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CARTOGRAPHY OF THE BRAZILIAN EMPIRE: BRIEF CONSIDERATIONS

Cartografia do Império Brasileiro: Breves Considerações

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ABSTRACT

This paper is a small part of the historical research on Cartography and Geodesy in Brazil, developed by the Laboratory of Cartography, GeoCart, Department of Geography, of Federal University of Rio de Janeiro, Brazil. Inside the historical research on the several mapping works developed during all the commissions designed between 1862 and 1890, to organize and to define the support to mapping the role Empire and also Rio de Janeiro State, including the Neutral Municipal district of Rio de Janeiro, there was need to know all early initiatives, which gave origin to the mapping systems used, before the Brazilian Independence from Portugal, during the 19th Century. It will be presented, after an introduction to early attempts, the Empire of Brazil cartographic organization with some cartographic maps, without geodetic support. In order to organize and mainly to include a scientific geodetic support, in 1862 was created the General Chart of Brazilian Empire Commission, to develop an orderly systematic mapping. The main personalities involved during the existence of the Commission, characteristics and actions that were accomplished will be presented also. At the end, two great attempts to make a precision geodetic triangulation network will be presented, one in Rio Grande do Sul State, and the other one in the Neutral Municipal district, Rio de Janeiro, which both supported the initial development of the Brazilian geodetic triangulation network.

Keywords: History of Cartography, Triangulations.

RESUMO

O presente artigo é uma pequena parte da pesquisa histórica sobre Cartografia e Geodésia no Brasil, desenvolvido pelo Laboratório de Cartografia, Geocart, do Departamento de Geografia, da Universidade Federal do Rio de Janeiro, Brasil. Dentro da pesquisa histórica sobre os vários trabalhos de mapeamento desenvolvidos pelas comissões designadas entre 1862 e 1890, para organizar e definir o suporte para o mapeamento sistemático de todo o Império e também do estado do Rio de Janeiro, incluindo o Município Neutro do Rio de Janeiro, sendo necessário conhecer todas as iniciativas anteriores, que deram origem aos sistemas de mapeamento usados, antes da independência do Brasil de

Portugal, durante o século XIX. Isso será apresentado depois de uma breve introdução de duas tentativas anteriores, à organização cartográfica do Império do Brasil, sem suporte geodésico. De modo a organizar e principalmente incluir um suporte geodésico científico, em 1862 foi criada a Comissão da Carta Geral do Império Brasileiro, para desenvolver um mapeamento sistemático ordenado. Da mesma forma, são apresentados os vultos de importância para a cartografia brasileira, durante a existência da Comissão, bem como as características e ações que os acompanharam. Por fim, serão apresentadas duas grandes tentativas para construir uma rede precisa de triangulações geodésicas, uma no estado do Rio Grande do Sul e outra no Município Neutro do Rio de Janeiro, com ambas dando apoio para o desenvolvimento inicial da rede brasileira de triangulação geodésica.

Palavras-Chave: História da Cartografia, Triangulações.

1. INTRODUCTION

Until the end of the 17th and beginning of the 18th century, the cartography developed in the Colony of Brazil, mainly in the coast as well as in the country side, was schematic and only qualitative, not allowing to obtain any kind of aproximate positioning in geographical coordinates.

At that time, facts relating the occupation and exploration of a colony´s territory by expeditions called "*entradas e bandeiras*" occurred, which left from São Paulo, São Vicente and some places of the south, arriving to the center-west, especially the captaincy of Goiás, lands of Mato Grosso and Madeira and Mamoré rivers basin and closing the Amazonian basin to the south. In this way, the explored areas were enlarged into the colony, clearly showing the needs to define Brazil limits with the west lands. Some isolated boarder´s demarcation movements, such as the Utrecht Treaty of 1715, negotiated with France the Oiapoque's River limits, closing the border limits to the north, but it was still not defined the border between the lands of Portugal and Spain. Portugal begins to develop an extensive program of scientific mapping, starting in 1728. On the other hand, the Spaniards remained static, relating to any demarcation processes, only coming to take similar solutions in 1734.

