Chapter 5
Philanthropic Capital for Mathematics

The US-based activities that we briefly recall in this chapter are an important reminder, within the crystalline sphere of scientific endeavors, of the truly global transformation that World War I had wrought:

> In November 1918 Germany's planned economy surrendered in the face of a second even more powerful economic vision—a triumphant model of 'democratic capitalism.' At the heart of the democratic war effort stood the much-heralded economic potential of the United States. World War I marked the point at which America's wealth stamped itself dramatically on European history.[1]

After the war, American philanthropy was often able to provide what European states could no longer afford. This held true for countries on both sides of the war frontlines:

> I expected to find some outstanding differences between the victors and the vanquished in the late war, at least in so far as economic state, after-war national psychology, etc. might affect the higher education in these countries; in this respect I was quite wrong for some of the victors seem to be in quite as bad a state as any of the vanquished.[2]

The support of scientific projects was realized and acted out according to the principles of American philanthropy and guided by the US scientific perspective and expertise. Indeed, American philanthropy had begun its tremendous works of donation well before the first World War. It had already marked its durable imprint on the academic landscape of the US in the nineteenth century. In Chapter 1 we had several occasions, for instance, to mention the university at Baltimore, which had been endowed by Johns Hopkins. What interests us here, however, is how such large scale private donations to science went international after World War I.

As far as mathematics is concerned, rich new sources of international support began to flow in the mid-twenties, i.e., at about the same time as the relevance of the IMU for Mathematics International started to dwindle. Focussing on research training at the highest level they single-handedly set a new standard for the intercontinental framing of scientific excellence. Scientific ideals which had been built up and

[1] See [Tooze 2014], p. 200.

[2] Augustus Trowbridge as quoted in [Siegmund-Schultze 2001], p. 56.

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cultivated in the USA, largely with European examples in mind, now made a strong reappearance in the applications for funding submitted by Europeans. As humanity moved closer to World War II these philanthropic resources were malleable enough to be increasingly used to relocate refugee scientists in America.

5.1 The Rockefeller Philanthropies

In the context of the present book it is legitimate to focus on visible, international effects of US philanthropy for mathematics. It is also requisite, since no history of mathematics of the 1920s and thirties would be adequate if it failed to record the impact of financial support on international mathematical networking, especially that provided by the Rockefeller Foundation. The only systematic study to date of the Rockefeller Foundation's activities in the domain of mathematics is the book [Siegmund-Schultze 2001].

The vantage point of the history of mathematics does not project a fair image of American philanthropy in general,[3] nor does it duly capture the global scale of an organization like the Rockefeller Foundation—mathematics was lagging behind in globalization. Already *The Digital History* offered today on the Foundation's website gives a first impression of the true breadth of the activities at the time. Activities to improve health care, both in America and on other continents, stand out, but archaeology, literature and theatre also show up. The activities for mathematics, which did not have its own explicit subheading, fall into the category of *Natural Sciences*.[4]

Yet there was one period in the history of the Rockefeller Foundation when mathematics was treated in practice as if a dedicated line of expenditure for it existed. This was when the grants were handled by the Foundation's *International Education Board* (IEB), created in 1923. The time spell ended in 1931. Afterwards the financing of mathematics went over to the Rockefeller Foundation, which survived, unlike the IEB, but accepted only a relatively small number of mathematicians. Even so, among these later grantees one finds well-known mathematicians of the twentieth century, for instance the winner of one of the first two Fields Medals in 1936, Lars V. Ahlfors (1907–1996), the Polish logician Alfred Tarski, and the British algebraic geometer John Arthur Todd (1908–1994). On the other hand, applications in the 1930s by outstanding mathematicians such as Andrey Nikolaevich Kolmogorov (1903–1987) or re-applications by former IEB fellows like Stefan Banach (1892–1945) and Bartel Leendert Van der Waerden were dismissed, sometimes officially on the grounds that there was no specific program for this field of knowledge. On the other hand, as the

[3] For a general, political history of American philanthropy, see for example [Zunz 2012].

