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## Railroads in western São Paulo State (Brazil) and the first discoveries of Late Cretaceous fossil vertebrates by naturalists and paleontologists

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### Abstract

The first railway companies formed in the São Paulo State during the last decades of the nineteenth century were intended to provide quick and inexpensive transportation to coffee – which was the main agricultural product of the period and had a wide acceptance in the international market. As a result of the construction of railroads, a big quantity fossil materials was discovered; most of them were collected by the workers of the railway companies which then sent the fossils to the Serviço Geológico e Mineralógico do Brasil – SGMB (Geological and Mineralogical Survey of Brazil) in Rio de Janeiro city and to the Paulista Museum in São Paulo city. Therefore, this study aims at providing a brief history of the first studies of Cretaceous vertebrates found in the countryside of the São Paulo State, demonstrating the relationship between these findings with the construction of railroads, and its contribution to the Brazilian paleontological research during this period.

### Keywords

Fossils, Railways, Cretaceous, São Paulo State (Brazil).

## 1. INTRODUCTION

In the nineteenth century, in the countryside of São Paulo State occurred different expeditions in quest for natural resources, native labor, occupation, settlement of the region and others (Souza, 1997). When it comes to natural resources, Orville Derby (1851-1915) was one of the first authors to mention that this part of the Brazilian territory was explored in the purposes of collection of plant and animal specimens, as well as ethnological data (Derby, 1889). Since the Imperial times (1822-1889), the Brazilian government had promoted and greatly stimulated data collection nationwide; it subsequently initiated the exploration of mineral resources in the central region of Brazil (Figueirôa, 1997).

During the final decades of the nineteenth century, in the state of São Paulo, the first railway companies were

established in order to provide a quick and inexpensive transportation, mainly to the coffee, reaching a great acceptance in the international market. Therefore, the 1870s watched the creation of railway companies such as Mogiana, Ituana, and Sorocabana, which merged with other railway companies already operating, such as the São Paulo Railway Company and the Companhia Paulista.

Consequently, the railways companies construction contributed to the research related with the Paleontology. The process of opening new railroads in sparsely populated regions resulted in the discovery of several fossils. Most of these fossils were collected by the workers of the railway companies and then sent to the institution Serviço Geológico e Mineralógico do Brasil – SGMB (Rio de Janeiro city, the capital of Brazil at that time, Rio de Janeiro State) and the Paulista Museum

(São Paulo city, São Paulo State). Therefore, the present article study focuses on the paleontological material collected during the construction of the railroads in the countryside of the São Paulo State, more specifically, on the northeastern and western regions of the state, where companies such as the Mogiana, the Sorocabana, and the Paulista, had developed their railroad network.

The article too presents a historical review of the early researches on Bauru Group Cretaceous vertebrate fossils found in the countryside of the São Paulo State and their relation with the construction of railways. We point out that the first discoveries of Cretaceous vertebrates from western São Paulo were mentioned by the Brazilian zoologist and biologist Rodolpho Theodor Wilhelm Gaspar von Ihering (1883-1939): in a short note in 1911. He reported the remains of turtles, crocodyliforms, and dinosaurs in the region of São José do Rio Preto (São Paulo State) which were found in railway embankments of the railroad company Estrada de Ferro Araraquarense.

## 2. THE BAURU GROUP: HISTORY AND STRATIGRAPHY

The tridimensional arrangement of the sedimentary rocks from the Bauru Group (*sensu* Soares *et al.*, 1980) is widely discussed in the geoscientific literature since the beginning of the twentieth century. The term “Bauru” was introduced in the geoscientific literature by Gonzaga de Campos (1905), who discovered this geological sequence in western São Paulo State during the construction of the railroad named “Estrada de Ferro Noroeste do Brasil”. At first, the name “Grês de Bauru” (Bauru Stoneware) was proposed but, later, it was modified to “Arenito Bauru” (Bauru Sandstone; Florence, 1907). In 1930, the Geography and Geological Survey of the São Paulo State, current Geologic Institute, adopted the name of the “Formação Bauru” (Bauru Formation).

