



Editorial

Foreword for the thematic volume of the PalEurAfrica project international symposium

Evolution and paleoenvironment of early modern vertebrates during the Paleogene



The PalEurAfrica project

The initial idea of PalEurAfrica (full title of the project: *Origin of the European modern faunas through Paleogene Central Africa collections*; Fig. 1(A, B)) was born 10 years ago from a discussion between Gregg F. Gunnell (Fig. 1(C)) and the first author (TS). They noted how little was known about the relationship between African and European Paleogene mammal faunas despite their geographical proximity. This was observed at the end of the editing process of a previous thematic volume on the dispersal of continental vertebrates during the Paleogene (Smith and Gunnell, 2013).

Giant leaps in knowledge about the evolution of the earliest modern vertebrates have been made over the last three decades thanks to important studies and discoveries by researchers in North America, Europe, North Africa and Asia. Recent advances made in the study of vertebrate evolution suggest that the earliest modern mammals such as primates (Fig. 1(D)), perissodactyls (odd-toed ungulates) and artiodactyls (even-toed ungulates), appeared suddenly in Europe, Asia, and North America at the Paleocene-Eocene Thermal Maximum (PETM) 56 Ma ago. Modern mammals likely originated during the late Paleocene in tropical habitats farther south. The PETM is the first and most prominent in a series of hyperthermals, short-lived events of extreme global warming. The PETM is especially important as an analogue for current global warming trends. Studies of the PETM have demonstrated its effect on past mammal dispersal, evolution and ecology, and highlighted potential biotic effects of future climate change.

Numerous international expeditions have focused on the northern continents, yielding collections that include the high quality PETM Belgian Dormal collection at the Royal Belgian Institute of Natural Sciences, Brussels (RBINS), recognized as the MP 7 reference-level of the mammalian biochronological scale for the European Paleogene (BiochroM'97, 1997). Yet in the tropics, only two fossil localities have yielded vertebrates from around this time interval, the Cerrejon coal mine in Colombia (Head et al., 2009) and the Vastan lignite mine in India (Rose et al., 2006). Extraordinary discoveries from these sites reveal early primates, bats, artiodactyls and other modern vertebrates although the origins of these groups have not been identified. Africa may hold keys to understanding the origin and diversification of modern mammal

groups, but the African Paleogene remains under-sampled, particularly sub-Saharan Africa.

When the new Belgian federal research program BRAIN-be (Belgian Research Action through Interdisciplinary Networks) was created end of 2012, we were among the first to apply in the thematic axis *Cultural historical and scientific heritage (Cross- and interdisciplinary exploitation/valorisation of federal heritage resulting from scientific expeditions)*. Interestingly, a unique collection of early Paleogene vertebrates from Central Africa documents Belgian expeditions of the Royal Museum for Central Africa (RMCA) by explorer Edmond Dartevelle in the Democratic Republic of Congo (DRC) and Angola. The PalEurAfrica project sought to identify Paleogene vertebrate faunas from Central Africa and to seek ancestors of modern mammals in Africa that gave rise to modern mammals in Europe and on other continents.

We assembled a team of experts in vertebrate paleontology, micropaleontology, geology and geochemistry. Our international and multidisciplinary team studied and digitized the Belgian Paleogene collections from earlier expeditions in Belgium (RBINS) and in DRC and Angola (RMCA). The history of earlier African expeditions was traced and excavation sites were identified and rediscovered through the use of archives. New excavations were organized in DRC and India to complete existing collections, using modern screen-washing techniques that enabled the team to find small vertebrates. A partnership was developed with international specialists in Central African fieldwork and faunas (a consortium including Duke University and Ohio University, USA). Targeted sampling of these sites also enabled the team to date and characterize them in detail, based on microfossils (Ghent University) and isotopic data (Namur University). The results of this project were regularly published in high impact factor journals and presented during diverse international congresses, and, at the end of the project, an international symposium was organized in Belgium to engage a broad network of Paleogene researchers to share findings and outcomes.

