Paleornithological Research 2013

Proceed. 8th Internat. Meeting Society of Avian Paleontology and Evolution

Ursula B. Göhlich & Andreas Kroh (Eds)

naturhistorisches museum wien

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A new roller (Aves: Coraciiformes s. s.: Coraciidae) from the Early Miocene of the Saint-Gérand-le-Puy area, Allier, France

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Abstract — *Miocoracias chenevali*, nov. gen., nov. spec., a new genus and species of roller (Aves: Coraciiformes s. s.: Coraciidae) is described from the Early Miocene of Saint-Gérand-le-Puy. This family had not yet been reported from the rich fossil avifauna of this area. Although the material is fragmentary it shows morphological characteristics different from those of the extinct family Geranopteridae, and can be attributed to the Recent family Coraciidae. The rodents found in the same locality make it possible to attribute it to the MN2a zone. An appendix gives an updated list of the fossil birds identified in the Saint-Gérand-le-Puy area.

Key words: Fossil birds, Early Miocene, Saint-Gérand-le-Puy, Mont Merle, Coraciidae, rollers

Introduction

The Coraciiformes sensu stricto include three extinct families, the Primobucconidae, the Eocoraciidae, the Geranopteridae, and two Recent families, the Coraciidae and the Brachypteraciidae (Mayr 2009). The Primobucconidae are known from the Early Eocene of Europe and North America and the Eocoraciidae are known from the Middle Eocene of Messel, Germany. In addition a nearly complete skeleton of a new genus and species has been described from the Lower Eocene of the Green River Fm., Wyoming, United States (Clarke *et al.* 2009). This new form, *Paracoracias occidentalis*, is placed in the suborder Coracii. Incidentally, the name Coracii has been applied to a clade that has been defined as follows: "the stem clade including all taxa more closely related to Coracioidea than to its nearest outgroup" (Clarke *et al.* 2009: p. 587). This clade definition is equivalent to the content of the Coraciiformes sensu stricto of Mayr (1998).

The Geranopteridae have been described in the Late Eocene or Oligocene of the Phosphorites du Quercy, in France, but in the new excavations they have been found only in Upper Eocene layers (Mayr & Mourer-Chauviré 2000; Mourer-Chauviré & Sigé 2006). They include the species *Geranopterus alatus* Milne-Edwards, 1892, *Geranopterus milneedwardsi* Mayr & Mourer-Chauviré, 2000, and some indeterminate Geranopteridae from the locality of Perrière (Mourer-Chauviré & Sigé 2006). In the old collections from Quercy, the age of which is not accurately known, there is also a Coraciiforme s. s. incertae sedis species A, represented by an almost complete tarsometatarsus (PQ 1216) (Mayr & Mourer-Chauviré 2000).

The species *Nupharanassa bohemica* Mlikovský, 1999, described from the Lower Miocene locality of Dolnice, Czechia, (MN 4b), initially

published 10 Dec. 2013

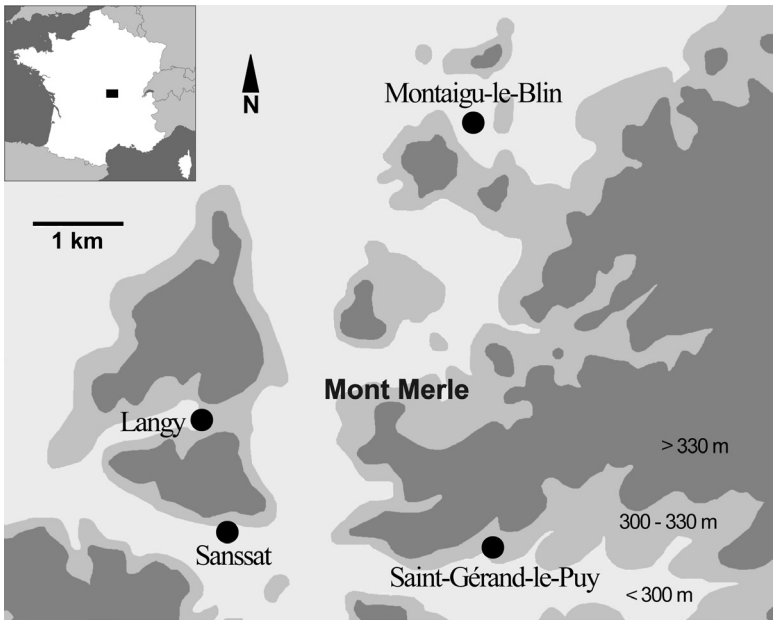

FIGURE 1. Location map of the Mont Merle locality, between the classical localities of Saint-Gérand-le-Puy and Montaigu-le-Blin. The contour lines indicate the height above sea level.

placed in the family Jacanidae, has been transferred to the genus *Geranopterus* and has become *Geranopterus bohemicus* (Mlikovský, 1999) (Mourer-Chauviré 1999).

