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In Memory

The achievements of Abdel Wahid Gaziry (1941-1989) in the field of vertebrate palaeontology

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Abstract - The experience and contributions of Abdel Wahid Gaziry (1941-1987) in the field of vertebrate palaeontology earned him the respect of the academic world, which recognized the importance of his discoveries and appreciated his dedication and commitment to research. In his short life, Abdel Wahid Gaziry published a significant body of work on Neogene fossil mammal systematics, origins, and evolution. Among the new species that he described were the shovel-tusker proboscidean *Konobelodon cyrenaicus* (Gaziry 1987) and the fossil Libyan hippopotamid *Hexaprotodon sahabiensis* Gaziry 1987. An active fieldworker throughout his career, Gaziry collected and catalogued a wide range of vertebrate fossil remains, including mammals, reptiles, birds, and fish. The outcome of his efforts has led to the establishment of a valuable collection within the Museum of Vertebrate Palaeontology at the Department of Earth Science of Benghazi University. This collection, consisting of numerous specimens, holds immense potential for future investigations, doctoral theses, and fostering international scientific cooperation.

Key words: geology, Libya, mammals, palaeontology, proboscideans.

Riassunto - I conseguimenti di Abdel Wahid Gaziry (1941-1989) nel campo della paleontologia dei vertebrati.

L'esperienza e i contributi di Abdel Wahid Gaziry (1941-1987) nel campo della paleontologia dei vertebrati gli sono valsi il rispetto del mondo accademico che ha riconosciuto l'importanza delle sue scoperte e ne ha apprezzato la dedizione e l'impegno nella ricerca. Nella sua breve vita Abdel Wahid Gaziry ha pubblicato un'importante mole di lavori sulla sistematica, l'origine e l'evoluzione dei mammiferi fossili del Neogene. Tra le nuove specie da lui descritte vi sono il proboscidato *Konobelodon cyrenaicus* (Gaziry 1987) e l'ippopotamo *Hexaprotodon sahabiensis* Gaziry 1987. Attivo sul campo per tutta la sua carriera, Gaziry ha raccolto e catalogato una vasta collezione di resti fossili di vertebrati, tra cui mammiferi, rettili, uccelli e pesci. Il risultato dei suoi sforzi ha portato alla creazione di una preziosa raccolta al Museo di Paleontologia dei Vertebrati del Dipartimento di Scienze della Terra dell'Università di Bengasi. Questa importante collezione riveste un immenso potenziale per future indagini, tesi di dottorato e per promuovere la cooperazione scientifica internazionale.

Parole chiave: geologia, Libia, mammiferi, paleontologia, proboscidati.

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INTRODUCTION

Prof. Abdel Wahid Gaziry was born on December 20th, 1941, and passed away on January 13th,1989 in Benghazi, Libya. He earned his Vordiploma-Geologie, Diploma-Geology, and PhD in Geology-Palaeontology all from the University of Hamburg, Germany, in 1967, 1970, and 1975, respectively (Fig. 1). Wahid, as he was known to friends and colleagues, was the first Libyan scientist and professor specialized in vertebrate palaeontology. He worked throughout his entire professional career as a professor and vertebrate palaeontologist at the Department of Geology at the University of Garyounis (now referred to as the University of Benghazi), Libya.

Among the main courses he instructed were Physical Geology, Historical Geology, and Invertebrate Palaeontology. He was an influential figure in the development of field geology studies of the department, regularly leading expeditions to Al Jabal Al Akhdar and As Sahabi in Libya and to the Alps in Europe (Fig. 2).

