PALEOGENE FAUNAL ASSEMBLAGE FROM ANTOFAGASTA DE LA SIERRA (CATAMARCA PROVINCE, ARGENTINA)

by

Guillermo M. LOPEZ *

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* Departamento Científico Paleontología Vertebrados, Museo de La Plata. Facultad de Ciencias Naturales y Museo U.N.L.P. Paseo del Bosque s/no, La Plata (1900), Argentina.

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ABSTRACT

The Paleogene faunal assemblage from Antofagasta de la Sierra (Catamarca, Argentina), is here presented, both in its geological and sistematic aspects. The fossil bearing levels are referred to the Geste Formation (Pastos Grandes "Group").

The described specimens belong to the Classes Reptilia (Orders Crocodylia, Serpentes and Chelonii) and Mammalia (three taxa from the Superorder Marsupialia, representatives of the Orders Edentata, Condylarthra, Pyrotheria and Astrapotheria, and six families of the Order Notoungulata).

This fauna is referred to the Mustersan Age, which in Patagonia represents the Middle Eocene. Such chronologic assignment is based on the presence of characteristic taxa, their evolutionary stage and on stratigraphic evidence.

Finally, a brief comparison with other faunal assemblages from the Early Tertiary of Argentina and Chile, is presented.

RESUME

Dans ce travail on présente l'association faunistique paléogène d'Antofagasta de la Sierra (Catamarca, Argentine), en considérant les aspects géologiques et systématiques. Les niveaux qui livrent les restes sont assignés au membre moyen de la Formation Geste ("Groupe" Pastos Grandes).

Des spécimens des Classes Reptilia (Ordre Crocodylia, Serpentes et Chelonii) et Mammalia (Trois taxa du Superordre Marsupialia, représentants des ordres Edentata, Pyrotheria, Astrapotheria et six familles de l'Ordre Notoungulata) sont décrits.

Cette faune est réferée au Mustersién qui représente l'Eocène moyen en Patagonie. Cette assignation chronologique est établie sur la base des taxons caractéristiques, de l'état évolutif de quelques taxa et sur des evidences stratigraphiques.

Finalement, on fait une brève comparaison avec d'autres associations du Tertiaire inferieur de l'Argentine et du Chili.

RESUMEN

En el presente trabajo se da a conocer una asociación faunística del Paleógeno de Antofagasta de La Sierra (Catamarca, Argentina), considerando aspectos geológicos y sistemáticos.

Los niveles portadores de los restos, son asignados al Miembro medio de la Formación Geste ("Grupo" Pastos Grandes).

Se describen especímenes de las Clases Reptilia (Orden Crocodylia, Serpentes y Chelonii) y Mammalia (tres taxa del Superorden Marsupialia, representantes de los órdenes Edentata, Pyrotheria, Astrapotheria y de seis familias del Orden Notoungulata).

Esta fauna es referida a la Edad Mustersense que en Patagonia representa el Eoceno medio. Dicha asignación cronológica se establece en base a taxones característicos, estado evolutivo de otros y por evidencias estratigráficas. Se realiza, por último, una breve comparación con otras asociaciones del Terciario inferior de Argentina y Chile.

INTRODUCTION

The classical Paleogene outcroppings of Patagonia, are known since the valuable contributions of F. Ameghino, S. Roth, A. Gaudry, W. Scott, W. Sinclair and M. Tournouer, by the end of the last century.

Except for the San José de Itaboraí fauna, from southern Brazil, described by Paula Couto (1952 a, b, c and d), the known Paleocene-Eocene mammals from South America were restrained, until some time ago, to the southern tip of the continent.

Only since twenty years ago, some outcroppings referred to this lapse, are known out of Patagonia. This fact has undoubtedly contributed to a better understanding of the evolution of South American faunistic associations. First, the peculiar vertebrate associations coming from the Santa Bárbara Subgroup formations (especially the Lumbrera Formation) in the Salta and Jujuy provinces, northwestern Argentina, were published. Those remains allowed to refer the bearing levels to Riochican (Upper Paleocene) and Casamayoran (Lower Eocene) Ages (see Pascual *et al.*, 1978 and Pascual *et al.*, 1981).

Later on, mammal remains were found in the Casa Grande Formation (Mustersan Age) in Jujuy province (Bond & López, 1995) and in the Rio Loro Formation (Paleocene) in Tucumán province (Powel & Palma, 1981). At last, the most ancient association was described for the Santa Lucía Formation, in Tiupampa (Bolivia), which was referred to the Lower Paleocene (Marshall and Muizon, 1988 and Gayet *et al.*,1991).

In 1986, Alonso and Fielding found a new site with Paleogene vertebrate remains in Antofagasta de la Sierra, Catamarca province (Argentina), placed in the southernmost sector of the Argentine Puna. These outcrops were correlated with the transitional beds between the Geste and Pozuelos formations from the Pastos Grandes Group-type-zone in Salta province, which also bear mammal remains (see Pascual, 1983). Later, those levels of Antofagasta de la Sierra (Catamarca province) were referred by Alonso (1992) to the Geste Formation Middle Member.

The above mentioned, is based on the "stage of evolution" of the recorded taxa. However, Marshall *et al.* (in press) assign the Tiupampa, Lumbrera and Itaboraí faunas to the Late Paleocene, based upon calibration by regional sequence stratigraphy and magnetostratigraphy.