In Africa Coraciiformes of indeterminate family had been reported from the Early Pliocene of Langebaanweg, South Africa (Rich 1980). These Coraciiformes belong to the family Alcedinidae (Olson 1994) and thus Coraciidae are still unknown at the present time in this avifauna. In Europe, the genus *Eurystomus* is known by an extinct species, *Eurystomus beremendensis* Kessler, 2010, from the Late Pliocene of Beremend 26, Hungary (MN 16) and by *Eurystomus* sp., from the Early Pleistocene of Betfia 2 and Betfia 9, Romania (Kessler 2010). In more recent localities the Coraciidae are represented by the Recent species, *Coracias garrulus* Linnaeus, 1758 (Tyrberg 1998).

The Mont Merle locality (Fig. 1) is situated near the town of Saint-Gérand-le-Puy (Allier, France), an area known for its rich Agenian vertebrate fauna (Viret 1929; Cheneval 1983a; Hugueney 1997). It is a limestone hill constituted by stromatolitic bioconstructions and marly sediments deposited in a lacustrine environment (Wattinne *et al.* 2003). A quarry was opened here, but it is now filled in. Washing and sieving of marl on the top of this hill yielded various fossil remains from fishes (mainly Cyprinidae), amphibians (Salamandridae), lizards (Lacertidae, Anguidae), amphisbaenians, snakes (Scolecophidians, Natricinae, Viperidae), marsupials (Didelphidae), insectivores (Soricidae, Talpidae), small carnivores, ungulates (Cainotheriidae, "Moschidae"), rodents (Sciuridae, Cricetidae, Eomyidae, Gliridae) and a lagomorph. Bird remains are not numerous and include only some crushed fossil bones of Palaelodidae, Laricolidae and a new Coraciidae.

Mont Merle is an unpublished new locality that has not been studied before. Some rodents make it possible to give it a dating. The Eomyid *Rhodanomys schlosseri* Depéret & Douxami, 1902, is represented by upper molars characterized by a continuous longitudinal ridge, and by their size which is included in the variation range observed at Fornant 11 (Engesser 1990) and at Chavroches (Hugueney *et al.* 2006). As the distribution of *R. schlosseri* covers only a short period, these teeth place the Mont Merle locality between the Paulhiac level (MN1) where *R. transiens*, predecessor of *R. schlosseri*, is present, and the upper part of the MN 2a level (top of the quarry of Montaigu-le-Blin and locality of La Chaux in Switzerland) where the species is not reported but is replaced by the Eomyid genus *Ritteneria*.

Material and methods

The anatomical terminology follows Baumel & Witmer 1993, and when necessary Howard 1929, and Ballmann 1969a. The fossil specimens are deposited in the collection of the Université Claude Bernard-Lyon1 (acronym FSL for Faculté des Sciences de Lyon) and in the collection of the Muséum d'Histoire Naturelle de Lyon (acronym ML). Other acronyms are: EC (locality of Escamps); EC3 (locality of Escamps 3), EC4 (locality of Escamps 4), MN (Mammal Neogene), PQ (Phosphorites du Quercy), PRR (locality of Perrière), and STG (Saint-Gérand-le-Puy).

Systematic Palaeontology

Order Coraciiformes sensu stricto (see Mayr 1998)
Family Coraciidae Batsch, 1788 (see Dubois & Bour 2010)

Miocoracias nov. gen.

Type species: *Miocoracias chenevali* nov. spec.

Diagnosis: Distal part of tarsometatarsus showing a foramen vasculare distale situated relatively proximally, proximodistally elongate, and obliquely oriented. Trochlea metatarsi IV slightly shorter than trochlea metatarsi III, and trochlea metatarsi II slightly shorter than trochlea metatarsi IV. On the dorsal face trochlea metatarsi III raised and extended by a longitudinal ridge. Trochlea metatarsi III distally splayed. On the plantar face, opening of foramen vasculare distale elongate and narrow. Canalis interosseus distalis open on the plantar side and forming an elongate and narrow sulcus. Trochlea metatarsi II showing a narrow and projecting wing. Proximal rim of trochlea metatarsi III raised compared to the surface of the fossa supratrochlearis plantaris. In distal view trochleae arranged along a weakly arched line.

Included species: Type species only.

Distribution: Early Miocene, Agenian, MN 2a, Saint-Gérand-le-Puy area, Allier, France.

Etymology: Greek, *Mio*, from the Miocene, and *Coracias*, modern genus of roller.

Miocoracias chenevali nov. sp.
(Fig. 2.1–2.7)

Holotype: FSL 444 229 right tarsometatarsus, distal part.

Paratype: FSL 444 320 right tibiotarsus, distal part, incompletely preserved.

Diagnosis: As for the genus.

Horizon and locality: Locality of Mont Merle, district of Saint-Gérand-le-Puy, Allier, France. Early Miocene, Agenian, Mammal Neogene Zone MN 2a.

