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A CONCISE HISTORY OF MEXICAN PALEOMAMMALOGY [1]

(With 6 figures)

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ABSTRACT: A brief historical account is given about the development of Mexican paleontological research. Although some knowledge existed from Prehispanic cultures, the main development occurs in three periods: colonial, 19th century, and Recent in accordance with the geographic boundaries for exploration. Also, the birth of academic paleontology is shown through scientific publications and the type specimens described at the end of the 19th and early 20th centuries.

Key words: Paleontology. Vertebrates. Mammals. Mexico. History of Biology.

RESUMEN: Una breve historia de la paleontología de mamíferos de México.

En este trabajo se hace una breve recapitulación cronológica acerca de los orígenes de la investigación paleontológica en mamíferos de México. Se muestran algunos conocimientos de las culturas prehispánicas, pero de manera principal el conocimiento obtenido en tres períodos: el colonial, el decimonónico y el actual, observado mediante el alcance geográfico de la exploración. Se muestra también el surgimiento de la paleontología profesional mediante la cantidad de publicaciones y los tipos descritos entre fines del siglo XIX y principios del XX.

Palabras Clave: Paleontología. Vertebrados. Mamíferos. México. Historia de la biología.

INTRODUCTION

Currently, paleontology is an important scientific discipline focused on understanding a series of biological processes, among which are geographic distribution, taxonomic characters determination, and primarily the establishing of evolutionary relationships of organisms. All of those topics have produced deep discussion between specialists. Bowler (1996) has synthesized the most important controversies. However, little analysis of the development of this scientific field in most geographic regions has been undertaken. For Latin America, some efforts have occurred in Brazil and Argentina (Lopes, 2000; Podorgny, 2005). For Mexico, historical research in the development of paleomammalogy is warranted as an explicative tool for the present state of the art. Nevertheless, it has been considered only in passing in a few papers (Miller & Carranza-Castañeda, 1984; Castillo-Cerón *et al.*, 1997), or as general accounts that can be used as a reference framework (Montellano-Ballesteros, 1999; Corona-M., 2002a; González & García, 2002; Gío Argáez, 2004; Carreño & Montellano-Ballesteros, 2005).

MATERIAL AND METHODS

In order to contribute to the historical analysis of the development of mammal paleontology in Mexico, a chronological perspective is proposed, highlighting the main outcomes at each stage and how those support, increase, and enhance the field development. The study uses information collected in regard to the main novohispanic chronicles produced between the 16th and 18th centuries by army personnel, priests, settlers, and scientists, noting geographic data and, if possible, the tentative identification of the specimen. Additionally, a synthesis of the literature has been produced for the mid-19th century to the first two decades of the 20th century (Corona-M., 2002a, b). Those data are the source of maps and graphic.

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RESULTS AND DISCUSSION

From Prehispanic to Colonial stages

Many examples abound in Mexico of knowledge concerning rocks and minerals among the prehispanic native groups. Fossils were only known as ornaments by the Olmecs and the Maya, although other uses may have occurred (González & García, 2002).

In accordance with the main novohispanic chronicles (*e.g.*, Francisco Hernández [Hernández, 1959] and Fray Bernardino de Sahagún [Sahagún, 1989]), the ancient Mexicans believed that the fossil bones of megafauna were remains of giants named *quinametzin*, antique people that inhabited the Earth. From those remains, native belief was that the grinded bone had medical properties (Sahagún, 1989).

The conquers, priests, and scientists that visited New Spain found these activities a point of meeting with the components of their own naturalist research. Researchers fed both on the native legends and European myths as well as on the knowledge from Aristoteles and Plinius. They explained the fossil remains of big vertebrates as giants that lived before the biblical flood, an explanation now known as the giant hypothesis of mankind (Pelayo, 1996).

With the conquers, a country-wide monitoring is started with the main focus on the findings of precious metals and natural resources to exploit, as it can be found in the writings of Hernán Cortés, Francisco Hernández, Fray Bernardino de Sahagún, Bernal Díaz del Castillo, Jerónimo de Mendieta, José Torrubia, Antonio Pineda, and Antonio de Herrera, among others (Corona-M., 2002b). During the overall process, animal remains were reported as large bones but without further analysis. From this period, animal fossils were known from eight country states and were characterized as a very large fauna (megafauna) (Fig.1).

