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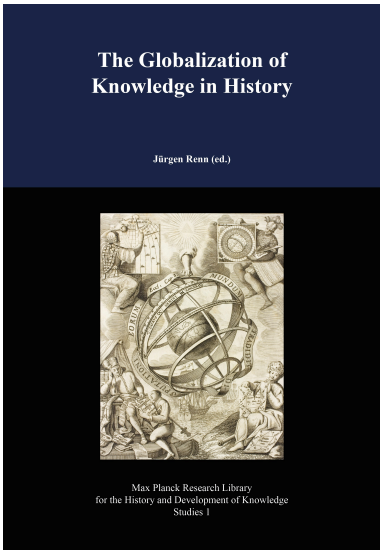

In: Jürgen Renn (ed.): *The Globalization of Knowledge in History*
Online version at http://edition-open-access.de/studies/1/

ISBN 9783844222388
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Printed and distributed by:
Neopubli GmbH, Berlin
http://www.epubli.de/shop/buch/17018

The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the Internet at http://dnb.d-nb.de

Chapter 18
The Introduction of the European University System in Brazil

Oscar Abdounur and Adriana Cesar de Mattos

18.1 Introduction

This chapter reviews the introduction of the European university system in Brazil, focusing on the foundation and institutional history the University of São Paulo (USP). In particular, it will analyze the contemporary dispute over the teaching of integral and differential calculus. The general curriculum taught at USP was originally conceived to be introduced by European scholars, as it was believed that in this way the university spirit would be transmitted and established. In particular, the Italian mathematician Luigi Fantappiè (1901–1956) played an important role in the establishment of the calculus curriculum, both in the Faculty of Philosophy, Science and Language (FFLC) of the new university and at the Polytechnic School of São Paulo.

The Brazilian universities were founded astonishingly late. From colonial and imperial times up until the republican period of the early twentieth century, Brazil for a number of reasons in fact continued to resist the adoption of a university system. Unlike the Latin American countries that had been colonized by Spain, Brazil's first university was founded only in 1934 in the context of the defeat of the state of São Paulo in the Constitutionalist Revolution of 1932 against the central government of Getúlio Dornelles Vargas (1882–1954). Vargas was leader of the Revolution of 1930, which ended the old Republic, and from 1930 to 1945 was president of the Republic of Brazil.

At the center of this case study is the dispute between the USP University Council and the Collegium of the Polytechnic School over the Chair of Complements of Analytical Geometry, Elements of Nomography and Differential and Integral Calculus. In this dispute, the ongoing resistance to the founding of the university and the general context of the arrival of the European scholars become evident. More specifically, it will become clear that a principal reason for this dispute was a disagreement about the epistemological context of calculus instruction for engineers. This resulted in a specific approach being established in the early 1930s that emphasized axiomatic rigor.

The very idea of a university met with singular resistance in Brazil (Teixeira 1989). In colonial times, Portugal from as early as the sixteenth century had refused to allow the Jesuits to introduce a university to the colony. Since the

time of José Bonifácio de Andrade Silva (1763–1838) and his struggle for Brazilian independence in the early 1820s, for over sixty years many projects for establishing universities had been proposed, but none of them were successful.

The situation did not improve even after the formation of the Republic in 1889. Resistance to the creation of a university in Brazil in fact had roots going back to the colonial period. Portugal's relations to its colonies followed a centralized model (Schwartzman 1979). This centralized model explains to some extent the strong contrast between the stable institutionalization of the Brazilian government during its independence process and what occurred in most other Latin American countries. Brazil's independence was atypical inasmuch as the other countries experienced wars and discontinuity of governments during their independence, whereas in Brazil there was no considerable turmoil during the passage from the colonial to the imperial period. This centralized tendency also explains why, contrary to popular belief, Brazil never had a Catholic church with indisputable authority and control, though the close relationships in Portugal between Church and State were transferred to the Brazilian colony and continued to exist in the Brazilian empire (Schwartzman 1979).

The following is based on the discussion in (Souza-Campos 1954) of the Brazilian education and scientific community up to the early 1950s. In addition, we have consulted the annual reports of the USP and Polytechnic School which comprise academic reports on seminars, conferences, talks and other documents mentioning the names of scholars who are today considered key players by historians of science in Brazil. We have furthermore consulted the minutes of the Polytechnic School Collegium and the University Council, which also contain substantial resources.

18.2 The Prehistory of the Creation of Universities in Brazil

In Brazil, both in colonial and in imperial times, government powers were able to resist or hinder the creation of a university, at least during the period when the government was strong enough. In most other Latin American countries, universities were founded much earlier during the Spanish colonial times, such as the National University of San Marcos in Lima, Peru (1551), Santo Tomas de Aquino University in Santo Domingo (1538) and the National University of Cordoba in Argentina (1613). In Brazil, the university made its first appearance only in 1934, that is, almost forty years after the proclamation of the republican regime in 1889.

The first constitution of the Brazilian Republic of 1891 was favorable to the creation of a university. Nevertheless, the initial period of the Republic experienced a strengthening of the anti-university tendencies. These were due to a preference for a pragmatic and positivist turn of higher education supposedly more suited to an ex-colony, emphasizing engineering, mining and agronomy. In a similar vein, humanities courses were considered to be futile and outdated since they seemed to be attached to the ecclesiastical model of the University of Coim-

bra.[1] Although the Brazilian positivists had taken an active role in the republican movement, they were against the implantation of a university system in Brazil and contributed to preventing its establishment. The positivist movement in Brazil originated around 1870 in the military. Positivist ideas were disseminated among the Brazilian soldiers who were influenced by Argentinian and Uruguayan soldiers during the Paraguayan war (1864–1870). Remarkably, although the positivist movement was representative of the republican movement in Brazil, some key ideas written into the first Brazilian constitution, such as the idea of creating university systems, were not shaped by them.