Referred material: ML STG 4048 right ulna. This ulna comes from the old collections and it is not possible to know from which locality it has been gathered.

Dimensions (in mm): Right tarsometatarsus, holotype: Length as preserved, 9.0; Distal width, 5.8; Distal depth, 3.1; Width of trochlea metatarsi III, 2.1; Depth of trochlea metatarsi III, 2.4. Right tibiotarsus: Length as preserved, 11.4; Width of shaft at the level of apophysis interna ligamenti obliqui, 2.6; Depth of shaft at the same level, 2.9; Depth of lateral condyle, 4.5. Right ulna: Total length, 53.7; Proximal width, 5.5; Proximal depth, 3.7; Width of shaft in the middle, 2.3; Depth of shaft in the middle, 2.5; Distal width from the cranial border of condylus dorsalis to top of tuberculum carpale, 5.5; Depth of condylus dorsalis, 4.8.

Etymology: This species is named after Jacques Cheneval in recognition of his numerous and valuable studies on the avifauna of the Saint-Gérand-le-Puy area.

Description and comparisons with the two Recent genera *Coracias* and *Eurystomus*

Tarsometatarsus (Fig. 2.1–2.3): On the dorsal face, the foramen vasculare distale is situated more proximally in *Miocoracias* and it is more proximodistally elongated than in the Recent genera. In *Coracias* and *Eurystomus*, the opening is dorsoplantarly orientated, while in *Miocoracias* the opening is slit-shaped, obliquely heading from the dorsolateral side to the plantaromedial side of the bone. This foramen is situated at the end of the outer extensor groove (Howard 1929).

This extensor groove is deeper in *Eurystomus* than in *Coracias*, and it is also very deep in *Miocoracias*. In *Miocoracias*, as in *Eurystomus* and *Coracias*, trochlea metatarsi IV is slightly shorter than trochlea metatarsi III and trochlea metatarsi II is slightly shorter than trochlea metatarsi IV. In the genus *Eurystomus* trochlea metatarsi III shows two projecting rims, separated by a well-expressed groove. This groove is fainter in the genera *Coracias* and *Miocoracias*. In *Eurystomus* and *Coracias* trochlea metatarsi III is relatively narrow, while it is slightly distally splayed in *Miocoracias*.

On the plantar face, in *Miocoracias*, the opening of the foramen vasculare distale is elongate and narrow, while it is more rounded in *Eurystomus* and *Coracias*. The canalis interosseus distalis, which runs from the foramen vasculare distale to the incisura intertrochlearis lateralis is not covered by a bony blade, and forms a narrow, elongate groove on the plantar side. This character is one of the main characteristics of the Coraciiformes s. s. Trochlea metatarsi II is more clearly separated from trochlea metatarsi III in *Miocoracias* than in *Eurystomus* and *Coracias*, it is narrower than in *Eurystomus* and it shows a wing less projecting plantarly than in *Coracias*. The proximal rim of trochlea metatarsi III is clearly raised compared to the surface of the fossa supratrochlearis plantaris, while in *Eurystomus* and *Coracias* this proximal part is not raised. Trochlea metatarsi IV shows a narrow and projecting wing in *Miocoracias* and *Eurystomus*, while this wing is less developed in *Coracias*. Fossa metatarsi I extends far distally in *Miocoracias* and *Eurystomus*, while it is situated more proximally in *Coracias*.

In distal view the trochleae are arranged on a faintly arched line as in both Recent genera.

Tibiotarsus (Fig. 2.4–2.5): The condylus medialis is not preserved. On the cranial face, the sulcus extensorius and the pons supratendineus are situated on the median axis of the bone, as in the Recent Coraciidae and Brachypteraciidae, while in most of the other Recent birds they are situated on the medial side of the bone. At the proximal part of the condylus lateralis, and on the lateral side of the pons supratendineus, there is a strong, point-shaped tubercle, the apophysis externa ligamenti obliqui (Ballmann 1969a), and on the medial side there is also a thin, elongate, and well projecting apophysis interna ligamenti obliqui.

Compared to the Recent genera *Coracias* and *Eurystomus*, the distal part of the tibiotarsus is less mediolaterally compressed, and the sulcus extensorius is shallower. The apophysis externa ligamenti obliqui is very sharp and projecting while its development is variable in the Recent forms: some specimens have an almost flat apophysis, situated in the continuation of the condylus lateralis, while some others have a sharp apophysis.

On the caudal face, the condylus medialis shows a wing which projects weakly medially, as in the genera *Eurystomus* and *Coracias*, and the condylus lateralis shows a wing less projecting laterally than in *Eurystomus*, but comparable to that of *Coracias*.

On the lateral face, the condylus lateralis is very rounded and the epicondylus lateralis is hardly indicated, as in *Eurystomus* and *Coracias*.

