

**THE BEGINNINGS OF THE PROFESSIONALIZATION IN MATHEMATICS IN BRAZIL
STARTING FROM THE 19TH CENTURY**

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Abstract

This talk I will discuss the development of mathematical investigation after the creation of the Royal Military Academy in 1810. In 1842, the first doctoral program in mathematics was established. It will be also discussed the creation of the first engineering (polytechnic) schools in the 19th century, the foundation of the Brazilian Academy of Sciences in the early 20th century, the creation of the first university in the country, and the consequent beginnings of the professionalization in mathematics in these institutions.

Keywords: Mathematics in Brazil, professionalization in Mathematics in Brazil

Resumo

Nesta conferência será apresentado o desenvolvimento da investigação matemática após a criação da Academia Real Militar no ano de 1810. Em 1842 foi instituído o doutorado em matemática. Também será apresentada a criação da primeira escola de engenharia no século XIX, a fundação da Academia Brasileira de Ciências no início do século XX, a criação da primeira universidade do país e conseqüentemente o início da profissionalização em matemática nestas instituições.

Palavras-chave: Matemática no Brasil, profissionalização da Matemática no Brasil

Introduction - a brief history of the colonial Period

The official history says that Brazil was discovered by accident when a Portuguese expedition to India, led by Pedro Alvares Cabral, swung too far westward in 1500. The first systematic effort to establish an organized government in Brazil was made in 1533, with the

division of territory into 15 hereditary captaincies. In 1549 the Crown sent an expedition to establish a royal government in Brazil. This year a great expedition arrived in Salvador, the first capital of the colony. This expedition included six Jesuits, the first of the regular Catholic orders in Brazil. The Jesuits and the royal government collaborated to firmly establish a centralized government and a missionary church whose primary goal was the conversion of the indigenous population. This proved to be difficult and the Jesuits began bringing "Indians" (Columbus' highly inaccurate term) to live in Jesuit controlled villages designed according to a European model. It was clear by 1570's that the Indian population was not a dependable source of labor for expanding sugar complex, thus African slaves became the primary source of labor in Brazil. By 1600 the transition to African labor in sugar plantations of coastal Brazil was complete and Brazil became the world's leading sugar producer. From 1580 to 1640 Portugal was united to Spain, and, as a part of the Spanish colonial empire, Brazil was exposed to attacks by Spain's enemies. Among these were the Dutch, who had just succeeded in establishing their independence. The Dutch captured the captaincy of Pernambuco and Johann Maurits, graaf von Nassau-Siegen, was the governor of this new possession. The development of the colonial period was the vast expansion in Brazil beyond the line of Tordesillas. This expansion contributed to the huge subcontinent of the country. Another factor of the development of the colonial period was the discovery of gold at the end of the 17th century in Minas Gerais state. African slaves from sugar plantations and directly from the gold-working regions of Africa introduced many of techniques employed by Brazilian miners. The impact of the gold mines upon the Brazilian economy was largely responsible for transferring the colony capital from Salvador to Rio de Janeiro in 1763. In 1807 Napoleon invaded Portugal. The Portuguese prince regent Dom João, afterward King Dom João VI, decided to take refuge in Brazil with his court in 1808. Until 1821 Rio de Janeiro city was the capital of the Portugal's empire. In the year 1821 Dom João VI went to Lisbon and his son Dom Pedro stayed as regent. Next year, 1822, on September 7th, he proclaimed the independence of Brazil.