Before returning to Libya after completing his doctorate Wahid (Boaz, 1993) served as an assistant lecturer at the University of Hamburg and worked as Hamburg Museum head from 1974 to 1976. He was a staff member of the Earth-Sciences department at Garyounis University in Benghazi, Libya from 1976 to 1989. Moreover, Wahid was a founding co-director of the International Sahabi Research Project together with the Libyan colleague Ali El-Arnauti, and American colleague Noel Boaz, from 1976 to 1989. As a pioneer in Libyan vertebrate palaeontology, he researched proboscideans, his speciality and passion (Boaz, 1993). He published several landmark papers during the 1970s and 1980s on fossil elephants from the Miocene of Turkey, the subject of his doctoral work, and from new research in Libya. His work significantly enlarged the known fossil inventory of the iconic four-tusked elephantid, *Stegotetrabelodon syrticus* Petrocchi 1941, discovered in the 1930s at

As-Sahabi and informally recognized as Libya's "national fossil," having been featured on two Libyan postage stamps over the years. He also undertook the detailed study and description of two other important collections of As-Sahabi fossil mammals – the hippopotamids, discovering and naming *Hexaprotodon sahabiensis*, a new species, and the related but uniquely distinct anthracotheres, first discovered in the Sahabi Formation in the 1940s and named *Libycosaurus petrocchii* Bonarelli 1947 in the mistaken belief that it was a Cretaceous dinosaur (Boaz, 1993). Gaziry's pioneering research showed that while the As-Sahabi hippo was closely related to species found in sub-Saharan Africa and the Arabian Peninsula, the As-Sahabi anthracothere was in contrast an endemic species, distantly related to Asian species but found in the Late Neogene of North Africa.

Indicative of Gaziry's wide-ranging interests are his work and contributions to invertebrates and stratigraphic geology. He started the collection and description of molluscan shells from the Benghazi beach, but he did not complete this research during his lifetime. This work has been resurrected and updated by Essam Abdulsamad, Fawzy Bu-Argoub, and Ahmed Muftah with added materials from the same area. An atlas entitled "Benghazi Sea Shells" will be published posthumously.

Gaziry considered himself not only a palaeontologist but, mindful of his extensive education in Germany, a geologist as well. He was an active collaborator in researching the stratigraphic context of As-Sahabi with Ali El-Arnauti and his Belgian colleague, Jean de Heinzelin, and shared in the early publications with them (Fig. 3).

This review aims to offer a thorough account of Gaziry's achievements and impact on the field of vertebrate palaeontology to duly acknowledge the accolades he has earned.

Fig. 1 – Field work at the As-Sahabi site with his PhD supervisor Prof. Ulrich Lehmann. Courtesy of Ali El-Arnauti. / Lavoro sul campo nel sito di As-Sahabi con il prof. Ulrich Lehmann, suo supervisore del dottorato di ricerca. Per gentile concessione di Ali El-Arnauti.

ABDUL WAHID GAZIRY'S CONTRIBUTION TO PALAEONTOLOGY

In 1976, Abdul Wahid Gaziry discovered and identified several Neogene mastodons from central, southwest, and west Anatolia as part of his PhD work (Gaziry, 1976). In his work, he identified many species from different types of skeletal elements and teeth he studied. An adult specimen of the genus *Choerolophodon* Schlesinger 1917 was first described, and the species subdivision of the genus was discussed. Wahid's studies demonstrated that the genus *Synoconolophus* Osborn 1929 is synonymous with *Choerolophodon*. Another important finding of his study was that the fossils of gomphotheres and associated faunas

Fig 2 – A field trip with students from the Department of Earth Sciences in the As-Sahabi area, 1983. Courtesy of Ali S. Elzyani. / Un'escursione nell'area di As Sahabi con gli studenti del Dipartimento di Scienze della Terra, 1983. Per gentile concessione di Ali S. Elzyani.

Fig. 3 – Abdel Wahid Gaziry (20 December 1941 – 13 January 1989). / Abdel Wahid Gaziry (20 dicembre 1941 – 13 gennaio 1989).

allow us to correct the only available biostratigraphic subdivision of the Anatolian non-marine Neogene sequence.