Ulna (Fig. 2.6–2.7): This ulna shows the characteristic shape of the rollers' ulnae. It is elongate and slender, with a slight curvature at its proximal part. The shaft is slightly flattened on its caudal side. Compared to the genus *Coracias*, the olecranon is less projecting proximally and wider at its basis. The cotyla dorsalis is extended distally by a long, narrow lip, clearly separated from the cotyla ventralis. This lip is more rounded in *Coracias*. The distal part of the fossil is not very well preserved, but the condylus ventralis is more projecting distally and the tuberculum carpale is sharper in *Miocoracias* than in *Coracias*. Still in *Miocoracias* there is a small depression on the proximal border of the tuberculum carpale, on its cranial side. This depression is absent in the Recent genera *Coracias* and *Eurystomus*.

The shape of the olecranon looks more similar to that of *Eurystomus*, the olecranon of which is short and wide at its basis. In *Miocoracias* the distal lip of the cotyla dorsalis is incurved and medially directed, while in *Eurystomus* it is dorsally directed. On the ventral side the tuberculum ligamenti collateralis ventralis is more projecting ventrally in *Eurystomus*. At the distal part the condylus ventralis is longer in proximodistal direction in *Eurystomus*.

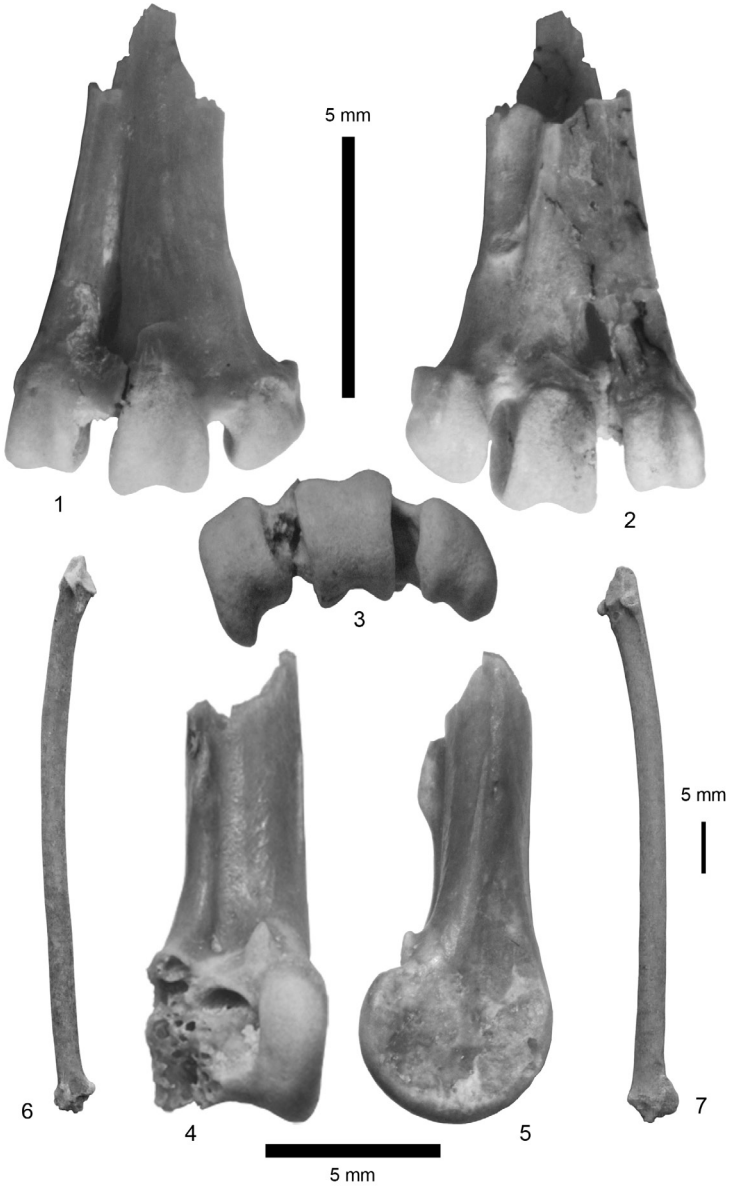

FIGURE 2. *Miocoracias chenevali* nov. gen. et nov. spec. from the Early Miocene of Mont Merle, district of Saint-Gérand-le-Puy, Allier, France. **1–3**, Right tarsometatarsus, distal part, holotype, FSL 444 229 (1: dorsal view, 2: plantar view, 3: distal view); **4–5**, Right tibiotarsus, distal part, paratype, FSL 444 230 (4: cranial view, 5: lateral view); **6–7**, Referred material, right ulna, ML STG 4048 (6: dorsal view, 7: Ventral view).