Science in Colonial Brazil - The work of Jesuits

Since the discovery there was a great interest from many Europeans, scientists or not, to obtain better and detailed information of the discovered territory. There are some Scientific Chronicles, which we can find information about flora, fauna and life of the natives. Hans Staden (1525-1576), a German, after his two journeys to Brazil (1548 and 1555), wrote a report, published in 1557 in Marburg, *Warhaftige Historia und beschreibung eyner Landschaft der wilden, nackten, grimmigen Menschenfresser-Leute...* (True History and Description of a Land belonging to the wild, naked, savage, man-munching people...), a fundamental text in the history of the discovery of Brazil. This text presents us how the natives built their houses, how they hunted, how they fished and how they prepared their foods. It is a very good material for the area of the ethnohistory and specifically the ethnomathematics. Other works, which were diffused scientific elements about the country for the Europeans are: *Singularitez de la France Antarctique* (Paris-1557), from André Thevet (1502-1590); *Historia Naturalis Brasiliae* (Amsterdam-1648), from George Marcgrav (1610-1655) - from 1638 and 1643, Marcgrav wrote the manuscript

Progymnastica mathematica americana, an astronomical study and observations; *De Medicina Brasiliensi* (Amsterdam - 1648), from Willien Pies (1611-1678). The above mentioned authors were in Brazil only to research, they didn't live in the country. There were many other "scientists", which worked in the country, as a missionary or by the government for example, and stayed until the end of their lives. Some of these were interested in science and made important research during colonial period. The best and successful research at that time was made by Jesuits.

When Portuguese governor Thomé de Sousa arrived in Bahia on March 29, 1549, he was accompanied by Jesuit Manoel da Nobrega, a member of a noble family. Nobrega had five companions. The Jesuit's instructions were to convert the Indians and educate the colonists. The society remained the major religious influence in Brazil for 210 years. The Jesuits constructed the first road from Bahia to São Paulo. They opened schools and seminaries. In one of the world's most innovator experiments, they brought young orphans from Portugal in the hope they would be able to learn the Indian languages and act as translators. Some of these orphans joined the Jesuits as adults.

Meanwhile, the Jesuits accumulated libraries in Bahia, Rio de Janeiro and other Brazilian cities. They studied the Indian languages and wrote grammars and recorded details of the indigenous cultures in books. Brazil became overwhelmingly Catholic as it is to this day. In the 18th century, the Society of Jesus (Jesuits) was perceived as so powerful and dangerous that many European nations suppressed it. In 1759, Marques de Pombal, the Portuguese chief minister, ousted the Jesuits from both Portugal and Brazil.

One of the most prominent Jesuit in Brazil was Padre José de Anchieta (1534-1597). Together with Padre Manoel da Nobrega, he was the founder of the Seminar of São Paulo, it is marking the beginning of São Paulo city. In academic field, Anchieta wrote the first grammar of an indigenous language and some prose tracts on history, philosophy, and religion. His scientific contribution was a manuscript about the flora and fauna of a region near São Paulo, in the coast. This manuscript is from 1560 and it was published as a book more than two centuries later: *Epistola quamplurimarum rerum naturalium quae S. Vicentii (nunc S. Pauli) provinciam incolunt, sistens descriptionem* (Lisboa - 1799). In field of science and mathematics, we can say that the most important Jesuit in colonial period was Valentin Stanzel¹. There is not much information about his life. We know that Stanzel was born in 1621, in Olmutz, Moravia - today Czech Republic. In 1637, he goes to the Jesus' Company. Stanzel studied Theology, Mathematics and classical Astronomy at Olmutz University. Later he was mathematics teacher at the same university. He was also at Prague University as lecturer for mathematics and grammar. In the year 1655 Stanzel went to Rome, and after it to Portugal, where he worked in Elvas and Lisbon as a mathematics teacher at the Jesuits. Stanzel went to Brazil in 1663, and lived there until his death on December 19th, 1705. Besides his missionary function he was also mathematics teacher at Jesuit school in Salvador. The local of scientific production of Stanzel is divided in three places: Prague, Lisbon and Salvador². In Salvador, where he lived the greater time of his life, his main scientific work was the astronomical observation. In 1665, he wrote

¹ The Portuguese form of his name is Estancel.