Fig.1- Map showing the current political division of Mexico and the localities of mammal fossil in Colonial Mexico (based on data from Corona, 2002a).

The states of Campeche and Querétaro are outstanding because currently few megafaunal records exist, since less than 10 localities for each are known for the Quaternary (Arroyo-Cabrales *et al.*, 2002). Those from the chronicles may be the oldest ones known. Also for this first period, only written documentation of the fossils exists, since the specimens were lost for a variety of reasons (*e.g.*, they were not completely fossilized; they were not preserved; or collectors did not care enough for them).

A second period started when the Spanish crown, in order to improve the mining of the country's natural resources that had turn into a very dynamic economic area, funded in 1792 the *Real Seminario de Minería* in Mexico City. This institution supported scientific development, trained specialists in mining, and developed the mining industry, while also encouraging exchange of knowledge between Europe and the Americas (Argueta Villamar, 2003; Flores Clair, 1999). This institution had outstanding personnel, like Fausto de Elhuyar, who discovered tungstene and was the Head of the Seminar. His stature and the influence of the well-known mineralogist Abraham Werner, who was the founder of the Neptunist school, helped the institution to be acknowledged in the European schools (Laudan, 1987).

This institution's role was most important in two areas within the scientific community, that of enhancement of a library and the edition of books. For the first issue, the institution had a policy to purchase the recent specialized scientific books, including personal libraries, like those from Joaquín Velásquez de León and Juan Eugenio Santelices, and several of the recent European editions. The library held over 3,000 volumes, most of them focused on basic and assaying sciences. The second issue was accomplished by publication policies that supported the edition of books by its own scientists, like that by Andrés del Río who, based on the notes for a mineralogy course, prepared a draft of the well-known book *Elementos de Orictognosia* (Flores Clair, 2001). This book was one of the first in the Americas to be published on this field of science, and also a discussion departure point for Neptunist theory, current at the time (Fig.2).

Fig.2- Cover of the book from Andrés del Río, and a picture of the *Colegio de Minería* made in 1864 by Casimiro Castro (both images taken from <www.palaciomineria.unam.mx>).

The last decade of the 18th century was also outstanding for the advertisement of the sciences by other means, like the establishment of the first Cabinet of Natural History, due to the activity of the surgeon and naturalist José Longinos Martínez Garrido. Without any official support, José Longinos was able to create a place to exhibit natural resources with the aim to reach a similar fame as the Madrid Cabinet. Specimens were provided from the Botanical Expedition by Miguel Sessé, as well as from amateur naturalists.

The Cabinet had a small library focused on natural history and other important sciences for the period, like physics, chemistry, mathematics, and medicine, as well as anatomy replicas and research equipment. The specimens were arranged as a systematic collection based on the *Systema Naturae* from Linnaeus, and had samples of minerals, plants, and animals (Maldonado Polo, 1999; Lozoya, 1984). Among those materials there were 17 proboscidean bones. Their importance was in denying the presence of giant humans, and in showing a modern characterization of fossils as organic beings. This exhibit was one of the first denials for the giantology theory presented at the time among the Spaniard naturalists and chronicles. This new tendency was also found in the notes of other vertebrate fossils finders, like those by Antonio Pineda and José Torrubia (Maldonado Polo, 1999; Corona-M., 2002a).

New items were brought to the public by the *Gaceta de México*, established in the mid-18th century. It was one of the first weekly journals and had regular space for scientific discoveries. It can be cited among these new items the opening of the Cabinet of Natural History that was noted due to the discoveries of several fossil vertebrates in the period from 1790 to 1799 and the first formal publications on fossil vertebrates for Mexico (Miller & Carranza-Castañeda, 1984; Montellano-Ballesteros, 1999; Corona-M., 2002a). They also demonstrated that naturalist endeavours were to create local academic institutions.

Beginning of Modern Paleontology

Changes were brought about by the Independence from the Spanish Crown in 1821, and by the visit to the country and publications on America's nature of Alejandro de Humboldt. Great interest now prevailed to survey the country lands that previously were forbidden. That interest brought into the country a large group of foreign geographers and naturalists for research all over Mexico (Maldonado-Koerdell, 1952).

