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History of Mathematics: Mathematics in the Americas and the Far East, 1800–1940

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The meeting was organized by Ivor Grattan-Guinness (Bengeo, Herts), David E. Rowe (Mainz) and Erhard Scholz (Wuppertal), who decided to concentrate on rather neglected developments in the history of mathematics, which, however, are the subject of interesting ongoing research. The 47 participants came from 16 different countries, including 3 participants from the Far East (China), 8 from Latin America, and 6 from North America. Apart from sessions devoted to these different geographical areas, discussing both the transfer of Western mathematics and indigenous developments, two specialized sessions were devoted to foundations and applied mathematics in the USA.

Among the topics discussed, the following may be mentioned here:
— processes of transference, adaptation, and translation of "Western" mathematics;
— institutional developments and the transference of institutional models;
— indigenous traditions, mainly if not exclusively in the Far East;
— emergence of indigenous, modern traditions of research.

As expected, it was found that the actual processes of mathematical modernization in the Americas and the Far East show great divergences. They range from the existence of an indigenous mathematical tradition having little common ground with the "Western" tradition, with subsequent difficulties of translation and adaptation (in the cases of China and Japan), to the hazardous developments, due to political instability and at times cultural isolation, that hampered greatly the introduction of modern mathematics in Latin America. The talks underscored the (frequently taken for granted) social, political and cultural requirements behind the emergence of an autonomous community of mathematicians. In the general discussion, emphasis was laid upon the role of military confrontations as an immediate triggering factor for the emergence of up-to-date mathematics education. This seems to have been one of the few common factors behind the different processes of modernization.

Only in a few cases, especially the USA, was it possible to talk about actual *research* and a mathematical research community. In most of the regions covered, communities of research mathematicians were only established around the mid-20th century.

Abstracts of talks

Annick Horiuchi (Université Paris VII)
The "naturalization" of Western mathematics in Japan (1850–1890).

The analysis of the subject rested on the basic idea that the introduction of Western mathematics into Japan is a broad and complex process which requires careful examination of the gradual transformation of both the mathematical community and mathematical knowledge. The talk began by outlining the situation of Japanese mathematical knowledge and education at the dawn of the Meiji Revolution, through the particular example of the school of Hasegawa, including an analysis of the related community of mathematicians. Then, we turned to an analysis of three mathematical textbooks written during the transition period: 1) Okamoto Norigumi's *First steps into geometry* [Kika shoho] (1876); 2) Tanaku Yatoku's *Treatise of algebra* [Daisu kyokasho] (1882); 3) Kikuchi Dairoku's *Treatise of elementary geometry* (1886).
The first text shows an interest in mathematical pedagogy which can be traced back to the *Wasan* schools that Norigumi had attended before coming to Western mathematics. The second points to the fact that algebra was quite easily received in Japan because of its relationship with traditional *Wasan* mathematics. But this introduction raised a number of difficulties linked to mathematical terminology: the wealth of the legacy also hurdled the creation of a definitive terminology. The third example sheds light on a new type of discourse on mathematics developed by a mathematician trained in British universities, granting mathematics a specific role in the intellectual training of the young Japanese.

Guo Shirong (Inner Mongolian Normal University,Huhhot, China)
Chinese mathematics at the end of the 16th century: The background to the transmission of European mathematics to China.

From the mid-14th century on, mathematics in China changed greatly its research fields. By the end of the 16th century, important mathematical results of the Song and Yuan periods (960–1368) were lost or not understood. Translation of the first six books of Euclid's *Elements* in 1607 established a new period. In the present talk, the background for the transmission of Western mathematics to China is examined: an outline description of Chinese mathematics in the 16th century is given, the status of mathematics toward the end of that century is analysed, and finally the background for the transmission is discussed.
During the later Ming dynasty, the most important and popular mathematical work was the *Suan Fa Tong Zong* [Systematic treatise on arithmetic], written and published by Cheng Dawei (1533–1606) in 1592. Therefore, the book is paid particular attention, analysing its contents, textual structure, material resources, as well as its dissemination and influence. On that basis, the characteristics and tendencies of "practical mathematics" are discussed. Because of the practical characteristics and of the "decline" of mathematics in the Ming dynasty, both Jesuit missionaries like Matteo Ricci and some Chinese intellectuals, such as Xu Guangqi and Li Zhi-

zao, seized the limitations of Chinese mathematics and took advantage of them to successfully establish a reputation of advancement and exactness for Western mathematics and science.

