis, 13.0. Ulna (IRScNB Av 37), width from dorsal margin of cotyla ventralis to ventral margin of cotyla dorsalis, 8.4; dorsoventral width of cotyla ventralis, 4.1.

Remarks - Together with the two coracoids, several other anseriform bones have been collected. All specimens come from a bird about the size of the recent *Bucephala clangula* (Common Goldeneye), and might belong to a single species. However, a reliable assignment of these to one of the coracoids (which are of similar size) is not possible.

Description and comparison - The quadrate exhibits the unmistakable morphology of the anseriform quadrate in that the processus oticus is very narrow medio-laterally (capitulum oticum and capitulum squamosum small and situated close together), and the processus mandibularis only bears two condyles (three in most other birds). Apart from being smaller, the bone is similar to the quadrate of the recent *Coscoroba coscoroba* in ove-

rall morphology. The processus oticus bears a weak eminentia articularis (terminology after Weber & Hesse 1995).

The fragmentary cranial part of the sternum exhibits a well-developed, circular pneumatic foramen on its ventral side. The area of the spina externa is damaged, but what remains indicates that if a spina externa was present, it was narrow and small; a spina interna is absent. There is a marked depression between the sulci articulares coracoidei. The cranial margin of the carina sterni is concave.

The two proximal ends of ulnae have the same size as in recent *Bucephala clangula*. Both are identical in their morphology and closely resemble the proximal ulna of recent Anatidae, only the facies articularis radialis is more excavated than in any of the recent taxa we investigated.

The two distal tarsometatarsi are rather poorly preserved but are identical in osteology, too. In its proportions, the more complete bone (IRScNB Av 39) resembles the rather long and slender tarsometatarsus of the recent genus *Dendrocygna*; it is less stout than the tarsometatarsus of *Romainvillia stehlini*. The dorsal surface of the shaft is flat, thus the latter has an almost rectangular cross-section (IRScNB Av 39). The trochlea metatarsi II is shorter than the trochlea metatarsi IV, like in *Dendrocygna* and *Mionetta* LIVEZEY & MARTIN, 1988 it does not bear a distinct groove (IRScNB Av 40). This groove is present in the majority of recent Anatidae and its absence was considered to be plesiomorphic by Livezey (1986). The trochlea metatarsi III is shifted medially. There is a small canalis interosseus distalis.

Discussion - The early Tertiary fossil record of Anseriformes (ducks, geese, swans, and allies) is very scanty and most taxa are known from few isolated bones only. Apart from the numerous remains of the peculiar wader-like family Presbyornithidae (see Olson & Feduccia 1980), the only substantial record is that of the lower Eocene species *Anatalavis oxfordi* OLSON, 1999a. *A. oxfordi* represents a very basal anseriform which distinctly differs from the taxa described in this study in the morphology of the coracoid (the foramen nervi supracoracoidei is much larger, and there is a large pneumatic foramen on the dorsal surface of the extremitas sternalis). Olson (1999a) considered *Anatalavis* to be closely related to the Australian Anseranatidae (Magpie Geese), but at least the large pneumatic foramen on the extremitas sternalis of the coracoid, which Olson (1999a) listed as a synapomorphy of *Anatalavis* and *Anseranas*, was considered to be plesiomorphic within the Anseriformes by Livezey (1986).

Two isolated coracoids from the Upper Eocene of England were described as *Petropluvialis simplex* by Harrison & Walker (1976) who assigned this taxon to the Burhinidae (Thick-knees, Charadriiformes). However, *Petropluvialis* certainly is no charadriiform bird (the coracoid of which is characterized by a larger and much more ventrally protruding facies articularis clavicularis), but another early Tertiary anseriform which closely resembles specimen IRScNB Av 33 (cf. *Paracygnopterus*) in the morphology of its coracoid. *Petropluvialis* mainly differs in the presence of a small foramen nervi supracoracoidei, which might have influenced Harrison & Walker's assignment of this taxon to the Charadriiformes. Like in anseriform birds, but contrary to the Charadriiformes, the extremitas sternalis bears distinct transversal striae of muscle scars. An assignment of *Petropluvialis* to the Anseriformes gains further support by the fact that from the same deposits, Harrison & Walker (1976) reported a fragmentary sternum of an anseriform bird which they named *Howardia eous*. Since the genus name was already preoccupied, Harrison & Walker (1979) later changed *Howardia* to *Palaeopapia*; future specimens might eventually show that *Petropluvialis simplex* and *Palaeopapia* ('*Howardia*') *eous* are synonymous.

The genus *Cygnopterus* LAMBRECHT, 1931, which also comes from the Oligocene of Belgium (MP ?23-24, according to Cheneval 1996), is much larger than the anseriform specimens described in this study, about the size of recent swans; '*Anas*' *creccoides* VAN BENEDEN, 1871 from Belgian deposits of the same age is known from an isolated humerus only, and thus cannot be compared with the remains described in this study.

Olson (1989:2026) assumed that 'anseriforms do not appear as a significant component in fossil avifaunas in the Northern Hemisphere until the early Miocene', and later stated that possibly 'the Anseranatidae was the more diverse family in the Northern Hemisphere in the Paleogene' (Olson 1999a:243). However, at least one of the anseriform birds from Boutersem (cf. *Paracygnopterus* sp.) appears to be a true member of the Anatidae, as evidenced by the reduction of the foramen nervi supracoracoidei, and this family thus was already present in the lowermost Oligocene of Belgium.

The presence of a foramen nervi supracoracoidei indicates that the other anseriform taxon (cf. *Romainvillia*) represents a more basal member of the Anseriformes. Mlíkovský (1996b) and Olson (1999a) considered it possible that *Romainvillia* belongs to the Anseranatidae but did not mention any evidence supporting this assumption. In the only known specimen of *Romainvillia stehlini*, the extremitas sternalis of the coracoid is broken, but what remains seems to indicate that this species lacks the large pneumatic foramen which is characteristic for the coracoid of the Anseranatidae. We are not aware of any derived character shared by *Romainvillia* and the Anseranatidae, and at present it seems equally likely that the fossil taxon is a basal member of the Anatidae (to which it was assigned in the original description).

CHARADRIIFORMES (Huxley 1867)

Remarks - There are coracoids of at least four charadriiform species in the avian material from Boutersem, all exhibit the characteristic large, and strongly ventrally protruding facies articularis clavicularis. Three species are further represented by distal humeri which also show the characteristic charadriiform morphology, e.g. by the presence of a very large processus supracondylaris dorsalis. Unfortunately, however, the tarsometatarsus, which is the most characteristic element of these birds, is