In 1825, the first national museum in Mexico was founded. It was more formal than practical due to the deep economical and political crises at the time. Such issues also affected other academic institutions, like the *Real Seminario de Minas*, that was extinguished and turned, first, into the *Colegio de Minería*, and later split into several small educational institutions that could not maintain the academic research endeavours (Gortari, 1980; Trabulse, 1983). Paleontological research was supported primarily by individual efforts. The museum (Museo Nacional) re-opened, however, between 1866 and 1867 and started a systematic increase of collections.

The analysis of the scientific publication record, including literature focused on fossil mammals and in the naming of new biological types furnished an overview of the development on the field at the time (Fig.3).

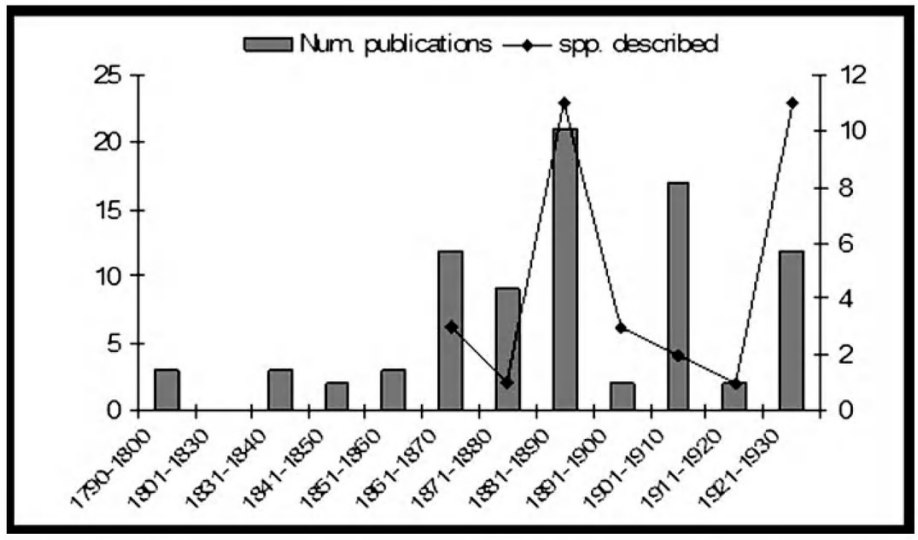

Fig.3- Double graph showing the mammal paleontological production from 1790 to 1930. The bars indicate number of publications, and line show the number of mammal-types described. More details in text.

Between 1838 and 1840, studies on mammoths and mastodonts by the well-recognized German scientists Christian Ehrenberg Ignaz von Olfers (CORONA-M., 2002a), and Herbert von Meyer (MEYER, 1840), were published. It was von Meyer who conducted the most important systematic research on Mexican paleontological materials at the time.

In the middle of the 19th century, a group of Mexican researchers started systematic studies of fossil mammals collected in the country. This endeavour was supported by the foundation of the *Sociedad Mexicana de Historia Natural*, constituted by most of the naturalists working at the Museo Nacional, and who established strong ties to the main American and European museums.

From 1860 to 1930, a systematic increment occurred in the scientific documentation in mammal paleontology. Three main issues were related to that: the visit and collaboration of foreign scientists; the opening of the first institutions focused on natural history studies; and the foundation of scientific societies. In the first issue, outstanding scientists were the Americans Joseph Leidy and Edward D. Cope, as well as the German naturalists, such as Roemer, Pohlig, Herbert von Meyer and Freudenberg. Most of them collaborated with local scientists, such as Antonio del Castillo, Mariano Bárcena, and Alfredo Dugès. Other important contributions came between 1901 and 1910 due to the research of other prominent American scientists, such as Henry F. Osborn as well as Gidley, Merriam, and Eaton.

Important publications for the period were: the synthesis on the discoveries in the Mexico Basin by Antonio del Castillo (CASTILLO, 1869); the *Catálogo de Fósiles del Museo Nacional* (VILLADA, 1897); and the outstanding report by FELIX & LENK (1889-1899), containing the findings on geology, volcanism, and fossils in the Mexico Basin, Oaxaca, Puebla, and the State of Mexico. Among the first documents written in Spanish, besides Villada's catalog, it can be cited: the publication by CUATÁPARO & RAMÍREZ (1875) describing a new species of *Glyptodon* from the Mexico Basin; and those by DUGÈS (1882, 1891), who recorded the fossil vertebrates from Guanajuato, and in particular described an extinct javelina (*Platygonus alemanii*), as well as other fossil remains associated with South America (Tab.1).