Roger Hart (Stanford University, USA)

Translating worlds: Incommensurability and problems of existence in seventeenth-century China.

J. Gernet, in his sophisticated study of the introduction by the Jesuits of Christianity into 17th century China, adopts the philosophical theory of conceptual incommensurability between Western and Chinese thought as a basis. J.-C. Martzloff adopts linguistic incommensurability as the framework for his analysis of the translation of the *Elements* into Chinese. Both base their claims on the assertion of E. Benveniste that language structures thought, and on the assumed absence of the copula "to be" in classical Chinese. This talk first re-examined the philosophical issues of translation, relativism, incommensurability, and the copula, following arguments of Derrida, Quine, and Davidson. I analyzed how the asserted radical differences between China and the West are imagined: by Martzloff as an artifact of his translations, which purport to demonstrate the very impossibility of translating; by Gernet as a result of his selection of pairs of opposing Chinese and European viewpoints. Their framework of incommensurability renders history incomprehensible: it collapses the complex interaction of individuals and subcultures to two mutually exclusive poles, 'China' and 'the West;' the Chinese converts, belonging to neither, can only be effaced as transparent, passive translators.
In historical context, the problem for the Jesuits and the Chinese converts was not the lack of the copula, but rather debate over the existence of spirits and God. Problems in translation served as a crucial patronage strategy for the converts: by introducing ambiguities in the translation of terms such as "sovereign on high" (shangdi), they produced documents that could be read by both the Chinese court and the Jesuits as expressions of allegiance. Translation was not an obstacle to dialogue but a crucial resource; the converts were active agents. Gernet's and Martzloff's claims of a radical difference between Europe and China represent a translation of the missionaries' own claims of the radical uniqueness of Christianity into a discourse of modern secularized philosophy.

Wann-Sheng Horng (National Taiwan Normal University)

Disseminating mathematics in late nineteenth-century China: The case with Wang Kangnian and the Shi Wu Bao.

In this talk, I discuss briefly Wang Kangnian's career as a journalist and his concern about disseminating mathematics in the context of the reform movement (Wei Xin Yun Dong, 1890–1898). By then the institutionalization of mathematics was destined to consolidate thanks to the founding of new (Western-style) schools in the period: not only the Imperial College, founded in the 1860s, but also educational institutions at the primary and high-school levels, which created a job market for mathematics teachers. Even so, mathematics as rhetoric for an intellectual change, presented via the mechanism of newspaper press at the time, deserves due study simply because mathematics was still the major component of Western knowledge to which the reformists paid much attention. The features of popularized mathematics reflect in many ways how mathematical knowledge was perceived by political reform activists. Wang Kangnian (1860–1911) served as manager of the *Shi Wu Bao* Press and had an enormous correspondence with intellectuals of the time (totaling 748 persons). Upon these letters, we can reconstruct a network by which he operated as an intellectual broker for Western knowledge in general and elementary mathematical knowledge in particular. This in turn helps shed light on the relationships between the USA (main source of influences upon mathematics education at the time) and China in the case of mathematical knowledge transmitted through the institutional basis of newspaper press.

Andrea Breard (Groebenzell, France)
On mathematical terminology in the late 19th century.

Zhu Shijie's treatment of series in his *Introduction to Mathematics* [*Suanxue qimeng*, 1299] and the *Jade Mirror of Four Unknowns* [*Siyuan yujian*, 1303] is one of the most celebrated cases in the history of Chinese *Yuan* mathematics. His terminological approach to "series" was revisited in various contexts by later mathematicians and historians of mathematics, in particular during the late 19th century after rediscovery of Zhu's text. Thereby the creation of a new or extended semiotic set for finite arithmetical series during Qing times raises several questions:

1) Was there any conceptual boundary between 'symbols' and 'names'? It seems that the operational and denominative nature of Chinese characters since early times was a preliminary to the fusion of both kinds of signs.