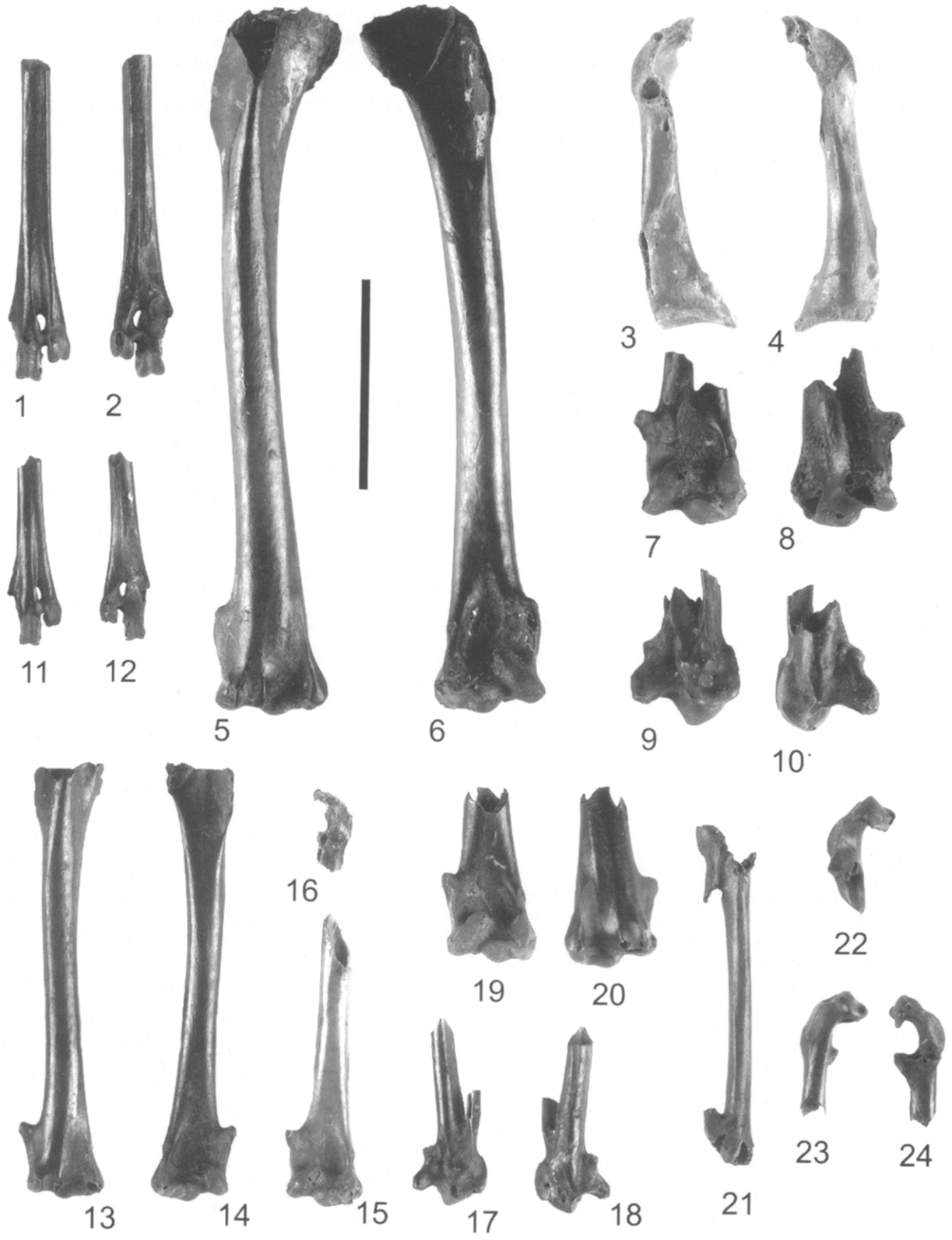

FIGURE 4 - Charadriiform birds from Boutersem. *Boutersemia belgica* nov. gen. nov. sp., distal part of left tarsometatarsus, holotype (IRScNB Av 41); **1**, dorsal side; **2**, plantar side. *Boutersemia belgica* nov. gen. nov. sp., referred specimens: incomplete left coracoid (IRScNB Av 42); **3**, dorsal view; **4**, ventral view; left humerus lacking part of the proximal end (IRScNB Av 43); **5**, caudal side; **6**, cranial side; distal end of right humerus (IRScNB Av 44); **7**, cranial side; **8**, caudal side; proximal end of left carpometacarpus (IRScNB Av 45); **9**, ventral side; **10**, dorsal side. *Boutersemia parvula* nov. gen. nov. sp., distal part of left tarsometatarsus, holotype (IRScNB Av 46); **11**, dorsal side; **12**, plantar side. *Boutersemia parvula* nov. gen. nov. sp., referred specimens: left humerus lacking the proximal end (IRScNB Av 47); **13**, caudal side; **14**, cranial side; distal end of right humerus (IRScNB Av 48); **15**, cranial side; extremitas omalis of right coracoid (IRScNB Av 49); **16**, dorsal side; proximal end of left carpometacarpus (IRScNB Av 50); **17**, ventral side; **18**, dorsal side. cf. *Boutersemia* nov. gen., species indeterminate: distal end of right humerus (IRScNB Av 51); **19**, cranial side; **20**, caudal side; incomplete left carpometacarpus (IRScNB Av 52); **21**, ventral side; extremitas omalis of left coracoid (IRScNB Av 53); **22**, dorsal side. ? Scolopaci, genus and species indeterminate, extremitas omalis of right coracoid (IRScNB Av 54); **23**, ventral side; **24**, dorsal side. Scale bar equals 10 mm.

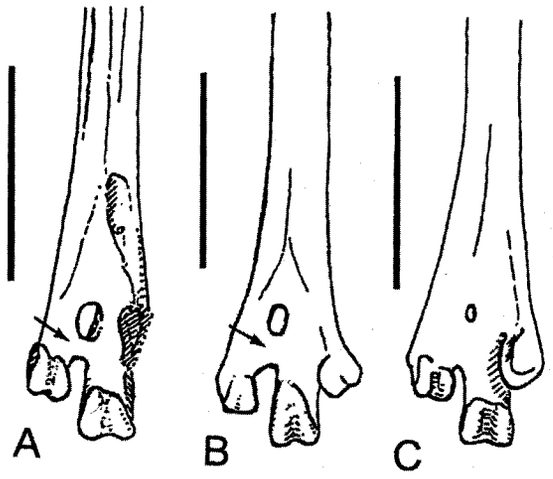

FIGURE 3 - Distal end of left tarsometatarsus of fossil and recent charadriiform birds in comparison. **A.** *Boutersemia belgica* nov. gen. nov. sp.; **B.** *Paractiornis perpusillus* WETMORE, 1930 (Glareolidae, after Olson & Steadman 1979); **C.** *Calidris alpina* (Scolopacidae). The arrow indicates the osseous bridge between the foramen vasculare distale and the incisura lateralis. Scale bar equals 5 mm. *Comparaison des extrémités distales du tarsométatarse gauche de Charadriiformes fossiles et récents.* **A.** Boutersemia belgica *nov. gen. nov. sp.;* **B.** Paractiornis perpusillus *WETMORE, 1930 (Glareolidae, d'après Olson & Steadman 1979);* **C.** Calidris alpina *(Scolopacidae). La flèche indique l'arc osseux entre le foramen vasculaire distal et l'incisura lateralis. L'échelle représente une longueur de 5 mm.*

preserved in only two species. Only these two species have been named, the assignment of the referred bones to the respective species is based on size.

? GLAREOLIDAE Brehm, 1831

Boutersemia nov. gen.

Type species - *Boutersemia belgica* nov. sp.

Included species - *Boutersemia parvula* nov. sp.