The foundation of important institutions for paleontological research occurred during this period. They were, as cited before, the *Museo Nacional* (1825) and the *Sociedad Mexicana de Historia Natural* (1868), including its official outlet *La Naturaleza*; and the *Sociedad Científica "Manuel Alzate"* (1884), later becoming the *Academia Nacional de Ciencias*.

Geographic coverage of the studies encompassed 14 states (Fig.4). The most important locality was at Tequixquiac, State of Mexico and nearby Mexico City. This locality was found, as was the case for several other localities at the time, during enhancement and increase of the sewer system of Mexico City. This excavation allowed the investigation into the sediments from one of the paleolakes from the Mexico Basin and procurement of a large number of specimens that enhanced the Mexican scientific collections. Camels, horses, proboscideans, glyptodonts, felines, bears, and ground sloths were among the studied fauna. Some of those taxa were quite similar to those discovered in North American sites at the end of the Pleistocene.

One of the discoveries that brought a wide interest by naturalists, and could be considered as the origin of both prehistory studies as well as archaeozoological studies in Mexico, is the bone known as "*sacro de Tequixquiac*" and its study. A camel sacrum, the bone is worked as representing an animal head. It is the first evidence of animal use by early people in the Mexico Basin. Although a recent view of the sacrum points to the evidence of a late work on the bone rather than while it was still fresh (O.J.Polaco, pers. comm., 2002), the bone has a historical importance for setting new trails for Mexican archaeological and paleontological studies (CORONA-M., 2002a).

CURRENT STAGE

During most of the 20th century, several foreign expeditions occurred, mainly by American professionals. One of the most important for the Pleistocene reconstruction was the search conducted in the 1940s by Chester Stock and personnel of the California Institute of Technology in San Josecito Cave, Nuevo León (ARROYO-CABRALES & JOHNSON, 1998; STOCK, 1943). Also in that decade, a synthetic study on the Quaternary Mexican mammals by MALDONADO-KOERDELL (1948) was published (Fig.5).

TABLE 1. Types described with Mexican specimens from the middle of 19th Century to early 20th Century.