The origins of the Brazilian Empire cartography remount to the begin of the 18th century, when an official cartographic mission began to develop the necessary limit demarcations and terrestrial positioning by the Jesuits priests Diogo Soares and Domingos Capacci, specially designated by Don João V, King of Portugal. The importance of these works, of the so called "mathematical priests" at that time, was the introduction of new cartographic positioning techniques in Brazil, calculating accurate longitudes through observed ephemerides and hourly differences relating to Jupiter satellites eclipses. In this way Brazil entered into a new cartographic phase. (CASSINI,1699).

With the accuracy of the latitude determinations, it would be possible to accuratly determine longitude and, as a consequence, to fix with high precision the positioning of the Tordesilhas meridian, essential for the demarcation of Portugal and Spain lands.

The mission given to the priests by D. João V, was explicitly assigned to map the south and the center-west, as well as to define new mapping rules for the entire Colony.

The works were accomplished from 1730 to 1748, and they were translated in maps including the east and south coasts, south of Brazil, as well as the country side until Paraná River. There were determined 197 lists of coordinates from Rio de Janeiro, São Paulo, Minas Gerais and Goiás captaincies.

Rio de Janeiro´s meridian, established on the Castelo Hill observatory, was chosen as the prime meridian to support mapping works. The observed differences among other prime meridians, like Paris and Ferro island, varied from 2 to 5 degrees, specially, in the south of the Colony.

On the other hand, it is supposed that changing Rio de Janeiro meridian to the prime meridian, would be an artifice to mask geographical coordinates, mainly longitudes relating to Paris or Ferro Island meridians, as the prime meridians (Cortesão, 1945).

In this way, there are defined the following possible conclusions for the priests' mission:

- Development and referencing of a new Colony Atlas to the Rio de Janeiro meridian;
- To avoid references to Paris and Ferro Island meridians and

• To know the accurate land positions relating to the Tordesilhas meridian.

In 1750, Alexandre de Gusmão led the Madrid Treaty to define and establish the land distribution between Portugal and Spain colonies. The basic premises of the negotiations were established to have a balance of the shared lands. These included: from the basins of Amazon and Prata river, being the first one to Portugal and the second one to Spain; to reserve for Portugal the Central Plateau, with gold and diamond mines; to extend limits to south and to join the Minas Gerais to the south livestock; to give an organic visibility to all territories explored by Portugal and finally to stabilize the sovereignty for the law sanction "*utis possidetis*."

To develop these points, besides having supporting documents, two elements were fundamental for the success of the negotiations by Portugal: the geographical knowledge of Alexandre de Gusmão and the maps that gave support and reliability to his strategy.

Spain was accepted as the base of negotiations called "Map of the Courts". This map was compiled through several other maps, such as Diogo Soares and Capacci´s, for southern areas, the chart of D´Anville for the Spanish lands of Prata river´s basin, still drawn on the Spanish Jesuits' maps from Paraguay. Yet, contributed maps from Gomes Freire de Andrade, for the center-west and part of the Amazonia, and from Charles Marie de La Condamine, a French scientist and explorer, from Rio Negro river valley, were accomplished in 1735.

The map of the courts, however, when drawn over a current map and taking the meridian of -51º as starting point, presents a distortion that allowed an erroneous interpretation, reducing the area destined to the Portuguese and increasing the area shared to the Spaniards.

These distortions are basically displacements in longitude, which at that time, no longer would make sense, as for instance, the mouth of the Madeira and Mamoré rivers, were diverted to the east in more than 9º. In other words, practically, 1000 km or 620 miles.

In all studies developed by Cortesão, is shown that the distortions were perfectly known by Alexandre de Gusmão and they matched to all Portuguese pretensions.

Thus, the Map of the Courts may be thought as a thematic document, faced to a geopolitics application, transmitting dissembling information for the Spaniards, a user who didn't know its power. As a result, in 1750 was already delineated the political image that Brazil presents today.

There is not a defined authorship for the map. However, he was designed and drawn in Lisbon under the direction and orientation of Alexandre de Gusmão. Two copies were made and called as "primitive maps", to distinguish them from copies made in 1751, three in Lisbon and three in Madrid, presenting some changings.

The Figure 1a shows the map sent by Gomes Freire de Andrade, to support Alexandre de Gusmão to design the Map of the Courts. It was made in 1746 and no author is known. Figures 1b and 1c, respectively, show the "primitive map" of 1749 and one of their copies of 1751, drawn in Lisbon.

Fig. 1a – Map of 1746.

1b – Primitve Map 1749.

1c – Copy of 1751.