2) Was there a difference in the development of terminology in writings continuing the Ancients and in translations from Western mathematical works? Li Shanlan's treatment of series seems to have been conducted within two different conceptual frameworks: (a) finite series [*Duo ji*] using traditional tools of triangular tables and the medieval *tian yuan* (a Japanese influence on the nomenclature?) (b) infinite series [*Ji shu*] with a syncretic symbolism for equations, interspersed with discursive algorithmic formulations.

3) What can be deduced about the absence of discursive "names" [*wu ming*] for mathematical objects (cp. the *jie suan* in the root extraction algorithm, that obtains its significance equally through its relative position)? Isn't this precisely a feature similar to the semiotics of modern algebraic symbolism?

Xu Yi-Bao (City University of New York)
The introduction of the calculus into China in the second part of the nineteenth century in social, political and cultural contexts.

In the 1850s the English missionary Alexander Wylie and the Chinese mathematician Li Shan-lan collaborated in translating a work by the U.S. mathematician Elias Loomis, *Elements of Analytic Geometry and of the Differential and Integral Calculus*, which appeared in 1859. This proved to be of considerable significance in the transmission of Western modern mathematics into China. Most calculus books written by Chinese mathematicians between 1860 and 1905 were devoted either to solving problems, elucidating difficult issues, or correcting mistakes in the translation.
Why translate a basic work on the calculus in the mid-1850s? On the one hand, Chinese intellectuals were forced to acknowledge the superiority of Western military power by the defeat in the two Opium Wars, and soon realized that Western science and mathematics were essential to China's military future. On the other, Wylie followed the example set by Matteo Ricci of seeking to convert the Chinese to Christianity by impressing them with the superiority of Western science. As for Loomis's book, it was a very popular textbook, designed for beginners, and had sold 25,000 copies by 1874.
Traditional Chinese mathematics influenced the translation of Western terminology and even of the notation. E.g., Wylie and Li rendered "differential" and "integral" by terms that can be found in Liu Hui's commentaries (ca. 263 A.D.) on the *Nine Chapters*. The selection was based on a deep understanding of traditional Chinese methods. A peculiar notation was adopted for the signs of derivation and integration, which looked awkward to Western eyes but would have seemed familiar to the Chinese (and was as easily manipulated as the usual Leibnizian notation). This facilitated adoption of the new ideas and their application to practical problems such as determining projectile trajectories.

Jean-Claude Martzloff (CNRS, Paris)
Review of the history of Chinese and Japanese mathematics.

The talks we were given show that Chinese and Japanese mathematics are both rich, intricate and complex traditions, still awaiting further studies from many angles. From what Horiuchi explained, it appears that Japanese mathematics mainly relied on private studies and schools; needless to say, we would be happy to know more about these schools, their relations with temple schools [*terakoya*], their economy, etc. As Guo Shirong has noted, Chinese mathematics also had its private side with the diffusion of popular arithmetical books, but another aspect was as important: dependence on astrology and astronomy practiced at an official level for the needs of the imperial authorities.
From the 17th to the end of the 18th centuries, translation of Western mathematical books was a consequence of missionary proselytism. This aspect of the question is extremely important and reveals that religion was the motive power of the diffusion of mathematics and science in China, but not in Japan where Christianism was forbidden.

From this it results that discussing Chinese mathematics during this period involves discussing the problem of translation of European books and textbooks—hence the problem of "incommensurability" discussed by Roger Hart. He concludes that we should historicize the presentation of the translation process itself. I wholly agree with him on this point. It should be noted that the Chinese classical language has been replaced by modern Chinese as the result of the language revolution from 1918. This involved not only the creation of numerous neologisms, but also a drastic modification of syntactic structures in a way which has made Chinese much closer to European languages.

Ubiratan d'Ambrosio (Universidade de São Paulo, Brazil)
The transfer of mathematical knowledge to the colonies: social, political and cultural factors.