Almeida & Barbosa (1953) divided the Bauru Group in two formations: Lower, also known as “Itaqueri”, and Upper, or “Marília”. Later, Freitas (1955) conducted stratigraphic, tectonic, and sedimentological studies in order to reconstruct the sedimentary paleoenvironment of the Bauru Series in the State of São Paulo. Thenceforth, other authors published similar studies with the same objective. These paleogeographic reconstructions were refined over the years due new discoveries in outcrops of the Bauru Group located outside São Paulo State, and due more accurate interpretations of structural and subsurface data, – made especially by Hasui (1968, 1969), Barbosa *et al.* (1970) and Suguio (1973) – which indicated active tectonic processes during the sedimentation of this unit.

The 1980s was quite prolific regarding the studying of the Bauru Group. There was an attempt to establish a lithostratigraphic hierarchy to its units as well as to reconstruct its paleogeography (see Barcelos, 1984). Suguio (1980) subdivided the Bauru Group in three lithostratigraphic units: Caiuá Formation (Washburne,

1930), Santo Anastácio Formation (Landim & Soares, 1976), and Araçatuba, São José do Rio Preto, Adamantina and Marília Formation.

Almeida *et al.* (1981) interpreted this sequence as group status. They also presented the following stratigraphy: Caiuá Formation (basal unit), Santo Anastácio Formation, Adamantina Formation, and Marília Formation. Fernandes (1992) presented a new proposal to subdivide the Bauru Group at northern Paraná State and at the Pontal do Paranapanema, elevating the Caiuá Formation to Caiuá Group (which was previously suggested by Fulfaro & Barcelos, 1991) and emphasizing two formations: Rio Paraná and Goio Erê, and assigning the Santo Anastácio Formation to the Caiuá Group. Fernandes (1992) also considers these units as part of a single sedimentary unit, which suggests a different tectonic context of the Paraná Basin.

Fulfaro & Barcelos (1992) consider that the Caiuá Formation should be differentiated from the Bauru Group. The authors interpreted the Caiuá Formation deposition as anterior to the deposition of the Bauru Group, which comprised a distinct tectonic-sedimentary event that reflects in the cractonic interior – the rift phase of the South Atlantic reactivation.

Fernandes & Coimbra (1996) endorsed the proposal of Fernandes (1992) by presenting a regional study regarding the Bauru Basin (Bauru and Caiuá Groups) as an individual geotectonic entity. Fernandes (1998) discussed the stratigraphy and the geological evolution of the eastern portion of the Bauru Basin through analysis of the depositional systems according to the distribution of facies associations. The study divided the Neocretaceous sequence in Caiuá Group (Rio Paraná, Goio Erê and Santo Anastácio Formations) and Bauru Group (Uberaba, Vale do Rio do Peixe, Araçatuba, São José do Rio Preto, Presidente Prudente and Marília Formations, including the Taiúva analcimite), which are partially chronocorrelated.

Batezelli (1998) and Batezelli *et al.* (1999, 2000) used surface and subsurface data to propose the formalization of the status of Araçatuba Unity to this Formation, and redefined its occurrence area in the Bauru Basin, presenting a model of paleogeographic evolution to Western São Paulo State. Fulfaro *et al.* (1999) identified evidences on field that show the Santo Anastácio Formation as a geosol formed over the sandy deposits of the Caiuá Group, indicating unconformity between this unit and the Bauru Group. The authors also proposed the division of the Bauru Basin (*sensu* Fernandes & Coimbra, 1996) in two large geotectonic units: Caiuá Basin (Lower Cretaceous) and Bauru Basin (Upper Cretaceous).

Hitherto, the latest stratigraphic revision of the Bauru Group (*sensu* Fernandes & Coimbra, 1996) was made by Fernandes & Coimbra (2000). Here, the lithostratigraphic division of the Bauru Group at the different areas where the fossils of Western São Paulo State were found during the expansion of the railway network partially follows the proposal of Soares *et al.* (1980).

### 3. ORGANIZATION OF THE RAILWAYS WITHIN THE COUNTRYSIDE OF WESTERN SÃO PAULO STATE

The first railway was opened in São Paulo State during the Empire period. Established in 1867, the São Paulo Railway Company was organized and directed by an English group. The English Company, as it was known, connected the cities of Santos and Jundiaí (Fig. 1), linking the dockland district of Santos to the fields of Jundiaí. There occurred the main outflow of coffee produced in the around of the Campinas city.