[4] See [URL 07]. Even though there is no special section dedicated to mathematics, browsing the site one does find a few related documents, for instance about John von Neumann, or on Vannevar Bush's *Differential Analyzer*.

1930s wore on, some mathematicians could profit from Rockefeller grants given to political immigrant scientists in the US.

Let us introduce the IEB in general by quoting from a portrait penned in 1941 by way of a summary of the book [Gray 1941]:

> The International Education Board was set up in 1923. The idea behind it was to help to make good some of the ravages of the War of 1914–18. The money, which amounted in all to nearly twenty-eight million dollars, was provided by John D. Rockefeller, jun., who ... imposed no conditions on the manner in which it should be spent, except that it should be used for 'the promotion and advancement of education throughout the world.' The inspiration with regard to the policy which should be followed came almost entirely from ... Dr. Wickliffe Rose [1862–1931][5].
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> What is education? In Rose's mind it became for the most part, not the dissemination of certain accepted ideas and cultural patterns, for that he felt might well be left to the various national Governments, but the desire to forward the understanding of the natural world by the best possible means. The claims of educational training, particularly training for agriculture, were not overlooked, but they played a subsidiary part in the comprehensive scheme which he put forward for the support of the best research institutions and the most promising scientific workers, whose work was being held up for lack of funds. ... [6]

In other words, at least for the natural sciences, the meaning of *education* in the name of the IEB was narrowed down to the most advanced sense, i.e., education towards high-level research. The funding for institutes was conceived accordingly as providing solid structures for research training. In particular, despite its name, the International *Education* Board did not till the same soil as the ICMI did in the field of mathematics—cf. Chapter 9 below.

> No considerations of national prestige were allowed to stand in the way, and except for agriculture, no attempt was made to strike a balance between the competing claims of the different branches of science, for in Rose's view, 'all knowledge is inter-related, and if we help in any one field we help in all the others.' So it came about that the greatest scene of the Board's activities lay in Europe, including the British Isles; but a small number of individual projects in the United States received some of the largest grants, while smaller ones found their way to such places as South Africa, China, the Philippines and New Zealand.
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> In all, 'fifty-seven universities, research centers, and other institutions were provided with new buildings, equipment, endowment and other material aids; and 603 individuals, chosen for their promise of future usefulness, were assisted in their higher education, given opportunity to study under world authorities in their chosen fields, introduced to new pastures of research under conditions which at the time seemed favourable to their development. Through grants for these various purposes, thirty-nine countries, representing Europe, Africa, Asia, Australasia, and the Americas, were aided.'[7]

Thus the IEB aid was essentially spent on two different kinds of projects: personal stipends and the funding of constructions for outstanding research centers. The question arises how IEB went about choosing the persons and institutions to be supported.

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[5] On W. Rose, cf. [Siegmund-Schultze 2001], pp. 27–30.

[6] See [Weatherwall 1941], p. 398.

[7] See [Weatherwall 1941], p. 398.

> A visit of Dr. Rose to Europe in 1923 initiated a scheme under which the whole world, but particularly war-worn Europe, was scoured for young scientific workers showing exceptional promise, whose studies were held up through lack of means. After careful scrutiny these were granted travelling fellowships for a year, which enabled them to profit by the best scientific experience available in the world in their own particular line. Within the five years, 1923–28, an exchange of workers and of scientific ideas took place on an unprecedented scale.
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> But this scheme of fellowships in science would have been held up by the cramped facilities existing in many of the leading research institutions. Realizing this, the International Education Board made available large sums to be spent upon buildings, equipment and endowment. One of the first institutions to benefit in this way was the Institute of Theoretical Physics at Copenhagen, under Niels Bohr [1885–1962]. . . . [8]

Starting with Rose's European journey, the IEB began—in the domain which interests us here—to design a map of mathematical Europe, or rather, of the Europe of mathematics and physics; of major persons and centers in the principal countries.

Both for the UK and for the overall constellation of European mathematics, Godfrey Harold Hardy was a key person to talk to.