Although the pre-Columbian civilizations in the Americas had considerable mathematical development, now identified as Ethnomathematics, after the Conquest this was ignored and the effort was to transfer European knowledge to the new world. This condition of consumers of knowledge produced elsewhere prevailed during the colonial times and the first century after independence. The kind of mathematics transferred served the immediate interests of the colonizers and, after the independence, of the dominating elite. The insertion of the new countries in the political and economical scenario of the world demanded the establishment of an intellectual elite capable of absorbing and producing knowledge, and creating their own institutions. Thus, in the second quarter of the 20th century we see the establishment of a few mathematical research groups in Latin Amcrica.
In the talk, the dynamics of knowledge transfer and the creation of research groups was analyzed as a cycle of knowledge—with phases of generation, intellectual and social organization, and diffusion. The analysis is guided by what I call "the basin metaphor," with the producers of knowledge as the mainstream and the peripheral nations as affluents. Some examples of the dynamics of transfer and production of mathematical knowledge in Latin America were given which point to the roles played by the military, by cultural imperialism, by new elites, and by European émigrés.

Elena Ausejo & Mariano Hormigón (Universidad de Zaragoza, Spain)
Mathematical connections between Spain and Latin America: From textbooks to the Revista Matemática Hispano-Americana (1820–1938).

The history of mathematical relationships between Spain and Latin America is largely unexplored, so that ho synthetic approach can be offered. This paper studies two different precise moments in this relationship. In the first one, right after liberating movements at the beginning of the 19th century, exiled Spanish liberals produced a peculiar kind of mathematical textbooks for the new Republics, the *catechisms*. This was an enterprise launched by the London-based editor Rudolf Ackermann, with the noteworthy collaboration of José Joaquín de Mora. In the second one, after the lost of the last Spanish colonies (Cuba, Puerto Rico and the Philippines) in 1898, the *Revista Matemática Hispano-Americana* established by Rey Pastor represents an attempt to establish some kind of mathematical relationship in the field of research.

Adrian Rice (University of Virginia, Charlottesville, USA)
Maximum effort, minimum effect: De Morgan and his Indian protégé.

In a recent article (*Mathematical Intelligencer* , 1993, No. 3, 47–51), C. Musès has drawn attention to a persistent problem facing mathematicians and historians of mathematics at the dawn of the new millennium: the continuing erosion of the West's awareness of its cultural mathematical heritage. Although the 20th century has witnessed much important work on the history of non-Western mathematics, much of this scholarly activity has focused on pre-modern (i.e., ancient and medieval) developments in those cultures. So, for example, while much fine work has been undertaken on the history of the mathematical sciences in the Indian subcontinent, historians are virtually silent on activity in that area after 1600.
Of course, some explanation for this is that very little of substance is known to have been produced by Indian mathematicians in the modern period. But, by using the specific example of an obscure 19th-century mathematician, Ramchundra (1821–1880), this paper puts forward another hypothesis for this lack of historical attention. It will be argued that, despite the best efforts of the British mathematician Augustus de Morgan (1806–1871) to publicise Ramchundra's work, the overall effect was minimal due to the apathy of the European mathematical community at the time.

Amy Dahan (CNRS, Paris)
The school of Andronov in non-linear oscillation and its transmission to the United States through Minovsky and S. Lefschetz.

The talk addresses the question: to what extent can we speak of a (one) theory of dynamical systems throughout the works of Poincaré, Liapunov, Andronov, Lefschetz, Smole, etc. I describe the intellectual, technical, institutional and political context in which Andronov, from the late 1920s until his death in 1952, developed a research program on non-linear oscillations, and what were the principal results of these works. He transferred Poincaré's results for hamiltonian systems to dissipative systems and worked on problems with a small number of degrees of freedom (electric currents, triodes, empty tubes, etc.) which presented self-oscillations.
I study the role of Minorsky, naval engineer in the USA, and his David Taylor Basin Report which contains references to these results and methods of the school of Gorki. Some years later, S. Lefschetz launched a new program of research at Princeton.

Gert Schubring (Universität Bielefeld, Germany)
A framework for the comparison of transmission processes of mathematics to the Americas.

The talk elaborated structural patterns permitting the comparison of transmission processes of mathematics from different European metropolitan countries to those emerging at the periphery in the Americas, and the eventual transformation of some of them to new, even metropolitan centers.
Different structural models for the organization of educational systems, from the secondary school to the university level, were analyzed. The reception of the French model of professionalized Ëcoles Spéciales and of the Prussian research imperative was discussed and documented.