In 1978, he discussed the phylogeny of the trilophodonts (gomphotheres) recovered from the Neogene deposits of Anatolia. This was a part of the Deutsche Forschungsgemeinschaft (DFG) project "Vertebrate Palaeontology in the Eastern Mediterranean region" (Sickenberg *et al*., 1975) The following taxa were identified via tooth, jaws, skulls, and postcranial fragments: *Gomphotherium angustidens angustidens, G. a. suptapiroides, G. a. turicensis, G. a. pasalarensis*, *Amebelodon* (*Amebelodon*) *fricki, Ameoecoaon* (*A.*) cf. *fricki, A.* (*Platybelodon*) cf. *danovi, Choreolophodon pentelici, Mastodon* (*Tetralophodon*) *grandincisivus, Anancus arvernensis*, and *Dinotherium giganteum.* The genera *Gomphotherium, Amebelodon*, and *Choerolophodon* belong to the same family (Gomphotheriidae), while he established a new subfamily Choerolophodontinae to accomodate choerolophodonts. Within the *Gomphotherium* group, molar teeth are found which are purely bunodont, simply built, remarkably cement-rich, and without signs of choerodonty and ptychodonty. They were considered to belong to a new subspecies of *G. angustidens*, namely *G. a. pasalarensis*. These taxa indicate a Late Miocene age (Gaziry, 1978).

Together with Noel Boaz and Ali El-Arnauti, Abdul Wahid Gaziry published "New fossil finds from the Libyan Upper Neogene Site of Sahabi" (Boaz *et al*., 1979). The outcome of this paper was to highlight the Sahabi (As Sahabi) area in Libya. They reported lithological, paleontological, and paleoanthropological discoveries in a more than 80 m thick sequence distributed along north-to-south-trending outcrops and suggested a Late Turolian to Ruscinian age (7-4 Ma) based on the mammalian taxa. Furthermore, more than 3,000 invertebrate and vertebrate fossil specimens had been collected, referred to different taxonomic groups, and used to fill a gap in the African fossil record.

In 1982, Abdul Wahid Gaziry published two articles in the Garyounis Scientific Bulletin special "Issue No. 4", where he was a co-editor with Boaz, De Heinzelin, and El-Arnauti. The first article gave a descriptive account of a member of the family Anthracotheriidae (*Libycosaurus petrocchii*) and another member of the family Hippopotamidae (*Hexaprotodon* sp.) from the Sahabi Formation, deriving from member "U1" of deltaic lagoon habitat, and member "V" of riverine habitat (Gaziry, 1982a). The other paper gives a descriptive account of three proboscidean species from the Sahabi Formation, *Stegotetrabelodon syrticus*, *Amebelodon* sp., and *Stegolophodon sahabianus*, where the latter is synonymous with *S. syrticus* (Gaziry, 1987a; Sanders, 2024). In contrast to its Asian counterparts, the Sahabi Formation was previously believed to be post-Messinian (Early to Middle Pliocene) in age (Gaziry, 1982b) (Figs. 4 and 5). El-Shawaihdi *et al*. (2022) confirmed the dating of this formation to be Late Miocene (Messinian).

Fig. 4 – Wahid in the field (Kufra) with some of his colleagues from the University of Garyounis (now Benghazi), starting from the left to right: Ali El-Arnauti, the late Mohammed Al Mokahel, Abdul Wahid Gaziry, and Ahmed El Hawat in 1977, according to Prof. Ali El-Arnauti. Courtesy of Ali El-Arnauti. / Wahid sul campo (Kufra) con alcuni colleghi dell'Università di Garyounis (oggi Bengasi). Da sinistra a destra: Ali El-Arnauti, il defunto Mohammed Al Mokahel, Abdul Wahid Gaziry e Ahmed El Hawat nel 1977, secondo il prof. Ali El-Arnauti. Per gentile concessione di Ali El-Arnauti.