² The list of his publications you can see by Nobre, Sergio. 1995.

manuscripts with the results of his observations and sent to Europe to be published in some of Europe's most important scientific periodicals of his time, such as *Acta Eruditorum Lipsiensis*, *Journal de Sçavants*, *Philosophical Transactions* and *Giornalle dei Letterati*³. A book with these manuscripts, names *Legatus Uranicus...* was published in 1683 in Prague. The observation of the comets in 1668, for example, was published in the *Giornalle dei Letterati* on September 31st, 1673. The Dutchman Christian Huygens (1629-1695) translated from the Italian magazine and published again in 1674 in the *Philosophical Transactions*. Isaac Newton (1642-1727) saw this English version of the observations of Stanzel, and quoted the results in the book 3 of his *Principia Mathematica*. This quotation is, undoubtedly, one of the most important above the Brazilian sciences in the 17th century. The quotation of Newton is in Latin language as follows:

Nam anno 1668 mart. 5 st. nov. hora septima vesp. R. P. Valentinus Estancius. Brasila agens, cometam vidit horizon proximum ad ocassum solis brumalem, capite minimo & vix conspicuo, cauda vero supra modum fulgente, ut stantes in litorre speciem ejus e mari reflexam facile cernerent. Speciem utique habetat trabis splendentis longitudine 23 graduum, aboccidente in austrum vergens, & horizonti fere parallela. Tantus autem splendor tres solum dies durabat, subinde notabiliterdecrescens: & interea decrescente splendore aucta est magnitudine cauda. Unde etiam portugallia quartan fere coeli partem (id est gradus 45) occupase dicitur, ab occidente in oriente splendore cum insigni protensa; nec tamen tota apparuit, capita semper in his regionibus infra horizontem delitescere. Ex incremento caudae & decremento splendoris manifestum est quod caput a sole recessit, eique proximum fuit sub initio, pro more cometae anni 1680⁴.

Although Valentin Stanzel is unknown in Brazil and also throughout the world, he can be considerate as one of the first mathematicians and scientists that worked in Brazil. Knowing his work, we can see that attempt in the direction of the development of science had happened since the colonial time.

³ In chronological sequence: *Giornalle dei Letterati* of 31. 09. 1673, vol. XI, pg. 134-6; *Philosophical Transactions* of 1674, S., 91; *Acta Eruditorum* year 1683 pg. 35, and 1685, pg. 235-7.; *Journal de Sçavants* of 26. 08. 1685, pg. 309-10. Camenietzki, C., Z. 1995. pg. 15.

⁴ Newton, Isaac. *Principia Mathematica*, book 3, pg. 507-508.

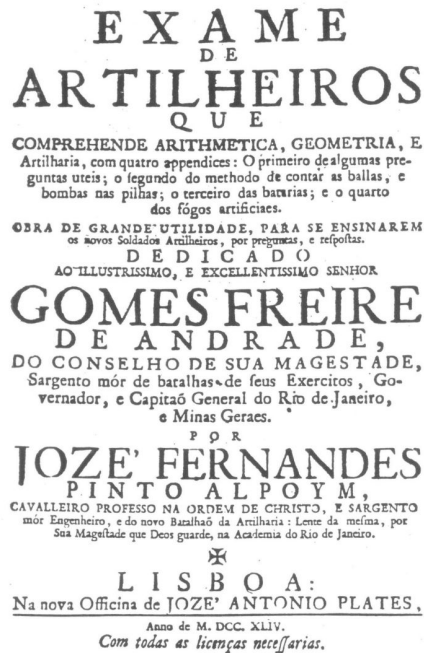


Fig. 1: Alpoim – Exame de Artilheiros - 1744

Another point to be distinguished in the history of mathematics in the Brazilian colonial time is the period that the Portuguese needed to have a better formation of their soldiers and officials. In the 17th and 18th centuries, military schools were created with the intention of giving instructions to the soldiers and officials of the safety forces of the country. For this reason, José Fernandes Pinto Alpoim (1700-1765), a military engineer, published in 1744 the first mathematics book written in Brazil, *Exame de Artilheiros* (Artillery), followed in 1748 by another work, *Exame de Bombeiros* (Bomb). Both were printed in Europe, Lisbon and Madrid, respectively, because there was no press in colonial Brazil. They are elementary books in an innovative methodology, with the objective of preparing for the admission exams to the military career, as it is suggested in the titles. Alpoim was formed at Coimbra University, as so were great part of the Brazilian intellectuality at that colonial time.