For almost ninety years, the São Paulo Railway has held the monopoly of coffee transportation to Santos harbor. The opening of railroads by the São Paulo Railway Company had a positive impact: other businessmen glimpsed the opportunity to profit/make big money with railway companies in a province devoid of fast and efficient transportation.

In 1868, the year after the opening of the São Paulo Railway, a group of coffee farmers and investors opened the railway company named Companhia Paulista de Vias Férreas e Fluviais. This railway connected Campinas city – the main coffee-producing area to the railroad network of the São Paulo Railway in Jundiaí town.

Soon emerged other railway companies connecting the most remote coffee-producing regions to the railroad network of the Paulista and the São Paulo Railway companies. In the cities of Itu and Sorocaba, companies Ituana and Sorocabana had transported local products to the São Paulo Railway. The Mogiana had transported the product from Amparo city to the railroad network of the Paulista company in Campinas city.

In the 1870s, the Companhia Paulista continued to expand to the region of Rio Claro, west of Campinas, a region where coffee plantations occupied the backcountry of the São Paulo State. Consequently, many other railway companies were created in the following years.

That way, the railroads were delineated according with the distribution of farms and coffee plantations. As a consequence, the distribution of railroads was not the most efficient one for a railway system. According to Adolpho Augusto Pinto (1903), the first railways were nicknamed “coffee-picking railways”, because it served the actual coffee plantations. The coffee-picking railways were dominant until the 1890s in the Campinas region up to São Carlos (a central area of the São Paulo State), between the towns of Itu and Sorocaba (an area known as “the sugar quadrangle”), and in the towns of Amparo and Jaguariúna up to Ribeirão Preto (northeast of the São Paulo State), all served by the Mogiana railroad network. In the 1890s, substantial changes had occurred in the distribution of railroads. The swap point of those changes was the opening of the railway connecting the coast to the remote Mato Grosso State. The discussions about the opening of a new railroad in that region dated back from the 1870s. This occurred right after the conflicts

triggered by the invasion of the Brazilian territory by the Paraguayan army of Francisco Solano López (1827-1870). Engineers, intellectuals, and politicians pleaded the opening of a new railroad that would be a faster and safer link between the commercial centers of the midwestern Brazil and the capital and main harbors (Campos, 2007).

The concession for the new railroad was granted to the bank União of São Paulo in the early years of the Republic. The bank later passed the concession to other investors. In 1905, after turbulent debates about further railroad delineation and possible connectable cities, the company named ‘Noroeste do Brasil’ initiated the railroad between the city of Bauru (São Paulo State) and the Corumbá town, Mato Grosso State.

The company ‘Noroeste do Brasil’ was the first company to explore the western highlands of São Paulo which, at that time, was completely unknown and practically devoid of “white men”. According to the classification of railway lines proposed by Adolpho Pinto, the Noroeste and other railways opened towards the western highlands of São Paulo were described termed as “strategic railways”. Unlike the “coffee-picking railways”, the strategic railways reached previously determined areas, and had a key role in the urbanization of the São Paulo State. After the inauguration of these railroads, several new cities emerged, and coffee plantations had expanded in the western highlands.

The main strategic railroads were opened during the first decades of the twentieth century by companies ‘Sorocabana’ (from Botucatu to Presidente Epitácio towns, parallel to the Paranapanema river), ‘Estrada de Ferro Araraquara’ (from Taquaritinga to Jales and Rubinéia towns, following the Rio Grande river) and ‘Paulista’ and its western ramification (from Marília to Panorama towns). These railroad companies shared a similar goal with the proposal of the ‘Noroeste do Brasil’: reaching the embankments of the Paraná and Rio Grande rivers, and taking its railroads into the Mato Grosso State – a course dictated by export agriculture. The last strategic railway that reached the Paraná river was the ‘Paulista’ company that first served the town of Panorama in 1962.