Fig. 5 – Team of scientists who participated in the conference of International Sahabi Research Project (ISRP), Naturhistorisches Museum, Mainz, Germany, August 25th, 1981. Left to right, front row: Ali El-Arnauti, Abdul Wahid Gaziry; second raw: Dorothy Dechant Boaz, Jean De Heinzelin, Heinz Tobien, Mrs. E. Heintz, Emile Heintz; third row: U. Schmidt, W. E. Meikle, Daryl P. Domning, B. Benefit, O. Neuffer, Noel T. Boaz, Salem Bazina. (Photo: E. Delson, Garyounis Scientific Bulletin 1982). / Il gruppo di scienziati che partecipò al convegno dell'International Sahabi Research Project (ISRP), Naturhistorisches Museum, Mainz, Germania, 25 agosto 1981. Da sinistra a destra, in prima fila: Ali El-Arnauti, Abdul Wahid Gaziry; in seconda fila: Dorothy Dechant Boaz, Jean De Heinzelin, Heinz Tobien, Mrs. E. Heintz, Emile Heintz; in terza fila: U. Schmidt, W. E. Meikle, Daryl P. Domning, B. Benefit, O. Neuffer, Noel T. Boaz, Salem Bazina. (Foto: E. Delson, Garyounis Scientific Bulletin 1982).

Furthermore, in 1986, Gaziry described fragments of the fossil bovids *Prostrepriceros houtumschindleri* (Rodler and Weithofer 1890) and *Oiocerosatropatens* (Rodler and Weithofer 1890) from Maragheh in Iran, which were identified based on cranial elements (teeth and horncores). Another taxon, *Gazella* sp., was identified through the examination of additional fossil teeth. However, further analysis of the discussed materials led to revisions in both the generic and specific diagnoses for *Prostrepsiceros* and *P. houtumschindleri* (Gaziry, 1986a).

In December 1986, Abdul Wahid Gaziry published further two papers. In the first one, he described a perissodactyl – *Lophiodon tapiroides* (=*Palaeotherium tapiroides* Cuvier 1812) – from several teeth present in the collection of the Geological-Paleontological Institute and Museums of the University of Hamburg (Fig. 6) (Gaziry, 1986b).

In the same year, in another paper co-authored with some of his German colleagues, he discussed the diagenetic processes that led to the transformation of calcareous shells of molluscs and echinoderms into gypsum from samples recovered from As-Sahabi site, in Libya, which they directly related to the Messinian Salinity Crisis (Bandel *et al*., 1986).

In 1987, Abdul Wahid Gaziry published three articles in the book "The Neogene Paleontology and Geology of Sahabi", where he was a co-editor with N.T. Boaz, El-Arnauti, De Heinzelin, and D.D Boaz (Boaz *et al*., 1987). The first paper dealt with the finding of two proboscidean taxa from the Sahabi Formation, *Stegotetrabelodon syrticus*, which have been described earlier from the site (Petrocchi, 1954), and introduced the new species *Konobelodon cyrenaicus*. The latter discovery represented the latest occurrence of the genus *Konobelodon* in the entire Old World (Gaziry, 1987a). The subsequent article focused on the identification of the anthracotheres, the predominant taxonomic group found in the As-Sahabi area. *Libycosaurus petrocchii*, based on the cranial and dental components of which he provided a full description, was found to be the species present at this site. This particular species bears a strong resemblance to the sexually dimorphic *L. anisae* found in the Miocene Tunisian deposits, yet it is clearly different from it (Gaziry, 1987c). The third article introduced a new species of the family Hippopotamidaefrom Sahabi: *Hexaprotodon sahabiensis*. This species shows a close affinity to *H. harvardi* Coryndon 1977 from Miocene deposits of Lothagam, west of Lake Turkana in Kenya. He ascribed the difference in the relative abundance of families Anthracotheriidae and Hippopotamidae in Sahabi Formation "Unit U-1" versus "Unit V" to habitat preferences – deltaic lagoonal and riverine, respectively (Boaz, 1982, 1987; Gaziry, 1987b), which now are completely different rock units, i.e., middle unit of Qarat Makada member of Sahabi Formation, and Pliocene Qarat Weddah Formation, respectively (El-Shawaihdi *et al*., 2022).