The Empire - the institutionalization of the mathematics in Brazil

The end of the colonial period in Brazil begins with the change of the capital of the Portugal's empire from Lisbon to Rio de Janeiro, when Dom João VI, and his court, went to Brazil. While colony Brazil didn't have press neither higher education institutions. Those who had resource were highlighted at Jesuit schools would do their studies in Portugal and they ended up studying at Coimbra University. With the arrival of the royal family in Brazil, in 1808, it was necessary to establish in the colony a primary infrastructure for the permanence of the royal family and of the aristocracy for a period that could be prolonged. Indeed, from Rio de Janeiro they would be able to run the businesses of the kingdom and it was established as the United Kingdom of Portugal, Brazil and Algarves in 1816. Many great institutions as the Royal Press, the Botanical Garden, the Real Museum, the Real Library, the Astronomical Observatory, Bank of Brazil and countless other were founded following a European pattern, so that the colonial metropolis could operate well. In the year of arrival of the Royal family, 1808, the first superior schools were founded: the Schools of Surgery (later Medicine) from Rio de Janeiro and Bahia; and the Academia Real Militar (Royal Military Academy) in Rio de Janeiro, this began his activities in 1811 with

engineering and mathematical course. It was the introduction of the Superior Mathematics in Brazil. The part of mathematics was divided in four years and the contents were:

- 1st year: arithmetic, algebra (even equations of third and fourth degrees), geometry, trigonometry and notions of spherical trigonometry;
- 2nd year: superior algebra, analytical geometry, differential and integral calculation;
- 3rd year: mechanics (static and dynamics), hydrostatic, hydrodynamic;
- 4th year: spherical trigonometry, optics, astronomy, geodesy

The adopted books were of Euler, Bézout, Monk, Lacroix and others, detached French texts. The first books translated into Portuguese to be used in the Course were: 1809 - *Elementos de Geometria* - Legendre; 1809 - *Elementos de Álgebra* - Euler; 1809 - *Tratado de Trigonometria* - Legendre. The translation of these books was an important factor in generating what we might call a mathematical style in Brazil.

The Military Academy was transformed at Military School of the Court in 1839 and in 1842 Doctor's degree was instituted in Mathematical Sciences. The first doctorate was granted to a youth from the province of Maranhão (northeast of the country), Joaquim Gomes de Souza (1829-1863), known as "Souzinha". Souzinha's doctoral dissertation "Modo de indagar novos astros sem auxilio das observações directas" (Way of investigating new stars without aid of the direct observations) was encouraged by the then recent discovery planet Neptune (1846). In order to write this work, he was based on the work of Laplace: *Traité de Mécanique Céleste*. Here, it must say that he used a relatively modern mathematics in comparison with the mathematics, which had been discussed in Europe. Souzinha was the first Brazilian mathematician which visited and submitted papers to European academies. He presented his results in the *Academie des Sciences de Paris* and