Throughout the twentieth century, the railways had been gradually losing their supremacy as the main transportation for producers. From 1930 onwards, as shown by Lagonegro (2003), the road transport started to conquer space with the opening of new highways. Many of these new roads were constructed following the railroads. The railway companies were gradually being closed until 1971, when the ‘Ferrovias Paulistas S/A (Fepasa)’ was created and the remaining railways started to be controlled by the State (Fig. 2).



Fig. 1: Geographic scheme of the São Paulo Railway Company railway line connecting the cities of Santos and Jundiaí (São Paulo State) (from Calo, 1978).

#### 4. RAILROADS IN WESTERN SÃO PAULO STATE

During the 1880-90s, the railway system had consistently developed in the São Paulo State (Matos, 1974); meanwhile, not coincidentally, great coffee production centers appeared in the towns of Limeira, São Carlos, Araraquara, Descalvado, Jaboticabal and Ribeirão Preto. During this decade, the São Paulo State developed significantly: the market had increased threefold, the

population had increased considerably, half of the coffee production in Brazil originated from São Paulo, and immigration also had shown a significant increase.

Most railways of São Paulo were financed through local capital raising by people involved with coffee production. Railway companies Paulista, Mogiana, and Sorocabana were organized and financed by successful coffee farmers from São Paulo and their allies in market and local government (Matos, 1974; Lopes, 2011). The construction of the 'Estrada de Ferro Noroeste do Brasil'

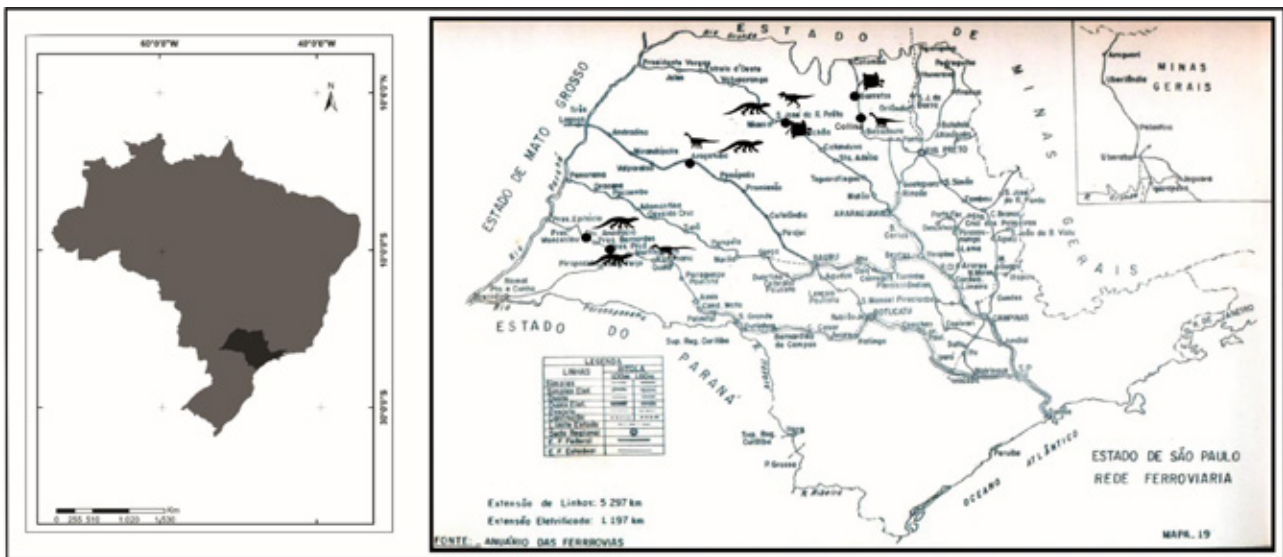


Fig. 2: Railroad network in western São Paulo State (modified from Bernadini, 2007).

began only in 1905, but unlike other main railways from São Paulo, this company was meant to reach new potential areas for agriculture and settlement (Carvalho, 2007).

After 1890, priorities changed and the railways were then built to open new areas for agricultural expansion, especially for coffee culture, and, consequently, settlement and land trade. Besides ‘Noroeste’, another example of railway expanding into the so-called “unknown hinterland” (“sertão desconhecido”, in Portuguese) was the Sorocabana, that expanded its railroad network into southwestern São Paulo (Matos, 1974; Boschetti, 2006). The Estrada de Ferro Mogiana company was created with the initial purpose of connecting the cities of Campinas and Mogi-Mirim, and, later, the city of Ribeirão Preto (1883) via São Simão town (1882); in 1887, to Franca city, and in 1888, to the Triângulo Mineiro (Minas Gerais State) and southwest of the Goiás State (Souza & Soares, 2010).