Diagnosis - *Boutersemia* nov. gen. includes small to very small charadriiform birds that are characterized by the combination of the following features of the tarsometatarsus: (1) foramen vasculare distale very large and (2) situated on the bottom of a well-developed, broad groove, (3) osseous bridge between foramen vasculare distale and incisura lateralis shorter than foramen vasculare distale, and (4) fossa metatarsi I distinct.

Differential diagnosis - Of the above-mentioned characters, (1) and (2) distinguish the new taxon from all other Charadriiformes except the Charadriidae and Glareolidae. Character (4) is plesiomorphic within the Charadriiformes and distinguishes the new genus from all Charadriidae. In character (3) it differs from recent Glareolidae, including the fossil genera *Mioglareola* BALLMANN, 1979 and *Paractiornis* WETMORE, 1930. *Boutersemia* nov. gen. further differs from the two fossil genera in the shorter and less asymmetric plantar articulation surface of the trochlea metatarsi III (Fig. 3).

Etymology - The genus name refers to the locality where the type species has been found. It is feminine in gender.

Boutersemia belgica nov. sp.
Fig. 4.1-10

Holotype - Distal part of left tarsometatarsus, lacking the trochlea metatarsi II (IRScNB Av 41; Fig. 4.1-2)

Differential diagnosis - *Boutersemia belgica* nov. sp. exhibits the diagnostic features of the genus *Boutersemia*. The new species is larger than *B. parvula* nov. sp., about the size of the recent Ringed plover, *Charadrius hiaticula*. It further differs from *B. parvula* in that there is a low ridge from the os metacarpale minus to the processus pisiformis (carpometacarpus), and in that the trochlea metatarsi IV (tarsometatarsus) reaches slightly farther distally.

Dimensions of the holotype - Length as preserved, 15.2; width of trochlea metatarsi III, 1.3; length of trochlea metatarsi III, 1.9, minimum width of shaft, 1.4.

Type locality - Boutersem near Bruxelles, Belgium.

Type horizon - Early Oligocene, MP 21.

Referred specimens - Incomplete left coracoid (IRScNB Av 42; Fig. 4.3-4); incomplete right coracoid (BOU-O-1-RS, collection R. Smith); left humerus lacking part of the proximal end (IRScNB Av 43; Fig. 4.5-6); distal end of right humerus (IRScNB Av 44; Fig. 4.7-8); proximal end of left carpometacarpus (IRScNB Av 45; Fig. 4.9-10).

Dimensions of the referred specimens - Humerus (IRScNB Av 43), distal width, 5.2; maximum length as preserved, 33.4; estimated total length, ~38. Carpometacarpus (IRScNB Av 45), distance from caudal margin of trochlea carpalis to tip of processus extensorius, 5.3. Coracoid (IRScNB Av 42), length as preserved, 15.0; distance from cotyla scapularis to tip of processus acrocoracoideus, ~4.1.

Etymology - From *belgicus* (Lat.): Belgian.

Description and comparison - Both in size and morphology, the tarsometatarsus of *Boutersemia belgica* resembles that of the early Miocene species *Paractiornis perpusillus* WETMORE, 1930 which has been assigned to the Glareolidae by Olson & Steadman (1979). A characteristic feature shared by both taxa is the large foramen vasculare distale which among extant Charadriiformes is only found

FIGURE 4 (suite) - *Oiseaux charadriiformes de Boutersem.* Boutersemia belgica *nov. gen. nov. sp., extrémité distale du tarsométatarse gauche, holotype (IRScNB Av 41);* ***1****, face dorsale;* ***2****, face palmaire.* Boutersemia belgica *nov. gen. nov. sp., spécimens attribués: coracoïde gauche incomplet (IRScNB Av 42);* ***3****, vue dorsale;* ***4****, vue ventrale; humérus gauche dont il manque une partie de l'extrémité proximale (IRScNB Av 43);* ***5****, face caudale;* ***6****, face crâniale; extrémité distale de l'humérus droit (IRScNB Av 44),* ***7****, face craniale;* ***8****, face caudale; extrémité proximale du carpométacarpe gauche (IRScNB Av 45);* ***9****, face ventrale;* ***10****, face dorsale.* Boutersemia parvula *nov. gen. nov. sp., extrémité distale du tarsométatarsus gauche, holotype (IRScNB Av 46);* ***11****, face dorsale;* ***12****, face plantaire.* Boutersemia parvula *nov. gen. nov. sp., spécimens attribués: humérus gauche dont il marque une partie de l'extrémité proximale (IRScNB Av 47);* ***13****, face caudale;* ***14****, face crâniale; extrémité distale de l'humérus droit (IRScNB Av 48);* ***15****, face crâniale; partie dorsale du coracoïde droit (IRScNB Av 49);* ***16****, face dorsale; extrémité proximale du carpométacarpe gauche (IRScNB Av 50);* ***17****, face ventrale;* ***18****, face dorsale. cf.* Boutersemia *nov. gen., espèce indéterminée: extrémité distale de l'humérus droit (IRScNB Av 51);* ***19****, face crâniale;* ***20****, face caudale; carpométacarpe gauche incomplet (IRScNB Av 52);* ***21****, face ventrale; partie dorsale du coracoïde gauche (IRScNB Av 53);* ***22****, face dorsale.* ?Scolopaci, *genre et espèce indéterminés, partie dorsale du coracoïde droit (IRScNB Av 54);* ***23****, face ventrale;* ***24****, face dorsale. L'échelle représente une longueur de 10 mm.*

in the Jacanidae, Glareolidae and Charadriidae, and which in *Boutersemia* and *Paractiornis* is situated on the bottom of a well-developed, broad groove. Like in *Paractiornis* (see description in Wetmore 1930), there is a small but distinct fossa metatarsi I, which indicates that a hallux was present (contrary to recent Charadriidae which lack the fossa metatarsi I). The trochlea metatarsi II is broken, but what remains indicates that it was distinctly shorter than the trochlea metatarsi IV and retroverted as in most recent Charadriiformes. The trochlea metatarsi IV reaches distally to about the mid of the trochlea metatarsi III. A canalis interosseus distalis is present.

The referred coracoids also are of similar size to the recent *Charadrius hiaticula*, and correspond well with those of recent Charadriidae and Glareolidae. Like in the latter two families, they exhibit a foramen nervi supracoracoidei which is absent in all recent members of the Scolopacidae, Rostratulidae, and Thinocoridae, as well as in the Oligocene family Turnipacidae (Mayr 2000). Like in all other limicoline Charadriiformes, the facies articularis clavicularis roofs the sulcus musculi supracoracoidei. The processus procoracoideus is broken in all specimens. On the medial side of the extremitas sternalis, just above the pointed angulus medialis, there is a small notch which is also present in many recent Charadriiformes.

The referred humeri show the typical charadriiform morphology, which is especially exemplified by the presence of a large processus supracondylaris dorsalis and a distinct sulcus nervi coracobrachialis (IRScNB Av 43, see Ballmann 1979). The distal end of the bone has the same size as in the recent Ringed Plover, *Charadrius hiaticula,* from which it is nearly indistinguishable in its morphology, too. The shaft, however, is more elongated in *Boutersemia belgica* than in *C. hiaticula*. The humerus of *Boutersemia* nov. gen. distinctly differs from the humerus of the Lari (gulls, terns, and allies) in the much shallower fossa musculi brachialis. Unfortunately, Charadriidae, Scolopacidae, and Glareolidae can hardly be distinguished on the basis of the distal humerus.