Karen V. Parshall (University of Virginia, Charlottesville, USA)
Historical contours of the American mathematical research community.

This talk presented a brief overview of the analysis presented in Parshall and Rowe's book *The Emergence of the American Mathematical Research Community, 1876–1900.* In that work, we provided at least a partial answer to the question: How did research-level mathematics develop in the United States from the colonial period to the outbreak of World War II? The discussion here was framed in terms of three developmental periods suggested by our study:
1) the hundred years from 1776 to 1876 during which mathematics existed, but within the context of the emerging US *scientific* community;
2) the quarter-century from 1876 to 1900 when a mathematical research community *per se* emerged in the United States; and
3) the four decades from 1900 to the outbreak of World War II which marked a time of consolidation and growth of that community.
During each of these periods, a variety of mathematical and extra-mathematical factors combined to create an environment conducive to and supportive of a high level of mathematical research.

Thomas Archibald (Acadia University, Wofville, Canada)
British and Continental norms and Canadian mathematics, 1880–1930.

This paper surveys the advent of an institutional infrastructure for mathematics in Canada, giving a brief account of the development of primary and secondary schooling in response to British structural changes, and then noting the major universities and their original roles and curricula. The central roles of McGill (important in Montreal, and with outposts in British Columbia) and Toronto (which united colleges of several religious denominations in order to allow high quality academic courses) was emphasized. The adherence of pre-1900 writers to British models dictated a very limited research activity, while later writers—notably J.C. Fields, Coxeter & Bravier, Webber & C. Krieger—followed a mixture of continental and British patterns to arrive at an early version of international mathematics.

Sergio Nobre (UNESP, Rio Claro, São Paulo)

Joaquim Gomes de Sousa (1829–1863) and Brazilian mathematics in his time.

Joaquim Gomes de Sousa, nicknamed "Sousinha," is known as the most important Brazilian mathematician of the 19th century and so we have chosen him to discuss the mathematics of Brazil's Imperial Period (1822–1888). Scientific institutionalization began in Brazil in 1808, with the coming of the Portuguese Royal family fleeing from the French invasion. Advanced texts in mathematics, mostly French, were subsequently introduced and translated; doctoral studies began at the Royal Military Academy in 1842. Sousinha, born in the province of Maranhão (northeast of the country), went to the capital Rio de Janeiro when he was 15. Four years later, in 1848, he presented his doctoral dissertation at the Military Academy, entitled "Dissertação sobre o modo de indagar novos astros sem auxilio das observações diretas" (Dissertation on the manner of searching for new stars without the help of direct observations); he was inspired by the discovery of Neptune some years before. His mathematical work extends to "Solution of numerical equations," "Definite integral method of integral partial differentials," "General methods of integration," "A work on sound," etc. A book of his, *Mélanges de calcul intégral*, was posthumously published at Leipzig by Brockhaus. This book contains texts that were submitted to the Academy of Paris in 1855 and to the Royal Society of London in 1856. Sousinha had strong ties to the Emperor and the Brazilian government, which help explain his quick, brilliant career.

Clara H. Sánchez (Universidad Nacional de Colombia, Bogotá)
Mathematics in Colombia in the 19th century.

The training of mathematicians at the National University in Colombia began in 1950. Before this, the history of mathematics is directly related with two institutions: the Escuela de Ingeniería at Bogotá (founded 1867) and the Sociedad Colombiana de Ingenieros (founded 1887). A brief sketch of the history of the antecedents and the foundation of both institutions was given, referring to the chair of mathematics of José Celestino Mutis at the end of the 18th century and the foundation of the Colegio Militar in 1848. At the Colegio, devoted to the training of civil and military engineers, formal studies of mathematics at a high level began, introduced by Lino de Pombo. A period of civil wars, political disturbances, and institutional weakness followed.
The Escuela de Ingeniería was inspired in the Ècole Polytechnique, training civil engineers with a strong emphasis in mathematics. This led to the creation of the chair "Profesor en Ciencias Matemáticas" at the Universidad Nacional in 1888. One of the requirements for graduation was to write a dissertation; we have found 34 manuscripts written between 1891 and 1903. These dissertations and the articles of the journal *Anales de Ingeniería*, edited by the Soc. Colombiana de Ingenieros and the most important journal of scientific interest, constituted the central part of the talk. Biographies of Pombo, Liévano, Rueda and the influential Garabito were given.