Comparison with the extinct family Geranopteridae

Tarsometatarsus: The distal part of the tarsometatarsus is known in *Geranopterus alatus* by two specimens from the Late Eocene of Escamps, EC4 n°5 (Mayr & Mourer-Chauviré 2000: fig. 8, Y–Z), and ES n°4. In *Geranopterus* the metatarsal trochleae are shorter and less individualized than in *Miocoracias*. In *Miocoracias* trochlea metatarsi III is more raised on the dorsal face, and it is extended by a longitudinal ridge; the outer extensor groove is deeper. In *Geranopterus* the dorsal surface of the tarsometatarsus is flatter. On the plantar face the proximal rim of trochlea metatarsi III is raised compared to the surface of fossa supratrochlearis plantaris in *Miocoracias* while in *Geranopterus* the two ridges, lateral and

medial, of trochlea metatarsi III gradually merge into the surface of this fossa. Trochlea metatarsi III is narrower in *Geranopterus* than in *Miocoracias*. The same characteristics are found on a distal tarsometatarsus of *G. milneedwardsi*, from the Late Eocene of Perrière, n° FSL 330 856, different from *G. alatus* by its smaller size.

In their phylogenetic analysis Clarke *et al.* (2009: p. 607) have used the character 68. Tarsometatarsus, distal interosseal canal: present, canal open on plantar side, forming a deep narrow sulcus between trochleae III and IV (0); absent (1). This open canal is coded as absent (1) in *Geranopterus* while it is coded as present (0) in *Eocoracias* and in the Recent Coraciidae and Brachypteraciidae. It is coded as (?) for the three species of Primobucconidae included in the analysis. This is clearly inaccurate because this character is an important synapomorphy of the clade including the Primobucconidae, Eocoraciidae, Geranopteridae, Coraciidae and Brachypteraciidae (Mayr *et al.* 2004; Mayr 2009). This character is not visible in *Eocoracias* and it is present in the Primobucconidae from the Eocene of France (Mayr *et al.* 2004) as well as in the Geranopteridae (Mayr & Mourer-Chauviré 2000; Mourer-Chauviré & Sigé 2006).

Geranopterus bohemicus looks very similar to *G. alatus* and differs from *Miocoracias* by its shorter trochleae metatarsi with narrow incisurae intertrochlearis, its trochlea metatarsi III which is not raised compared to the dorsal surface of the shaft and not distally splayed. It differs also by the dorsal surface of the shaft, which is flat, and by trochlea metatarsi IV, which is narrower. Finally Mlikovský indicates in the diagnosis of this species "a rather smooth transition between the trochlea metatarsi tertii and fossa supratrochlearis plantaris" (Mlikovský 1999: p. 122). This characteristic corresponds well to the genus *Geranopterus* and differs from the genus *Miocoracias*.

Tibiotarsus: In *Geranopterus alatus* the tibiotarsus is known by two distal extremities from the locality of Escamps, EC3 n°7 and EC4 n°3 (Mayr & Mourer-Chauviré 2000: fig. 8, T–U), and in *G. milneedwardsi* by a distal part from the locality of Perrière, n° PRR 2621. In *G. alatus* the sulcus extensorius and the pons supratendineus are deeper inside the shaft. On the medial side the epicondylus medialis is very projecting. In *Miocoracias* the pons supratendineus is more cranially brought forward, the apophysis externa ligamenti obliqui is more projecting and the epicondylus medialis is hardly visible.

In *G. milneedwardsi* the shaft is very narrow compared to the condyles; the sulcus extensorius is faintly indicated; both condyles, lateral and medial, are narrow, very close together, and strongly projecting cranially. The apophysis externa ligamenti obliqui is projecting. The pons supratendineus is situated between the proximal parts of the condyles. Both epicondyles, lateral and medial, are not well marked.

Ulna: In the genus *Geranopterus* only the distal part of the ulna is known. In this genus, as in *Miocoracias*, the tuberculum carpale is very sharp but the condylus ventralis is flatter and more proximodistally elongate in *Geranopterus* (see Mayr & Mourer-Chauviré 2000: fig. 8, K–L).

Comparison with the small forms from Perrière

Two other, smaller forms, designated as Geranopteridae, genus and species indeterminate, have been reported from the late Eocene locality of Perrière, in the Quercy, level MN 17b (Mourer-Chauviré & Sigé 2006). A distal part of tibiotarsus, n° FSL 367088, corresponds to a bird smaller than *G. milneedwardsi*. It differs from *Miocoracias* by the fact that the sulcus extensorius and the pons supratendineus are deeper between the condyles. A distal part of tarsometatarsus, n° FSL 367073, corresponds to a bird which was still smaller than the preceding one (Mourer-Chauviré & Sigé 2006: pl. 1, i–j). In this form the shaft is very narrow, and triangular in cross section. Trochlea metatarsi IV is not preserved but trochlea metatarsi II is strongly plantarly displaced. This form differs from *Miocoracias* by its very narrow shaft and its trochlea metatarsi II plantarly displaced.