The referred proximal carpometacarpus has the same size as in the recent *Charadrius hiaticula*, and also closely resembles that of recent limicoline Charadriiformes. It differs from the superficially similar carpometacarpus of the Rallidae in the shorter symphysis metacarpalis proximalis. There is a low ridge from the os metacarpale minus to the processus pisiformis and a ligamental attachment scar on the ventral surface of the proximal end of the os metacarpale minus.

Boutersemia parvula nov. sp.
Fig. 4.11-18

Holotype - Distal part of left tarsometatarsus, lacking the trochlea metatarsi II (IRScNB Av 46; Fig. 4.11-12).

Diagnosis - *Boutersemia parvula* nov. sp. exhibits the diagnostic features of the genus *Boutersemia*. The new species is 1/3 smaller than *B. belgica* and about the size of the smallest species of recent Charadriiformes, e.g. Kittlitz's Plover, *Charadrius pecuarius*. For further differences see diagnosis of *B. belgica*.

Dimensions of the holotype - Length as preserved, 8.9; width of trochlea metatarsi III, 1.0; length of trochlea metatarsi III, 1.4; minimum width of shaft, 1.2.

Type locality - Boutersem near Bruxelles, Belgium.

Type horizon - Early Oligocene, MP 21.

Referred specimens - Left humerus lacking the proximal end (IRScNB Av 47; Fig. 4.13-14); distal end of right humerus (IRScNB Av 48; Fig. 4.15); distal end of right humerus (BOU-O-2-RS, collection R. Smith); extremitas omalis of right coracoid (IRScNB Av 49; Fig. 4.16); proximal end of left carpometacarpus (IRScNB Av 50; Fig. 4.17-18); proximal end of right carpometacarpus (BOU-O-3-RS, collection R. Smith).

Dimensions of the referred specimens - Humerus (IRScNB Av 47), distal width, 3.6; maximum length as preserved, 21.4; estimated total length, ~24. Carpometacarpus (IRScNB Av 50), distance from caudal margin of trochlea carpalis to tip of processus extensorius, 3.6. Coracoid (IRScNB Av 49), distance from cotyla scapularis to tip of processus acrocoracoideus, ~2.3.

Etymology - The species name is derived from *parvulus* (Lat.): very small.

Description and comparison - Apart from being distinctly smaller, the holotypic tarsometatarsus of *Boutersemia parvula* only differs from that of *B. belgica* in that the trochlea metatarsi IV reaches slightly less far distally.

As far as comparable, the referred coracoid and humeri do not differ morphologically from *B. belgica*.

The referred proximal end of the carpometacarpus also is very similar to *B. belgica* and is only distinguished in that there is no ridge from the os metacarpale minus to the processus pisiformis, and that the processus extensorius of the os metacarpale alulare is somewhat narrower and more protruding.

cf. ***Boutersemia*** nov. gen., species indeterminate
Fig. 4.19-22

Referred specimens - Distal end of right humerus (IRScNB Av 51; Fig. 4.19-20); distal end of right humerus (BOU-O-4-RS, collection R. Smith); incomplete left carpometacarpus (IRScNB Av 52; Fig. 4.21); extremitas omalis of left coracoid (IRScNB Av 53; Fig. 4.22).

Dimensions - Humerus (IRScNB Av 51), distal width, 4.3. Coracoid (IRScNB Av 53), distance from cotyla scapularis to tip of processus acrocoracoideus, 3.6.

Remarks - This species is intermediate in size between *Boutersemia belgica* and *B. parvula,* but otherwise does not differ in its morphology. Since the tarsometatarsus is unknown, its assignment to the genus *Boutersemia* is tentative.

? SCOLOPACI (sensu Strauch, 1978)

Genus and species indeterminate
Fig. 4.23-24

Referred specimen - Extremitas omalis of right coracoid (IRScNB Av 54; Fig. 4.23-24).

Dimensions - Distance from cotyla scapularis to tip of processus acrocoracoideus, ~2.7.

Remarks - The coracoid IRScNB Av 54 differs from the coracoids assigned to *Boutersemia* in that it lacks a foramen nervi supracoracoidei. The absence of this foramen has been considered to be

a synapomorphic character of the Scolopaci (Jacanidae, Scolopacidae, Rostratulidae, Thinocoridae, and Phalaropidae) by Strauch (1978).

Discussion - According to del Hoyo et al. (1996), the Charadriiformes (shorebirds) include 18 recent families, the early Tertiary record of which still is very scanty (Brodkorb 1967; Olson 1985; Mayr 2000). From Eocene deposits only very few 'higher' (sensu Olson 1985) charadriiform birds are known (e.g., Olson 1999b; Mayr 2000). Most of the pre-Miocene taxa have been assigned to the Scolopacidae (Olson 1985), but a very distinctive new Oligocene family, the Turnipacidae, was recently described by Mayr (2000) from Céreste (France). The Turnipacidae share many similarities with recent Turnicidae and are clearly distinguished from the charadriiform birds described in this study.

The new genus *Boutersemia* corresponds to recent Glareolidae, Charadriidae, and Jacanidae - and differs from the other charadriiform families - in the large foramen vasculare distale of the tarsometatarsus; outgroup comparisons with other neognathous birds suggest, that this feature probably is derived within the Charadriiformes. The other referred skeletal elements of *Boutersemia* are also similar to the corresponding bones of recent Glareolidae and Charadriidae (but trenchantly differ from the corresponding elements of the Jacanidae which, for example lack a greatly enlarged process supracondylaris dorsalis on the humerus). The new genus especially resembles *Paractiornis* WETMORE, 1930 from the early Miocene of North America, which Olson & Steadman (1979) assigned to the Glareolidae. The latter authors listed features which distinguish *Paractiornis* from all recent charadriiform families except the Glareolidae, and concerning the distal end of the tarsometatarsus virtually all of these also apply to *Boutersemia*. Compared to recent Glareolidae, *Boutersemia* most closely resembles the genera *Stiltia* and *Glareola* (Glareolinae), whereas in the (more derived, see Strauch 1978) genera *Rhinoptilus* and *Cursorius* (Cursoriinae) the hallux is reduced, and the foramen vasculare distale is smaller; *Cursorius* further lacks a foramen nervi supracoracoidei (coracoid).

Boutersemia is distinguished from all recent members of the Charadriidae in the presence of a distinct fossa metatarsi I which indicates that a hallux was present. However, the presence of this fossa certainly is plesiomorphic within the Charadriiformes, and there remains the possibility that the fossil taxa from Boutersem represent ancestral members of the Charadriidae in which the hallux has not yet been reduced. The tentative assignment of *Boutersemia* to the Glareolidae in this study is mainly based on overall morphology and needs further confirmation from the discovery of additional skeletal material (especially the shape of the beak is highly characteristic in the Glareolidae).

The oldest certain fossil record of the Glareolidae is from the early Miocene of Germany (Ballmann 1979), the Charadriidae also have no certain record from deposits older than Miocene in age (Olson 1985).