> The leading English mathematician Godfrey H. Hardy had been one of the first European scientists to be contacted by Rose during his trip to Europe in the fall of 1923. The two men met in Oxford, on December 23, 1923, and Rose got advice about promising mathematicians in Europe but no request proper from the English side. This changed when Rose got back to England, shortly before leaving Europe, and met Hardy in London, once again, on April 14, 1924.[9]

Hardy's role as correspondent for the IEB goes well beyond his own research fields, analysis and analytic number theory; it fits in with his outspokenness in favor of Mathematics International since World War I. Already during the war Hardy sternly refused to transport national preferences into scientific life. For instance, the Latin dedication of the joint book [Hardy & Riesz 1915]—the final manuscript had to be finished by Hardy himself; correspondence with his Hungarian coauthor was increasingly difficult—translates:

> To the mathematicians (how many and wherever they may be): that they may soon again take up, as is to be hoped, the confraternity of their works which is currently disrupted, we, the authors, friends and foes at the same time, present and dedicate [this book].[10]

The war years put him at odds with most Cambridge colleagues. In 1919 he accepted the Savilian chair in Oxford. This is where Rose first met him to hear his views on mathematical Europe. It was also from Oxford that Hardy intervened in or commented on many of the correspondences about the exclusion policy of the IRC,

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[8] See [Weatherwall 1941], p. 398. This article was written during World War II; on p. 401 one reads: "some of the work of the Board is already in ruins." The piece ends on a disillusioned note, timidly hoping for a brighter future after the war.

[9] See [Siegmund-Schultze 2001], p. 40; cf. pp. 247–249 for Hardy's note addressed to IEB at the second meeting, on behalf of the London Mathematical Society.

[10] Cf. [Corry & Schappacher 2010], p. 435. For Hardy's own account of World War I in Cambridge, see [Hardy 1942]. Cf. June Barrow-Green's chapter in [Aubin & Goldstein 2014], pp. 59–124.

the IMU, and the first post-war ICMs which we have mentioned in the preceding Chapter 4.

As of 1925 an office in Paris was established under the direction of the rich polyglot Augustus Trowbridge from Brooklyn, New York, who had obtained his PhD in Physics at the University of Berlin in 1897. His regularly kept diary ("log") is one of the central sources exploited by Siegmund-Schultze for the book [Siegmund-Schultze 2001]. Trowbridge was well-connected with the Paris scientific milieu. And for situating the merits and needs of European mathematics at large he could rely on reconnaissance missions undertaken by the leading American mathematician George David Birkhoff (1884–1944), the father of Garrett Birkhoff (1911–1996).

> . . . George David Birkhoff travelled to Europe together with his family in the second semester of the academic year 1925/26 (probably starting in February 1926). He had planned a shorter stay in Europe within a sabbatical year, but stayed several months longer (until September 1926) on the basis of the support given by the IEB. Birkhoff chose France as his temporary home and country of departure for various trips to several European countries. In Paris he collaborated closely with American physicist Augustus Trowbridge, who was heading the European office of the IEB in the city. At the end of his journey, on 8 September 1926, Birkhoff submitted to Trowbridge a 12-page-long "Final General Memorandum for Dr. A. Trowbridge."[11]

In terms of physical constructions, these explorations resulted in two new buildings for mathematics, both granted by IEB on the same day in December 1926, and both inaugurated in 1928: the *Institut Henri Poincaré* (IHP) in Paris, and the *Mathematisches Institut* of Göttingen University.[12] Each one of them was apparently seen by the American donors as a contribution to a scientific campus. This vision fit reasonably well with the pre-existing buildings for physics, fluid mechanics, and chemistry in Göttingen near which the new Mathematical Institute was built. Also the *Institut Henri Poincaré* found itself close—in fact, very close—to other institute buildings (like chemistry and oceanography) that had recently been finished. This condensed Pierre and Marie Curie 'campus' is in the vicinity of Sorbonne University from the turn of the century, which is architecturally much more confined and squarely occupies full city blocks with internal courts. Lecture halls, a rich library, reading and seminar rooms, and also collections of mathematical models, were the visible assets for research training in both new institutes financed by the IEB.