Comparison with a Coraciiformes s. s., incertae sedis, species A (n° PQ 1216)

This form is known by an almost complete tarsometatarsus illustrated in Mayr & Mourer-

Chauviré (2000: fig. 9G–I). *Miocoracias* shares with this form the presence of an elongate and oblique distal vascular foramen, situated at the bottom of a deep outer extensor groove. But it differs from it because in *Miocoracias* trochlea metatarsi II is slightly shorter than trochlea metatarsi III while in PQ 1216 it is distinctly shorter. On the plantar face, unlike *Miocoracias*, trochlea metatarsi III does not have a raised rim, and its two ridges, lateral and medial, merge gradually into the surface of the fossa.

Discussion

The Coraciiformes sensu stricto are represented at the present time by two families, one restricted to Madagascar, and the other mainly distributed in the tropical regions of the Old World (Fry 2001). As it was first indicated by Harrison (1979) small non-passerine birds were much diversified in the early Tertiary of the Northern Hemisphere and occupied the ecological niches which are now occupied by the passerines. Among these small non-passerine birds there are stem group representatives of Coraciiformes s. s., Alcediniformes, Upupiformes, Caprimulgiformes, Apodiformes, Coliiformes, Psittaciformes, etc. Stem group representatives of Coracii are known in the Early Eocene of North America (Clarke *et al.* 2009; Ksepka & Clarke 2010) where rollers are no longer present. These stem group representatives have progressively disappeared and some orders are now only represented by a few relict families.

The stem group family Geranopteridae is still present in the locality of Dolnice, in Czechia, the age of which is MN 4b (Mlikovský 2002) and thus clearly younger than the age of the type locality of *Miocoracias*.

The presence of the genus *Miocoracias* fills a gap between the Eocene and the Recent forms. The small quantity of material found in the Saint-Gérand-le-Puy area can be explained by the fact that this fossil avifauna is mainly composed of waterbirds and only includes a small proportion of terrestrial birds.

The Saint-Gérand avifauna includes a large quantity of forms belonging to families, or subfamilies, the recent distribution of which is mainly tropical. Cheneval (1989) already indicated this abundance in the aquatic avifauna, but the same observation can be made for the terrestrial avifauna. The taxa corresponding to a tropical climate are: Anatidae (genus *Mionetta*), Palaelodidae, Phoenicopteridae, Ciconiidae (tribe Leptoptilini), Threskiornithidae, Pelecanidae, Sagittariidae, Pteroclididae, Psittacidae, Coliidae, Trogonidae and Phoeniculidae. The presence of Coraciidae is in line with this presence of tropical taxa, whether exclusively (taxa with only tropical species, not migrating to temperate zones), or not. In the Recent Coraciidae, most of the species are migratory but they breed and winter inside the intertropical zone, or very close to it (Fry 2001). Two species only are long distance intercontinental migrants, the European Roller (*Coracias garrulus*) and the Dollarbird (*Eurystomus orientalis*). These tropical taxa retreated from the high and middle latitudes during the second half of the Miocene and the Pliocene, leaving in some cases emergent long-distance migrants (Louchart 2008).

Acknowledgements

We thank M. Malhuret who allowed us access to the Mont Merle, Marion Petit who helps us to collect fossil remains, Didier Berthet for the loan of the material from the Muséum de Lyon, and Christine Lefèvre, from the Muséum national d'Histoire naturelle de Paris, for the loan of comparative material. We thank Antoine Louchart and Marco Pavia for their careful comments which have improved the manuscript.

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Appendix

Updated list of the avian species reported in the whole of the localities known as "Saint-Gérand-le-Puy". The material from the old collections comes from different quarries and its age is not accurately known; this age can be MN 1, MN 1/2, or MN 2a (Hugueney 1997). However the largest part of the quarries has yielded fossil material corresponding to the MN 2a zone. This list is founded upon the following works: Ballmann 1969b; Cheneval 1983b, 1984; Cheneval & Escuillié 1992; Mourer-Chauviré 1995; Bocheński 1997; Mlikovský 1998; Mourer-Chauviré 2000; Mlikovský & Göhlich 2000; Mlikovský 2002; Hugueney *et al.* 2003; Göhlich & Mourer-Chauviré 2005; De Pietri *et al.* 2011a, 2011b, 2012; Mayr & Smith 2012; De Pietri & Mayr 2012; De Pietri 2013. The systematic order follows the list of the International Ornithologists' Union (Gill & Donsker 2012). Some modifications brought by Mlikovský (2002) have not been integrated because they do not seem well-founded.