In February 12th, 1761, the governments from Portugal and Spain signed a new treaty denominated Pardo Treaty, cancelling everything that had been agreed in 1750 by the Madrid Treaty. Among others, the main reason was the divergences on the Missions Territory, on the Prata river, which had been incorporate to Portugal. Santo Ildelfonso's Treaty, negotiated by Marquês de Pombal, was signed on October 1st, 1777, maintaining the basic principles of the Madrid Treaty, but imposing to Portugal a substantial loss of territories in the Prata River area. However, there were returned to Portugal the occupied lands in Santa Catarina and Rio Grande do Sul, by the Spaniards, during the time just after the Madrid Treaty.

All treaties imposed the need to acknowledge territories, taking them to several mapping and demarcations missions, to confrontation and recognition of these areas. So, after this time, dozens of maps were made, with a reasonable accuracy determined by the astronomical processes used.

2. CHART OF NEW LUSITÂNIA

In this way, at the end of the 17th Century, Portugal government was the owner of a great amount of sparse cartographic information Colony, which would be joined to show it entirely. Thus, Don Rodrigo de Souza Coutinho, Minister of the Navy and Foreign Domains, ordered to make the "General Chart of Brazil", and being appointed as a chart organizer, Portugal´s court engineer, Dr. Antonio Pires da Silva Pontes.

In 1798, Silva Pontes, leading a group of several designers, geographers and cosmographers, composed by 34 personalities, linked to Portugal and its Colonial cartography, designed and drew the Chart of New Lusitânia. It was used for that effect the latest information they had been using in the limits demarcations, mainly to those that were represented by "their accurate latitude and longitude positioning", according to the ordered document.

The "drawers" were José Joaquim Freire and Manoel Tavares da Fonseca. Miguel António Ciera, an Italian astronomer, helped to organize all astronomical observation conferences. He came to Portugal in the middle of the 18th century, to be part of the commission that would make the topographical limits demarcation of all Portuguese possessions in Southern America.

This chart was denominated as "Geographical Chart of Spherical Orthogonal Projection of New Luzitânia or State of Brazil", (Carta Geográfica de Projeção Esférica Ortogonal da Nova Luzitânia ou Estado do Brazil), as shown in its legend. Besides that legend, quite long

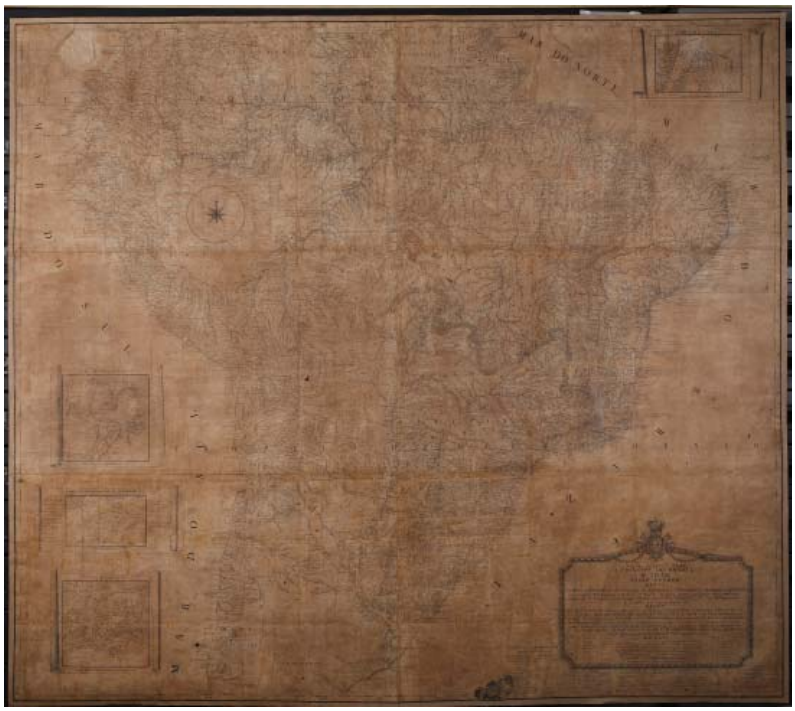

Fig. 2 - Chart of New Lusitania of Silva Pontes.

and self explanatory, it is also represents the organizer's name, designers and thirty four other cartographic authorities who approved it, among priests, doctors, military, scientists, explorers, defining an important list of names linked to Portugal and Brazil Cartography.