Mario Otero (Universidad de la República, Montevideo, Uruguay)

On the origins of the Uruguayan school of mathematics (1903–1942).

The paper covered:

1. An introduction on the present state of mathematics, and on developments in the colonial period and after independence.
2. The contribution of E. García de Zúñiga (trained in Berlin, 1903–05) to
   1. mathematical programs of modern mathematics (1915), contrasting with the previous backward situation
   2. the mathematical library, which included sources andhistoriographical material
   3. his studies of the history of mathematics
   4. his mathematical research
3. A comparison of the Uruguayan polemics with the UHUK discussion concerning mathematics for engineers.

Angel Ruiz (Universidad de Costa Rica)
Mathematics in Costa Rica: 1800–1940.

In this talk we offered a general outline of the history of mathematics in Costa Rica from 1800 to 1940, and analyzed some of its most important characteristics:

1. institutions where mathematics was developed, from the Casa de Enseñanza (1814), transformed into a university in 1843, through the Escuela Normal (1915), to the Universidad de Costa Rica (1940);
2. programs, influences, and foreign professors, emphasizing the role of Spanish, German, Swiss and Italian intellectuals; and
3. the general socioeconomic and political context of the country.

Eduardo L. Ortiz (Imperial College, London)
Roosevelt's "good neighbour" inter-American policy and its impact on the development of the exact sciences in Latin America.

The Good Neighbors policy inaugurated by president Roosevelt found a response among a group of Harvard professors in the early 1940s. With this policy as a background to their initiatives, several professors made efforts to establish a more direct contact with their colleagues in the until-then officially neglected Inter-American network. Their activities affected most significantly Mexico,Perú, Chile, Argentina and Uruguay.

This is a case in which some of the most powerful US academic institutions and private foundations, but not the State Department, played together to get the project started, and for some time supported its continuation. Two distinguished Harvard mathematicians, George D. Birkhoff and Marshal H. Stone, together with the astronomer Harold Shapley, played a leading role in the development of these contacts.

Alejandro Garciadiego (Universidad Nacional Autónoma de México)
Dirk Struik in Mexico, 1934.

In this talk I discussed Struik's early life before he visited Mexico in the summer of 1934. This trip provided an opportunity to personally witness the effects of a social revolution. I also commented on some of the reasons why it was not possible, at the time, to attempt to establish a professional school of mathematics in Mexico. There was then no mathematical society, nor a mathematics department in Mexico. The physics and mathematical societies were established in the 1940s thanks to the activities and financial support of Vallarta, who had previously expent ten years in the USA.

Umberto Bottazzini (Centro Linceo *B. Segre*, Roma)
Italian mathematicians in Latin America in the 1930s.

In the talk the influence of Italian mathematics on Latin America was discussed by referring to the main examples: the work done by Fantappié and Albanese in Brazil, by B. Levi and Terracini in Argentina.
Both of these cases are related to political circumstances: in 1934, following an agreement between the Italian and the Brazilian government, Fantappié was invited to Sao Paulo and mainly contributed in establishing the mathematics department there. Albanese joined him in 1936 and remained in Sao Paulo until 1942, whileFantappié left for Italy in 1939.
Quite different was the case of B. Levi and Terracini, who were forced to leave Italy in 1938 because of the racial laws which prevented Jews from teaching and having academic positions. Eventually Levi and Terracini succeeded in finding a position in Argentina, in Rosario and Tucumán resp. B. Levi established there for the rest of his life and contributed heavily to create a mathematical center at Rosario. Terracini returned to Italy in 1948 and became one of the prominent figures of post-war Italian mathematics.

Circe Mary Silva da Silva (Universidade Federal do Espirito Santo, Vitoria, Brazil)
The contributions of a Portuguese mathematician to the development of mathematics in Brazil and Argentina.