O. Galliformes
F. Quercymegapodiidae Mourer-Chauviré, 1992
Genus *Ameripodius* Alvarenga, 1995
Ameripodius alexis Mourer-Chauviré, 2000
F. Phasianidae Horsfield, 1821
Genus *Palaeortyx* Milne-Edwards, 1869
Palaeortyx gallica Milne-Edwards, 1869
Palaeortyx brevipes Milne-Edwards, 1869
Palaeortyx prisca (Milne-Edwards, 1869)
syn. *Palaeortyx intermedia* Ballmann, 1966
Palaeortyx phasianoides Milne-Edwards, 1869
Palaeortyx media Milne-Edwards, 1869
(nomen nudum)

O. Anseriformes
F. Anatidae Leach, 1820
Genus *Mionetta* Livezey & Martin, 1988
Mionetta blanchardi (Milne-Edwards, 1863)
Mionetta consobrina (Milne-Edwards, 1867)
Mionetta natator (Milne-Edwards, 1867)
Genus *Cygnopterus* Lambrecht, 1931
Cygnopterus alphonsi Cheneval, 1984
O. Gaviiformes
F. Gaviidae Coues, 1903
Genus *Colymboides* Milne-Edwards, 1867
Colymboides minutus Milne-Edwards, 1867

O. Procellariiformes
F. Procellariidae Leach, 1820
Indeterminate genus
Indeterminate genus *arvernensis* (Milne-Edwards, 1871), syn. *Puffinus arvernensis* Milne-Edwards, 1871, and *Plotornis arvernensis* (Milne-Edwards, 1871) (Cheneval 1984; Mayr & Smith 2012)

O. Phoenicopteriformes
F. Palaelodidae (Stejneger, 1885)
Genus *Palaelodus* Milne-Edwards, 1863
Palaelodus ambiguus Milne-Edwards, 1863, syn. *Ibidopodia palustris* Milne-Edwards, 1871, syn. pro parte *Probalearica problematica* (Milne-Edwards, 1868) (Cheneval & Escuillé 1992)
Palaelodus gracilipes Milne-Edwards, 1863, syn. *Palaelodus minutus* Milne-Edwards, 1868 (Cheneval 1983)
Palaelodus crassipes Milne-Edwards, 1863
Genus *Megapaloelodus* Miller, 1944
Megapaloelodus goliath (Milne-Edwards, 1868)
F. Phoenicopteridae Bonaparte, 1831
Genus *Phoenicopterus* Linnaeus, 1758
Phoenicopterus croizeti Gervais, 1852

O. Ciconiiformes
F. Ciconiidae Gray, 1840
Genus *Grallavis* Cheneval, 1984
Grallavis edwardsi (Lydekker, 1891b)

O. Pelecaniformes
F. Threskiornithidae Richmond, 1917
Genus *Gerandibis* De Pietri, 2013
Gerandibis pagana (Milne-Edwards, 1868) syn. *Milnea gracilis* Lydekker, 1891a (Cheneval 1984)
F. Ardeidae Leach, 1820
Genus *Proardeola* Harrison, 1979
Proardeola walkeri Harrison, 1979
F. Pelecanidae Rafinesque, 1815
Genus *Miopelecanus* Cheneval, 1984
Miopelecanus gracilis (Milne-Edwards, 1863)

O. Suliformes
F. Sulidae Reichenbach, 1849
cf. Genus *Empheresula* Harrison, 1975
cf. *Empheresula arvernensis* (Milne-Edwards, 1867)
F. Phalacrocoracidae Reichenbach, 1850
Genus *Oligocorax* Lambrecht, 1933
Oligocorax littoralis (Milne-Edwards, 1863)
Genus *Nectornis* Cheneval, 1984
Nectornis miocaenus (Milne-Edwards, 1867)

O. Accipitriformes
F. Sagittariidae Grandori & Grandori, 1935
Genus *Pelargopappus* Stejneger, 1885
Pelargopappus magnus (Milne-Edwards, 1868)
F. Accipitridae Vieillot, 1816
Genus *Aquilavus* Lambrecht, 1933
Aquilavus depredator (Milne-Edwards, 1871)
Aquilavus priscus (Milne-Edwards, 1863)
Genus *Milvus* Lacépède, 1899
Milvus deperditus Milne-Edwards, 1871
Genus *Promilio* Wetmore, 1958
Promilio incertus (Gaillard, 1939)
Genus *Palaeohierax* Milne-Edwards, 1871
Palaeohierax gervaisii (Milne-Edwards, 1863)

O. Otidiformes
F. Otididae Rafinesque, 1815 (?)
Genus *Otis* Linnaeus, 1758 (?)
Otis agilis Milne-Edwards, 1871 (nomen nudum)

O. Gruiformes
F. Rallidae Vigors, 1825
Genus *Palaeoaramides* Lambrecht, 1933
Palaeoaramides christyi (Milne-Edwards, 1869), syn. *Palaeoaramides eximius* (Milne-Edwards, 1869)
Genus *Paraortygometra* Lambrecht, 1933
Paraortygometra porzanoides (Milne-Edwards, 1869)
F. Gruidae Vigors, 1825
Genus *Palaeogrus* Portis, 1884
Palaeogrus excelsus (Milne-Edwards, 1868)
Genus *Probalearica* Lambrecht, 1933
Probalearica problematica (Milne-Edwards, 1868)