Already in the Summer of 1924, Gösta Mittag-Leffler's application for IEB funds to insure the survival of the *Institut mathématique Mittag-Leffler* had been turned down. He and his wife had decided to set up a foundation around the extraordinary mathematical library in the generous villa at Djursholm, outside of Stockholm,

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[11] See [Siegmund-Schultze 2001], p. 46; Birkhoff's memorandum is reproduced there on pp. 265–271.

[12] See Chapter V of [Siegmund-Schultze 2001]. I have also greatly profited from an inspiring lecture comparing both buildings from the point of view of the history of architecture, delivered by Bernd Hoffmann, Göttingen, at the eightieth birthday celebration of the IHP in 2008.

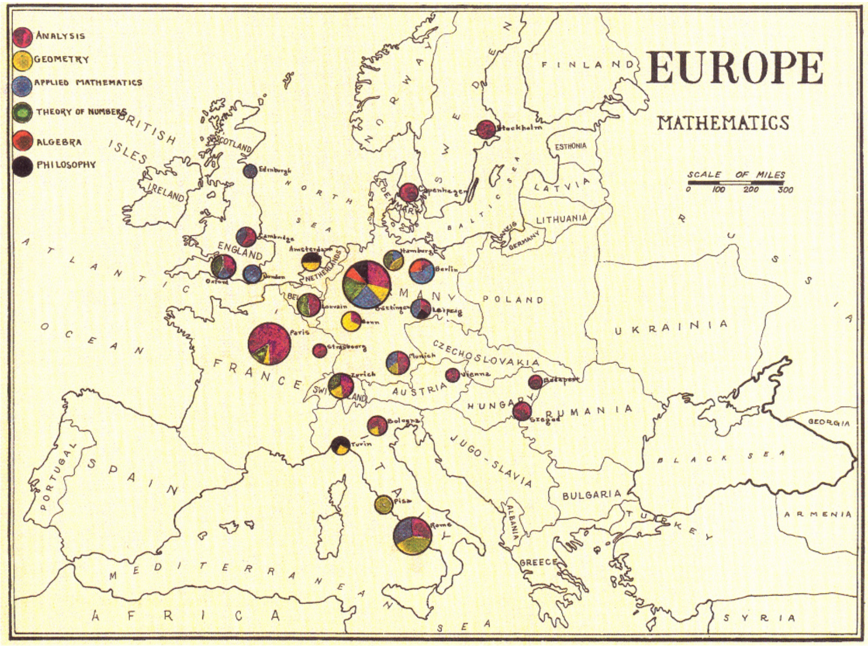

Fig. 5.1 Rockefeller map of mathematical centers in Europe, 1927. The colours indicate the various branches of mathematics: analysis, geometry, applied mathematics, theory of numbers, algebra, philosophy. Credit: [Arch. RAC].

Sweden. The *Institut mathématique Mittag-Leffler* had been formally created in 1919. The main reason for the IEB to abstain from helping this splendid site was apparently its isolated situation.[13]

The denial to fund Djursholm in contrast highlights the IEB's expectations to the effect that the grants for the IHP and Göttingen would create attractive and lively research centers. Paris was of course well chosen in this respect already because of the city's attractiveness for students, also from abroad; in fact, Rockefeller money also went into the construction of the central building of the Paris *Cité universitaire*, a complex of international student residences in the South of the capital. Mathematically, the newly founded IHP would play a particularly visible role in the development of mathematical statistics and probability theory.[14] As to Göttingen, the proximity between mathematics and physics seems to have played an important part in convincing the IEB to invest in this place. In Section 6.1 below about Emmy Noether's legacy, we will analyze the peculiar purely mathematical message which young researchers would pick up there and spread in the 1920s and early 1930s.

[13] See [Siegmund-Schultze 2001], pp. 178–180.

[14] See [Catellier & Mazliak 2012], and [Siegmund-Schultze 2001], pp. 169–175.