The spherical orthogonal projection seems the equivalent projection of Sanson-Flamsteed. It is a projection where the meridians are curved, with the concavity going back to the central meridian which, in this case, was established by the meridian 315º, referencing to Ferro Island. The central meridian is projected based on a straight line and each parallel is projected as equidistant parallel straight lines. The scale displayed is a graphic one, corresponding to 1/3.865.000.

Only two copies of this chart are known, one is in the Tombo Tower, in Lisbon, Portugal and the other one is in the 5th Surveying Division of the Brazilian Army Geographical Service, in Rio de Janeiro. The existing copy in Brazil came from Portugal with the royal family in 1808. A third copy, made in Brazil in the middle of the 19th century, is in the Map Library of External Affairs Ministry, in Rio de Janeiro, Brazil.

Noteworthy in this map is its rich details, relating mainly to the hydrographic network, representing mountains, cities and villages place names, among others, as well as a quite accurate location of the Indians tribes which in habited the country side.

It is possible to say that the Brazilian systematic cartography had a real beginning with this map and along the demarcations missions. One of the demarcators was Lt Col Ricardo Franco de Almeida Serra whose name is linked to the Fort de Coimbra history, in Mato Grosso do Sul and border demarcations in Brazilian center-west.

3. THE BRAZILIAN EMPIRE CARTOGRAPHY

Starting to analyze the cartography corresponding to the Brazilian Empire, it is noticed, at first, a reasonable period of time, among the last works accomplished in the Colony, for the first ones performed by the Empire.

No negligence relating the country mapping was observed. The territory mapping processes continued, but in a regional way, with provinces charts, borders definitions, hydrographic surveys and some geodetical support structures, as the beginning of the geodetic triangulation network occurred. The works developed by the military engineers, mainly of Brazilian Army, in country side, were significant, but several other personalities, also came to stand out.

A great amount of maps were designed, referring to the several provinces, topographical plans, hydrographic maps of the Amazonian and Prata basin rivers and borders maps. An example is the Province of Goiás map, published in 1836, work of Marshal Raimundo José da Cunha Matos, when he was governor of the Province, traveled and recognized the entire territory.

Viscount Beaurepaire Rohan, in 1844, explored low Paraguay River, as well as in 1846 he defined the connection between Guarapuava and Paraná River and Iguaçu River the navigability to its mouth. Jerônimo Francisco Coelho, made several recognitions, surveying and maps in the coast of Santa Catarina, and he was the author of the "Mappa Topográphico of the South Part of the Province of Sta. Catharina", of 1842. Later he would come the President of Pará and Rio Grande do Sul Provinces and finally Minister of the Brazilian Empire.

Army Colonel Jacob Conrado Niemeyer and Generals José de Souza Soares d`Andréa, Baron of Caçapava, and Pedro de Alcântara Bellegarde, were active geographers and cartographers of this time, organizing the "Chart of the Brazilian Empire ", published in 1846 and republished twice, one in 1857, ordered by the Marquis of Caxias, when he was War Minister, and the second time in 1873, organized by the Baron Duarte da Ponte Ribeiro.

The Figure 3 presents the copy of 1873, at the collection of the Laboratory of Cartography of Federal University of Rio de Janeiro.

In 1852 Pedro de Alcântara Bellergarde and his uncle, Colonel Niemeyer, worked in the map called "Chorographic Chart of the Province of Rio de Janeiro", published in 1865 with the cooperation of the Marshal Beaurepaire Rohan, as shown in the Figure 5.

Fig. 3 - Chart Of Brazilian Empire 1873 (1846).

Fig. 4 - Legend of the 1873 Chart.

In spite of the considerable amount of cartographic activity developed, it was mainly made through scattered and discontinuous works dispersed in the immense Brazilian territory, in a great part supported by positioning astronomy. Due to the lack of coordinated actions on geographical and cartographic works, there was not yet a geodetic support, as a consequence, it was not possible without adopting of a coordinate and geodetic system, to assure an accurate representation of the space at any place.

During this time were developed around 75 maps on the several Brazilians regions: 17 in the northern, 8 in the western, 6 in the southern, 31 in the eastern and 3 in the central region. Still other maps were developed, 2 regionals and 8 nationwide.