## 5. THE UPPER CRETACEOUS BAURU GROUP FOSSIL COLLECTIONS

Many naturalists, paleontologists, and technical workers collected vertebrate fossils from the Cretaceous, especially in the railroad embankments from western São Paulo and from the Triângulo Mineiro (Candeiro *et al.*, 2004).

The first formal record of fossils in western São Paulo is assigned to Ihering (1911) who, for the first time, acknowledged the existence of Cretaceous reptiles remains represented by undetermined specimens of turtles, crocodyliforms, and a theropod dinosaur (carnivorous) from the rural region of São José do Rio

Preto municipality. These fossils were found during the excavation of a water well in the rural area of this municipality; these latter reported these materials by Mezzalana (1976) to the Geographic and Geologic Survey of the São Paulo State. At that time, German-Brazilian doctor, professor, and ornithologist Friedrich Albrecht von Ihering (1850-1930) was the head of the Paulista Museum.

Although the São José do Rio Preto region was recognized as the first location in Western São Paulo where remains of Cretaceous vertebrates were found, most of the following fossil discoveries were made during the construction of railroads in Western São Paulo. In 1917 (Oliveira, 1929), Guilherme Bastos Milward reported the presence of fossils in the regions of Presidente Prudente and Santo Anastácio. Later, reptile (turtles and dinosaurs) specimens were collected by engineers during the construction of the railroad Estrada de Ferro Sorocabana. The specimens were sent to the head office of the Geographic and Geological Survey of the São Paulo State. Milward found crocodylian bones during the sinking of water wells nearby the railway station named ‘Ferrea de Alvares Machado’, which were sent to the Geological and Mineralogical Survey of Brazil. Many fossil records (chelonians, crocodylians and dinosaurs) were found during sinking of water wells in the surroundings of the lines of the railroad named ‘Ferro Paulista’ (Oliveira, 1929).

The first mention of fish remains in the Bauru Group was made by Pacheco (1913), and concerned isolated scales found in the Collina region. The publication also mentioned ganoid scales found in the Itambé municipality and a *Lepidotes* specimen found in Collina. Following studies confirmed these records to the region and to other locations in Bauru (Leonardos & Oliveira, 1943;

Barbosa, 1955; Price, 1955; Arid & Vizotto de, 1971; Mezzalira, 1959, 1966; Brito & Campos, 1982; Gayet & Brito, 1989; Bertini *et al.*, 1993).

In the embankments of the Estrada de Ferro Sorocabana Railroad, in the municipalities of Presidente Prudente and Santo Anastácio, remains of crocodyliforms were collected by Brazilian geologist Guilherme Bastos Milward, and later described as *Sphagesaurus huenei* by Llewellyn Ivor Price (1950). The first formal description of a turtle from the Barretos region is known as “*Podocnemis*” *harrisi* Pacheco, 1913 (Oliveira & Romano, 2007). According to Price (1953), this material is the first record of fossil turtle in South America (though the genus was already known from Cretaceous rocks of Argentina).

Many vertebrate remains, collected and deposited in the SMGB, were found in the railway embankments of companies Noroeste Railroad (EFN), Sorocabana Railroad (EFS), and Mogiana Railroad (EFM). Among them were crocodyliforms from Poço Florido, in Presidente Prudente (EFS), collected in 1920 by Guilherme Bastos Milward.

In 1927, remains of testudines and of sauropod dinosaurs from the same area were collected by geologist Mathias Gonçalves de Oliveira Roxo; turtles and titanosaurids from Araçatuba-Jupiá (EFN) were collected by Alberto L. Wanderley. In Araçatuba, crocodyliform remains were found and assigned to *Goniopholis paulistanus* by Roxo (1936). German paleontologist Friedrich von Huene (1875-1969) briefly described fossils of titanosaurids from Collina area, and crocodyliform teeth from Barretos municipality that were found in the railway embankments of the EFM (Huene, 1931). Huene (1933) assigned the crocodyliform remains from Barretos to *Brasileosaurus*

*pachecoi*. Later on, many authors considered the material as a *nomen nudum* (e.g., Candeiro & Martinelli, 2006; Bittencourt & Langer, 2011) (see Fig. 3 and Tab. 1).