António Aniceto Ribeiro Monteiro, born in Angola (1907), studied mathematics in Lisbon and got his doctoral degree in France under the direction of Fréchet (1936). Monteiro was not only an outstanding mathematician, he also cooperated in Portugal and in his countries of adoption to the formation of researchers and mathematics teachers. Back in Portugal he founded the journal *Portugalia Matemática*, the first devoted exclusively to this discipline. But he was not admitted to any university because of his left-wing political beliefs; the same would later happen in Brazil, where he had no working opportunities and was sacrificed for his political ideas. Fleeing from Salazar's dictatorship, Monteiro arrived in Brazil in 1945 recommended by Einstein, G. Beck and von Neumann. In the context of cultural isolation provoked by the war, there was in Brazil enthusiasm for physics and mathematics. The work of Monteiro and his

Brazilian students in topology culminated in *Arithmetique des espaces topologiques*, a book presented in 1950 in honor of Fréchet. His student Leopold Nachbui reached international recognition as a mathematical logician.

In 1949 Monteiro traveled to Argentina, where he stayed until his death. First he created a Mathematics Institute at the Universidad Nacional in Cuyo; from 1957 he organized and headed the Instituto de Matemática at Bahía Blanca, where he implemented teacher's training. His research was now devoted to algebra and non-classical logics, and he formed a group of researchers in algebraic logic.

Ivor Grattan-Guinness (Bengeo, Herts, UK)
Mathematical logic and set theory in the USA, 1900–1940.

When the USA finally, and rapidly, became a major country for mathematics from the 1890s (or so) onwards, foundational studies quickly became popular. In this talk I shall trace the developments of mathematical logic and set theory, which were deeply intertwined through the logicism of Russell & Whitehead. The father-figures were E.H. Moore (Chicago) and the philosopher Josiah Royce (Harvard). Their followers and students contributed especially from the 1910s (Royce students Wiener, Sheffer, Lewis) through new figures of the 1920s (Changer, Langford, Church) to the new stars and immigrants of the 1930s (Carnap, Quine, Gödel) and the founding of the *Association of Symbolic Logic* in the mid 1930s—by another Royce student.

Michael Scanlan (Oregon State University, Corvallis, USA)
American postulate theorists and model theory.

The talk outlined the foundational work of a group of US mathematicians called American Postulate Theorists, and their influence on Tarski's work founding model theory in the 1930s. American Postulate Theorists were influenced by European foundational work of the period around 1900, such as that of Peano and Hilbert. In the period 1900–1940, they developed an indigenous American approach, making free use of interpretations of precisely formulated axiomatic theories to prove such metatheoretic properties as independence, consistency, and, in some cases, completeness of axiom sets. This approach to foundations was in many respects similar to that of Tarski, who frequently cited their work. The work of American Postulate Theorists can be viewed as providing a paradigm of the theories and concepts investigated in model theory.

The talk also examined the possibility of a more specific impetus to Tarski's model-theoretic investigation, arising from his study in 1927–1929 of a paper by C.H. Langford proving completeness for various axiom sets for linear order. This used the method of elimination of quantifiers. The talk concluded with an examination of one example of Langford's methods to indicate how their correct formulation calls for model theoretic concepts.

Moritz Epple (Universitäten Mainz und Bonn)
Some remarks on topology at Princeton.

In the talk, the question was discussed whether and how fragments of 19th-century knowledge about problems in analysis situs were transmitted to the modern environment of topological research at Princeton during the first decades of the 20th century. As the conceptual framework of "modern," combinatorial topology was rather different from the intuitive, geometric approach to Riemann surfaces, etc. in the late 19th century, such a transfer of knowledge, mathematical objects and techniques was not unproblematic. By analyzing an example—J.W. Alexander's "Note on Riemann Spaces" of 1920—I tried to show that
(a) a substantial reception of 19th century topological knowledge took place,
(b) in the reception, a substantial transformation of the respective objects and techniques happened; and
(c) parts of the received knowledge remained "silent," i.e., were not presented in printed texts.

Reinhard Siegmund-Schultze (Berlin)
The transfer of the ideal of applied mathematics to the USA, 1900–1950.