The text of the Brazilian constitution in fact supported liberal ideas whose essential political issues were in accordance with the political principles of the United States. A crucial characteristic of this text was the autonomy it conferred to the states of Brazil, for example, the Brazilian constitution equipped the new republic with a decentralized political model. A naive understanding of the institutionalization of the democratic republic could lead to the assumption that once this new political regime came into force, the pro-university faction would become strong enough to carry out the implementation of the university system. However, it took another forty years before this undertaking was actually realized, not least because of the political presence within the new regime of the Brazilian positivists.

At the beginning of the twentieth century, there was an increase in the number of vocational schools in Brazil, such as schools of engineering, agriculture and so forth. In 1900 there were thirteen such schools in the whole country: by 1920 the number had risen to thirty-four and by 1930 there were eighty-six. According to Sampaio (1991), this increase brought about the establishment of technical teaching with a scientific base, which depended on the development of a specifically scientific institution. This process contributed to the return of discussions about the implementation of the institution of university in Brazil.

The 1920s and 1930s also saw the emergence of scientific and artistic movements in Brazil, which strengthened the discussions in favor of the creation of a university. According to Schwartzman (1979), in 1922 the "Semana da Arte Moderna" in São Paulo enabled Brazil to produce its own art and therefore facilitated greater contact with the most original artistic movements of Europe. Also in the 1920s, the Academia Brasileira de Letras (Brazilian Academy of Letters) and the Associação Brasileira de Educação (Brazilian Association of Education) grasped the spirit of renewal of Brazilian science and education, initiating a strong movement to expand and modernize the educational system of Brazil at all levels. The Academia Brasileira de Ciências (Brazilian Academy of Science), created in 1917, encouraged publications in the journal *Revista Brasileira de Ciências* and promoted exchange with foreign scientists such as Émile Borel, Emil Grey, Henri Abraham, Henry Piéron, Albert Einstein, Paul Janet, Émile Marchouy and George Dumas, who visited Brazil in the 1920s.[2]

[1] See, also for the following, the discussion in (Sampaio 1991).
[2] See (Schwartzman 1979). See also (Kennefick 2012; Tiomno Tolmasquim 2012).

The Academia Brasileira de Letras is a Brazilian literary society founded at the end of the nineteenth century by a group of forty writers and poets inspired by the Académie Française. It is concerned with the national language of Brazil, Portuguese, and as well with Brazilian literature. The Academy is considered to be the most prestigious institution and authority in Brazil dedicated to the Portuguese language. The Associação Brasileira de Educação was founded in 1924. It encouraged the Movimento Reformador da Educação Pública (Reform Movement for Public Education), which demanded free public education. One of the most important leaders of this movement, the teacher, educator and Brazilian sociologist Fernando de Azevedo (1894–1974), wrote the manifesto of the pioneers of the new education movement in 1932. Its purpose was the reformulation of educational politics, comprising both basic and higher education. The former supported the democratization of education whereas the latter strongly supported the creation of a university in Brazil. Finally, the Academia Brasileira de Ciências was founded in 1916 in Rio de Janeiro and aimed to sponsor and disseminate science production in Brazil.

From 1927, a number of studies and initiatives were dedicated to secondary education and to the question of a Brazilian university. They were supported by the newspapers *O Estado de São Paulo* and *Jornal do Comércio*. Members of a commission established by the Associação Brasileira de Educação visited São Paulo, Bahia and the Minas Gerais states, and the section responsible for technical and higher education gathered the opinions of experts and professionals on a number of themes. These included the most suitable university model for Brazil, the question of whether research institutions should be included in the universities, which teaching methods should be used, as well as questions related to the professional status of university lecturers (Souza-Campos 1954). Between 1927 and 1929, a series of national conferences on education took place which dealt with themes such as the relationships between the universities and scientific research, the meaning of "university" and the problems in defining its role. Participants included prominemt Brazilian intellectuals such as Amoroso Costa, Tobias Moscoso and Theodoro Augusto Ramos (1895–1935). The main ideas underlying these conferences involved the separation of professional learning and scientific activities, the notion of free investigation and the concept of university autonomy (Schwartzman 1979). The ideal of creating a university in Brazil was based on the belief that the production and dissemination of knowledge through universities was crucial to a nation of global import (Souza-Campos 1954).

The first educational reform with national character was established in 1931 by the former minister of health and education Francisco Campos during the federal government of Getúlio Vargas. It established a layered curriculum with compulsory attendence and teaching at two levels: the first fundamental level would take five years and the additional level would take two years. The reform also required qualification at both of these levels in order to enter higher education. The educational reform of Francisco Campos was clearly orientated toward paralyzing

the pro-university movement. The pro-university movement was supported instead by organized and autonomous scientific communities, as well as by the active sectors of the Academia Brasileira de Ciências and especially by liberal members of the Associação Brasileira de Educação (Schwartzman 1979).

At least two models can be identified that were considered as options in the dispute about what kind of university Brazil would adopt: the liberal model proposed by intellectuals linked to the Academia Brasileira de Ciências, and the model proposed by Francisco Campos's education reform. Despite the fact that the first university in Brazil, the USP, was based on the liberal model, from 1937 it was Francisco Campos's concept of a national university within a centralized system that predominated. Despite this outcome, the USP became the main academic institution in Brazil.