In 1920, turtle and dinosaur remains collected in Presidente Prudente were mentioned in the Annual Report of the Geological and Mineralogical Survey of Brazil, reported by Professor Guilherme Bastos Milward at the time of the construction of the railroad Estrada de Ferro Sorocabana (Oliveira, 1929). The same report stated that bones of a large dinosaur and the pelvic

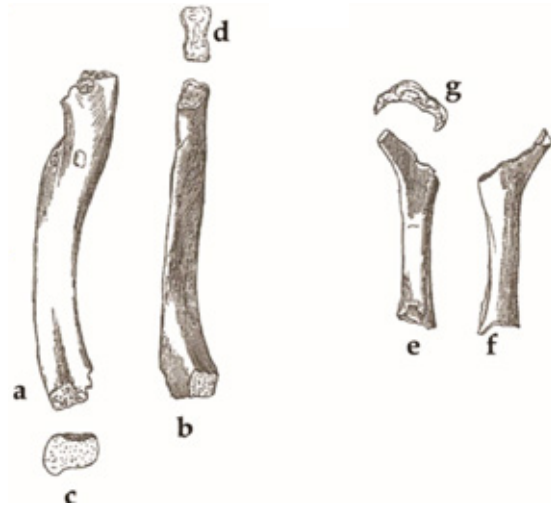


Fig. 3: First species figured from the Late Cretaceous of western São Paulo State - *Brasileosaurus pachecoi* von Huene, 1931 fragments. A-D, femur; E-G, humerus (modified from Huene, 1931).

Table 1: Vertebrate fossils collected from western São Paulos State railway early twentieth Century.

Railroad	Municipality	Taxa	Naturalist
Estrada Noroeste	São José do Rio Preto	Chelonia indet. Crocodyliforme indet. Theropoda indet.	Rodolpho von Ihering
Estrada de Ferro Sorocabana	Presidente Prudente/Santo Anastácio	<i>Sphagesaurus huenei</i>	Guilherme Bastos Milward
Estrada Noroeste	Barretos	“ <i>Podocnemis</i> ” <i>harrisi</i>	Joviano Pacheco
Estrada de Ferro Sorocabana	Poço Florido, Presidente Prudente	Crocodyliformes indet.	Guilherme Bastos Milward
Estrada Noroeste	Araçatuba-Jupiá	Chelonia indet. Sauropoda indet. Titanosauria indet.	Mathias Gonçalves de Oliveira Roxo
Estrada de Ferro Sorocabana	Araçatuba-Jupiá	<i>Goniopholis paulistanus</i>	Alberto L. Wanderley and Mathias Gonçalves de Oliveira Roxo
Estrada Noroeste	Collina	Titanosauria indet.	Friedrich Von Huene
Estrada Noroeste	Barretos	<i>Brasileosaurus pachecoi</i>	Friedrich Von Huene
Estrada de Ferro Sorocabana	Presidente Prudente	Dinosauria indet.	Guilherme Bastos Milward



bone of a turtle, also found in road embankments near Santo Anastácio town, were sent to the Geographic and Geological Survey of the São Paulo State.

The age of the sediments of the “Bauru sandstone” was assigned to Jurassic considering the records of: *Megalosaurus* (?), *Goniopholis* (?), *Podocnemis* (?); fishes, and *Lepidotus*; according to Oliveira (1929), all specimens were from Barretos and São José do Rio Preto towns, and also included remains of *Goniopholis* (?) and a teeth of “*Thecodontosaurus*” of the family “Zanclodontidae”. In addition, Roxo (1929) assigned the bones from Barretos to *Ceratosaurus*, and the remaining material of crocodyliforms to *Pholidosaurus*. There were also remains of turtles and dinosaurs from Presidente Prudente (EFS) deposited in the Geological and Mineralogical Survey of Brazil.