Alonso *et al.*(1988) made a preliminary list of the fossil remains found in this new locality, referring the bearing levels to the Mustersan Age.

In this work we describe the vertebrate remains found in Antofagasta de la Sierra, especially the ungulate mammals, which, as in most South American Paleogene faunal associations, constitute the dominant forms.

The specimens were referred to the Classes Reptilia (Orders Crocodylia, Serpentes and Chelonii) and Mammalia (three taxa from Superorder Marsupialia, representatives of the Orders Edentata, Condylarthra, Pyrotheria and Astrapotheria, and six families of the Order Notoungulata) (see Figure 2)

This fossil assemblage, is the first diverse one coming from Northwestern

Argentina that can be referred to the Mustersan Age, which in Patagonia is conventionally assigned to the Middle Eocene. It is noteworthy that, though the fossil remains of the Casa Grande Formation are referred to this Age (Bond and López, 1995), they are represented only by three taxa and cannot properly be called a "faunistic association".

The fossils from Antofagasta de la Sierra are numerous but fragmentary, mainly isolated teeth, some of them with pre-depositional wear. These specimens were collected during three fieldseasons in the region by the staff of the Departamento Científico Paleontología Vertebrados, Museo de La Plata, in 1986, 1988 and 1993, being all currently deposited in this museum.

ABBREVIATIONS

MLP: Museo de La Plata (Departamento Científico Paleontología Vertebrados).

I,C,P,M: upper incissors, canines, premolars and molars.

i,c,p,m: lower incissors, canines, premolars and molars.

GEOGRAPHIC SETTING

Antofagasta de la Sierra is located in northern Catamarca province, Argentina (26° 04'S, 67° 24'W) (see Figure 1). This zone corresponds to the southernmost boundary of the Argentine Puna, and is placed 3440 m above sea level. There is a southern way to this village, through the locality of Belen by provincial route 43 and a northern one through San Antonio de los Cobres and Salar de Pocitos (Salta province) along provincial routes 43 and 17.

The fossil bearing outcrops are located within the village, in two different sectors. One at the island-hill ("cerrito isla") behind the Health Station, 100 m from the central plaza. The other, in the canyon behind the church following the ranges along the cementery. These two sites represent the same lithostratigraphic unit, and most of the fossils were found in them.

GEOLOGICAL BACKGROUND OF PASTOS GRANDES GROUP

The fossil-bearing sediments of Antofagasta de la Sierra were correlated with the transitional beds between Geste and Pozuelos formations (Pastos Grandes Group), whose type-profile is located about 200 km farther north of the village (Alonso and Fielding, 1986). Afterwards, Alonso (1992) considered them as the Middle Member of the Geste Formation. This criterion is followed in this paper.