In 1987, Abdul Wahid Gaziry introduced and described fossil giraffe remains as *Samotherium* (*Alcicephalus*) *neumayri* and Giraffidae indet. from the upper Miocene (Turolian) of Marāgheh/Iran (Gaziry, 1987d). Furthermore, in 1987, he published an article describing his collection of vertebrate fossils from the Jabal Zaltan area, central Libya, which yielded a new proboscidean species *Choerolophodon zaltaniensis* (Fig. 7) (Gaziry, 1987e), *Gomphotherium a. pasalarensis*, and a new small anthracothere, *Merycopotamus maradensis*. Except for *G. a. pasalarensis*, which was first described from Turkey, these taxa are known only from Libya. The gomphotheres members provide evidence indicating that the age of the deposits is more recent than the Lower Miocene (Gaziry, 1987d). The anthracothere that Gaziry have described in this study (*Merycopotamus maradensis*), is somehow ignored by many authors (e.g., Pickford, 1991; Holroyd *et al*., 2010). However, from the measurements and description provided in Gaziry's study, and by comparing them with the description and measurements of material relating to *Afromeryx zelteni* Pickford 1991 obtained from the same site and held at the University of Bristol (Pickford, 1991; Holroyd *et al*., 2010), we advance the hypothesis that a closer analysis would provide further evidence to support our suspicion that Afromeryx zelteni Pickford 1991 could potentially be synonymised with *Merycopotamus maradensis* Gaziry 1987.

Despite his unfortunate passing in 1989, his colleagues persevered and carried on his work, ensuring that his pub-

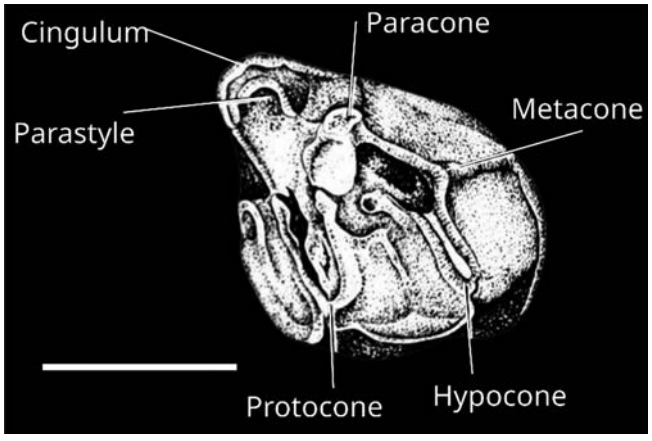

Fig. 6 – An example of the described molar of *Lophiodon tapiroides*, left M3, occlusal view, scale scale equals 4 cm (Gaziry, 1986b). / Un esempio del molare descritto di *Lophiodon tapiroides*, M3 sinistro, vista occlusale, scala grafica 4 cm (Gaziry, 1986b).