ORDER	TAXON	AUTHOR	LOCALITY	STATE	RELATIVE AGE
Perissodactyla	*Equus conversidens*	Owen, 1869	Villa de Guadalupe	D.F.	Pleistocene
Artiodactyla	*Palauchenia magna*	Del Castillo, 1869	Tacubaya	D.F.	Pleistocene
Perissodactyla	*Equus tau*	Owen, 1869	Valle de México	Mexico	Pleistocene
Edentata	*Glyptodon mexicanus*	Cuatáparo & Ramírez, 1875	Tequixquiac	Mexico	Pleistocene
Edentata	*Scelidotherium guanajuatense*	Dugés, 1882	Rancho de Arperos	Guanajuato	Pliocene?
Perissodactyla	*Hippotherium montezuma*	Leidy, 1882	Tehuichila	Hidalgo	Pliocene?
Proboscidea	*Dibelodon tropicus*	Cope, 1884	Tequixquiac	Mexico	Pleistocene
Perissodactyla	*Equus barcenoi*	Cope, 1884	Tequixquiac	Mexico	Pleistocene
Perissodactyla	*Equus crenidens*	Cope, 1884	Tequixquiac	Mexico	Pleistocene
Artiodactyla	*Eschatius conidens*	Cope, 1884	Tequixquiac	Mexico	Pleistocene
Artiodactyla	*Eschatius longirostris*	Cope, 1884	Tequixquiac	Mexico	Pleistocene
Artiodactyla	*Holomeniscus vitakerianus*	Cope, 1884	Tequixquiac	Mexico	Pleistocene
Perissodactyla	*Hippotherium peninsulatum*	Cope, 1886a	Tehuichila	Hidalgo	Pliocene?
Perissodactyla	*Hippotherium rectidens*	Cope, 1886b	Tehuichila	Hidalgo	Pliocene?
Perissodactyla	*Protohippus castilli*	Cope, 1886a	Tehuichila	Hidalgo	Pliocene?
Artiodactyla	*Platygonus alemani*	Dugés, 1891	Moroleón?	Guanajuato	Quaternary
Proboscidea	*Mastodon oligobunis*	Cope, 1893	Tequixquiac	Mexico	Pleistocene
Edentata	*Glytodon nathorsti*	Felix & Nathorst, 1893	Valle de Ejutla	Oaxaca	Pliocene?
Carnivora	*Felis hyaenoides*	Freudenberg, 1910	Tequixquiac	Mexico	Pleistocene
Carnivora	*Hyaenognathus* (*Porthocyon*) *mathewi*	Freudenberg, 1910	Tequixquiac	Mexico	Pleistocene
Edentata	*Brachyostracon cylindricus*	Brown, 1912	Ameca	Jalisco	Pleistocene
Edentata	*Nothotherium mexicanum*	Freudenberg, 1921	Tequixquiac	Mexico	Pleistocene
Proboscidea	*Rhynchotherium tlascalae*	Osborn, 1921	nd	Tlaxacla	Pliocene?
Proboscidea	*Mastodon oligobunis* var. *antiquissima*	Freudenberg, 1922	Valle de Amajac	Hidalgo	Pliocene?
Proboscidea	*Elephas columbi* var. *falconeri*	Freudenberg, 1922	Tequixquiac	Mexico	Pleistocene
Proboscidea	*Mastodon oligobunis* var. *intermedia*	Freudenberg, 1922	Valle de México	Mexico	Pliocene
Perissodactyla	*Teloceras* (*Aphelops*) *felici*	Freudenberg, 1922	Tequixquiac	Mexico	Pleistocene
Proboscidea	*Elephas columbi* var. *felicis*	Freudenberg, 1922	Ejutla	Oaxaca	Pleistocene
Proboscidea	*Elephas columbi* var. *silvestris*	Freudenberg, 1922	Ejutla	Oaxaca	Pleistocene
Proboscidea	*Mastodon oligobunis* var. *felicis*	Freudenberg, 1922	nd	Puebla	Pliocene
Proboscidea	*Mastodon oligobunis* var. *progressa*	Freudenberg, 1922	Cañada de Acultzingo	Puebla	Pliocene-Pleistocene
Artiodactyla	*Capromeryx mexicana*	Furlong, 1925	Tequixquiac	Mexico	Pleistocene