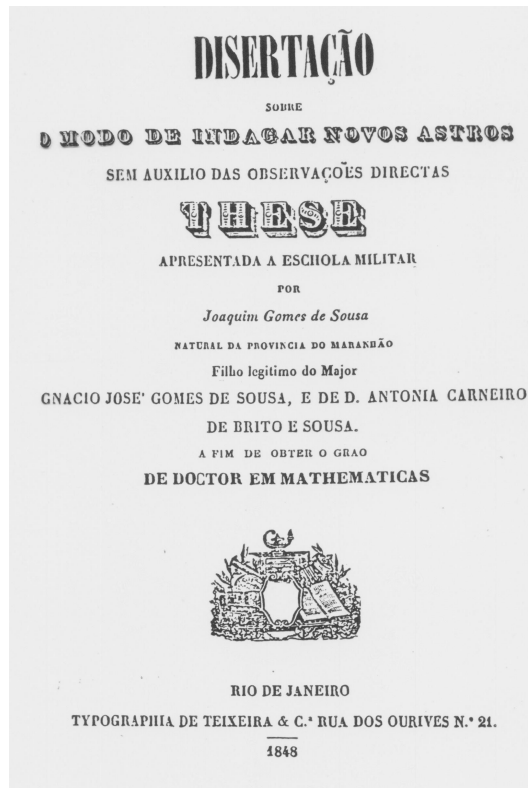


Fig. 2: Souzinha's doctoral dissertation

in the *Royal Society*. His mathematical papers were posthumously published as *Mélanges du Calcul Intégral*, as an independent book printing by Brockhaus, of Leipzig, Germany, in 1889. This work, dealing mainly with partial differential equations, is permeated by very interesting historical and philosophical remarks, revealing the familiarity of the author with the most important mathematical literature available at the time. This was possible due to the existence of private collections in Maranhão, his home state in the Northeast. The contents of these libraries, as well as the details of their acquisition, are as yet an open field of research. Gomes de Souza is a typical scholar from the half nineteenth century in South America. He is described as a “curious talent of jurist, mathematician, medical doctor and poet”.⁵

The first contributions to the mathematics, and also to the science in Brazil, as well as from Sousinha, for example, they were only individual results. At that time there was no research groups.

In the course of the 19th century, we notice a growing interest in the philosophical ideas of Auguste Comte (1798-1857) all over Latin America. His philosophical doctrine, known as Positivism, placed Mathematics in a central position. But the positivistic movement was impregnated by the demands of building up the ideological framework of the new countries. This was a major concern of the emerging political elites. These ideas were influential in Mathematics and the Sciences in general, particularly in Brazil⁶

The Republic - The first university and research centers

At the end of the 19th century, with the beginning of the republic, Brazil was influenced very much of the positivism thoughts. For the mathematicians in Brazil the mathematical works of August Comte also a big role played. The books of Comte were translated into Portuguese and were very popular by the scientists. They were approximately like one Bible for the mathematicians in Brazil. At the time, many mathematical textbooks were written and most followed the thoughts of the positivism. A little time later started a big dispute between the supporters and the opponents of Comtes thought in the area of the mathematics. The positivism is an extensive research-topic for the history of the mathematics in Brazil.

At the beginnings of the 20th century, the modernization of the scientific institutions began in Brazil. The first famous mathematicians of the country were from the college for engineering, in Rio de Janeiro city: Otto de Alencar Silva (1874-1912), Manuel Amoroso Costa (1885-1928) and Theodoro Augusto Ramos (1895-1935).

Otto de Alencar Silva was a strict opponent of the positivism. His main-work was in the area of the analysis and he introduced the mathematical work of Felix Klein in the country.

Amoroso Costa established the Brazilian academy for science, and had closes contacts with Émile Borel. After recommendation of Borel, Amoroso Costa was guest at Sourbone University in the year 1928. Due to his intercession, famous scientists, like

⁵ See D'Ambrosio, Ubiratan. 1998.

⁶ See work of Silva, Circe M. S. da. 1999.

Émilie Borel (1922), Jacques Hadamard (1924), Albert Einstein (1925), Marie Curie (1926) and others, visited Brazil.