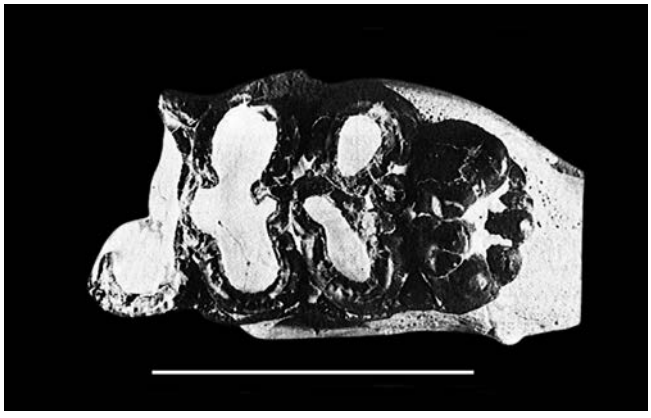

Fig. 7 – *Choerolophodon zaltaniensis* Gaziry 1987, holotype, left maxilla with M3 fragment, Jabal Zaltan, central Libya, occlusal view, scale bar equals 10 cm (Gaziry, 1987e). / *Choerolophodon zaltaniensis* Gaziry 1987, olotipo, mascella sinistra con frammento di M3, Jabal Zaltan, Libia centrale, vista occlusale, scala grafica 10 cm (Gaziry, 1987e).

lications remained uninterrupted. In 1994, the discovery of a new species, *Bunolophodon grandidens*, was documented in the Upper Freshwater (Oberen Süßwassermolasse) (OSM) region of southern Germany. This species belongs to the gomphotheres, which are known to inhabit the Old World. By examining the tooth morphology, he postulated the existence of three separate evolutionary lineages (Gaziry, 1994a) (Fig. 8).

Additionally, another article published in 1994 focused on gomphothere found in the Dinotheriensanden (Germany; Miocene), which is currently curated at the Hessian State Museum Darmstadt. The initial investigations provided further evidence supporting the classification of *Tetralophodon longirostris* as a member of the stegotetrabelodonts, but now it revised to be a member of tetralophodont gomphotheres (Konidaris *et al*., 2023). It was also determined that *Stegolophodon wahlheimensis* belonged to the stegolophodont group, indicating that stegolophodonts were not exclusive to Asia (Gaziry, 1994b).

In 1997, a thorough investigation was carried out by Gaziry regarding the proboscideans unearthed in (Dorn-Dürkheim 1, Rheinhessen, Germany). The results of the study unveiled the presence of three separate gomphothere taxa, specifically *Stegotetrabelodon lehmanni* Gaziry 1997, *Tetralophodon atticus* (Wagner 1857), and *Stegolophodon wahlheimensis* (Klähn 1922). Later, Konidaris & Roussiakis (2018) renamed *S. lehmanni* Gaziry 1997 to *Anancus lehmanni* (Gaziry, 1997). It is worth noting that Gaziry's identification of *A. lehmanni* in the Turolian of Germany holds significant importance as it marks the earliest documented occurrence of this genus (Konidaris & Roussiakis, 2018).

RESPECT TO ABDUL WAHID GAZIRY FROM OTHER SCIENTISTS

Jeheskel Shoshani and Pascal Tassy in their book "The Proboscidea: Evolution and Palaeoecology of Elephants and their Relatives" wrote a dedication to Gaziry who, like other scientists, has devoted his career to the study of fossil proboscideans (Shoshani & Tassy, 1996).

Two taxa celebrate Dr. Abdel Wahid Gaziry with the use of his family name 'Gaziry'. The first taxon, the ostracod *Monoceratina gaziryi*, was described by his student Ali El Sogher (El Sogher, 1996).

This species was collected from Danian Hagfa Shale in wells E46-20 and E57-20, Sirt Basin, as a smooth-surfaced species of *Monoceratina*. It is characterized by 4-5 weakly developed small ventral ridges with a shallow groove running parallel to the anterior margin (Fig. 9) (El Sogher, 1996). The second taxon, *Gaziryina* was introduced as a new genus name (Muftah & Boukhary, 2013), revising the previous combination *Nummulites pulchellus* from the Shahhat Marl Member of Al Bayda Formation exposures in Al Jabal al Akhdar area (Fig. 10) (Muftah & Boukhary, 2013).