The international symposium

In the framework of the PalEurAfrica research project (see <http://www.paleurafrica.be>), we convened an international symposium from September 10th to 13th, 2019, related to the

PalEurAfrica

Origin of the European modern faunas through Palaeogene Central Africa collections



Fig 1. A, B. Banner (A) and logo (B) of the PalEurAfrica research project (2013–2020; see <http://www.paleurafrica.be>) and of the international symposium held at the Royal Belgian Institute of Natural Sciences in Brussels on September 10th–13th 2019. C. Dr. Gregg F. Gunnell, PalEurAfrica partner and director of the Division of Fossil Primates of Duke University Lemur Center. D. Lectotype of the earliest Eocene primate *Teilhardina belgica* from the RBINS Dormaal collection.

evolution and paleoenvironment of early modern vertebrates during the Paleogene at the RBINS (Fig. 2), bringing together 62 experts from 14 countries on four different continents. This allowed us to gather specialists who work on macro- and micropaleontology, bio- and isotope stratigraphy, paleoenvironments, paleobiogeography and geology of Paleogene vertebrate bearing sites. This international meeting celebrated the memory of our PalEurAfrica partner Gregg F. Gunnell (1954–2017; Fig. 1 (C)), who tragically died in the middle of his career, having made significant contributions to our understanding of Paleogene vertebrate evolutionary history.

Over three days, 51 abstracts were presented (38 talks in technical sessions, 10 posters, and 3 keynote lectures). The fourth day was dedicated to a fieldtrip in eastern Belgium which gathered 40 participants to visit three classic vertebrate localities that were opened for the meeting: Maret (middle Paleocene, MP 1–5), Dormaal (earliest Eocene, MP 7), and Hoogbutsel-Boutersem (early Oligocene, MP 21) (Fig. 3).

The thematic issue

This thematic issue of *Geobios* compiles 14 papers that are part of the research project PalEurAfrica and were related to the symposium dedicated to the memory of our friend and colleague Gregg F. Gunnell. Contributions explore an array of Paleogene vertebrate groups across continents (Europe, Africa, India, Asia, and North America) on diversity of topics including:

- the description of lepidosirenid lungfishes from the late Oligocene of Tanzania (Claeson et al., 2021);
- giant softshell turtles from the PETM of north-western Europe (Pérez-García and Smith, 2021);

- new insights on the early diversification of colubroidean snakes based on the stem-colubriiform *Thaumastophis* from the early Eocene of India (Zaher et al., 2021);
- the giant aquatic snake *Palaeophis africanus* from the middle Eocene of the Congo Basin (Folie et al., 2021);
- the first North American pipe snakes (Head, 2021);
- the oldest lampprophiid snake from the late Oligocene of Tanzania (McCartney et al., 2021);
- a reassessment of the “mammalian-woodpecker” ecological niche of the Paleocene Euramerican plesiadapid *Chiromyoides* (Boyer et al., 2021);
- a body size evaluation of the mesonychid *Dissacus* through the PETM in Wyoming (Solé et al., 2021b);
- new hyaenodonts from the early Eocene of the Paris Basin (Solé et al., 2021a);
- the first omomyid primate from Anatolia (Beard et al., 2021);
- the diversity of notharctid and microchoerid primates as well as paromomyid plesiadapiforms from a new early-middle Eocene locality of Quercy (Godinot et al., 2021);
- an early-middle Eocene mammal assemblage from Inner Mongolia (Paepen et al., 2021);
- a new basal raoellid artiodactyl from the middle Eocene of Jammu and Kashmir (Rana et al., 2021);
- and a revision of the Oligocene hyracoids found by Darteville's expeditions in the Congo Basin (Tabuce et al., 2021).

Gregg F. Gunnell's legacy

Gregg died on September 20, 2017 at the age of 63 while undergoing treatment for lymphoma, a diagnosis he received only a few weeks before his death. He left an impactful legacy of more than



Fig 2. Participants at the PalEurAfrica international symposium in front of the paleontology building (Janlet aisle) of the Royal Belgian Institute of Natural Sciences, Brussels on September 10th 2019 (Thierry Hubin, RBINS Photography). From left to right. Low rank: Cécilia Cousin, Annelise Folie, Simon Sweydan, Narimane Chatar, Ornella Bertrand, Zoi Kynigopoulou, Matthew Borths. Middle rank: Emmanuel Gheerbrant, Marc Augé, Rajendra Singh Rana, Kenneth D. Rose, Thierry Smith, Hecham Sallam, Samir Zouhri, Richard Smith, Philip D. Gingerich, Heather Ahrens, Márton Rabi, Jamie MacLaren, Andrej Čerňanský, Julien Lalanne, Hussam Zaher, Najia Elboudali, Marc Godinot, Florence Quesnel, Johan Yans, Fabrice Lihoreau, Nancy J. Stevens, Renate Rabenstein, Romain Weppe, Hans P. Püschel, Ellen R. Miller. High rank: Peter Stassen, Bin Bai, Yuan-Qing Wang, Qian Li, Constance Bronnert, Jérémy Tissier, Nathan Vallée Gillette, K. Christopher Beard, Gerald Mayr, Martin Jehle, Nicolae Trif, Vlad Codrea, Robert Speijer, Gilles Escarguel, Olivier Lambert, Floréal Solé, Rodolphe Tabuce, Stephen Louwyte. Not on the picture: Thierry De Putter, Pauline Coster, Aldo Impens, Stéphane Jouve, Florias Mees, Grégoire Métais, Frederik Migom, Marieke Paepen, Adan Pérez-García, Thomas Steeman, Modh Waqas.