18.3 The Constitutionalist Revolution of 1932

Before we discuss in detail the creation of the USP we will first review the Constitutionalist Revolution which provides the main historical context for the creation of the first university in Brazil. The main political figure of this period was Getúlio Vargas, president of Brazil, first as dictator from 1930 to 1945, and then in a democratically elected term from 1951 until his suicide in 1954. His government was marked by nationalism, industrialization, political centralization and populism. Vargas widely supported workers' rights and was an anti-communist. In the context of the impact of the Great Depression on the Brazilian economy, Vargas came to power through a coup d'état in the Revolution of 1930, which marked the end of Brazil's oligarchic Old Republic (1889–1930). Regional leadership supported by the Armed Forces who were dissatisfied with São Paulo's political dominance backed Vargas, the defeated candidate in an electoral process that had been denounced as fraudulent, as was often the case in the Old Republic. Vargas successfully influenced the next presidential election and instituted an authoritarian regime in 1937 known as Estado Novo (New State), prolonging his hold on power. He transformed Brazil from an agricultural to an industrialized country, protecting domestic industries and sponsoring the necessary infrastructure. With the global rise of democracy in the aftermath of World War II, Vargas agreed to cede power in free elections, thus ending the dictatorship of the Vargas Era.

During the Constitutionalist Revolution of 1932, also known as the Paulista War, the population of the state of São Paulo rose up against the central government of Getúlio Vargas in fighting that lasted from 9 July to 4 October. The movement was triggered by local dissatisfaction with Vargas's disrespect of the autonomy of Brazilian states and demanded a new constitution for Brazil. Although the state of São Paulo was defeated, Vargas granted some of the main claims of the revolutionaries, such as the appointment of an elected non-military state governor and the decree for a new constitution in 1934. This new constitution, however, lasted only for a short period, since in 1937 Vargas closed the

National Congress and created another constitution that established the authoritarian regime, known as "Estado Novo." The Constitutionalist Revolution was the first major revolt against the government of Vargas and the last major armed conflict in the history of Brazil.

The revolution had been supported by São Paulo's bourgeoisie and demanded a democratic constitution for the republic of Brazil, as well as the administrative independence of the state of São Paulo. It had no longer been possible to reconcile the political elite of this state with Vargas's central government. Although the financial crises in São Paulo during this period may have played a role, the roots of discontent in this state stemmed mainly from the resentment and injured pride of its people (Hilton 1982, 28). Regarding the relative degree of autonomy that the states enjoyed before the 1930s, the Constitutionalist Revolution can be seen as a final echo of the old Republic. Traditional groups all aimed to regain control of state administration. This aim was much stronger than the antagonisms that divided the republicans and democratics and sufficed to unite them against the centralized regime of Vargas (Hilton 1982, 329). A new constitution would thus provide a way to regain the autonomy of the state. In the end, the inevitability of armed conflict derived from the fact that Vargas in 1930 did not hand over state leadership to a Paulista, that is, to a native of the state of São Paulo, who had been chosen by its people.

In May 1933, after the defeat of the revolutionaries, Armando de Salles Oliveira (1887–1945) was elected governor of São Paulo as part of a compromise between São Paulo and the central government. Had Vargas in November 1930 handed over the state of São Paulo to a prominent member of the democratic party linked to the cause of the Revolution, then the country would probably not have entered into civil war in July 1932 (Hilton 1982). More generally, after the Revolution Vargas conceded many of the demands that had caused unrest in 1930.

18.4 The Creation of the USP in the Context of the Constitutionalist Revolution of 1932

The creation of the USP resulted from Getúlio Vargas's acceptance of Armando Salles de Oliveira as leader of the government of São Paulo in the final negotiations with the leaders of the Revolution (Hilton 1982). The university was created by official decree of the government of São Paulo on 25 January 1934. It was based on the liberal model, which was not the model proposed by the central government so tension between both institutions was inevitable. Several attempts to found universities in Brazil had been made before the creation of the USP, many of which remained mere concepts or paper decrees that never actually materialized. At the University of Rio de Janeiro, for example, the institutions of higher education were not under the administrative control of the university. In contrast, in the case of the USP, the higher education institutions involved did not retain their autonomy. The creation of the USP in 1934 can be considered as the most im-

portant undertaking in the history of science and education in Brazil. Its creation and development differed considerably from that of the other universities in Brazil (Schwartzman 1979).

The creation of the USP constituted a political, marketing and epistemological endeavor by a number of figures: the governor of São Paulo, Armando de Salles Oliveira; the owner of the newspaper *O Estado de São Paulo* Julio César Ferreira de Mesquita Filho (1892–1969); and by other Brazilian intellectuals. Mesquita Filho first studied in Europe, returning to Brazil to attend the School of Law of São Paulo, Largo de São Francisco. He began as a journalist in the evening edition of the *State*. Exiled for the first time after the defeat of the Constitutionalist Revolution, Mesquita Filho returned to São Paulo to create, together with de Salles, the USP. Mesquita Filho believed a university could provide Brazil with a new political and cultural elite. He had been one of the leaders of the Revolution and was convinced that the people of the state of São Paulo should be prepared to fight to defend their political rights (Hilton 1982). While not all of the people were similarly motivated, they were all convinced that to end the problems related to the hostility of the revolutionary regime installed by Vargas in 1930, sooner or later it would be necessary to take up arms. Another of the intellectuals involved in the creation of the university, Paulo Alfeu Junqueira Duarte (1899–1984), participated as leader of one of the more active clandestine groups, the so-called "núcleos de ação." Indeed, some civilians and military figures in Sao Paulo had been conspiring ever since the failed uprising in April 1931. Duarte was a biographer, poet and journalist. He was close to General Isidore, who by mid-1931 had secretly mobilized army officers. He also took part in the Constitutionalist Revolution and later held the Chair of Prehistory at the USP (Hilton 1982, 41; Silva 1997).

In 1934 Brazil was also entering the Industrial Revolution. The Constitutionalist Revolution had revealed the weaknesses of the military industries in Brazil (Hilton 1982). The delays and other difficulties experienced in attempts to buy materials abroad revealed the danger of external dependency. This led to a systematic effort in the post-war period to stimulate civil industries to contribute to the military. The main target in this move towards military autonomy was the industry of São Paulo, which had faced many difficult situations during the three dramatic months of the Constitutionalist Revolution.