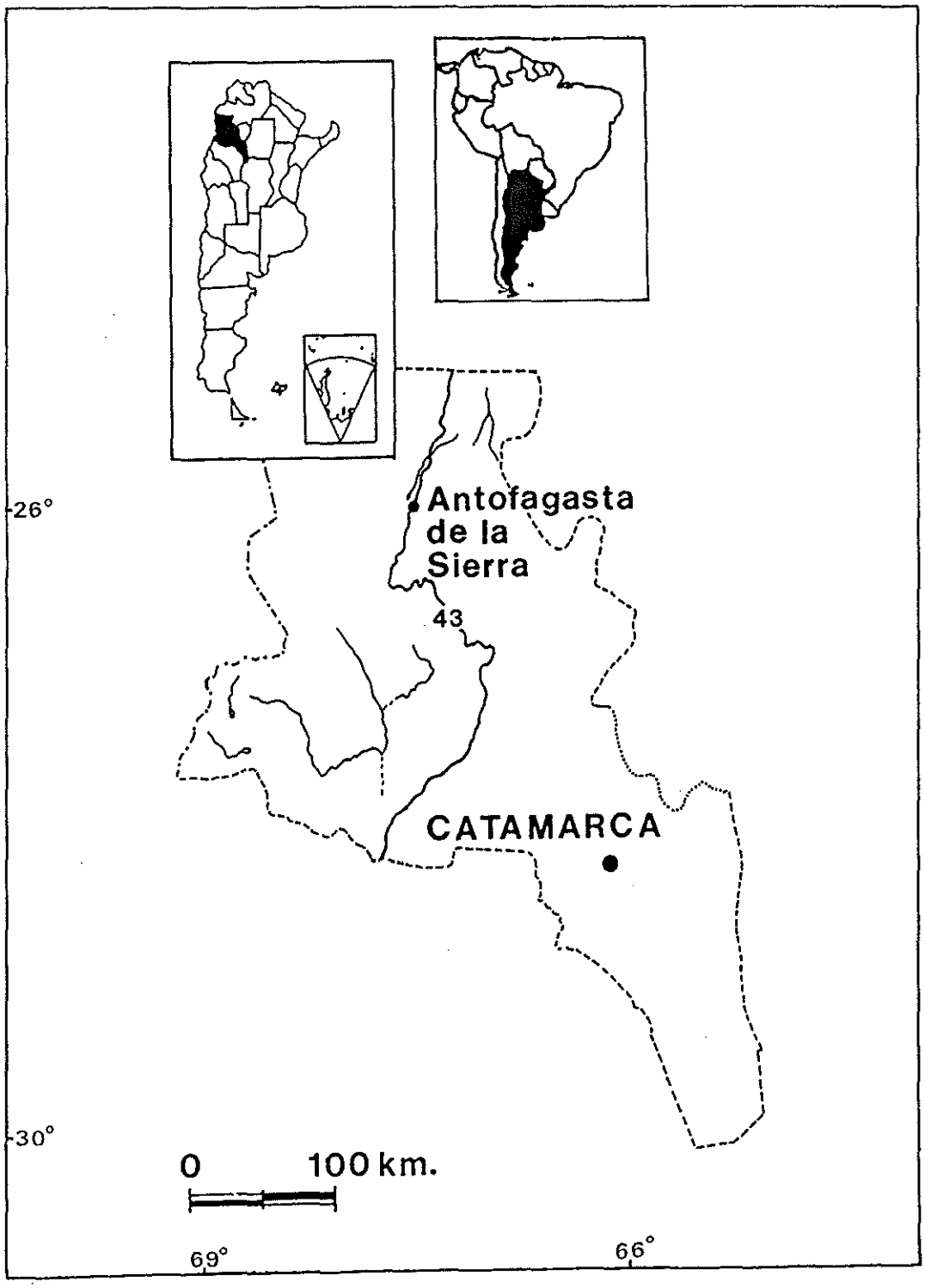

Figure 1.— Location map of Antofagasta de la Sierra, Catamarca province, Argentina.

The Pastos Grandes Group was defined by Turner when he surveyed the 7 C-plate "Nevado de Cachi" (Salta province) of the Carta Geológico-Económica de la República Argentina (Turner, 1960: 204; 1964: 31). It is composed of clastic sediments of different grain size, intercalations of evaporites, and pyroclastic levels in the upper part. It outcrops in the Salta Puna, between the Salar de Pozuelos and Salar de Pastos Grandes. Its colour varies from purplish to greyish-brown, and was deposited in continental environments.

This Group is formed from bottom to top by the Geste, Pozuelos and Sijes formations, conformably. Alonso (1992) considered that the word "Group" should be used only in a practical sense because it includes rocks from different sedimentary cycles.

In the type profile zone, this Group overlies discordantly metamorphized Precambrian silty sediments of the Copalayo Formation. The Geste Formation is mainly composed of purplish conglomerates and medium to coarse grained sands. It passes concordantly to the Pozuelos Formation, also composed of clastic sediments, together with diatomite and salt banks. This transitional boundary, prevented the recognition of a clear limit between both units, and hindered the stratigraphic location of the fossil-bearing level. This problem is discussed below. The uppermost Sijes Formation is composed of fine-grained lime-argyllous sediments, with intercalations of pyroclastic levels and chemical sedimentary rocks (mainly borates). Their identity is easily recognizable by its colour shift from pink to reddish brown, the decrease of clastic elements and the presence of the first pyroclastic beds (tuffs) (see Alonso, 1992).

Unlike the Pastos Grandes sequence, the Antofagasta de la Sierra sediments (about 500 m-thick) overlie unconformably a metasedimentary basement of leptometamorphic shales and greywackes of the Falda Ciénaga Formation, dated upon its graptolithes content as Ordovician (Aceñolaza *et al.*, 1976). All this assemblage is covered by a Mio-Plio-Pleistocene ignimbrithic layer ("Lavas del Volcán Galán"), in strong angular unconformity, and by Quaternary alluvium. The fossil-bearing sediments are composed of red coarse-grained sandstones, with conglomerate intercalations and at least four green-yellowish micaceous sandstone banks, easily noticed on the hill-chain behind the cementery. In the uppermost part of the sequence, the argillous materials form typical gulches which in some sectors darken the sediments. These outcroppings are here considered as the Geste Formation Middle Member, in agreement with Alonso (1992).

ANNOTATED LIST OF THE FOSSIL VERTEBRATES

1) REPTILIA

A) Order **CROCODYLIA** OWEN, 1860
Suborder **MESOSUCHIA** HUXLEY, 1875
Infraorder **SEBECOSUCHIA** SIMPSON, 1937

Family **SEBECIDAE** SIMPSON, 1937
gen. et sp. indet.

Material: MLP 86-V-6-13 Two fragments of teeth. MLP 93-VI-1-1/4 complete isolated tooth.

Observations: The serrated margins of these isolated teeth allow us to refere them to the Family Sebecidae, but their fragmentary state makes difficult a generic assignment.

This Family was recorded in Patagonia in Casamayoran (Early Eocene) and Deseadan (Early Oligocene) sediments from Chubut province. Out of this region, sebecids were recorded in the Lumbrera Formation (province of Salta) referred to the Casamayoran Ages by Pascual *et al.*, 1981, and in Divisadero Largo Formation from Mendoza province (Divisaderan Age, Late Eocene).

Outside Argentina, this Family has a larger distribution. There are records from the Paleocene of Itaboraí (Brazil) and Santa Lucia Formation in Bolivia (Buffetaut & Marshall, 1991). Its extinction, among other reasons, was related to the carnivores arrival in South America in the Middle Miocene.

This record suggests some paleoenvironmental inferences, as the Sebecids are mostly terrestrial forms, inhabiting lowland plains with abundant water-courses and vegetation, in humid and at least, subtropical climate (see Gasparini *et al.*,1986).

From these same sediments come some osteoderms referable to the Order Crocodylia.