Fig. 3: Otto de Alencar Silva



Fig. 4: Amoroso Costa



Fig. 5: Theodoro Ramos

Theodoro Ramos had his promotion on superior analysis in the college for engineering, in Rio de Janeiro, but he spent great part of his life at the polytechnic school in São Paulo, where he introduced modern mathematical topics for the study. Theodoro Ramos was also guest at Sourbone University and the results of his lectures was published as book “Leçons sur le Calcul Vectoriel” by the Librarie Scientifique Albert Blanchard.

With the foundation of the first university in Brazil, in 1933, São Paulo University, Theodoro Ramos was responsible for the employment of some scientists from foreign countries in order to reinforce the teachers of the university. To the philosophical faculty came for the chair of physics Gleb Wataghin (1899-1986), student of Enrico Fermi, and for chair of mathematics Luigi Fantappiè (1901-1956), student of Vito Volterra, all two from Italy. Later, after recommendation of Fantappiè, another Italian adopted the chair of analysis - Giacomo Albanese came from Palermo and was student of Ulisses Dini and Francesco Severi. *This group established the so-called „Italian-school” at the faculty.*

Fantappiè worked in functional analysis and Albanese in the algebraic geometry. The first students of Fantappiè and Albanese enforced the mathematical research at the university: Candido Lima da Silva Dias, Domingos Pisanelli and Omar Catunda (functional analysis), Benedito Castrucci (analytic geometry) and Edson Farah (superior analysis). Due to the beginning of the 2nd World war, the Italians came back to Italy, but Gleb Wataghin, Jew, remained and later received the Brazilian citizenship. It is known that Fantappiè was engaged in the fascist movement high and that he lost to fight on the side of the Italian government to Europe.

After War, even many other famous scientists came to São Paulo University. For mathematics, first was Andre Weil, then Jean Dieudonné, that worked both at the philosophical faculty almost 3 years. Later came Oscar Zariski, Jean Delsarte and

Alexander Grothendieck, but they were employed only short time at university. *This group established the so-called „French-school” at the faculty.*

Weil was employed on the chair for higher analysis. His expression about the faculty was written in his biography: *My predecessor Albanese had been a respectable expert in the area of the geometry and had been collected an exceptionally good library, above all in the area of the algebraic geometry, for the faculty specially.*



Fig. 6: André Weil



Fig. 7: Jean Dieudonné

André Weil established an important mathematical research-group at São Paulo University and his students played a very important role in the mathematical research-area in the second half of the 20th Century. With great influence of Andre Weil, the first mathematical society of Brazil was founded in 1946 –the mathematical society of São Paulo. Both, Weil and Dieudonné, gave lectures of high mathematics at the university, and these lectures were written down by some student on Portuguese and later were published society by the Sao Paulo’s society. 1947 Weil went to Chicago, but for many years, he remained in the close contact with his Brazilian students.

In the fifties, with the foundation of the „Conselho Nacional de Pesquisas“ (National Research Council of Brazil), the first Brazilians Mathematicians went to the USA to take their graduate studies. Professors of the Mathematical Faculty at São Paulo University also went to USA and Europe to take their pos-graduate studies, for example Omar Catunda to Princeton, USA, Cândido Lima da Silva Dias to Harvard, USA, Luiz Henrique Jacy Monteiro to Harvard, USA, Chaim Samuel Hönig to Paris and Carlos

Benjamin de Lyra to Paris. As they return, news mathematical research groups were founded at São Paulo University.

Because of the political problems in Spain and Portugal, many scientists fled to Latin America, above all to Brazil and Argentina. Therefore the Portuguese to Brazil and the Spaniards to Argentina. Among the Portuguese mathematicians, Antonio Aniceto Monteiro was the most famous. Student of Maurice Fréchet, Monteiro was founder of the society of mathematics in Portugal and of the mathematical journals *Portugaliae Mathematica* and *Gazeta de Matemática*. Monteiro went to Rio de Janeiro 1945. In Rio de Janeiro, he worked at the national of philosophical faculty and, like Andre Weil in São Paulo, he established an important research-group on the field of the abstract algebra. Monteiro was founder of the mathematical magazine *Summa Brasiliensis Mathematicae*, who was, together with the magazine of the São Paulos mathematics society, the diffusions way of the mathematical science in Brazil. As opponents of the Salazars government in Portugal, Monteiro had also political problem in Brazil. Therefore he went, 1949, to Argentina, and from 1957 he coordinated an important mathematical center at the Universidad Nacional del Sur in Bahia Blanca.