In São Paulo, the group involved in the movement for the creation of a university was constituted by Theodoro Ramos, an engineer from the Polytechnic School, Julio de Mesquita Filho, Fernando de Azevedo, director of the Instrução Pública do Estado de São Paulo (Public Training Center for the State of São Paulo) and Paulo Duarte. Armando de Salles Oliveira put these names forward for the organizing committee charged with establishing the USP. Mesquita Filho was the president of this committee and Ramos charged with bringing European scholars to Brazil. Still in this context, an important undertaking assumed by Mesquita Filho and Duarte, together with Fernando de Azevedo was to establish the Faculty for Philosophy, Sciences and Languages which was to integrate all

fields of knowledge and become a prestigious center for basic scientific research (Silva 1997). Several factors are responsible for the success of the USP. One of them is that the university inherited prestige from the School of Medicine, the School of Law and the Polytechnic School, all of which were integrated during its creation. Another important factor was the role of the Faculty of Philosophy, Sciences and Language, which did not come into being until the foundation of the USP.

18.5 The International Perspective in the Creation of the USP

Julio de Mesquita Filho affirmed in 1937 that only a radical reform of the educational apparatus in the country and the instauration of a strong educational policy could avoid chaos in Brazil. The goal was to prepare an "intellectual elite," who would lead Brazilian society to progress, happiness and freedom. Comparing the situation of Brazil with that of other countries that had suffered a major defeat, Mesquita Filho commented:

> At the end of the Revolution of 1932, we had the feeling that destiny would have put São Paulo in the same condition as Germany after Jena, Japan after the bombing by the North American navy, and France after Sedan. The history of these countries would suggest the medicines for our evils. We had experienced the terrible adventures provoked, on the one hand, by the ignorance and incompetence of those who before 1930 had decided on the destiny of our state and of our nation, and on the other hand, by the emptiness and the pretension of the revolution of October 1930. Four years of close contact with the leaders of the two tendencies convinced us that the problem of Brazil was mainly a question of culture. Thus is the importance of our university and also of the Faculty of Sciences and Letters (FFCL).[3]

The new university would be public and free of religious influence; it would be an integrated institution and not a group of isolated schools. At its center would be the Faculty of Philosophy, Sciences and Language, with lectures given by Europeans. Research activities would be led by a full-time team working with the most modern forms of science. Practical work would be left to the professional schools. The university would have administrative and academic autonomy and create a new elite, who would assume the leadership of the country and make São Paulo a leading state in the federation (Schwartzman 1979).

According to Teixeira (1968), in the 1930s Brazilian intellectuals and politicians believed that the creation of a faculty for philosophy, sciences and language would mean the inclusion of disciplines not necessarily associated with a professional vocation. The main purpose of the USP was to offer broad instruction

[3]This is part of the speech delivered by de Mesquita Filho on the occasion of the first students' graduation from the FFCL in 1937, see (Mesquita Filho 1939).

comprising courses on scientific subjects, literature, arts, philosophy and other subjects. In order to succeed in creating a university with such features, Brazilian intellectuals and politicians believed it was necessary to bring in delegations of European scholars, whose experience would encourage the development of a university spirit among the students.

In 1934 Theodoro Augusto Ramos was commissioned by the governor of São Paulo, Armando de Salles Oliveira, to head a delegation to the academies of Europe to hire researchers for the newly created Faculty of Philosophy, Science and Languages at USP. Ramos studied civil engineering at the Polytechnic School of Rio de Janeiro (1917) before obtaining his Ph.D. in physics and mathematics. He was then elected member of the Brazilian Society of Sciences (1918) and appointed Chair of the Polytechnic School of São Paulo (1922). The delegation to Europe also comprised the faculty chairs Georges Dumas, Paul Rivet (1876–1958) and Pierre-Marie-Felix Janet (1859–1947). Rivet was a French ethnologist, and Janet a French neurologist and psychologist.

Around 1934 many Brazilian intellectuals were influenced by Europe and America, whether they had studied at foreign universities or not. For example, Cândido Lima da Silva Dias (1913–1998) was influenced by the famous group of French mathematicians around Nicolas Bourbaki. He became the first director of the Institute of Mathematics and Statistics, IME/USP (Silva Dias 1994). He began his studies at the Ecole Polytechnique in 1932, but moved to the newly created subsection of mathematics at USP in 1934. His first academic paper in 1941 on the theory of analytic functions inspired him to pursue a teaching career, to which he devoted himself for fifty-four years. From 1948 to 1949 he went to the United States, more specifically to Harvard, Princeton and Chicago, the three main centers of mathematics at that time. He dedicated his life to stimulating scientific research in mathematics and to the training of new researchers, as well as the dissemination and improvement of mathematical culture in the country.

Although the theoretical knowledge of European scholars was not necessarily the same as that of Brazilian scholars, all of these intellectuals shared the ideology of a university based on "general culture," as manifested in the Faculty of Philosophy, Sciences and Language. Naturally, Armando de Salles Oliveira and Julio de Mesquita Filho expected European scholars to support this ideology and worked to instill this in their Brazilian students. According to Petijean, the organizing committee agreed not to invite Germans or Italians to the chairs of humanities in order to prevent their nationalist influence. They invited French scholars to teach "human sciences," such as sociology and history, and Italians and Germans to teach mathematics, physics and chemistry (Petijean 1996).

In 1934, Europe was economically and politically unstable, a situation that was favorable to Brazil in its foundation of the USP. Some European intellectuals were eager to leave Europe, a situation that facilitated negotiations with these scholars. Many communist intellectuals moved to the American continent, but

also nationalist intellectuals who went to spread their ideas, as was the case with Fantappiè (Petijean 1996).