At that time the personality of Baron Duarte da Ponte Ribeiro begins to stand out in the history of the Brazilian cartography.

4. THE GENERAL CHART OF THE EMPIRE

In 1862 was created the Commission of the General Chart of the Empire, under the supervision of Dr. Antônio Maria de Oliveira Bulhões. The objective of this commission was to organize, design and create a Brazilian geographical Chart strictly through scientific methods. For this purpose it would be necessary to apply an accurate geodetic support, defined by a triangulation network, as France had made

Fig. 5 - Chorographic Chart of the Province of Rio de Janeiro

at that time.

The works were planned in 1864 and initiated in 1867. The triangulation of the Neutral Municipal district were planned also and two geodetic bases were measured. This triangulation suffered with the administrative problems that were common in the Empire, where the financial crisis was chronic, and the works were suspended.

The planning established 42 sheets to compose the chart at the 1: 1.000.000 scale. In 1871 31 of these were ready. Although, in 1872 the Commission verified that all sheets needed changing, due to the deficient information that composed them. Therefore, the execution of this work was cancelled, due to lack of reliability.

The causes of the works´ delay were the large country territory, its difficult access to scientific information and the lack of preparatory works that would propitiated an accurate geodetic survey, through methods already used more than one and a half century ago by developed countries in Europe, as well as the chronic financial resources lack.

To organize the Chart and to overcome those difficulties Dr. Antonio Maria decided to apply some methods of expedite geodesy. These methods had been applied successfully in Ethiopia, presenting some results, in spite of not been rigorous, they were fast and economical, and could be corrected later.

In this way it would be possible to obtain a reasonable topographical country outline, much more accurate than all others performed until that moment. In spite of it had been totally backed, in practice the solution didn´t give good results.

In 1873, assumed the Commission of the General Chart of the Empire, Dr João Nunes Campos, immediately verifying serious problems with the worked material, in disagreement with existent information and relating to the used map projection, consisting of the modified Flamsteed projection, while it had been drawn in the normal Flamsteed projection.

Face these problems it was ordered the work of a new Chart of Brazil, to be drawn in the modified Flamsteed projection, divided now, no more in 42 sheets, but in 30 sheets.

In 1874 the Commission direction goes to the Marechal Beaurepaire Rohan, who had organized in 1843, a General Chart of Brazil, to be presented in the Universal Exhibition of Vienna.

In the reality, it was never possible to a fully accomplish of the planned work. It was verified and necessary to appeal to the cartographic works developed in the colonial period, coming under this aspect the precious cooperation of Baron Duarte da Ponte Ribeiro.

Ponte Ribeiro was devoted for many years of his life to study the limits of Brazil, together with the Baron of Rio Branco. He collected in Portugal, in Brazil and in several countries of Spanish America, charts and geographical maps of Brazil and from the bordering areas. He could supply in a large way, with his knowledge and cartographic documentation, the difficulty and lack of the necessary preparatory works for the chart. Thanks to his intervention it could be organized the Chart of the Empire, presented in the Philadelphia Exhibition, in 1875. . Instead the 30 sheets, was defined to reduce the sheet number to 4, worked with the same information, but reducing the scale to a half of the original one.

The chart was drawn by Jose Martins Penha and Jose Cupertino do Amaral, with help of Jose Ribeiro da Fonseca Silvares. It was taken as prime meridian, the meridian over the Sugar Loaf Rock, once it was defined the disassembles of the Castelo hill where was the old Jesuits College, through where passed the meridian of Domingos Capacci's and Diogo Soares Charts.

The chart was assembled by the contribution of old and modern cartographic works, collected almost of them by Ponte Ribeiro, divided by the several Brazil regions. It was used of septentrional region 85 maps, of western, 43 maps; southern, 45 maps; oriental, 116 lmaps; central area, 17 maps; maps that represented territories in more than one of the 5 areas, 15 maps and maps of the whole Brazil, 9 maps.

Relating to border areas, it was used the cartographic works of the demarcations expeditions of the 18th century, mainly those to define the limits proposed by Santo Ildefonso's Treaty.

For the Northern region the contribution is particularly noticeable, because 32of the 85 maps, were from the limits demarcations of that time.

For the eastern, although having been used a great number of modern works, were taken

from old maps, as the one of New Lusitânia, which represented the collection of many previous works.