As to the individual grants extended to mathematicians, between 1924 and 1931, the IEB financed research sojourns of a total of 86 predominantly young mathematicians; three women and 83 men. Their fields of interests ranged widely, from logic, via all principal domains of pure mathematics, to applied fields like aerodynamics and statistics. Since Rockefeller grants for mathematicians became rather the exception after 1931, only the IEB period represents a fair measure of the internationalizing effect of Rockefeller money for mathematics. In terms of nationalities, 16 Germans, 14 Americans, among them 2 women, 11 Frenchmen, 6 men from Poland, 5 men and one woman from the USSR, 4 Austrians, 4 Czechs, 4 Hungarians, 4 Swiss; 3 men each from Holland, and the UK; 2 men each from Italy, Norway, Romania, and the Kingdom of Yugoslavia; and one mathematician each from Finland, Greece, and Japan received IEB grants.[15] So we are looking essentially at an affair between Europe and the US. Since they are so strongly represented, let us take a quick look at the IEB grant recipients from Poland and the USSR.

The Polish mathematicians who received IEB grants were the emblematic Stefan Banach, the topologist Witold Hurewicz (1904–1956), the analyst Szolem Mandelbrojt (1899–1983)—who had actually been based in France since 1920, would obtain French citizenship in 1927, and become Hadamard's successor at *Collège de France* in 1938—, the famous statistician Jerzy Neyman (1894–1981), the expert in fluid mechanics (and diplomat in his later years) Piotr Szymański (1900–1965)[16], and the analyst Antoni Zygmund (1900–1992). All of them went to Paris at least for part of their grant, except Hurewicz who spent the academic year 1927/28 in Amsterdam, hosted by L.E.J. Brouwer.

The Russian topologist Pavel Alexandrov (1896–1982) also spent a year (1925) in Holland, welcomed by Brouwer,[17] and in 1826–27 he was granted 8 months in Princeton,[18] invited by Solomon Lefschetz (1884–1972). Alexandrov's former teacher Luzin, in spite of the fact that he could no longer claim to be a young researcher, was finally granted a stay in Paris in 1928, one year after his former student Dmitrii Menshov (1892–1988). While Menshov was recommended by Arnaud Denjoy (1884–1974) and Paul Montel (1876–1975)—as well as by his teacher Luzin, Luzin was backed by Lebesgue; yet he had to try twice before he was admitted. In his French application, which is apparently difficult to translate, Luzin concentrates on set theory, adopting the point of view of *naming infinity*, which we have briefly touched upon in Section 2.1.1 above.[19] The same year Luzin also participated at the Bologna ICM where he sketched his take on the foundational debate.[20]

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[15] See [Siegmund-Schultze 2001], pp. 288–301, for the total list of 130 mathematicians known to have either received IEB grants or to have been sponsored by Rockefeller grants later in the 1930s; see pp. 96–106 for remarks on the lucky and some of the less lucky applicants.

[16] See [Urbanowicz & Tijsseling 2016].

[17] For more background on this stay, in particular Pavel Urysohn's (1898–1924) work and tragic death and Emmy Noether's role, see [Rowe 2021], pp. 109–120.

[18] This is Princeton University. The *Institute for Advanced Study* did not exist yet—see Section 5.2 below.

[19] See [Siegmund-Schultze 2001], p. 250. Cf. [Graham & Kantor 2009], esp. pp. 205–211.

[20] See Proceedings ICM 1928, Vol. 1, pp. 295–299.

The only non-American woman among the IEB fellows, Nina Karlovna Bari (1901–1961)[21] had also been a student of Luzin's. She had profited from the opening of the universities for women in 1918 as a consequence of the Bolshevik Revolution and was in fact the very first woman to graduate from Moscow State University. Nina Bari would become full professor there in 1932. At the Bologna ICM in 1928 she presented in a sectional talk the peculiar result to the effect that every continuous function on a real interval is the sum of at most three functions of the form $f \circ \phi$, with both f and ϕ absolutely continuous. Thanks to the IEB, Nina Bari could spend nine months in Paris in 1929.