B) Order **SERPENTES** LINNÉ, 1758
Suborder **ALETHINOPHIDIA** NOPCSA, 1923
Superfamily **BOOIDEA** GRAY, 1825
Family **BOIDAE** GRAY, 1825
Subfamily indet.

Material: M.L.P. 93-VI-1-5 vertebral fragment isolated.

Observations: A conspicuous hemal ridge suggests that this fragment belongs to a vertebra from the middle or posterior region of the body of a small sized animal. It may be assigned to Boinae as well as to Madtsoiinae, due to its fragmentary state. The biochron of both subfamilies is in accordance with the span of time to which the bearing sediments are referred.

C) Order **CHELONII** BRONGNIART, 1800
Suborder indet.

Material: Isolated bony plates from plastron and carapace.

Observations: These plates cannot be assigned to any Suborder, because of their

preservation state, so they have no collection number. Informally, they can probably be considered as belonging to the Family Pelomedusidae, recorded in the Lumbrera Formation, on account of their similar shape.

2) MAMMALIA

A) Superorder **MARSUPIALIA** ILLIGER, 1811
Order **POLYDOLOPIMORPHIA** AMEGHINO, 1897
Family **PREPIDOLOPIDAE** PASCUAL, 1980 a

? ***Prepidolops alonsoi*** PASCUAL, 1980 a

Material: MLP 86-V-6-3 right mandibular ramus with p3-m2. MLP 86-V-6-4 left mandibular ramus with p2. MLP 86-V-10-10 right mandibular ramus with p2-p3 very much worn.

Observations: The assignment of this material to the Family Prepidolopidae was based on the presence of an hypertrophied p3 (just like plagiaulacoids), but unlike the homologous tooth of Polydolopidae, it lacks the cutting serrated ridges and accesory cusps. Another feature used to refer it to this family were the "didelphoid-type" molars. There is a trend towards the loss or decrease in size of the last molars of Prepidolopidae. This material represents precisely a final taxon, or at least, a derived one for those characters, as it can be observed in the loss of m4 and m3 which is much smaller than m2. *Prepidolops didelphoides* and *P. molinai* (Pascual 1980 b) preserved four molars in the mandible and the m3, though smaller than m2, has no difference in size as the material here presented. Another difference among these two species is the greater reduction of the trigonid both in m1 as in m2 of the new material.

These structural differences agree with their stratigraphic position as both *P. didelphoides* and *P. molinai* come from the Lumbrera Formation (Casamayoran; Riochican according to Marshall *et al.* in press), while *P. alonsoi* was described by Pascual (1983) from the Pozuelos Formation (here considered as middle levels of the Geste Formation) correlated with the Antofagasta de la Sierra outcrops, probably Mustersan.

As these remains cannot be compared with the type material (see Pascual, 1983) which is composed of upper teeth, they are considered as ? *P. alonsoi*. The molariform structure, the reduction of the number of molars and their size, reveal a more derived taxon than that from the Lumbrera Formation. This fact, together with an equivalent stratigraphic position, indicate probably that they belong to this species and that a new taxon is not warranted.

B) Family **BONAPARTHERIIDAE** PASCUAL, 1980 a

Bonapartherium sp. nov.

Material: MLP 93-VI-1-6 fragment of right maxillae with complete M1-M3.

Observations: The intermediate stylar cusps (B and C) fused respectively with the paracone and the metacone, forming the masticatory surface, and the general structure of the crown, allow the reference of this remain to the Family Bonapartheriidae. This Family was established upon materials coming from the Lumbrera Formation (Salta Group) of Casamayoran Age (see Pascual, 1980 a).

The presence of derived characters in this material *(i.e.* a greater hypsodoncy degree and the lack of labial cingulum) with respect to *Bonapartherium hinakusijum* is concordant with younger bearing levels. With this record, the chronological distribution of the family is increased.

C) Order **SPARASSODONTA** AMEGHINO, 1894
Family **PROBORHYAENIDAE** AMEGHINO, 1897

cf. ***Arminiheringia*** AMEGHINO, 1902

Material: MLP 88-V-10-4 right m4 isolated with complete paraconid and anterior root.

Observations: This element suggests a large sized carnivorous marsupial, tentatively referred to the genus *Arminiheringia.* Though its general structure and size are very similar to that genus, there are some differences such as the smaller talonid and lower crown.

The genus *Arminiheringia* was described from Casamayoran sediments of Patagonia and was also recorded in the Lumbrera Formation (Salta Group) northwestern Argentina. It is one of two genera shared by such distant regions. Their different faunistic composition was considered by Pascual *et al.*(1981) as the result of paleobiogeographic differences.

The Deseadan genera *Proborhyaena* and *Pharsophorus* have greater differences and they are also larger.

A larger study of the marsupials from the Antofagasta faunal assemblage is in press (see Goin, *et al.*, in press).

D) Order **XENARTHRA** COPE, 1889
Suborder **CINGULATA** ILLIGER, 1811
Family **DASYPODIDAE** BONAPARTE, 1838
Tribe ? **ASTEGOTHERIINI** AMEGHINO, 1906

Material: MLP 86-V-6-24, MLP 86-V-6-25, MLP 88-V-10-11, MLP 88-V-10-12, MLP 88-V-10-16, MLP 88-V-10-18, MLP 88-V-10-19 to 49 Isolated bony scutes of the carapace.