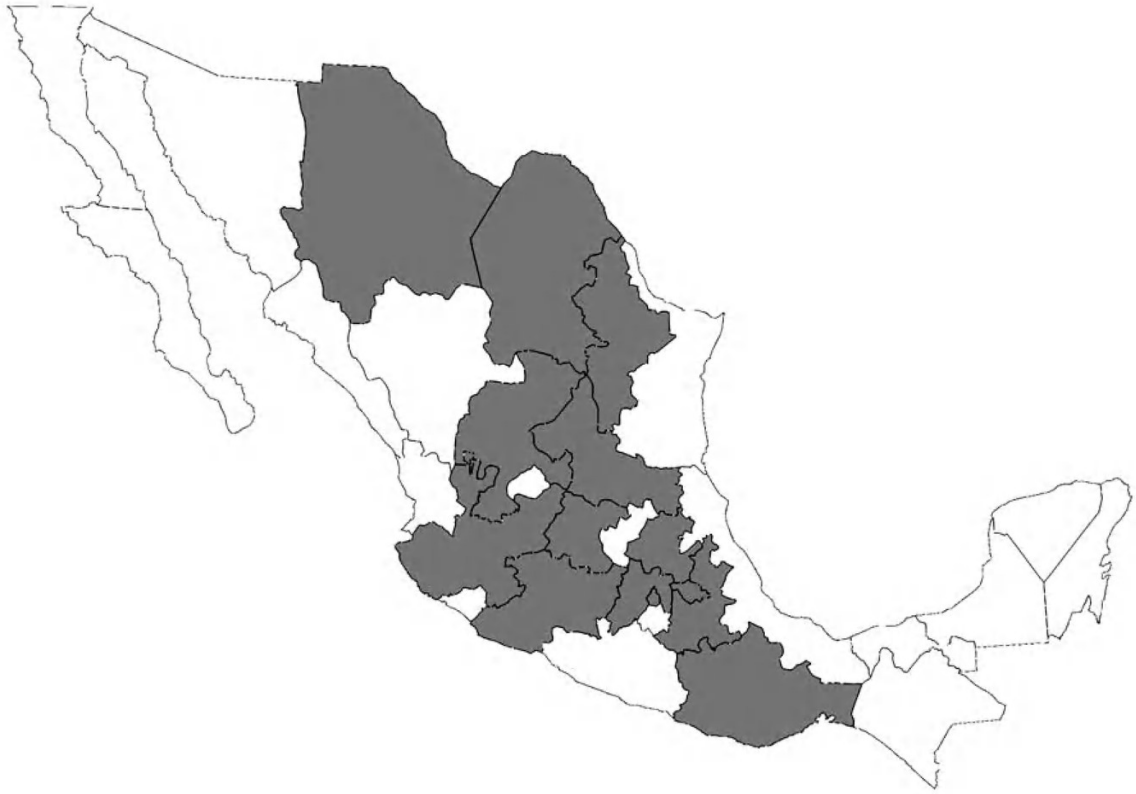

Fig.4- Map showing in the current political division of Mexico the findings of mammal fossil in the 19th century.

By the 1960s, courses on paleontology were started at the *Instituto Politécnico Nacional* (IPN) and the *Universidad Nacional Autónoma de México* (UNAM). Being the main teaching institutions, they also supported and provided an enhanced trained force for other institutions conducting field research. That cooperation is the case with the Geology Institute from UNAM, and the *Instituto Nacional de Antropología e Historia*, as well as departments from several state universities.

Several important publications were produced during the 1960s. Among these are the *Catálogo Paleomastozoológico Mexicano* by Álvarez (1965) and *Localidades de Vertebrados Fósiles en la República Mexicana* by Silva-Bárcenas (1969). The first correlations with US faunas were undertaken and rised the interest in the tempo and mode of the faunal exchange with South America, mainly by horses, gomphotheres, edentates, and camelids, and also focusing the interest in the man animal relationships by the early hunters-gatherers.

Currently, for the Mexican Quaternary, localities are known all over Mexico, while Tertiary localities are known from 11 states and only three for the Mesozoic (Fig.6).

In the mid-1990s, a substantial change occurs in the diffusion of knowledge, with many papers appearing in peer-reviewed foreign journals. Furthermore, a broadening transpires on the researched topics, adding to the basic systematic studies. Contributions are included from other disciplines, like paleomagnetism and isotope theory. Also, a major emphasis is placed on integrative paleobiological studies that include evolutionary patterns and paleoenvironment reconstruction. This activity produces a continuous data updating the fossil mammals and localities, *i.e.*, the synthesis compiled by Montellano-Ballesteros & Arroyo-Cabrales (2002).

In this new 21st century, paleontology in Mexico is represented by a large number of researchers and institutions, including its professional society (*Sociedad Mexicana de Paleontología*, SOMEXPAL).

REVISTA DE LA SOCIEDAD
MEXICANA DE HISTORIA NATURAL
Tomo IX. Nos. 1-2-junio, 1948

LOS VERTEBRADOS FOSILES DEL CUATERNARIO EN MEXICO

MANUEL MALDONADO-KOERDELL (*)

A la memoria del Ing. D. Antonio del Castillo, primer Presidente de la Sociedad Mexicana de Historia Natural y del Dr. D. Manuel M. Villada, autor del primer Catálogo de Fósiles del Museo Nacional de México.

Hace casi 80 años, al organizarse la primitiva Sociedad Mexicana de Historia Natural, en el mes de septiembre de 1868, su primer Presidente, el sabio mineralogista, geólogo y paleontólogo D. Antonio del Castillo (1870) expresaba en su discurso inaugural las siguientes frases alusivas a los estudios que debían emprenderse para conocer mejor las formas animales extintas de nuestro país:

"La Fauna fósil nos dará a conocer aquellas especies, géneros y familias que han desaparecido de nuestras regiones, y las que se han perdido completamente para el globo terrestre por la sucesiva renovación de los seres orgánicos que en cada época geológica o edad del mundo, ha acontecido".

"Así, por ejemplo, refiriéndonos a la época más próxima a la nuestra, a la que los geólogos llaman post-terciaria, sabemos por los innumerables restos fósiles de elefantes, de mastodontes y de megaterios esparcidos en sus capas, que en ella predominaron los grandes mamíferos, y comenzaron a vivir el caballo, el buey y la llama, que estos últimos han sobrevivido hasta la época actual; pero que se perdieron para el Continente Americano los dos primeros, y sólo sobrevivió la última, confinada ahora a habitar las altas

(*) Discurso inaugural como Presidente en 1948.