The talk traced particular and selective lines of influence of the German ideal of applied mathematics in the USA. With respect to the mathematical context, Hilbert's spirit, as revealed in the direct methods of the calculus of variations and in integral equations, as well as mathematical modeling, as exemplified in aeronautical research, proved most influential. Reception was promoted by early and later immigrants to the US and implied—to a certain extent—a recurrence to classical analysis and partial differential equations, traditions which were not particularly well represented in the US. Different social and ideological conditions in the US as compared to Germany did not facilitate the reception of the German example either. The German book publishing system (Courant/Hilbert 1924/37) was still dominant. The crucial topic of diverse traditions in education could not be fully dealt with in the talk, but Courant's policies were shortly examined.
Émigré Richard Courant supported the idea to skip the particular German example of a separate institute for applied mathematics. At the same time, he recurred to the "principle of combined teaching and research" which should help overcome the divide between "man education" and (partly German-inspired) elitist research. Grasping that cleavage around 1950 Courant could, once again and mutatis mutandis, draw on Klein's experiences in Germany around 1900, however substituting "man education," which had not been a phenomenon of Klein's times, for "technical" or "professional" education.

Skuli Sigurdsson (Max-Planck-Institut, Berlin)
Mathematical modernization and the mathematical-physicist émigrés.

Having shown a cartoon depicting Albert Einstein at the blackboard, the talk began with a quote from Roland Barthes's "The brain of Einstein" (Barthes, *Mythologies*): "Through the mythology of Einstein, the world blissfully regained the image of knowledge reduced to a formula. Paradoxically, the more the genius of the man was materialized under the guise of his brain, the more the product of his inventiveness came to acquire a magical dimension, [...] The historic equation $E = mc^2$ [*], by its unexpected simplicity, almost embodies the pure idea of the key, bare, linear, made of one metal, opening with a wholly magical ease a door which had resisted the desperate efforts of centuries." Having thus set the stage I illustrated the theme of simplicity (and harmony [*]) by discussing what another émigré, Hermann Weyl, wrote in *Raum - Zeit - Materie* (Dover ed., p. 23).
The lecture was then devoted to exploring what modernization (modernity) and emigration meant to theorists such as Einstein and Weyl. Attention focused on: —modernization/ modernity: simplicity or complexity; —pure vs. fundamental research; —pragmatism (US) vs. hierarchy (Germany/Institutes); —technology and the engendering of complexity. The lecture ended citing Weyl's lecture at the Bicentennial Conference at Princeton University in 1946. There Weyl rejected G.H. Hardy's distinction between real and dull mathematics (see Weyl, Nachlass, ETH Archive Zürich, Hs 91a: 18).

Patti W. Hunter (Naperville, IL, USA)
An unofficial community: American mathematical statisticians before 1935.

In 1935, a group of mathematical statisticians in the United States announced the founding of a new professional organization, the Institute of Mathematical Statistics. While this event marked an important stage in the process of the formation of the US mathematical statistics community, those who initially participated in the Institute constituted a small, loosely organized, but well-linked group within the broader scientific world even before they joined together formally to promote their discipline. The character of this proto-community was shaped in important ways by European, particularly British, statisticians, and by the orientation of the American mathematical research community toward pure mathematics. Paying particular attention to these influences, the talk examined some aspects of their education, employment and interests in order to determine how mathematical statisticians in the US set themselves apart from other scientists and worked to define their discipline before the community acquired its official status.

Jens Høyrup (Universiteit Roskilde, Denmark)
Mahavira's geometrical problems: traces of unknown links between Jaina and Mediterranean mathematics in the classical ages.

The practical mathematical tradition that we know best from its reflection in the Babylonian text material falls into a "traditional" and an "innovative" type, the latter becoming visible first in Seleucid and Demotic sources. Greek theoretical mathematics seems to be inspired exclusively by the former type, whereas the ill-known "low" Greek tradition also borrows from the latter.

Mahavira turns out to know about both types, and distinguishes explicitly between them by putting them under different headings. A connection close to Mahavira's own times (9th century CE) seems to be excluded; instead his treatise appears to present us with evidence of connections between Jaina mathematics and the "low" tradition(s) of the Mediterranean during the ages which became "classical" both from theJaina and the European perspective.

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