Observations: This material was presented by Alonso *et al.*, 1988 as cf.

Astegotherium or *Prostegotherium*. Both genera belong to the Tribe Astegotheriini, according to Vizcaíno (1990 and 1994), who following the old idea of F. Ameghino, divided the Stegotheriini into two tribes (*i.e.* Astegotheriini and Stegotheriini). Most of the scutes are thin, with straight anterior and posterior edges, a central lageniform figure, and a few piliferous holes in their posterior margin. All these features permit their reference to the new range Astegotheriini, but this assignment deserves a detailed study which is not within the objectives of this work. However, it is noteworthy that whether they belong to one tribe or the other, these materials cannot be referred to any known genus.

Together with these scutes and without their own collection number there are some scutes resembling those of the genus *Utaetus* by their general structure. This genus was recorded in the Casamayoran of Patagonia, and though it belongs to another subfamily (Euphractinae), it is mentioned here due to its doubtful assignment.

E) Order **CONDYLARTHRA** COPE, 1881
Family **DIDOLODONTIDAE** SCOTT, 1913

cf. ***Ernestokokenia*** AMEGHINO, 1901

Material: MLP 86-V-6-2, isolated left lower molar (m1 or m2).

Observations: This molar only indicates the presence of a small sized condylarth, with bunoid features resembling such forms as *Ernestokokenia* of Patagonian Riochican and Casamayoran Ages. Noteworthy is the absence of representatives from this order in the Lumbrera Formation, whereas these are very frequent and diverse in equivalent Ages of Patagonia. The later record of this group in Antofagasta de la Sierra (*i.e.* Middle Eocene) is showing not only different scenarios, but furthermore, that those changes observed in Patagonia were noticed later in the northwest of Argentina. As will be seen later, something similar happens within the Archaeohyracidae.

Finally, it is noteworthy that some condylarths from the Patagonian Mustersan (not yet described) are generally bigger while those of similar size are more lophodont (M. Bond, pers. comm.).

F) Order **PYROTHERIA** AMEGHINO, 1895
Family **PYROTHERIDAE** AMEGHINO, 1895

Propyrotherium sp. AMEGHINO, 1901

Material: MLP 86-V-6-1 distal portion of tusk (incisive), probably lower right.

Observations: Despite the fragmentary state of this specimen, its kind of wear, dentine structure and distributional pattern of the enamel, indicate it to be a Pyrotheria tusk (incisive) clearly different from those defenses (canines) of Astrapotheria (*i.e.* *Astraponotus*). On the other hand, this fossil is very similar to those referred to

Propyrotherium sp. from the Patagonian Mustersan Age (see Simpson, 1967). Therefore, it is referred to that genus. The presence of a species referable to the genus *Propyrotherium* which is a typical genus of the Mustersan Age and clearly more primitive than *Pyrotherium* of the Deseadan Age (Oligocene), is one of the main arguments used to assign the fossil-bearing levels to a Mustersan Age (Middle Eocene).

G) Order **ASTRAPOTHERIA** LIDDEKER, 1894
Suborder **ASTRAPOTHERIOIDEA** AMEGHINO, 1894
Family **ASTRAPOTHERIIDAE** AMEGHINO, 1887

gen. et sp. indet.

Material: MLP 86-V-6-26 isolated right lower p2.

Observations: Anterior premolars are not always diagnostic pieces of an order, and this conflictive premolar is not an exception. It is here considered as an Astrapotheriidae only due to its slight resemblance with Casamayoran premolars from Patagonia such as those of *Albertogaudrya* sp. This fossil differs from the P2 of the Mustersan *Astraponotus* sp. in its more compressed and cutting shape.

The anterior premolars of *Propyrotherium* (Order Pyrotheria) are not known and the presence of a tusk of the above described genus suggests that this tooth may pertain to a new primitive representative of the Order Pyrotheria.

H) Order **NOTOUNGULATA** ROTH, 1903
Suborder **NOTIOPROGONIA** SIMPSON, 1934
Family **NOTOSPYLOPIDAE** AMEGHINO, 1897

gen. et sp. indet.

Material: MLP 88-V-10-12/15 isolated right upper P2-M2 of the same individual. MLP 93-VI-1-9 isolated right M2.

Observations: These molariforms are undoubtedly refered to the Family Notostylopidae, but their generic assignment is not so clear. They resemble the *Boreastylops-Otronia* group (see Vucetich, 1980) in their degree of hypsodonty and general crown structure, but unlike these latter genera they show a true crochet and not a papillae series.

It is worthy to compare these teeth with the unnamed Notostylopidae of the Tinguiririca fauna of central Chile, as both of them have a similar structure (see Wyss *et al.*, 1990 and 1994). The only differences between them are: the greater separation between paracone and parastyle, the lack of lingual cingulum and a greater development of the premolar posterior cingulum in the Catamarcan specimens. These two forms are undoubtedly very closely related.

I) ? Family **NOTOSTYLOPIDA** AMEGHINO, 1897

Material: MLP 86-V-6-14 right upper Dm1 or Dm2.

Observations: Due to the general structure of the crown we refer this deciduous element, tentatively to the Family Notostylopidae.

J) Suborder **TOXODONTA** SCOTT, 1904
Family **ISOTEMNIDAE** AMEGHINO, 1897

gen et sp indet.