18.6 The Internal Structure of the USP and the Controversial Status of Mathematics

As mentioned above, the creation of the USP in 1934 led to a loss of autonomy for the institutions of higher education in the state of São Paulo. The directors of the academic institutions were then appointed by the governer of São Paulo, Armando de Salles Oliveira. The consequence of this loss of autonomy was the enforcement of ideals that did not correspond to the tradition of the independent and vocational schools, such as the schools of medicine, law and of polytechnic engineering, which had been founded during the times of the empire (Teixeira 1968).

The governer de Salles appointed the rector as well as the directors of the institutions of higher education, including the director of the Polytechnic School. The engineer Fonseca Telles was appointed director by the government in absence of the Polytechnic School Collegium (USP 1935). The Polytechnic School lost its self-administration, evidenced by the fact that the new director oversaw the school's supervisory body (USP 1935).

The case of the Polytechnic illustrates the controversial status that the introduction of European ideals had for the university. The ideal of the university based on the Faculty of Philosophy as integrating all areas was evidently not shared by everyone. That a mathematician rather than an engineer should occupy the chair of mathematics at this school was the expression of the idea that subjects of "general culture" should be taught by lecturers of the Faculty of Philosophy, or more precisely, the Faculty of Philosophy, Science and Language. For the engineers of the Polytechnic School, however, a mathematician was unacceptable, since a mathematician was not considered capable of teaching the approach that engineers found necessary for their purposes (USP 1935). A mathematician would present this knowledge, prioritizing axiomatic rigor, at the expense of immediate applications, an approach typical of those who graduated in courses of "general culture" (USP 1935).

The majority of the advisers of the Polytechnic School Collegium did not accept the proposal to appoint the mathematician Luigi Fantappiè, however, arguing that mathematics for engineers should be taught by engineers (USP 1935). Fantappiè was born in Viterbo, Italy. He began his studies at the Scuola Normale Superiore in Pisa in 1918 and graduated with a doctorate in 1922. After studying from 1922 to 1924 at various universities abroad, he worked in Rome and Cagliari. In 1926 he was appointed Chair of Algebraic Analysis at the University of Florence; he then moved to Palermo to take up the Chair of Infinitesimal Analysis. He was invited by Theodoro Ramos to help set up the mathematics curriculum at the USP and also to assume the Chair of Complements of Analytical Geometry,

Elements of Nomography and Differential and Integral Calculus at the Polytechnic School. Fantappiè returned to Italy in 1939 at the outbreak of World War II when he was offered the Chair of Higher Analysis at the University of Rome, a position he held for the rest of his life.[4] Fantappiè's appointment by Director Fonseca Telles was rejected by the Polytechnic School Collegium (USP 1935). Over a period of twenty years, this chair would be a matter of contention between those who ran the mathematics course at the FFCL and the Polytechnic School at the USP (Marafon 2001).

The examination held to fill the Chair of Complements of Analytical Geometry, Elements of Nomography and Differential and Integral Calculus took place in 1933. Even before 1934, one of the candidates, Omar Catunda, suggested there were irregularities in the exam and requested that the examination be investigated by the juridical advisor. This investigation set off a series of legal and political events that reinforced the authority of the university over the Polytechnic School. Omar Catunda was born in 1906 in Santos, Brazil. He studied at the Polytechnic School of São Paulo in 1930 and worked briefly as an engineer for the local government in Santos. In 1933 he took the examination for the Chair of Complements of Analytical Geometry, Elements of Nomography and Differential and Integral Calculus and was approved as a candidate of second rank. In 1934 he became the assistant to Luigi Fantappiè at the USP. In 1944 he took over the Chair of Analysis at the FFCL. He not only initiated many young people in the research in his field of functional analysis, but also played a central role in restructuring the teaching of mathematics analysis. In 1963, Catunda retired from the USP and assumed a position at the Federal University of Bahia, where he remained until his death in 1986.

18.7 Fantappiè and the Dispute Concerning the Chair of Calculus at the Polytechnic School

Up until 1934, to be a mathematician in Brazil meant being affiliated with a chair of mathematics at an engineering school since at that time no high-level mathematics courses existed; up until that time the teaching of mathematics was the sole responsibility of the engineering schools.

In 1934, with the creation of the USP, Italian mathematicians were invited to Brazil to collaborate in shaping the mathematics conceptions in the courses of the FFCL. In particular, as we have discussed, Fantappiè was invited to assume the mathematics chair at the Polytechnic School. This chair was established at the same time for the new USP and the old Polytechnic School, institutions represented by the University Council and the Collegium of the Polytechnic School, respectively.

Four names will be at the focus of this section, three of which will already be familiar to the reader: Fantappiè, Ramos, director of the FFCL, Omar Catunda,

[4] See http://www-history.mcs.st-and.ac.uk/Biographies/Fantappie.html.

and José Octavio Monteiro de Camargo. Camargo was a mechanical and electrical engineer who graduated from the Polytechnic School in 1922. Since he had ranked first, he was entitled to a scholarship to study abroad. While based in Brussels and Liège in Belgium, he also worked in Germany and Italy. Between 1928 and 1933 he was the Deputy Chair of Complements of Analytical Geometry and Elements of Nomography Differential and Integral Calculus at the Polytechnic School. In November 1933, he applied for the chair and was ranked in first place, but another candidate appealed the examination so that it was annulled in 1934. Camargo also appealed against this result and won the case by a decree of 18 June 1938. He became a member of the University Council in 1938 (USP 1938).