150 papers including 18 book chapters. Ten of those papers were published after his death. Among the last was a revelatory study that demonstrated the relationship between the latest Eocene lemur *Plesiopithecus* from Egypt, Miocene *Propotto leakeyi* from Kenya, and Madagascar's aye-aye, ultimately suggesting the origin of aye-ayes may be in mainland Africa and strepsirrhine primates may have dispersed to Madagascar multiple times (Gunnell et al., 2018).

Gregg studied at the University of Michigan where he obtained his bachelor's and master's degrees in anthropology in 1976 and 1979, and a PhD in anthropology and geology in 1986. Then, he worked for more than 20 years alongside his PhD advisor Philip Gingerich as coordinator of the vertebrate fossil collections at the University of Michigan Museum of Paleontology. Due to the excellent reputation of the collections, Gregg met all generations of researchers coming from around the globe to study them. Gregg also served as an important mentor to many students of Paleogene paleontology, for example taking one of the authors on this article (NS) to the field to collect fossils for the first time and launching many careers with his kindness and training.

Much of Gregg's early career was focused on early Paleogene mammals, especially primates, but his research took a turn in 2000, when he described *Tanzanycteris*, a middle Eocene bat found while he was part of an expedition in Tanzania. So began Gregg's research on the origin of bats, delicate-boned animals he was attracted to, he said, because their rarely preserved fossils "interest

nobody." His fascination with bats led him to describe – in collaboration with other bat experts – the complete skeleton of *Onychonycteris*, the most primitive bat ever found. The receipt of this discovery was so amazing that the journal *Nature* used it for its cover page (Simmons et al., 2008).

Gregg joined Duke University in 2011 to take the helm of the Duke Lemur Center's Division of Fossil Primates where he replaced the late paleontologist Elwyn Simons (Fig. 4). Gregg spent more than 40 years collecting fossils in Wyoming, Pakistan, Egypt, Tanzania, and more recently, southeast Asia. A few days before he died, he left instructions for the organization of an expedition to Indonesia as part of a project funded by the National Geographic Society. It is therefore not surprising that Duke University news office named Gregg "the Fossil Hunter". When he was not in the field, he was globetrotting to museums in Europe, Asia and Africa, discovering game-changing fossils in drawers passed over again and again by others who had not recognized their significance.

Memories of Gregg live in the minds of all who were privileged to work with him. His colleagues described him as a calm, dedicated, and unusually-gifted fossil collector; he was always welcoming, encouraging and supportive of students and young researchers; he was one of the kindest, gentlest, and most thoughtful colleagues many of us had the pleasure to work with. On November 4, 2017, a memorial was organized at the Duke Lemur Center that gathered more than 100 friends of Gregg, more than 80% being vertebrate paleontologists. Because the PalEurAfrica



Fig 3. Participants at the PalEurAfrica field trip in the Paleocene marine deposits of Maret (**A, B**), earliest Eocene fluvialite stratotype of Dormaal (**C, D**) and early Oligocene fluvio-lacustrine deposits of Hoogbutsel (**E, F**) on September 13th 2019.

symposium drew a similar pool of experts, many of whom worked with Gregg, we are happy to dedicate this thematic issue to his life and work.