Gruiformes (Bonaparte, 1854)

RALLIDAE Vigors, 1825

Remarks - There are three species of small rails (Rallidae) in the material from Boutersem which are distinguished in size. Two species are represented by distal humeri and coracoids, and the latter present derived features of the Rallidae (e.g., small extremitas omalis, processus procoracoideus extending well down the shaft, and facies articularis clavicularis being divided into two points).

Belgirallus nov. gen.

Type species - *Belgirallus oligocaenus*, nov. sp.

Included species - *Belgirallus minutus*, nov. sp.

Diagnosis - *Belgirallus* nov. gen. includes small to very small rails which are characterized by a strongly medially protruding epicondylus ventralis and a short processus flexorius (distal end of humerus); the condylus ventralis protrudes farther distally than the condylus dorsalis and the processus flexorius (Fig. 5). The coracoid bears a short processus procoracoideus and the lateral and medial margin of the shaft are nearly parallel.

Differential diagnosis - *Belgirallus* nov. gen. differs from the late Eocene to Late Oligocene genus *Quercyrallus* LAMBRECHT, 1933 in the more craniocaudally compressed distal end of the humerus and

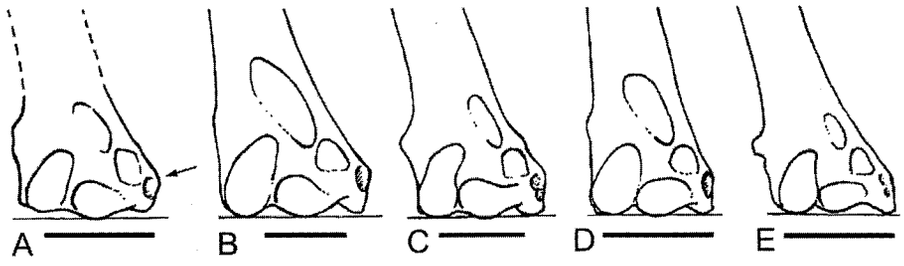

FIGURE 5 - Distal end of right humerus of recent and fossil Rallidae in comparison. **A**. *Belgirallus oligocaenus* nov. gen. nov. sp.; **B**. *Aramides cajanea*; **C**. *Gallinula chloropus*; **D**. *Crex crex*; **E**. *Amaurornis flavirostris*. The arrow indicates the epicondylus ventralis. The horizontal lines illustrate that in *Belgirallus* nov. gen. the condylus ventralis protrudes farther distally than the condylus dorsalis and the processus flexorius. Scale bar equals 5 mm. *Comparaison des extrémités distales de l'humérus droit de râles récents et fossiles.* **A**. Belgirallus oligocaenus *nov. gen. nov. sp.;* **B**. Aramides cajanea; **C**. Gallinula chloropus; **D**. Crex crex; **E**. Amaurornis flavirostris. *La flèche indique l'épicondylus ventralis. Les lignes horizontales iindiquent que chez* Belgirallus *nov. gen. le condylus ventralis est plus saillant en direction distale que le condylus dorsale et le processus flexorius. L'échelle représente une longueur de 5 mm.*