CONCLUSIONS

Abdul Wahid Gaziry played a crucial role in the establishment of the Department of Earth Sciences and the research on Sahabi and Jabel Zelten vertebrates, focusing on proboscideans, anthracotheres, hippopotamids, and other fossils. His contributions over five decades were substantial, making him a key figure in advancing the field not only in Libya but also internationally. His extensive body of work

Fig. 8 – *Bunolophodon grandidens* Gaziry 1994. a) Holotype, right M3 from Massenhausen near Freising, b) left M3 from Gweng near Mühlbach am Inn, scale bar equals 10 cm (Gaziry, 1994a). / *Bunolophodon grandidens* Gaziry 1994. a) Olotipo, M3 destro di Massenhausen presso Freising, b) M3 sinistro di Gweng presso Mühlbach am Inn, scala grafica 10 cm (Gaziry, 1994a).

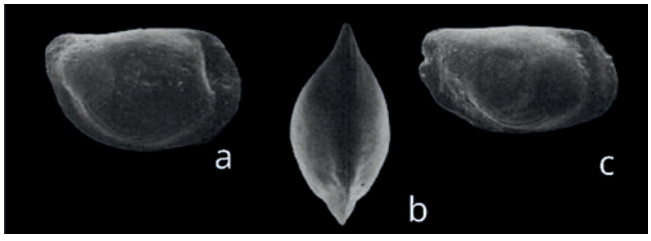

Fig. 9 – SEM images of specimens of *Monoceratina gaziryi*; a) Female right carapace (Holotype), X60; b) Male, ventral view, X84; c) Male right carapace, X53.2 (El Sogher, 1996). / Immagini al SEM di esemplari di *Monoceratina gaziryi*; a) Carapace destro della femmina (olotipo), X60; b) Maschio, vista ventrale, X84; c) Carapace destro del maschio, X53,2 (El Sogher, 1996).

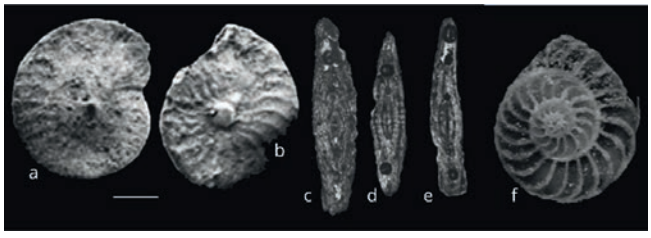

Fig. 10 – *Gaziyrina pulchellus*: a and b) side view, c-e) axial sections, f) equatorial section, upper Eocene limestones from Wadi Az Zad in Al Jabal al Akhdar, Libya, scale bar equals 0.5 mm (Muftah & Boukhary, 2013). / *Gaziyrina pulchellus*: a e b) vista laterale, c-e) sezioni assiali, f) sezione equatoriale, calcari dell'Eocene superiore di Wadi Az Zad ad Al Jabal al Akhdar, Libia, scala grafica 0,5 mm (Muftah & Boukhary, 2013).

included various articles on fossil vertebrates, such as the introduction of a new proboscidean subfamily, Choerolophodontinae, and the naming of a new species, *A. lehmanni*, in honour of his doctoral supervisor Prof. Ulrich Lehmann. Gaziry also identified several new species within the proboscidean group, including *G. a. pasalarensis*, *K. cyrenaicus*, and *C. zaltaniensis*. Furthermore, his research extended to hippopotamid species, notably with the discovery of *H. sahabiensis*. Furthermore, Gaziry's contributions also encompassed the family Anthracotheriidae, where he identified *M. maradensis* as a new species from Jabel Zelten. Overall, Gaziry's discoveries and achievements have solidified his standing as a prominent figure in the realm of vertebrate palaeontology research.

Gaziry's work has been comparatively little cited in published studies due to the lack of access to his publications, as we noted in our online survey. To remedy this shortcoming, a personal profile of the late Abdel Wahid Gaziry was created and maintained by one of us (M.A.) on ResearchGate (https://www.researchgate.net/profile/Abdel-Wahid-Gaziry) where the body of his publications can be accessed.

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