

Contributions to the Eocene palaeontology and stratigraphy of Beira Alta, Portugal

I — A Synoptical table

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The sedimentary units on the very extensive erosion platforms that cut nearly all relief of the Hercynian basement in Beira Alta province, Portugal, were poorly known. This applies both to stratigraphy and age, since no detailed field studies were carried on and no fossils had been found. Facies similarities led to some hypotheses without adequate support. Correlations had sometimes been proposed between earlier deposits and late Cretaceous sediments close by (or within) the western meso-cenozoic basins, whereas younger beds were more or less classified according to geomorphological criteria.

Classification has not yet been fully attained. However research is in progress since the first contribution concerning the Côja site (1953) and the first upper Eocene dating (1964).

Near half a century of research seem to justify the presentation of a short synthesis as contained in the following Synoptical Table.

Upper Eocene sites at Beira Alta — Synoptical table

1953

(or somewhat earlier, as far as findings are concerned):

— Fossil bones are found at the Empresa Cerâmica da Carriça Lda. clay quarry near Côja.

— Mr. J. de Castro Nunes, then in charge of the Arganil Museum, gives notice of these findings to the Director of the Serviços Geológicos de Portugal, A. de Castello Branco, who in turn informs G. Zbyszewski.

— Arganil Museum and the Côja quarry are visited by Professors C. Teixeira and D. Thadeu; an account is published by Castro Nunes (local newspaper "A Comarca de Arganil", Aug. 13).

— Bones are sent by Castro Nunes through D. Thadeu to G. Zbyszewski, who publishes a note (ZBYSZEWSKI, 1953) where he ascribed some specimens to a "Cervidé de la taille d'un Cerf élaphe" but cannot decide whether "il s'agit de Cervidés tertiaires ou quaternaires" (*ibid.*, pp. 59-60); however, molar structure was clearly that of a Perissodactyl, and even if it was indeed a Cervid, its rather large size would certainly point out to (at least) a post-

middle Miocene age; a brief geological description is given.

1956:

— geologist P. Martins de Carvalho, who was doing field work for the Empresa de Cerâmica da Carriça Lda. collected (or otherwise was given) some further bones that he sent to Professor M. Montenegro de Andrade at the Universidade de Coimbra.

1959:

— (June-July) field work at the same area around Côja was carried on by J. Oliveira (technician, Serviços Geológicos de Portugal); a geological sketch was produced but never published.

1963:

— Comparison with stratigraphic evidence from Eocene beds between Zamora and Salamanca in Spain suggested M. T. Antunes to review the mammalian remnants from Côja: after comparative work at the Muséum National d'Histoire Naturelle, Paris, where type specimens from Paris basin were observed, a *Palaeotherium* cf. *crassum* and thus a near certain Ludian (upper Eocene) age are recognized; for the first time an Eocene age was demonstrated in Portugal (ANTUNES, 1963).

1964:

— (April) M. T. Antunes, while trying to collect more fossils at the same site, was given a mammalian hemimandible found in a clay prospecting pit.

— (August) M. T. Antunes works at Empresa Cerâmica da Carriça Lda. quarry in order to get more detailed stratigraphic data, to locate the level(s) where fossils had been found and to excavate the fossiliferous beds; a maxillary from a small mammal is found along with scant bone fragments, in about 4 cubic meters of sediment, but washing and sieving at the site failed to produce positive results.

— (November) M. T. Antunes tries again but only finds a poorly preserved bone fragment, the last fossil that seems to have been collected there.

1965:

— previous results are taken into account by ZBYSZEWSKI (1965), who discusses in general their stratigraphic meaning; converging with viewpoints previ-

ously held in Portugal (where most pre-Miocene continental sediments were regarded without any proof as Oligocene), our 1963 conclusions are distorted as the Ludian age, even if acknowledged, was considered by him as lowermost Oligocene.

1967:

— (October): complementary field data are obtained and a detailed stratigraphic section is studied by M.T. Antunes.

— in another paper (ANTUNES, 1967) a detailed lithostratigraphic account is given; local units were characterized and among them a "Côja Group" that comprises what was later called "Arcoses de Côja" Formation, this being clearly recognizable; two new mammalian taxa are identified, *Peratherium* cf. *cuvieri* and *Diplobune secundaria*; Côja fauna is accurately reported to higher levels in the Ludian, uppermost Eocene, like the well-known fauna from the "haute masse" from the Paris Gypsum; Eocene-Oligocene limits are discussed, and the relationships with Pyrenean orogeny are shown.

1972:

— taking into account our previous results, J. JIMÉNEZ-FUENTES (*Studia Geologica*, III, pp.106-107, Salamanca) presents a correlation attempt between Portuguese Eocene (and maybe older) units North of the Central Chain and others between Zamora and Salamanca.

1973:

— Mr. A. Brum Ferreira visits another clay exploitation at Naia, between Canas de Sabugosa and Tondela (Cerâmica da Beira, Lda.), some 30 km North of Côja, where he is told of findings of fossils; he passes this information to A.M. Galopim de Carvalho, who in turn averts M.T. Antunes.