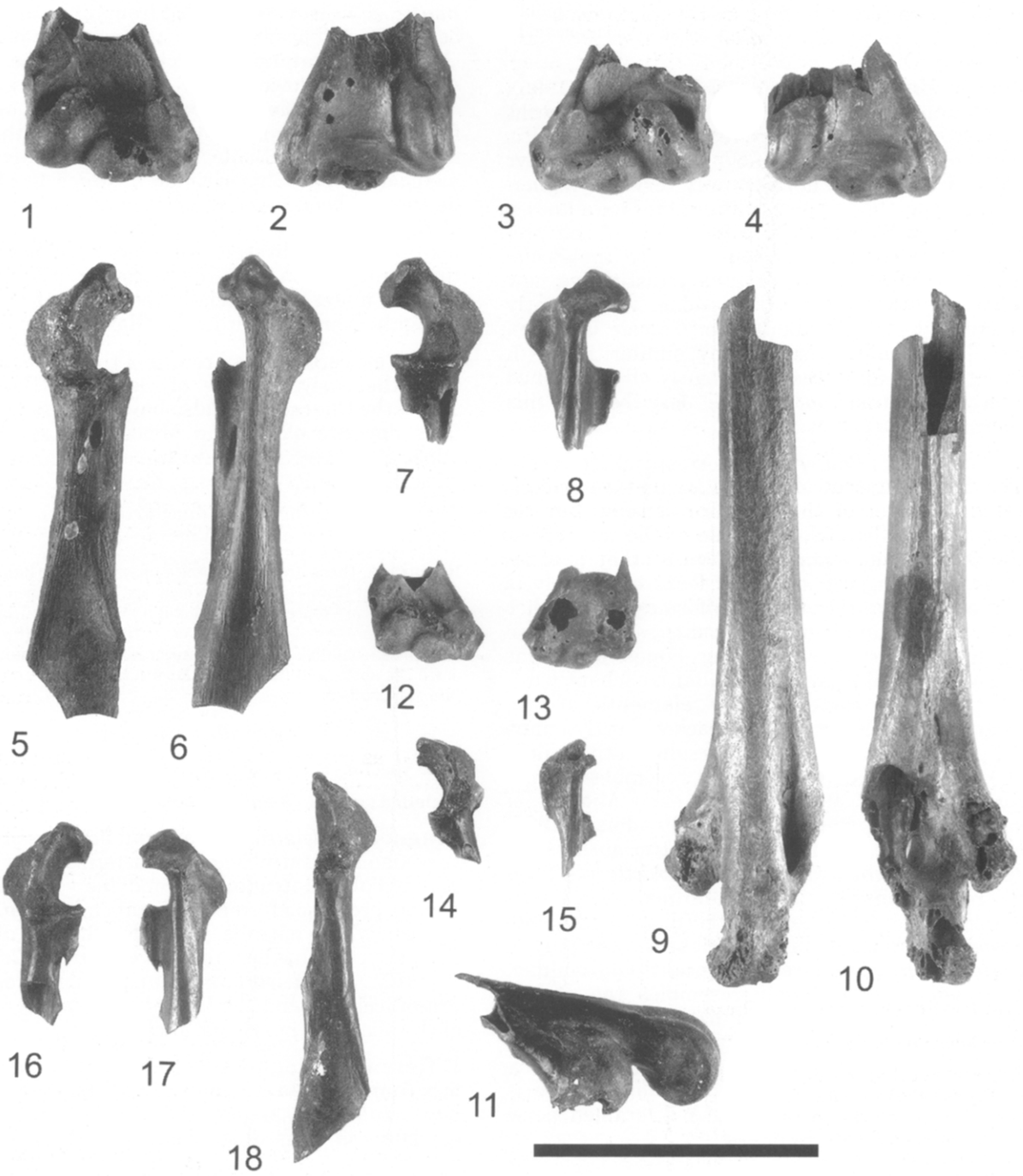

FIGURE 6 - Rallid birds from Boutersem. *Belgirallus oligocaenus* nov. gen. nov. sp., distal end of right humerus, holotype (IRScNB Av 55); **1**, cranial side; **2**, caudal side. *Belgirallus oligocaenus* nov. gen. nov. sp., referred specimens: distal end of left humerus (IRScNB Av 56); **3**, cranial side; **4**, caudal side; incomplete left coracoid (IRScNB Av 57); **5**, dorsal side; **6**, ventral side; extremitas omalis of right coracoid (IRScNB Av 58); **7**, dorsal side; **8**, ventral side; incomplete distal end of left tarsometatarsus (IRScNB Av 59); **9**, dorsal side; **10**, plantar side; fragmentary distal left tarsometatarsus (IRScNB Av 60); **11**, medial view. *Belgirallus minutus* nov. gen. nov. sp., distal end of right humerus, holotype (IRScNB Av 61); **12**, cranial side; **13**, caudal side. *Belgirallus minutus* nov. gen. nov. sp., referred specimen: extremitas omalis of right coracoid (IRScNB Av 62); **14**, dorsal side; **15**, ventral side. cf. *Belgirallus* nov. gen., species indeterminate, extremitas omalis of left coracoid (IRScNB Av 63); **16**, dorsal side; **17**, ventral side; incomplete right coracoid (IRScNB Av 64); **18**, dorsal side. Scale bar equals 10 mm. *Râles de Boutersem.* Belgirallus oligocaenus *nov. gen. nov. sp., extrémité distale de l'humérus droit, holotype (IRScNB Av 55);* ***1****, face crâniale;* ***2****, face caudale.* Belgirallus oligocaenus *nov. gen. nov. sp., spécimens attribués: extrémité distale de l'humérus gauche (IRScNB Av 56);* ***3****, face crâniale;* ***4****, face caudale; coracoïde droit incomplet (IRScNB Av 57);* ***5****, face dorsale;* ***6****, face ventrale; partie dorsale du coracoïde droit (IRScNB Av 58);* ***7****, face dorsale;* ***8****, face ventrale; extrémité distale incomplète du tarsométatarse gauche (IRScNB Av 59);* ***9****, face dorsale;* ***10****, face palmaire; tarsométatarse gauche distal fragmentaire (IRScNB Av 60);* ***11****, vue médiale.* Belgirallus minutus *nov. gen. nov. sp., extrémité distale de l'humérus droit, holotype (IRScNB Av 61);* ***12****, face crâniale;* ***13****. face caudale.* Belgirallus minutus *nov. gen. nov. sp., spécimen attribué: partie dorsale du coracoïde droit (IRScNB Av 62);* ***14****, face dorsale;* ***15****, face ventrale. cf.* Belgirallus *nov. gen., espèce indéterminée, partie dorsale du coracoïde gauche (IRScNB Av 63);* ***16****. face dorsale;* ***17****, face ventrale; coracoïde droit incomplet (IRScNB Av 64);* ***18****, face dorsale. L'échelle représente une longueur de 10 mm.*

in the more medially protruding epicondylus ventralis. The genus *Rupelrallus* FISCHER, 1997 from the early Oligocene of Germany (MP 23-24, according to Mlíkovský & Hesse 1996) is much larger, unfortunately in the only known specimen of this species both the distal humerus and the extremitas omalis of the coracoid are not preserved (see Fischer 1997). The coracoid of the genus *Ibidopsis* LYDEKKER, 1891 from the Upper Eocene of England (see Harrison & Walker 1976) also is much larger, and has a more circular foramen nervi supracoracoidei and a stouter shaft. A number of other early Tertiary putative rails are known from distal tibiotarsi only, and thus cannot be compared with *Belgirallus* nov. gen. (*Eocrex* WETMORE, 1931, *Palaeorallus* WETMORE, 1931, *Fulicaletornis* LAMBRECHT, 1933; see Cracraft 1973; Olson 1977). All of these birds are much larger than the species of *Belgirallus* nov. gen.

The distal humerus of *Belgirallus* nov. gen. closely resembles that of the Messelornithidae, but the new genus differs from *Messelornis* HESSE, 1988 in the less cup-like facies articularis scapularis of the coracoid, and from *Itardiornis* MOURER-CHAUVIRÉ, 1995 in the more excavated facies articularis scapularis and the shorter processus procoracoideus.

Etymology - The genus name is derived from *Belgium* (Lat.): Belgium, and *rallus* (Lat.): rail.

Belgirallus oligocaenus nov. sp.
Fig. 6.1-11

Holotype - Distal end of right humerus (IRScNB Av 55; Fig. 6.1-2).

Differential diagnosis - *Belgirallus oligocaenus* nov. sp. exhibits the diagnostic features of the genus *Belgirallus*. The new species is slightly larger than the recent Black Crake, *Amaurornis flavirostris,* and about two times larger than *B. minutus.*

Dimensions of the holotype - Distal width, 6.3.

Type locality - Boutersem near Bruxelles, Belgium.

Type horizon - Early Oligocene, MP 21.

Referred specimens - Distal end of left humerus (IRScNB Av 56; Fig. 6.3-4); distal end of left humerus (BOU-O-5-RS, collection R. Smith); incomplete left coracoid (IRScNB Av 57; Fig. 6.5-6); extremitas omalis of right coracoid (IRScNB Av 58; Fig. 6.7-8); incomplete distal end of left tarsometatarsus (IRScNB Av 59; Fig. 6.9-10); fragmentary distal end of left tarsometatarsus (IRScNB Av 60; Fig. 6.11).

Dimensions of the referred specimens - Coracoid (IRScNB Av 57), length as preserved, 15.6; distance from center of cotyla scapularis to tip of processus acrocoracoideus, 3.7; minimum width of shaft, 2.2. Tarsometatarsus (IRScNB Av 59), width of trochlea metatarsi III, ~1.7; length of trochlea metatarsi III, ~3.0; minimum width of shaft, 2.5.

Etymology - The species name refers to the Oligocene age of the species.

Description and comparison - In its proportions, the distal humerus of *Belgirallus* nov. gen. most closely resemble the distal humerus of the recent *Aramides cajanea* (Grey-necked Wood-rail). In the other rallid genera we investigated (*Crex, Gallirallus, Amaurornis, Rallus, Porzana, Porphyrio, Gallinula,* and *Fulica*) the epicondylus ventralis protrudes less far ventrally, and the processus flexorius projects farther distally. The fossa musculi brachialis is shallow and situated near the medial margin of the bone. The tuberculum supracondylare ventrale is well-developed. The sulcus scapulotricipitalis is shallow, the sulcus humerotricipitalis is wide and shallow, too. Like in *Aramides*, a processus supracondylaris dorsalis is absent (a small process is present in many other recent Rallidae, e.g. *Amaurornis*).

In its overall morphology, the referred coracoid resembles the corresponding bone of recent rails, e.g. *Amaurornis flavirostris*. The facies articularis scapularis is a concave depression, though it is not as deeply excavated and not as circular as in the Charadriiformes. The facies articularis clavicularis is small, and like in recent rails is divided into two points by a depression in its middle. The processus procoracoideus is rather small, like in *Crex* or *Rallus*, in the Himantornithinae and some recent genera of the Rallinae (e.g., *Canirallus, Aramides*) this process is much longer and broader. Like in all other rails, the flange of the processus procoracoideus extends well down the shaft. The foramen nervi supracoracoidei is small (much larger in recent *Himantornis, Gallirallus,* and *Canirallus*) and situated closer to the extremitas omalis than in all recent Rallidae we investigated. Most of the extremitas sternalis is broken, but what remains shows that the impressio musculi sternocoracoidalis was excavated.