Relating to the Brazilian coast, also previous hydrographic works were taken, like the one of Jose Fernandes Portugal and Patrician Jose de Sousa, both from 18th century and from the beginning of the 19th century.

Finally, in l875 the General Chart of the Empire Commission, published the "Chart of the Empire", presented at the International Exhibition of Philadelphia, showed in figures 6 and 7. The chart was built in 1: 3 710 220 scale and under the modified projection of Flamsteed. The central meridian was the meridian of Sugar Loaf, with a displacement of 0º 00' 57" to the east of the Imperial Astronomical Observatory of Rio de Janeiro.

Fig. 6 - Chart of 1875 (reduced).

In 1876 was instituted the use of the "Archive Chart" or "Carta Arquivo". This kind of maps would be distributed to all provinces, so that their deficiencies and mistakes would be verified and corrected in the General Chart of the Empire. Unfortunately, the results were insufficient.

In the Final Report of the Commission of the General Chart of Empire of Brazil, presented in 1878 Marshal Baurepaire Rohan rendered praises to Ponte Ribeiro's work.

The Commission, however, had a quite short life, being extinguished in 1878.

As an initiative of Baron de Capanema it was created, yet in the same year, the Itinerary Chart Commission to survey roads and trails of the country side, but it had also a short life, being extinguished only two years later. It was mostly composed of Austrian engineers, which accomplished only some surveys and some astronomical determinations.

5. DEVELOPEDTRIANGULATIONS IN EMPIRE

In spite of to be linked to the Empire General Chart Commission the geodetic triangulations in Brazil, initiated some works in a previous period, between 1852 and 1857 by Marshal Francisco José Souza Soares d'Andréa, Baron de Caçapava, covering the Brazilian-Uruguayan border, from the mouth of Chuí and Quarai rivers.

The purpose of this triangulation was to support border´s demarcation works. It was considered, at that time, the largest monument of the military cartographic engineering and undoubtedly, it was the first established and calculated triangulation made in Brazil and South America.

In 1860, Baron Pedro Alcântara Bellegarde, with an identical objective, worked over this triangulation, prolonging it for the entire extension of Lagoa Mirim.

These two became the first geodetic networks accomplished in Brazil.

Figure 8 shows the Plane Chart of the Border of Chuy, containing the limits lines projected by the Commission of Brazilian - Uruguayan border, as well as the initial structure of the triangulation.

Fig. 7 - Legend of the 1875 Chart.

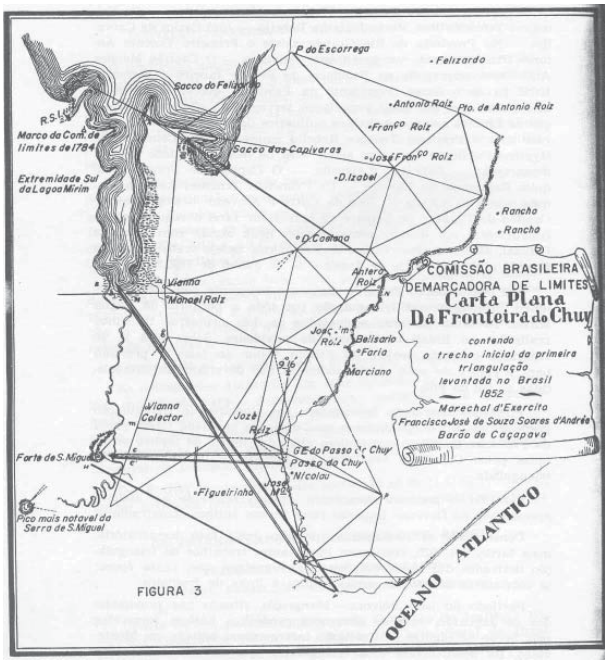

Fig. 8 - Plane Chart of the Border of Chuy. Annual of the Management of the Geographical Service, nr 7.1956.

On the other hand, the works developed in the Neutral Municipal district, in Rio de Janeiro city, began in 1866, as a consequence of a request from General Finance Office, who was interested to make the city´s cadastre and to organize a support topographical plan.