## 6. THE METHODOLOGICAL EXPLORATION IN WESTERN SÃO PAULO

Somehow the paleontological explorations had not developed consistently in the areas where railways had been constructed in western São Paulo. The work of fossils collect was directly related to the opening of railway embankments, the foundation construction of train stations, and the construction of water wells that provided water supply to railways.

Mezzalira (1980) pointed out that the geological and paleontological studies in western São Paulo made a major breakthrough in 1886 with the creation of the Geographic and Geological Survey of the São Paulo State. The Survey under the guidance of Orville A. Derby had benefitted from a major collaborative network consisting of Brazilians and foreigners, such as Luiz F. Gonzaga de Campos, Francisco de Paula Oliveira, Teodoro Sampaio, Guilherme Florence, Eugen Hussak, Albert Loefgren, and Joviano Pacheco. This technical team had been collaborating to discover and record many Cretaceous fossil deposits in the São Paulo State.

The permanent presence of railroads in western São Paulo at the end of the nineteenth century and in the first decades of the twentieth century, had favored naturalists, paleontologists, and technicians that collected Cretaceous fossils. These data grew fat on the work of Gonzaga de Campos, Guilherme Bastos Milward, Rodolpho von Ihering, Mathias Oliveira Roxo, and Alberto L. Wanderley. The first systematic naturalist “explorations” mentioned in the literature as fossil hunts in western São Paulo, were conducted by Joviano Pacheco in 1913, and by Guilherme Bastos Milward in 1915 (Oliveira, 1929). It was not only the opening of railways that had a direct impact in the discovery of fossil bones such as crocodyliform bones. The water wells drilled to supply the vicinities of the train station of Álvares Machado with potable water also delivered fossils collected by Milward and later deposited in the Geological and Mineralogical Survey of Brazil. In the municipalities of Barretos,

Collina, and Monte Alto, numerous vertebrate fossils were found thanks to the water-collecting drills. In the literature, a few references mention such circumstances. However, Oliveira (1929) insisted on the importance of these references: “In wells drilled to provide water supply to residents, and in the so-called ‘corte de Guajussara’, nearby the Train Station of Álvares Machado, Milward found bones of a crocodylian, which are exhibited in the showcases of the Geological and Mineralogical Survey of Brazil” (Oliveira, p. 36; translated by the authors). Ihering (1911), also showing that, at that time, Cretaceous fossils of the Bauru Group already presented a pattern of being found both in impacted areas of the railroad construction and in localities where water wells were being constructed.

As also observed by Oliveira (1929), the well sinking method applied during the construction of water wells in Presidente Prudente and Santo Anastácio regions allowed the discovery of many reptile fossil bones (turtles, crocodylians, and dinosaurs). These specimens are similar to the records found in the municipalities of Barretos, Collina, and Monte Alto.

Therefore, the explorers from the end of the nineteenth century and beginning of twentieth century deposited the collected specimens in institutions based in the cities of Rio de Janeiro and São Paulo. The Geological and Mineralogical Survey of Brazil had a fundamental role in the development of Geosciences as a whole, and was the core source for the first Brazilian paleontology group that overcame the necessity of sending the fossils abroad. The Geological and Mineralogical Survey of Brazil was created in Rio de Janeiro city in 1907, under the guidance of Orville Derby (1851-1915) within the scope of collecting concrete and detailed information about geography, relief, geological structure, roads, mineral resources and soil types (Figueirôa, 1997). The progress of the railroad to Western São Paulo, as well as the geological reconnaissance works and the well-sinking activities, allowed the discovery of many fossil remains which were all sent to the Geological and Mineralogical Survey of Brazil, the Comissão Geographic and Geological Survey of the São Paulo State, and the Paulista Museum.

Thanks to an administrative reorganization, the Serviço Geológico was transformed in the National Department of Mineral Production, in 1934, as a result of a hardworking of this institution and the progress they had made with this science (Cassab, 2004). Nowadays, its paleontological collections, importance of which was above-mentioned, are housed in the museum Ciências da Terra Museum, currently under the responsibility of the institution Mineral Resources Research Company, in Rio de Janeiro city.