O. Charadriiformes
F. Haematopodidae Bonaparte, 1838
New material to be described (De Pietri *et al.* 2012)
F. Recurvirostridae Bonaparte, 1854
Genus *Himantopus* Brisson, 1760
Himantopus brevipes Milne-Edwards, 1871 (nomen nudum)
F. Charadriidae Vigors, 1825
New material to be described (De Pietri *et al.* 2012)

Scolopaci sensu Paton *et al.* 2003
F. incertae sedis
Genus *Scolopacimilis* De Pietri & Mayr, 2012
Scolopacimilis lartetianus (Milne-Edwards, 1863)
Scolopacimilis sp.
Genus *Becassius* De Pietri & Mayr, 2012
Becassius charadriioides De Pietri & Mayr, 2012
F. Scolopacidae Rafinesque, 1815
Genus *Elorius* Milne-Edwards, 1868
Elorius paludicola Milne-Edwards, 1868
Genus ? *Elorius* Milne-Edwards, 1868
? *Elorius limosoides* De Pietri & Mayr, 2012
Genus *Parvelorius* De Pietri & Mayr, 2012
Parvelorius gracilis (Milne-Edwards, 1868)
Genus ? *Parvelorius* De Pietri & Mayr, 2012
? *Parvelorius calidris* De Pietri & Mayr, 2012
Genus and species indeterminate

Suborder Laromorphae De Pietri *et al.*, 2011a
F. Laricolidae De Pietri *et al.*, 2011a
Genus *Laricola* Mlikovský, 2002
Laricola desnoyersii (Milne-Edwards, 1863)
Laricola elegans (Milne-Edwards, 1868)
Laricola totanoides (Milne-Edwards, 1868)
Laricola intermedia De Pietri *et al.*, 2011a
Laricola robusta De Pietri *et al.*, 2011a
Family incertae sedis
Genus *Sternalara* De Pietri *et al.*, 2011a
Sternalara minuta De Pietri *et al.*, 2011a
Sternalara milneedwardsi De Pietri *et al.*, 2011a

O. Pteroclidiformes
F. Pteroclididae Bonaparte, 1831
Genus *Leptoganga* Mourer-Chauviré, 1993
Leptoganga sepultus (Milne-Edwards, 1869)
Genus *Gerandia* Lambrecht, 1933
Gerandia calcaria (Milne-Edwards, 1869)

O. Psittaciformes
F. Psittacidae Illiger, 1811
Genus *Archaeopsittacus* Lambrecht, 1933
Archaeopsittacus verreauxi (Milne-Edwards, 1871)

O. Strigiformes
F. Tytonidae Ridgway, 1914
Genus *Necrobyas* Milne-Edwards, 1892
Necrobyas arvernensis (Milne-Edwards, 1863)
Genus *Prosybris* Brodkorb, 1970
Prosybris antiqua (Milne-Edwards, 1863)
F. Strigidae Vigors, 1825
Genus *Mioglaux* Mlikovský, 1998
Mioglaux poirrieri (Milne-Edwards, 1863)

O. Apodiformes
F. Apodidae Hartert, 1897
Genus *Procypseloides* Harrison, 1984
Procypseloides ignotus (Milne-Edwards, 1871)

O. Coliiformes
F. Coliidae Swainson, 1837
Genus *Limnatornis* Milne-Edwards, 1871
Limnatornis paludicola Milne-Edwards, 1871
Limnatornis archiaci (Milne-Edwards, 1871)

O. Trogoniformes
F. Trogonidae Lesson, 1828
Genus *Paratrogon* Lambrecht, 1933
Paratrogon gallicus (Milne-Edwards, 1871)

O. Coraciiformes
F. Coraciidae Batsch, 1788
Genus *Miocoracias* nov. gen.
Miocoracias chenevali nov. spec. (this paper)

O. Bucerotiformes
F. Phoeniculidae Bonaparte, 1831
Genus *Phirriculus* Mlikovský & Göhlich, 2000
Phirriculus pinicola Mlikovský & Göhlich, 2000

O. Piciformes
F. Picidae Vigors, 1825
Genus *Piculoides* De Pietri *et al.*, 2011b
Piculoides saulcetensis De Pietri *et al.*, 2011b

O. Passeriformes
F. Laniidae Rafinesque, 1815
Genus *Lanius* Linnaeus, 1758
Lanius miocaenus Milne-Edwards, 1871
F. Ploceidae Sundevall, 1836
Genus *Passer* Brisson, 1760
Passer sp.
F. Motacillidae Horsfield, 1821
Genus *Motacilla* Linnaeus, 1758
Motacilla humata Milne-Edwards, 1871
Motacilla major Milne-Edwards, 1871
F. Fringillidae Vigors, 1825
Genus *Loxia* Linnaeus, 1758
Loxia sp. 1
Loxia sp. 2