Fantappiè is regarded as one of those responsible for a change in the approach to teaching mathematics at the Polytechnic School and for how the mathematics curriculum at the FFCL was shaped. This turned out to be based on axiomatic rigor influenced in general by the Italian mathematicians, a claim commonly accepted by the historiography of the USP and presented, for instance, in interviews with the mathematicians from the FFCL, such as Cândido Lima:

> The presence of foreign teachers at the pioneer stage of the Faculty of Philosophy was crucial, important and refreshing. Fantappiè, for example, introduced in Brazil the mathematics courses, previously taught only in polytechnics and engineering schools, which had been restricted to the infinitesimal calculus. Fantappiè developed courses of an entirely different nature: group theory, continuous groups, number theory, differential forms applied to analysis, tensorial analysis. (Silva Dias 1994)

According to the interview by Cândido Lima da Silva Dias (1997), Ramos had the freedom and knowledge to choose Europeans to shape mathematics in the FFCL. Another testimony comes from Milton Vargas, born in Niterói in 1914. He studied at the Polytechnic School of São Paulo during the 1930s, graduating in 1938 as electrical engineer and in 1941 as a civil engineer. He made important contributions to the research field of ground mechanics and accepted a chair at the Polytechnic School of the USP in 1952. He received the title doctor honoris causa from the University of Rio de Janeiro and since 1988 has been emeritus doctor at the Polytechnic School of the USP, the highest honor ever granted to a lecturer at this institution. Milton Vargas emphasized the pivotal role of the new mathematics teaching:

> The success of these two basic courses: mathematics given by the Italians Luigi Fantappiè and Giacomo Albanese, and physics by the Italo-Russian Gleb Wataghin is explained by the higher didactical capacity of these excellent teachers and by the fact that they were aware that they were also teaching future engineers. The influence of this new approach to training engineers was remarkable. It occurred at precisely the time when the evolution of technology required higher mathematics and advanced physics to solve technological problems. Even today

> the engineering teaching at the Polytechnic of São Paulo cannot escape the echoes of that great revolution promoted by Fantappié, Albanese and Wataghin (Oliveira 2007, 20).

The minutes of the University Council evince no consensual opinion about Fantappiè's teaching at the Polytechnic School (USP 1935). Apart from this, the director of the Polytechnic School's decision to appoint Fantappiè to the Chair of Calculus was seen as an affront by most members of the Collegium of the Polytechnic School. This situation set off a dispute between the Collegium and the University Council, which led the Collegium to seek juridical review of the case. During the University Council meeting of 13 March 1935, the juridical advisor Abrahão Ribeiro was presented as a referee:

> [...] he recognizes the high value of the lecturer Fantappiè and thinks that to the Polytechnic School it would be more desirable to have a teacher who is purely professional and he does not see any advantage in high cultural education [general culture]. He quotes Professor Ammann from Karlsruhe to support this thesis: "In all the technical colleges, the first three or four semesters comprise mainly mathematics, mechanics, natural and economic sciences. We do not consider these to be science in themselves, as in the universities, but always from the viewpoint of their applications. For technical colleges, however, there is a great difficulty in the fact that teachers of these disciplines, most of whom come from universities, only rarely—if ever—can adapt themselves to the needs of the superior technical college. They teach in a very abstract way, without regard for technical applications. Mathematics cannot help but discourage the young students unless they can apply it on the basis of technical studies. Consequently it is an urgent need for superior technical schools to train mathematical engineers who are encouraged by the understanding of the technical problems to reveal to the young students the necessity and beauty of this auxiliary science. One could thus achieve very different results of mathematical studies. Thus it began that chairs for mathematics were entrusted to engineers, as has already been done almost universally with regard to the chairs for mechanics." (USP 1935)

This dispute is representative of a process which, in the twentieth century, occurred at most institutions of higher education where mathematics was taught as an auxiliary science. In our case, we have seen that mathematics at the Polytechnic School even became a matter of dispute in a legal and political sense. Who would be the better lecturer, Fantappiè, the mathematician, or Camargo, the mechanical and electrical engineer? Since the fundamentals of calculus would be taught according to the teacher's approach, it was a matter of contention rather than choosing the "right" candidate.

The detailed history of the appointment was extemely intricate and litigious. According to the minutes of the Polytechnic School Collegium (USP 1935) Jorge Americano argued, based on the Polytechnic School Statute:

> Since the Chair's replacement must be established in accordance with Article 112, Fantappiè cannot be hired to this chair because he is not the Chair of Calculus as well. In this case, it is the responsibility of the Polytechnic School Collegium to appoint a substitute, and the director's responsibility to implement this resolution according to the article mentioned above.

Jorge Americano remembered the important fact that the unoccupied chair depended on appeal, which, had this turned out in Otavio Camaro's favor, would have resulted in its immediate occupation by him. The previous occupation of the chair by a foreign lecturer, in this case Fantappiè, could have resulted in an embarassing situation. The University Council, however, approved the Fantappiè for the Chair of Calculus. According to Fernando de Azevedo's argument, this case could be regarded as a case of omission for this statute. In this situation the Council decided to vote. In a vote by the Committee on Legislation and Appeals, the decision was approved against the votes of the chairs Ricardo Gaspar Jr., Octavio Teixeira Mendes and Jorge Americano (USP 1935). Gaspar Ricardo Jr., a member of the University Council, declared that the decision had not taken the Polytechnic School Collegium into account. He considered this to be an act offensive to his own prestige, asserting that he would not subordinate himself to the deliberation of the University Council and that he would appeal to the competent authorities. After expressing his opinion he left the meeting (USP 1935).