As far as comparable, the referred distal tarsometatarsi (IRScNB Av 59, IRScNB Av 60) are similar in their overall morphology to the distal tarsometatarsi of recent Rallinae. Unfortunately, however, the two specimens are too fragmentary to allow detailed comparisons. The fossa metatarsi I is a distinct depression. The trochlea metatarsi III is longer than wide, and less stout than in *Rupelrallus* FISCHER, 1997. The trochlea metatarsi II is strongly retroverted and does not reach as far distally as the trochlea metatarsi IV.

Belgirallus minutus nov. sp.
Fig. 6.12-15

Holotype - Distal end of right humerus (IRScNB Av 61; Fig. 6.12-13).

Differential diagnosis - *Belgirallus minutus* nov. sp. exhibits the diagnostic features of the genus *Belgirallus*. The new species is about half the size of *B. oligocaenus,* and the smallest early Tertiary rail known so far.

Dimensions of the holotype - Distal width, 3.9.

Type locality - Boutersem near Bruxelles, Belgium.

Type horizon - Early Oligocene, MP 21.

Referred specimen - Extremitas omalis of right coracoid (IRScNB Av 62; Fig. 6.14-15).

Dimensions of the referred specimen - Distance from center of cotyla scapularis to tip of processus acrocoracoideus, ~2.3.

Etymology - From *minutus* (Lat.): tiny.

Description and comparison - Apart from its size, the humerus resembles that of *Belgirallus oligocaenus* nov. sp. Like in the latter, the epicondylus ventralis is strongly protruding.

The facies articularis scapularis of the referred coracoid is slightly shallower than in *B. oligocaenus*.

cf. ***Belgirallus*** nov. gen., species indeterminate

Fig. 6.16-18

Referred specimens - Extremitas omalis of left coracoid (IRScNB Av 63; Fig. 6.16-17); incomplete right coracoid (IRScNB Av 64; Fig. 6.18).

Dimensions - IRScNB Av 63, distance from center of cotyla scapularis to tip of processus acrocoracoideus, 2.9.

Remarks - This species is intermediate in size between *Belgirallus oligocaenus* and *B. minutus*. The coracoid does not differ from that of the genus *Belgirallus*. However, since the distal humerus is unknown from this species, it has not been named.

Discussion - Rails (Rallidae) are an osteologically homogenous family which comprises 33 extant genera (Taylor 1996). Olson (1973) distinguished two subfamilies within the Rallidae, the Himantornithinae, which includes a single recent species, the Nkulengu Rail, *Himantornis haematopus*, and the Rallinae to which all other recent rails belong. A recent phylogenetic analysis by Livezey (1998) also resulted in a sister group relationship between *Himantornis* and all other recent rails. *Himantornis* differs from the Rallinae and the rails from Boutersem in several features of its postcranial osteology, e.g. in the presence of a large pneumatic foramen on the dorsal side of the extremitas sternalis of the coracoid, in the long and broad processus procoracoideus, and in the very low trochlea metatarsi II. In all of these features, the rails from Boutersem correspond with the Rallinae, but due to the absence of an appropriate outgroup it is difficult to determine the polarity of these characters (i.e. if they are derived or primitive within the Rallidae).

Together with the genera *Ibidopsis* Lydekker, 1891 from the Upper Eocene of England and *Quercyrallus* from the Upper Eocene to Upper Oligocene fissure fillings of the Quercy (France), the rails