Material: MLP 86-V-6-19 isolated canine. MLP 86-V-6-21 left lower m2 with the anterior portion of trigonid broken. These specimens were not found associated, and they are described together only by practical reasons.

Observations: The isolated canine only documents the presence of a large isotemnid (comparable with forms such as *Periphragnis*). It is noteworthy that this family is the only one within the Suborder Toxodontia whose canines are enlarged and not reduced, incisive-like, or absent such as the remaining families.

The lower molar (m2) has a proportionally higher crown than Casamayoran forms (i.e. *Pleurostylodon* and *Pampatemnus*) and due to the lack of labial and lingual cingula it differs apart from Mustersan forms such as *Periphragnis*.

Bond and López (1995) correlated the sediments of Antofagasta de la Sierra with the Casa Grande Formation of Jujuy province, based on this tooth, as it is a common taxon of both units.

K) Family **NOTOHIPPIDAE** AMEGHINO, 1895

cf. ***Pampahippus*** sp. BOND & LÓPEZ, 1993

Material: MLP 86-V-6-12 isolated left lower p3.

Observations: This molar is very similar from those of *Pampahippus* (Bond and López, 1993), of the Casamayoran Lumbrera Formation (Salta Group). Its presence, together with prepidolopid marsupials, indicate the persistence of ancient lineages co-existing with taxonomic groups that appear for the first time in northwest sediments (i.e. Interatheriidae Notopithecinae and Archaeohyracidae) and strikingly not recorded in the Santa Bárbara Subgroup formations nor in the Casa Grande Formation of Jujuy. It must be remembered that these two families are very frequent and diverse in Patagonian localities referable to that age.

In this premolar we can observe those generalized features of the Notohippidae (see Bond & López, 1993). It greatly differs from the structural pattern of the post-Mustersan hypsodont-Notohippidae including those recorded in central Chile

(Tinguiririca fauna).

L) Suborder **TYPOTHERIA** ZITTEL, 1893
Family **OLDFIELDTHOMASIIDAE** SIMPSON, 1945

Suniodon catamarcensis LÓPEZ, 1995

Material: MLP 93-VI-1-7 maxillar fragment with right P2-M2, MLP 93-VI-1-13 isolated P3 or P4.

Observations: Although the general structure of premolar and molars follows the generalized pattern of the Oldfieldthomasiidae, the lack of anterior cingulum in these teeth distinguishes to *Suniodon catamarcensis* from the remainders; this taxon is yet exclusive from Antofagasta de la Sierra.

Based upon the preserved alveollus of P1 it can be clearly established that this piece was double-rooted, a very rare character among mammals. Several features such as the hypsodonty degree, the lack of mesostyle and a slight metacone, double-rooted P1 and non-bifurcated main valley, relates it to such patagonian forms as *Kibenikhoria*, *Ultrapithecus* and *Tsamnichoria*. However, these three genera have a very well developed anterior cingulum. Tentatively, the Riochican genus *Kibenikhoria* (upper Paleocene) can be considered as a probable structural ancestor in a trend towards the loss of the cingulum. The isolated premolar is lesser worn, the groove which separates the parastyle from the paracone is deep, thus, the latter acquires a spike-like form.

M) *Colbertia* sp. PAULA COUTO, 1952 d

Material: MLP 93-VI-1-15 isolated right M2.

Observations: This specimen cannot be structurally distinguished from the upper molars of *Colbertia lumbrerense* (BOND, 1981). The genus *Colbertia* is recorded in the "Itaboraian" Age (Middle Paleocene) of Rio de Janeiro (Brazil) and of Casamayoran Age (Lower Eocene) from Salta province, Argentina. Its record in Antofagasta de la Sierra also indicates the persistence of ancient lineages in Northwestern Argentina.

It must be remembered that the genus *Colbertia*, together with those forms of Divisadero Largo Formation (Mendoza province), would constitute a different "morphological group" from that one composed of Patagonian genera (see Bond, 1981), further adding the above described taxon (L item).

N) gen. et sp. indet.

Material: MLP 86-V-6-15 portion of mandibular ramus with m2-m3, MLP 86-V-6-16

portion of mandibular ramus with m3.

Observations: The lower molars of the Oldfieldthomasiidae and the Henricosborniidae have a very similar structure, that is why it is not easy to make a secure familiar assignment with small isolated fragments. In this work, the reference of the specimens to the Family Oldfieldthomasiidae is supported by its more lophodont shape and higher crowns, both features very different from those of known contemporaneous Henricosborniidae.

Its general shape it resembles more such basal forms as the *Colbertia* species (Brazilian "Itaboraian" Age and northwestern Argentina Casamayoran Age; see also Marshall *et al.* in press) than those materials coming from the Divisadero Largo Formation (Mendoza province), in which the entoconid is fused with the hipoconulid. In these molars, these latter cups preserve their individuality and retain a bunoid shape.

It is not unlikely that these materials belong to the same taxon than the formerly considered remains (M item) but, since these are not comparable elements and were not found associated, it is more cautious to consider them independently.

For additional information about the oldfieldthomasids of Antofagasta de La Sierra, see López (1995).