The Geological and Mineralogical Survey of Brazil has housed the first fossil collection named as *Collecção de Paleontologia do Serviço* which, according to Oliveira (1929), was designated as a standard collection or type and contained in 1927.

The Cretaceous fossils from Western São Paulo, included in the *Collecção de Paleontologia do Serviço*, display their oldest record dated back to 1917: *Sphagesaurus huenei* Price, 1950. Only seven records from western São Paulo are dated in this catalogue (see Tab. 2). Despite the relatively abundant fossil record in São Paulo, few were appropriately catalogued, but all of them can still be found without any cataloging in the paleontological collection of the National Department of Mineral Production.

Furthermore, it is significant to emphasize the researchers who had studied the Western São Paulo for paleontological purposes were *stricto sensu* reported their findings in literature. Their scientific works were linked to the expansion of the railway network in western São Paulo. They had contributed to trigger the ongoing development to the Brazilian paleontology, and had supported the works of the Geological and Mineralogical Survey of Brazil and of the Geographic and Geological Survey of the São Paulo State, for example.

## 7. CONCLUSION

The present study displays a historical overview correlating the construction of railways with fossiliferous discoveries, especially in Western São Paulo, during the construction of railroads in the end of nineteenth century and began the twentieth century. The findings of Cretaceous fossils contributed not only to the development of the Brazilian Paleontology, increasing the general interest for new discoveries, but also contributed to the study of Cretaceous period in Brazil. The modernization that resulted from advances in agriculture, with the creation of institutions and committees, opening of new railways, among others accelerated the consolidation process of paleontological science and fossil storage in Brazil.

The present study reveals information such as: the development of railway facilities contributed to the creation of specific conditions for the study of fossils in Brazil, but also aroused the interest of the Brazilian and

Table 2: Cretaceous fossils found in the railway areas of Western São Paulo and recorded in the *Collecção de Paleontologia* of Geological and Mineralogical Survey of Brazil.

Nº	Designation	Location	Collector	Date
	Turtles, titanosaurs	Araçatuba-Jupiá E. F. Noroeste	Alberto L. Wanderley	1935
	Crocodyliforms	Curucaia E. F. Sorocabana Presidente Bernardes	Guilherme Bastos Milward	?
	Crocodyliforms	Guajussara Km 812 (former 814) Lins	Guilherme Bastos Milward	?
	Crocodyliforms	Poço Florindo Presidente Prudente E. F. Sorocabana	Guilherme Bastos Milward	1920
	Testudinata indet. Sauropoda	Araçatuba-Jupiá E. F. Noroeste do Brasil	Alberto L. Wanderley	
	Testudinata indet. Sauropoda	Poço Christiano Presidente Prudente E. F. Sorocabana	Mathias O. Roxo	October, 1927
	Crocodyliforms, <i>Goniopholis paulistanus</i> , Roxo, 1936	Araçatuba	Alberto L. Wanderley	1935
	<i>Sphagesaurus Huenei</i> Price, 1950	E. F. Sorocabana between Presidente Prudente and Santo Anastácio, Catanduva area	Guilherme Bastos Milward	1917
	Titanosaur	E. F. Araraquarense, 6km western of Votuporanga		
890	Crocodyliforms 3 teeth	Corte da Guajussara E. F. Sorocabana	Guilherme Bastos Milward	November 30, 1973
912	Crocodyliforms 1 tooth	Between Guarucaia and Santo Anastácio	Guilherme Bastos Milward	December 4, 1973
	Theropoda vertebral center	Pacaembu E. F. Noroeste do Brasil	Lewellyn Ivor Price	1953

foreign researchers to study their geological context; the record of the fossil collection, as well as the respective participation of the Geographic and Geological Survey of the São Paulo State, Paulista Museum, and Geological and Mineralogical Survey of Brazil in the processing and study of discovered fossils.

It was also retrieved reports and scientific articles of institutions and committees which helped to understand the part of paleontological studies in Brazil. It also highlighted the bonds between researchers (paleontologists, naturalists and technicians) at that time and those still available nowadays, and between them and the institutions. Thus, we must emphasize the impact of these researches related to the main economic product of that moment in Brazil: coffee, and how the development of railways had much contributed to the study of the Cretaceous period of Western São Paulo.

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