— (September): Carvalho and Antunes were shown by Mr. Álvaro Fernandes (quarry manager) the Naia exploitation, where a bone (tentatively ascribed by Antunes to a humerus of a *Palaeotherium*) was exposed; a stratigraphic section was summarily sketched by Antunes, showing above the granite substratum (a) a lower unit of conglomerates, sands and clays, more or less carbonaceous and grey-coloured, with trunks, (b) apparently separated by an unconformity, an upper unit of greenish, arkosic clays with white bones.

1974:

— (June): field work proceeds at Naia; another section shown by A. Fernandes is studied at a nearby point named Cabecinhas, exposing particularly well the lower, carbonaceous unit; sediment samples are taken and yield some pollen and spores (J. Pais); a fragment of coaly trunk from a tree fern from the same unit is given by the Director of Cerâmica da Beira, Lda.

1975:

— (February or March): remains from a tortoise are found at Naia by A. Fernandes.

— (September): A. Fernandes presents M.T. Antunes with the tortoise bones he collected, and shows a new clay exploitation at Bairro das Cumieiras, NW Tondela; both the lower carbonaceous and the upper greenish units are exposed.

— in a paper on a new Eocene crocodylian, *Iberosuchus*, ANTUNES (*Comunic. Serv. Geol. Port.*, LIX, pp.315-317) gives a synthesis on Eocene Formations

in Portugal and western Spain and respective correlations; the "Arkoses et argiles fossilifères de Côja, Naia, Nave de Haver, etc." are separated from other units and reported to the Ludian.

1976:

— (June): field work is resumed (M.T. Antunes, A. Brum Ferreira and J. Pais) with a revision of the stratigraphic sections at Côja and Naia (at Cabecinhas, new carbonaceous clays samples are collected for palynological study) and new observations at Barreiro de Besteiros near Tondela.

1977:

— a study on the Naia tortoise is published (ANTUNES & DE BROIN, see References) along with a geologic introduction; the presence of ?*Cheirogaster* sp. affords a chronological element as it indicates a pre-Upper Oligocene and post-Middle Eocene age; correlation between greenish, arkosic clays from Naia and Côja is confirmed, and definitely not based on lithological similarity only.

1978:

— in his thesis on the revision of the tertiary marsupials from Europe, J.Y. CROCHET reports without any doubt the Côja one to *Peratherium cuvieri*; a memoir is published - 1980, *Les Marsupiaux du Tertiaire d'Europe*, Edit. Fondation Singer-Polignac, Paris, see pp.198 and 248; hence this marsupial became an additional evidence for a Ludian age (levels 2 to 5; cf. D.E. RUSSELL *et al.*, pp.41-43 - see References).

— in an extensive study of erosion surfaces in the Northern part of Beira region (A.B. FERREIRA, *Memórias do Centro de Estudos Geográficos*, nº4, Lisboa; see pp.38-39, 200-201, 296-297), the fauna from Côja appears as a key chronological reference, providing some basis for correlations with surfaces and overlying sedimentary units in western Spain.

1979:

— M.T. ANTUNES (*Ciências da Terra* (UNL), Lisboa, nº5; see pp.161-162) presents a synthesis on the sedimentary units that overlie granites and other basement rocks in the Beira Alta province; the "Arenitos de Côja" are dealt with again.

1983:

— A.F. SOARES, R.P. REIS & S. DAVEAU (*Memórias e Notícias*, Publ. Mus. Lab. Mineral. Geol., Univ. Coimbra, nº96; cf. pp.12-16) attempt to correlate lithostratigraphic units from basins on the basement (Lousã, Arganil) to those from the western basin, on older Mesozoic; the Côja unit with Ludian fauna (referred to as "Arcoses de Côja") correlations are not clearly established.

1984:

— M.T. ANTUNES, who in the previous years carried on prospection for fossils, is averted by Ing. Almiro, Director of Cerâmica da Beira, Lda, of the discovery of a fossil trunk in the lower unit (carbonaceous clays). In September, the site is visited by Antunes, J.C. Pais and C. Estravís; samples are collected.

1985:

— geomorphologic and sedimentological studies on the Lousã and Arganil basins are published (S. DAVEAU *et*

al., *Memórias do Centro de Estudos Geográficos*, n°8, Lisboa; see p.167), the importance of the Côja site being stressed.

1986:

— previous recuperation of a few long forgotten specimens, without any label or other reference but from the first (1953) Côja collection, allows ANTUNES (see References) to recognize two new taxa: a tortoise, *Geochelone* (s.gen.) sp., possibly the same as the *Geochelone* (?*Cheirogaster*) sp. from Naia; and *Anoplotherium* cf. *commune*; the Côja fauna is now more

accurately reported to the level 4 (Montmartre) of the Ludian.

1988:

— (December): Mr. P.Proença e Cunha finds the bone fragments collected at Côja in 1956 and subsequently sends them to Antunes.

1990:

— (January): Antunes studies the 1956 collection at the Paris Museum, and prepares the account published here.