Azevedo argued that the case of the appointment of the lecturer Fantappiè to the Chair of Calculus had already been resolved since it had been collectively accepted against the vote of Lucio Martins Rodrigues. Gaspar Ricardo advocated appointing the engineer José Monteiro de Camargo to the Chair of Calculus for the sake of fairness (USP 1935). Director Fonseca Telles refuted Ricardo Gaspar's argument stating that the school had a Committee of Inspectors that would be responsible for analyzing the appointment process in due time. He also criticized the opinion of Dr. Abrahão Ribeiro. Telles argued in favor of Fantappiè:

> If the Council established the statute, who would be better than the Council to interpret the statute? According to the spirit of the statute and of its legislators, in the case of a vacant chair it was not even necessary to bring the case to the Collegium [of the Polytechnic School]. The director brought the case to the Collegium in a spirit of liberty [democratic spirit] in order to avoid being accused of acting as a dictator. Due to the appointment made [Fantappiè], it was contrary to the statutory rules and he appealed to the University Council. (USP 1935)

Azevedo criticized Gaspar Ricardo's arguments:

> With regard to the doctrine held by Gaspar Ricardo concerning practical teaching being strictly professional in the colleges [institutes of higher education], he disagrees substantially. It seems wrong to him. [...] Application is the function of theory and can only be good for the people in the context of the "general culture." He says that the issue of the abilities of Fantappiè and Monteiro de Camargo as teachers cannot be discussed by the University Council. (USP 1935)

Indeed, the Polytechnic School Collegiate was subordinated to the University Council:

> The Chancellor of the USP remarks that the Polytechnic School Collegium is obliged to accept the deliberations of the University Council and that, by law, it not only has a duty, but also the right to be represented. (USP 1935)

Azevedo proposed a special committee to try to broker the peace between the Polytechnic School Collegium and the University Council and to require the governor to solve the matter of the 1933 examination for the Chair of Calculus in which Camargo was involved. The meeting was adjourned after voting on the measure, which was defeated by six to four (USP 1935).

The appointment of Fantappiè was in agreement with the general aims of the intellectuals, politicians and journalists who favored the creation of a university involving European scholars. According to Oliveira (2007), Fantappiè personified the formalist view. The formalist movement was a major current in the mathematical community of the twentieth century. It was associated with a movement that began in the nineteenth century and is known today as the arithmetization of analysis. Oliveira (2007) suggests that the influence of Fantappiè was felt mainly in the mathematics course at the USP. After 1938 the Polytechnic School acquired the teaching status it had enjoyed before 1934, since José Monteiro de Camargo ultimately took over the Chair of Complements of Analytical Geometry, Elements of Nomography and Differential and Integral Calculus by order of the governor Adhemar Pereira de Barros (1901–1969). In other words, the final match was won by the engineer José Monteiro de Camargo in 1938. As we have seen above, he was ranked first in the 1933 examination, but this was annulled in 1934 by the juridical advisor of the USP after an appeal by Omar Catunda. Fantappiè and other European scholars, on the other hand, collaborated to create the Faculty of Philosophy, Sciences and Language, and with it to concretize the ideal of the university.

18.8 The Shift of the Mathematics Curriculum

In 1934 the official calculus curriculum of the Polytechnic School was shaped by Rodolpho Baptista de San Thiago (1870–1933), who was an engineer at the Polytechnic and Chair of Calculus until 1933 before his replacement by Luigi Fantappiè in 1934 (Oliveira 2003). He had been responsible for analytical geometry and infinitesimal calculus at the Polytechnic School since 1904. His lecture manuscripts are entitled "infinitesimal calculus" and in them he presented notions of function and continuity, in addition to explanations about the special methods of infinitesimal analysis: the method of exhaustion applied by Archimedes; Leibniz's method of the infinitesimal; Newton's method of the first and last ratios; and Lagrange's method of derivatives. The 1930 syllabus for the differential and integral method, published in the 1932 Annual Report of the Polytechnic School, shows an introduction to series, citing the convergence and expansions of the logarithm and exponential series functions. This agenda was used to introduce Lagrange's method, which appears in the second introductory topic. The methods of Newton and Leibnitz are also included in this program.[5]

This raises the question of what Fantappiè taught when he held this chair. According to Oliveira (2007), Fantappiè was responsible for a change in the foundations of the calculus course, for which he adopted the textbook by Severi (1933).[6] The way that Fantappiè taught mathematics induced a different kind of involvement in the students than the instruction by de San Thiago (Silva Dias 1994). The students of the newly established Mathematics Department and the students of the Polytechnic School were the first to benefit from this teaching.

It was the idea of limits as the foundation of calculus that characterized the change conceived by Fantappiè. Severi's book defined limits through the Weierstrass conception, i.e., using the ε-δ method. Severi's concept of the real number, built by means of Dedekind cuts (Oliveira 2007), endowed the teaching of calculus with a formalist approach. From the point of view of the history of mathematics in Brazil, the arrival of the Italians contributed to the consolidation of the axiomatic rigor as the abstract approach according to which calculus should be taught in Brazil. This approach had already been introduced by Ramos, who was responsible for the choice of mathematicians and physicists to be invited to the USP.

The concepts presented in differential and integral calculus now acquired a characterization that no longer depended on movement or time. For example, the geometrical or physical characterization of the derivative was substituted by the corresponding definition involving the limit of a function, that is: For all ε and δ exists such that, if $0 < | x - a | < \delta$ then $0 < | f(x) - L | < \varepsilon$, and continuity according to the Weierstrassean conception. In the twentieth century, infinitesimal

[5]San Thiago's syllabus *Curso de Cálculo de Rodolpho Baptista de San Thiago* (1904). Archives of the Polytechnic School of São Paulo (Oliveira 2003).

[6]For biographical details of Severi, see http://www-history.mcs.st-and.ac.uk/Biographies/Severi.html.

analysis (Robinson 1996) and calculus occupied a place only in the philosophy of mathematics. Both mathematics production and mathematics teaching saw their fundamentals dictated by axiomatic rigor.

According to Oliveira (2007) other important aspects of Severi's text include the weight given to discrete mathematics, with algebra comprising half of the text besides calculus, and the fact that historical dates are included for all subjects treated.