O) Family **INTERATHERIIDAE** AMEGHINO, 1887
Subfamily **NOTOPITHECINAE** SIMPSON, 1945

Punapithecus minor LÓPEZ & BOND, 1995

Material: MLP 86-V-6-5 maxillary fragment with left P1-M3. MLP 86-V-6-6 mandibular fragment with left p3-p4. MLP 88-V-10-1 maxillary fragment with right DP2-M2. MPL 88-V-10-2 maxillar fragment with strongly worn left P4-M2?. MLP 88-V-10-3 maxillary fragment with right M1-M3. MLP 88-V-10-5 maxillary fragment with strongly worn left P3-M2. MLP 88-V-10-8 mandibular fragment with right p3-p4?. MLP 88-V-10-9 mandibular fragment with left m2-m3. MLP 83-X-31-1 isolated right m1 or m2. MLP 93-VI-1-14 mandibular fragment with right m2.

Observations: *Punapithecus minor* is a particular Notopithecinae with more brachyodont teeth than those of the Patagonian genera. The upper premolars are subtriangular due to the backward position of the protocone and the forward placement of the parastyle, which give both elements an elonged mesiodistal shape, as it happens within the remaining Notopithecinae. The molars are quadrangular with well-differentiated protocone and hypocone, both preserving their individuality. Except for the Casamayoran genus *Antepithecus*, the remaining Notopithecinae show a trend towards the early fusion of these cups, which, added to the presence of a smooth and low cingulum, make this species a generalized (or conservative) form with respect to these characters.

The anterolingual and posterolingual fossettes disappear very early with wear, while the central valley is simple and opened lingually, like those Casamayoran forms such as *Antepithecus* and the Mustersan ones such as *Guilielmoscottia*. In the

Notopithecus species the main fossa is closed and takes a complex shape, because of its anterolabial lenghthening.

The general structure of the upper molars resembles that of *Antepithecus brachystephanus*, but the structure of the lower teeth and the great difference in size, make these materials from Antofagasta de la Sierra a different taxon.The size of *Punapithecus minor* is the most conspicuous feature, it is smaller than the remaining representatives of the subfamily, even more, it is half the size of the smallest forms (*i.e. Notopithecus*).

These materials were referred to this subfamily taking mainly into account the structure of the lower molars, which have very opened trigonids, and have acquired the typical shape of the Notopithecinae. Besides, a less-transversal disposition separates them from their homologous of the families Henricosborniidae and Oldfieldthomasiidae.

As it was already mentioned, the representatives of the subfamily Notopithecinae appeared in northwestern Argentina later than in Patagonia (*i.e.* Middle Eocene), where they have been one of the most characteristic Riochican and Casamayoran faunal components (Upper Paleocene and Lower Eocene, respectively).

P) Suborder **HEGETOTHERIA** SIMPSON, 1945
Family **ARCHAEOHYRACIDAE** AMEGHINO, 1897

gen. et sp. nov.

Material: MLP 88-V-10-6 isolated left lower m3. MLP 86-V-6-8 portion of mandibular ramus with right m2. MLP 86-V-6-9 isolated lower m1 or m2. MLP 86-V-6-10 isolated upper left M1 or M2. MLP 86-V-10-11 portion of mandibular ramus with p3-m1.

Observations: Though the upper and lower teeth were not found associated, according to their armonic structure and similar size, they are considered as pertaining to the same taxon.

Just like the Interatheriidae Notopithecinae, the members of this family appeared also lately in sediments of the northwest. This material also suggests the existence of a new genus and species for the Family Archaeohyracidae, strengthening the idea of a very different biogeographic history of the northwest with respect to Patagonia during the Eocene.

Whereas the general structure of these molars resemble those of *Eohyrax rusticus* of Patagonian Casamayoran age, the absence of molar cingula and the difference in size (they are the smallest of all the known Archaeohyracidae) separate it from this latter species. The lack of molar anterior cingula is considered as a derived character of the family and it is found in all post-Casamayoran representatives.

These same features separate these materials from those forms like *Eohyrax isotemnoides* and *Pseudhyrax eutrachytheroides* (Casamayoran and Mustersan Ages,

respectively).

3- OTHER REMAINS

Numerous remains have been collected, which, because of their bad preservation state, could not be referred exactly to any family. Like the MLP 93-VI-1-10 and MLP 93-VI-1-11, two lower jaw fragments with quite deteriorated teeth crowns, that could only be referred to the Order Notoungulata. Numerous teeth fragments and osseous remains which do not provide additional information, have no assignment, nor repository number.

DISCUSSION

From the above analysis it is clear that the Geste Formation sandstones outcropping at Antofagasta de la Sierra bear a rich and varied vertebrate fauna, especially mammals, which contributes to the knowledge of the evolution of the extra-Patagonian Paleogene communities.

This assemblage, composed mostly by isolated teeth, allows the recognition of a great species diversity, in which native ungulates prevail, just like most faunistic associations in South American Paleogene.

In the Figure 2, we can see a low-degree of faunal similarity with the coeval Patagonian associations, with new genera and species and other ones referred with doubts to Patagonian genera. This situation is not linked with the fragmentary character of this fauna, but rather to other evidence that Patagonian communities and those of the Argentine northwest had an independent history at least during the lower Tertiary. Recent palaeobiographic works (see Zinsmeister, 1979, 1982 and Crisci *et al.*, 1991) support the idea that the biota of the southern tip of South America is more related to those of Antarctica, New Zealand and Australia, rather than with those elsewhere on the continent.