With the foundation of the „Conselho Nacional de Pesquisas“ (National Research Council of Brazil), was created its research institutes and one of the most important is the *Instituto de Matemática Pura e Aplicada / IMPA* (Institute of Pure and Applied Mathematics) - Located in the city of Rio de Janeiro. IMPA organized in 1957 the *Primeiro Colóquio Brasileiro de Matemática* (First Brazilian Mathematics Colloquium) in the touristic resort Poços de Caldas. Approximately 50 mathematicians from Brazil, including researchers and graduate students, were invited. A few foreign lecturers were also invited. The Brazilian Mathematics colloquia would since then meet regularly, every two years for two weeks in July in Poços de Caldas.

One of the most prominent Brazilian mathematicians from Rio de Janeiro State was Leopoldo Nachbin. He graduated in Engineering in 1943 at *Escola Nacional de Engenharia da Universidade do Brasil*. In the Department of Mathematics of the *Faculdade Nacional de Filosofia da Universidade do Brasil* in Rio de Janeiro he had the opportunity of joining an academic staff to which belonged the Italian mathematicians Gabriele Mammana

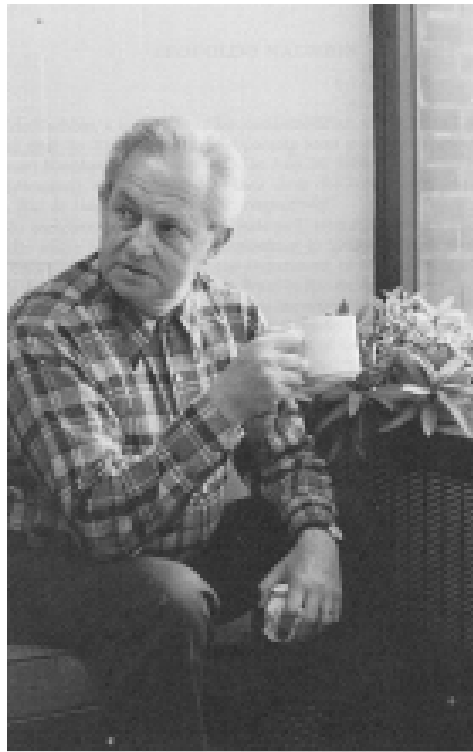


Fig. 8: Leopoldo Nachbin

(a former student of Mauro Picone) and Luigi Sobrero (a former student of Levi-Cevita). He was one of the founders of the physics and mathematics institutes, *Centro Brasileiro de Pesquisas Físicas* (CBPF) and *Instituto de Matemática Pura e Aplicada* (IMPA), both in Rio de Janeiro. In 1967, together with Heitor Gurgulino de Sousa, he also was a founder of the *Escuelas Latinoamericanas de Matemática/ELAM* (Latin American Schools of Mathematics), a mathematical event that takes place every two years throughout Latin America.

An overview of current development of Mathematics in Latin America results from the investigation about the study of the *Colóquios Brasileiros de Matemática* and of the *Escuelas Latinoamericanas de Matemática*. Probably IMPA has been the most influential institution in the development of Mathematics in Latin America since the fifties. Brazilian Colloquia of Mathematics, later to be also followed by the Latin American Schools of Mathematics, were very important factors in consolidating Mathematics in Latin America. I believe a research project focused about this would be a most relevant contribution to the history of mathematics in Latin America.

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