Acknowledgment

We thank all participants, authors and reviewers who contributed to this thematic issue. We are grateful to the symposium staff members Annelise Folie, Cécilia Cousin, Simon Sweydan,

Julien Lalanne, Narimane Chatar, Floréal Solé, Aldo Impens, Richard Smith and Florias Mees for their assistance. We gratefully acknowledge support of Hugues Ghénne, Boudewijn Herbots, and Chris Vervliet, respectively mayors of Orp-Jauche, Zoutleeuw, and Boutersem townships for access to fossil localities. The symposium was funded by the Belgian Science Policy Office (BRAIN network project BR/121/A3/PALEURAFRICA); we thank the program coordinator Maaïke Vancauwenberghe for her assistance and support during the six years of the project.

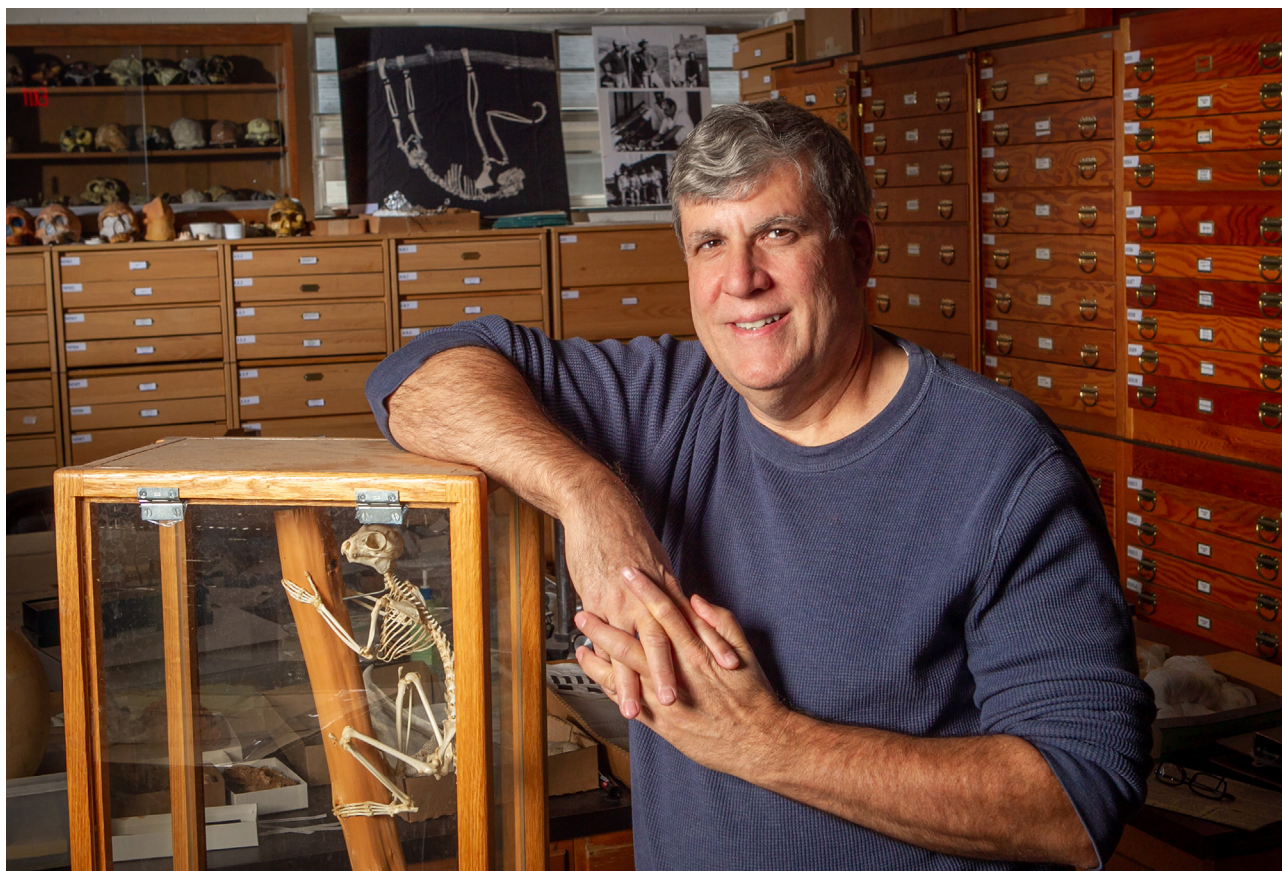


Fig 4. Dr. Gregg F. Gunnell at the Duke Lemur Center's Division of Fossil Primates in 2011 (Jon Gardiner, Duke Photography).

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Received 5 April 2021

Accepted 14 April 2021

Available online 24 April 2021

¹ Invited editor.