The assignment of the fossil-bearing levels to the Geste or the Pozuelos formations is rather difficult in account of their transitional boundary. According to the original interpretation of Turner (1960 and 1964) these levels must be placed in the upper third of the Geste Formation. Pascual (1983) following the interpretations of Alonso, Gutiérrez and Raskovsky, considered the formational limit under the fossil-bearing stratum; so, these remains would come from the lowermost part of the Pozuelos Formation. Late geological interpretations of Alonso (see Alonso *et al.*, 1988 and Alonso, 1992) considered those limits originally established by Turner, correct. Thus, the fossil-bearing strata are again placed in the Geste Formation, establishing that the Antofagasta de la Sierra facies represent the middle member of this Formation.

a) Order Crocodylia
Suborder Mesosuchia
Infraorder Sebecosuchia
Family Sebecidae
gen. et sp. indet.

b) Order Chelonii
Suborder indet.

c) Order Serpentes
Suborder Alethinophidia
Superfamily Booidea
Family Boidae
Subfamily indet.

d) Superorder Marsupialia
Order Polydolopimorphia
Family Prepidolopidae
? Prepidolops alonsoi

e) Family Bonapartheriidae
Genus *Bonapartherium*
Bonapartherium sp. nov.

f) Order Sparassodonta
Family Proborhyaenidae
cf. Arminiheringia

g) Order Edentata
Suborder Cingulata
Family Dasypodidae
Tribe ? Astegotheriini

h) Order Condylarthra
Family Didolodontidae
cf. Ernestokokenia

i) Order Pyrotheria
Family Pyrotheridae
Propyrotherium sp.

j) Order Astrapotheria
Family Astrapotheriidae
gen. et sp. indet.

k) Order Notoungulata
Suborder Notioprogonia
Family Notostylopidae
gen. et sp. indet.

l) Family ? Notostylopidae

m) Suborder Toxodontia
Family Isotemnidae
gen. et sp. indet.

n) Family Notohippidae
cf. Pampahippus

o) Suborder Typotheria
Family Oldfieldthomasiidae
Suniodon catamarcensis

p) *Colbertia sp.*

q) *gen. et sp. indet.*

r) Family Interatheriidae
Subfamily Notopithecinae
Punapithecus minor

s) Suborder Hegetotheria
Family Archaeohyracidae
gen. et sp. nov.

Figure 2.— Faunal list for mammal-bearing sediments of Antofagasta de la Sierra.

THE AGE OF THE FOSSIL-BEARING LEVELS

The fauna here described permits the reference of the Geste Formation (or at least the fossil bearing level) to the Mustersan Age that corresponds to the Patagonian Middle Eocene, coincident with Alonso *et al.*, 1988.

This assignment is based on the presence of characteristic taxa, the evolutionary stage of some members and stratigraphic evidence.

Thus, we can conclude that:

(1) The presence of the genus *Propyrotherium*, caracteristic of the Mustersan Age of Patagonia, is very important to refer these sediments to that Age.

(2) The Prepidolopidae and Bonapartheriidae (Marsupialia) have more derived features than those coming from the Lumbrera Formation (Casamayoran Age).

(3) The Notostylopidae are similar to those of the Patagonian Mustersan Age (*i.e. Otronia*)

(4) Several features of the crown structure of the Archaeohyracidae indicate an evolutionary stage comparable with post-Casamayoran representatives of this Family.

(5) The Oldfieldthomasiidae are more generalized than those coming from Divisadero Largo Formation (Divisaderan Age).

(6) The presence of common elements with the Casa Grande Formation of Jujuy (*i.e.* Isotemnidae) allows a more safer correlation between both formational units. If we consider that the Casa Grande Formation in Mina Aguilar (Jujuy) overlies the Casamayoran Lumbrera Formation we can refer these levels from Antofagasta de la Sierra to a post-Casamayoran time-span or at least, post-Lumbrera.

When we mention the age of the bearing-levels, we refer always to the land Mammal-Age scheme proposed for the Patagonian Paleogene. This follows a practical purpose but the exact correlation between Argentine Northwest and Patagonia still needs more refinement.

FAUNAL COMPARISONS

Comparing this Local Fauna with that of Tinguiririca (central Chile) recently described by Wyss *et al.*, 1990, 1993 y 1994, we can conclude that because of the absence of Rodents and presence of taxa with more generalized features (*i.e.* Interatheriidae Notopithecinae, Notohippidae and Archaeohyracidae) the assemblage from Antofagasta de la Sierra is older, and it can be considered under the time range of the Mustersan Age, while the Chilean fauna is referred to post-Mustersan - pre-Deseadan (see Wyss *et al.*, 1993).

If we consider the fauna from Divisadero Largo (Mendoza province, Divisaderan Age), we may conclude that the association from Antofagasta de la Sierra is older, as it comes out when the members of the Family Oldfieldthomasiidae are compared (see item N).

Only three remains are known from the Casa Grande Formation (Jujuy province). One of them is the oldest Leontinidae known and the two other are referred to the Family Isotemnidae (see Bond and López, 1995). The Casa Grande Formation can be referred also to the Mustersan Age, due to a common taxon with Antofagasta de la

Sierra levels (see Item J), but unlike the Catamarcan levels, the taxonomic diversity is much higher.

Undoubtedly, together with the faunistic assemblages of Tinguiririca (Chile) and from Divisadero Largo Formation (Mendoza) this new fauna provides a better understanding of mammalian communities outside Patagonia in the second half of the Eocene (Mustersan-Deseadan hiatus).

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