Under the direction of engineer Antônio Maria Oliveira Bulhões, the Imperial Court Inspectory of Public Works, decided to develop a geodetic triangulation. It was performed of small triangles network, covering the urban and surrounding areas. The departure base was located in the fields of Jacarepaguá, measuring 5.994 m and closing in other base, measured in Arpoador beach, with 3.019 m length. To attend its densification, it was still measured other third base in Santa Cruz, with 9.423 m length. Figure 9 depicts an outline of the Neutral Municipal district network.

Figure 9 net of triangulation of the Neutral Municipal district and part of the outline of the triangulation, in existent drawing in the National Archive, Rio de Janeiro.

For this mission it was entrusted engineer, José Manoel Silva who practically accomplished it entirely, even crossing serious financial problems due to the precariousness of the Empire finances. The works stopped in 1868, by the extinction of the Section of Triangulation. Due to the same financial problems of the General Chart, the Commission abandoned the project of Public Works Inspectory for the development of a new network.

With the creation of the Commission of the General Chart of the Empire it was decided in 1870, the pursuit of the triangulation works once they were considered of extreme importance to reach the objectives outlined for the Neutral Municipal district cadastre chart.

The triangulation was developed between Santa Cruz and Magé Channel bases, Province of Rio de Janeiro. The first base of this work, was not the same of the original one, it was measured at 2.509,82 m length and it was also located in Santa Cruz. For the first time in Brazil a basimeter French Brunner et Freres was used.

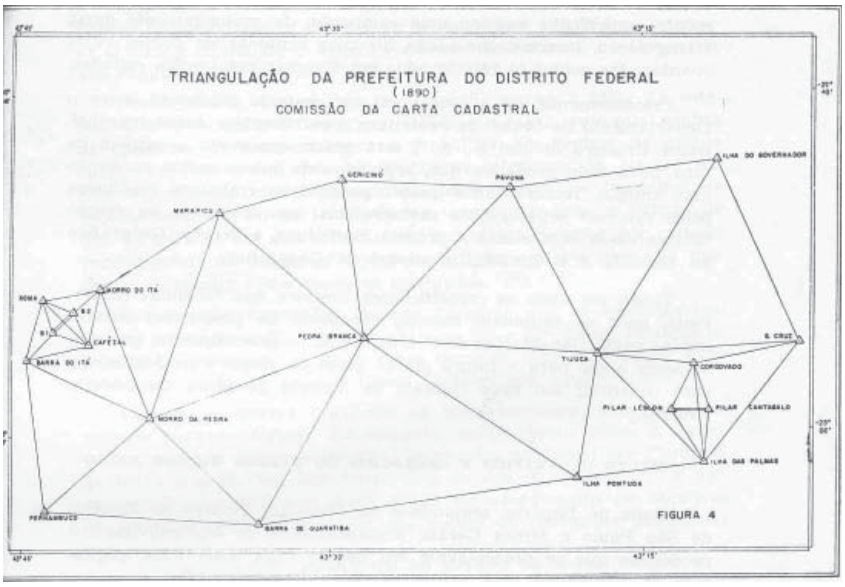

Fig. 9 - Triangulation of the Neutral Municipal District (Rio de Janeiro).

All first order vertexes were built in the land with masonry pillars and iron towers. The ellipsoid initially adopted was Bessel 1841 ellipsoid. At the end of the works, it was changed to the Clarke ellipsoid from 1866.

The initial project planned to assemble an astronomical observatory in Santa Cruz, providing calculus to the initials geographical coordinates and the fundamental starting azimuth of the network, as well as, the construction of a tidal station in Sepetiba bay.

6. CONCLUSIONS

With this simplified overview of the Cartography and of its own history, during the Empire period, it can be observed that even without a great cartographic production and the support that geodetic needs, lots of works were made in spite of the Empire´s difficulties.

Practically, all the works served as support for the ones that were developed in the Republic, beginning with the Commission of the General Chart of Brazil, in 1903, and being reinforced the need of a geodetic triangulation network to allow the necessary mapping works of the entire territory.

Eminent geographers and cartographers left their names marked in the History of Brazilian Cartography. Names as, Ricardo Franco de Almeida Serra, Colonel; Conrado Jacob de Niemeyer, Colonel; Generals José de Andréa Souza Soares, Baron de Caçapava and Pedro de Alcântara Bellegarde; Baron Duarte de Ponte Ribeiro; Marshall Beaurepaire Rohan, among others, will be reminded always as those who worked for the implantation of the Scientific Cartography in Brazil.

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