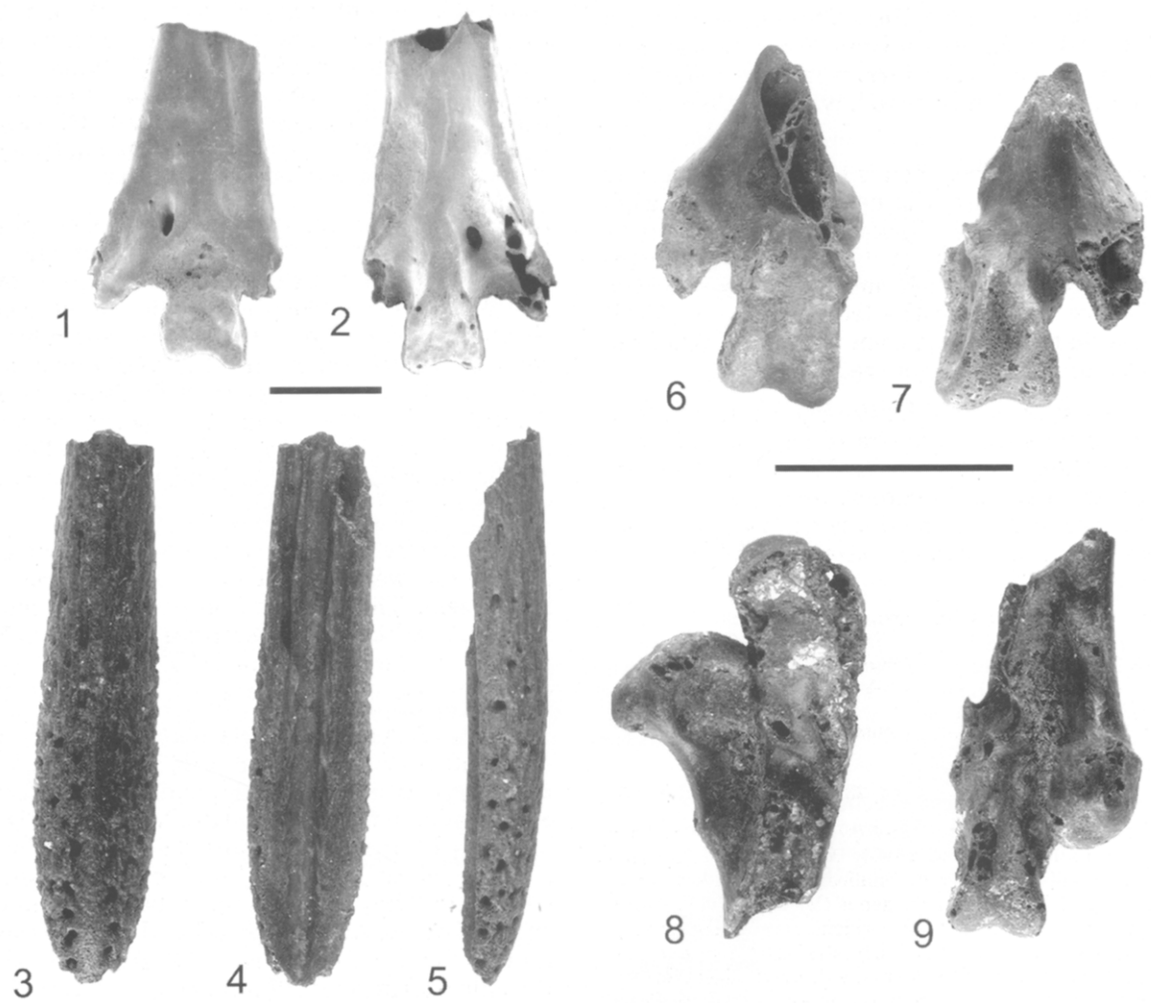

Figure 7 - Pici, family, genus and species indeterminate, distal end of right tarsometatarsus (IRScNB Av 65); **1**, dorsal side; **2**, plantar side; scale bar equals 1 mm. Aves *incertae sedis*, family, genus, and species indeterminate, rostrum maxillae (IRScNB Av 66); **3**, dorsal side; **4**, ventral side; **5**, lateral side. cf. Idiornithidae distal end of left tarsometatarsus (IRScNB Av 67); **6**, dorsal side; **7**, plantar side. cf. Phoenicopteriformes, distal end of left tarsometatarsus (IRScNB Av 68); **8**, medial view; **9**, plantar side. Scale bar equals 10 mm (same scale bar for 3-9). *Pici, famille, genre et espèce indéterminés, extrémité distale du tarsométatarse droit (IRScNB Av 65); **1**, face dorsale; **2**, face plantaire; l'échelle représente une longueur de 1 mm.* Aves incertae sedis, *famille, genre et espèce indéterminés, rostrum maxillae (IRScNB Av 66); **3**, face dorsale; **4**, face ventrale; **5**, face latérale. cf. Idiornithidae extrémité distale du tarsométatarse gauche (IRScNB Av 67); **6**, face dorsale; **7**, face palmaire. cf. Phoenicopteriformes, extrémité distale du tarsométatarse gauche (IRScNB Av 68); **8**, vue médiale; **9**, face palmaire. L'échelle représente une longueur de 10 mm (même échelle pour 3-9).*

from Boutersem are among the earliest certain record of the Rallidae known so far (see Cracraft 1973; Harrison & Walker 1976; Olson 1977).

PICIFORMES (Meyer & Wolf, 1810)
PICI (sensu Simpson & Cracraft, 1981)

Family, genus and species indeterminate
Fig. 7.1-2

Referred specimen - Distal end of right tarsometatarsus lacking the trochleae metatarsorum II and IV (IRScNB Av 65; Fig. 7.1-2).

Dimensions - Medio-lateral width of trochlea metatarsi III, 0.8.

Description and comparison - Although the specimen is very fragmentary, it is preserved well enough to allow a reliable assignment to the Pici (barbets, toucans, woodpeckers and allies). Like in all members of this taxon, the dorsal surface of the tarsometatarsus is very flat and all three trochleae lie in the same plane if the bone is seen from its distal end. The trochlea metatarsi IV is broken but its remaining base indicates that it was widely splayed laterally like in recent Pici. The small trochlea metatarsi III is slightly asymmetric with the lateral rim being smaller; its furrow is shallow. The trochlea metatarsi II appears to have been narrow like in recent Pici.

Discussion - The specimen is the earliest record of the Pici known so far; the next-oldest comes from the late Oligocene (MP 29) of Germany and is about eight million years younger (Mayr 2001 - unfortunately this bird has been outdated very quickly). The shallow furrow on the trochlea metatarsi III indicates that the species from Boutersem probably was not trunk-climbing like recent Picidae.

In size, the species from Boutersem corresponds to the smallest recent members of the Pici, e.g. the species of the genus *Picumnus*. Because of its the fragmentary nature, it cannot be discerned whether the specimen from Boutersem belongs to one of the recent families or to an extinct taxon.

Aves *incertae sedis*

Family, genus and species indeterminate
Fig. 7.3-5

Referred specimen - Rostrum maxillae (IRScNB Av 66; Fig. 7.3-5).

Dimensions - Length as preserved, 23.4. Maximum width, 5.2.

Remarks - The specimen is a narrow and elongated rostrum maxillae. In its shape it most closely resembles the tip of the beak of the recent charadriiform families Rostratulidae and Scolopacidae (especially snipes of the genus *Gallinago*). Like in *Gallinago*, the beak of the fossil taxon widens towards the rounded tip and appears to have been fairly straight (in recent Rostratulidae it is more curved). Like in the Rostratulidae, there are many large foramina neurovascularia, whereas in those Scolopacidae with a similar bill shape there are foveae instead of foramina. There is a distinct furrow along the median line of the ventral of the beak side, which is also present in *Gallinago*, *Scolopax*, and some other recent Scolopacidae. The tip of the beak of the Threskiornithidae (ibises) is more curved and further differs in that there is a pair of longitudinal furrows along its sides.

The bill shape and the presence of so many foramina for sensorial nerves indicate, that the bird probably was probing the soil with its beak in search for food.

CONCLUSIONS

There is meanwhile an extensive fossil record of birds from the Lower and Middle Eocene of Europe, namely from Messel and the London Clay, but early Oligocene fossils of small birds still remain very scarce. The only European deposits which yielded a great number of small early Oligocene birds are those of the Quercy (France). However, in the Quercy localities terrestrial birds of dry, open habitats dominate (Mourer-Chauviré 1995), and the composition of the avifauna trenchantly differs from that of Boutersem. Neither Anseriformes nor Piciformes have been found so far, and Charadriiformes and Rallidae appear to have been rare (Mourer-Chauviré 1995).

Oligocene birds are known from Belgium since a long time, but the few taxa described so far are from younger, Rupelian, deposits (e.g., van Beneden 1871; Cheneval 1996). From other early Oligocene localities of Europe also very few small birds were described, and most are known from single isolated bones only (e.g., Harrison & Walker 1979); the same is the case with other, non-European early Oligocene avifaunas (e.g., Weigel 1963; Kurochkin 1976). Rasmussen et al. (1987) described a diverse avifauna from the early Oligocene of Egypt which, however, entirely differs in its composition from that of Boutersem.

Apart from the fact that a fair number of small birds has been collected, the specimens from Boutersem also greatly contribute to our knowledge on the early Oligocene avifauna of Europe, because many of the taxa are represented by more than one skeletal element. The avian remains from Boutersem provide the earliest fossil record of the Anatidae and Pici, and the specimens of the Anseriformes, Charadriiformes, and Rallidae are among the most substantial early Tertiary record of these groups described so far.

Although very tiny birds are preserved, no passeriform birds were identified in the material from Boutersem. This further confirms the absence of this order, which today comprises more than 3/5 of all bird species, in the early Oligocene of Europe (see also Olson 1985; Mourer-Chauviré et al. 1989).

There are few remains of larger birds in the material from Boutersem which are, however, too fragmentary to allow a reliable identification. A distal end of a tarsometatarsus (IRScNB Av 67; Fig. 7.6-7) might belong to the Idiornithidae (Gruiformes), extinct relatives of the seriemas (Cariamidae) which are fairly common in early Oligocene deposits of France. Another distal end of a tarsometatarsus (IRScNB Av 68; Fig. 7.8-9) resembles that of Phoenicopteriformes (flamingos), which are also known from early Oligocene deposits of France (Mourer-Chauviré 1995).

The presence of ducks among the avian remains from Boutersem indicates an aquatic paleoenvironment, which is also in concordance with the fact that remains of large cursorial birds, such as the Idiornithidae, are very rare (in the early Oligocene deposits of the Quercy, these birds have been found

in great numbers, see Mourer-Chauviré 1983). Although recent Glareolidae usually occur in dry, open habitats, especially the genus *Glareola* is often associated with inland waters; rails are found both in aquatic and forested habitats. The almost complete absence of arboreal birds (the only exception being the above described remain of a piciform bird) further indicates the absence of forests in the close vicinity of the locality.

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