In San Thiago's texts the definition of the limit is as follows:

> The definition of infinitesimal analysis derives from the fact that the method of Leibniz is the one more usually accepted. Before introducing the method of Leibniz, let us give a notion of the old method, which was the foundation of differential calculus. It is called the *limit* of a quantity, a fixed quantity which a variable approaches without ever reaching it. The difference between the fixed limit and the variable can become smaller than any given quantity. If we suppose a circumference and a polygon inscribed in it, and if we always duplicate the number of sides, the polygon will approach the circumference and the latter will be the limit of the former.[7]

According to Oliveira (2007), Severi's book was adopted within a year of San Thiago's replacement by Fantappiè at the Polytechnic School and used for several years in the mathematics and physics courses of the FFCL—USP. In 1939, after writing the "The Course of Mathematical Analysis," Fantappiè returned to Italy. This text had the same theoretical foundation as Severi's book and was edited by Professor Omar Catunda, his assistant at the time. According to Silva Dias (1994) Fantappiè's lectures were given in Italian. The physicist Wataghin initially gave his lectures in Italian, and later in Portuguese.

An important role in supporting the shift of the mathematics curriculum was also played by the creation of the Mathematics Library:

> I remember well the foundation of the Mathematics Library. Fantappiè was very dedicated to this initiative. When he came from Italy, he brought many books and journal collections and donated them to the library, marking the beginning of the Mathematics Library. He also included some books from the Polytechnic School. When Fantappiè returned to Italy in 1939, our library was already appreciable and has grown ever since. As a result of the university reform of 1970, all books related to this subject were brought together into the Library of the Institute of Mathematics, consequently generating a reasonable collection if compared to the libraries of North America and Europe

[7]San Thiago's syllabus. Curso de Cálculo de Rodolpho Baptista de San Thiago (1904). Archives of the Polytechnic School of São Paulo (Oliveira 2003).

> universities. What few people know, however, is that the initial impetus for the formation of this library was given by Luigi Fantappiè. (Silva Dias 1994)

18.9 Conclusions

The conflict concerning mathematics teaching at the newly founded USP was played out on several levels: it was a conflict between different conceptions of the university itself, including its role in society and its openness to foreign influences; an institutional conflict about administrative autonomy between the Polytechnic School Council and the University Council; a political conflict in the aftermath of the Constitutionalist Revolution; a dispute concerning the didactic value of mathematical axiomatic rigor versus the merits of a more intuitive understanding of infinitesimal calculus; a struggle over the role of tradition; and the relation between fundamental and applied science, between mathematics and engineering. The conflict unfolded in terms of an intellectual dispute, of academic politics, but also decisively involved juridical litigation. In the history we have reconstructed, all of these dimensions were intertwined and thus all shaped the final outcome.

The final outcome, on the one hand, was the fact that José Monteiro de Camargo took over the Chair of Calculus in 1938, and this apparently represented a victory of tradition over modernity. From another perspective, however, the final outcome was Luigi Fantappiè's long-lasting influence on future generations of students, despite the relatively short duration of his stay in Brazil.

Both "final outcomes" were the consequence of both global and local factors and of long-term historical developments. The theme of the university had been discussed in Brazil for over four centuries. When such an institution was finally established, it followed a by then almost universally accepted model, which included the then prevailing international trends for treating certain subjects, such as mathematical axiomatic rigor to mathematics. Local resistance against this international trend involved an intellectual debate about the nature of mathematics teaching, which could have been a starting point for the development of new didactic approaches that combined practical with rigorous aspects. Instead, however, the conflict, which had been ongoing in Europe since the nineteenth century, was settled by juridical intervention and not by a new intellectual synthesis between those demanding mathematics teaching close to the intuitions of engineers and those demanding mathematics teaching that would open doors to a globalized culture of science. In other words, the Brazilian case represents neither the (short term) victory of tradition, nor the (long-term) victory of modernity, but rather a missed opportunity to negotiate local and global knowledge.

As we were able to show in this paper, the modernist approach represented by mathematical axiomatic rigor did not simply prevail (even if only temporarily) because it represented the most progressive direction in mathematics, but rather because of very specific local political circumstances. Mathematical axiomatic

rigor was adopted by Fantappiè, who was appointed by Theodoro Ramos, a member of the university's organizing committee, appointed by the president of this committee, de Mesquita, who in turn, was appointed by the govenor of the state of São Paulo, de Salles, who was elected by the people of São Paulo. This, finally, leads back to the final negotiations after the Constitutionalist Revolution.

The history of the universities in Brazil is neither connected, as it was in other countries, with overcoming ecclesiatic traditions in favor of laical education, nor with the establishment of a nation state encompassing this education. In fact, Brazil after the Proclamation of Republic had laical education as a principle. Compared with the other Latin American countries, Brazil was an economically and culturally successful nation, even though it did not yet have a university. Certainly, the idea of a university was closely associated with certain liberal ideas. The beginning of the twentieth century saw political changes in several countries throughout the American continent, which were characterized by the strengthening of the liberal movement and promotion of universities. Nevertheless, the "liberal context" was in itself not enough to actually create a university, as the several failed attempts in Brazil illustrate. Only specific favorable circumstances such as those associated with the Constitutionalist Revolution enabled the Brazilian liberal movement to finally create a university.

Was the creation of the USP thus a historical accident, happening so late that it actually no longer made a difference to the development of Brazil as a nation? To respond affirmatively to this question would mean to ignore another important context of the university's creation that we have hardly touched upon here, that of the Industrial Revolution which took place in Brazil in the 1920s. It would have been hardly possible to sustain this Industrial Revolution and attain the present state of development without the flourishing Brazilian university system which began with the creation of the University of São Paulo. But even this affirmative answer leaves other questions open for further study: what university model would best serve the specific demands of Brazil today, and was the model whose establishment under rather contingent political circumstances in the 1930s that we have reviewed in this paper really without alternatives?

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