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Fig.5- Cover from one of the main publications of the current period.

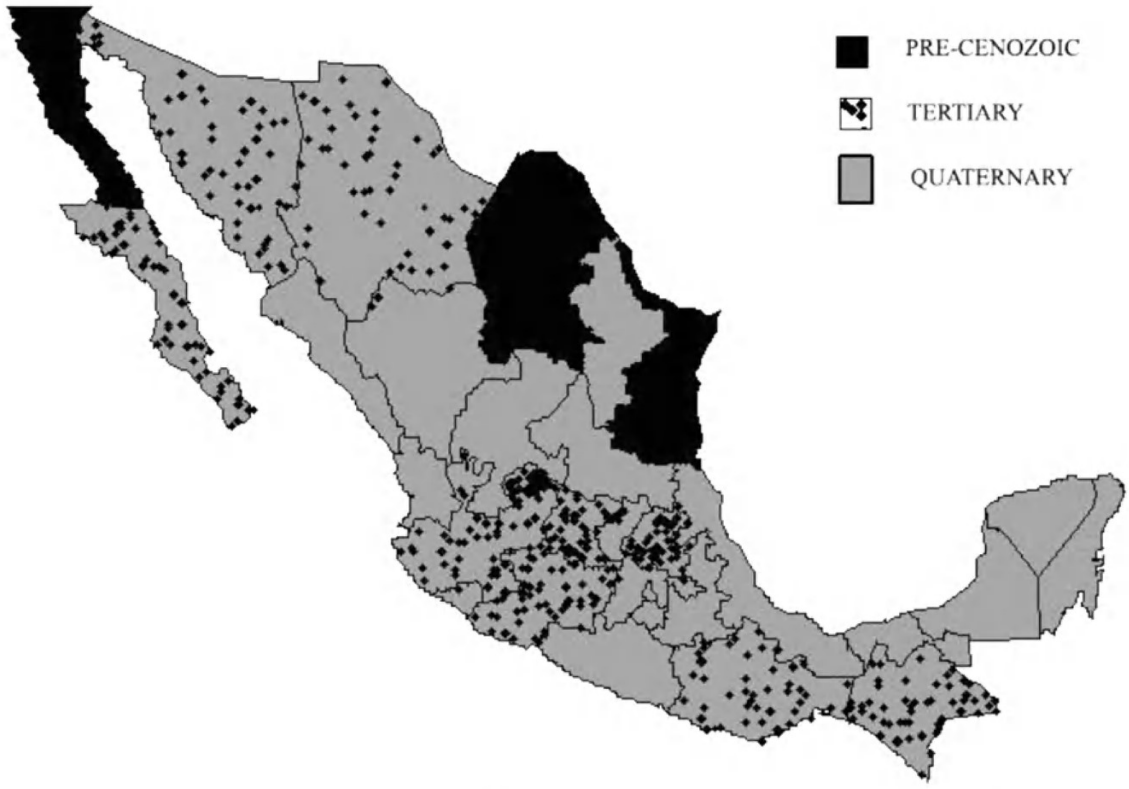

Fig.6- Map showing the chronological covering of the current studies in paleomammalogy, data from MONTELLANO-BALLESTEROS & ARROYO-CABRALES (2002).

An increase in the social impact of paleontology is also occurring, as shown by the building of several local museums. Among the more important ones are in Guadalajara, Saltillo, Ciudad Victoria, Sabinas, and Cuernavaca. Another important issue has been the joint endeavour of the federal government, the academic institutions, and the SOMEXPAL to establish a legal framework to define and protect the paleontological heritage. Lastly, a third area that is being increased is the production of educational materials.

CONCLUSION

In approximately 200 years, the paleontological endeavour in Mexico has moved from naturalist conceptions based on the European knowledge to the diffusion of important geological theories to evolutionary concerns, where it is currently located. Theoretically, scholars have moved from giantology to Neptunism to Darwinian evolution. Such a slow but constant development is proving important for the creation of strong research teams with up-to-date infrastructure and well-prepared personnel. Equally important is the impact on society with new museums and travelling exhibits.

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