The remaining two IEB fellows from the USSR were: Abram Samoilovitch Besicovitch (1891–1970), who used his IEB fellowship as a stepping stone towards his future career in the UK, and the complex function theorist Vasilii Leonidovitch Gontcharov (1896–1955), who would later be known in the USSR for his elementary textbooks.[22]

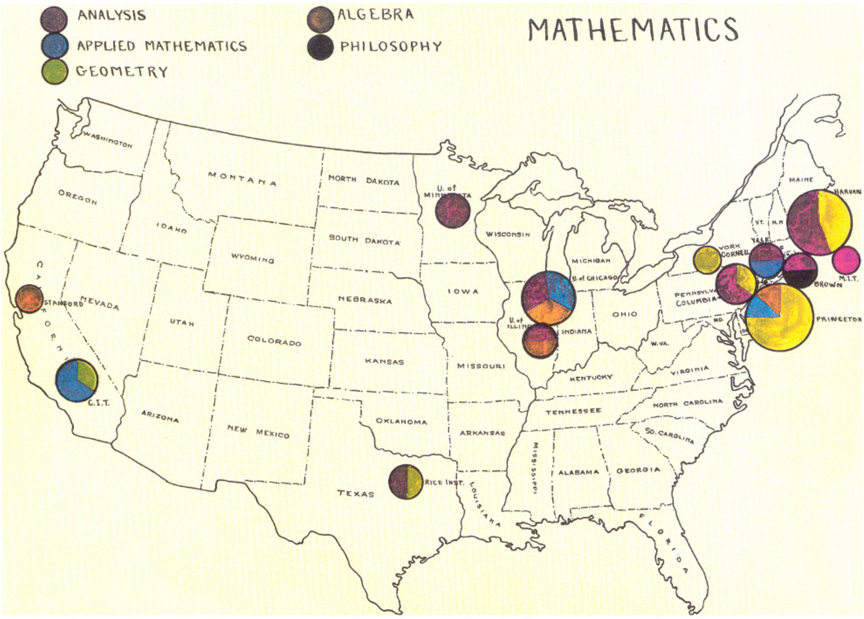

Fig. 5.2 Rockefeller map of mathematical centers in the USA, 1927. The colours indicate the various branches of mathematics: analysis, geometry, applied mathematics, theory of numbers, algebra, philosophy. Credit: [Arch. RAC].

[21] Both in the Italian Bologna Proceedings and in many of her publications in Western media, her name is transliterated as 'Bary', even though her Russian name ends with a single plain letter 'i.'

[22] Cf. [Siegmund-Schultze 2001], pp. 125–132, for a general discussion of IEB's perspective on Soviet Russia.

Before closing this subsection, we ought to remind ourselves that the Rockefeller Foundation was only the biggest actor in a broad field of philanthropic initiatives. This is obvious in the realm of mathematics when one looks at fellows of the *John Simon Guggenheim Foundation*, even though these grants, which started roughly at the same time as those of the Rockefeller Foundation, were limited to US citizens or residents. Their list for the second decade, 1935–1945, includes some of the most influential mathematicians of the twentieth century, such as Paul Erdős (1913–1996), Marshall Harvey Stone (1903–1989)—who would play a dominant role in recreating the IMU after World War II—, as well as the rewriters of algebraic geometry Oscar Zariski and André Weil.[23] Many of these later grants concern mathematicians who had emigrated to the US before. This will be put into perspective in Chapter 7 below. Actions of the Rockefeller Foundation in the 1930s will also be recalled coincidentally in Section 6.1.

For the time being, let us summarize for the record that the activities of the IEB and similar philanthropic foundations in the domain of mathematics led to the construction of two mathematical institutes, in Paris and in Göttingen, and provided generous help to a fair number of researchers. Since these actions were embedded in a very broad range of philanthropic activities, sweeping the spectrum of scientific domains and sometimes encompassing geographic regions which were not on the mathematical map yet, one may say that philanthropic convictions and a US-based analysis of the scientific world did more to promote a certain spirit of Science International between the two World Wars than any other international institution. Furthermore, they were major novel steps in pushing scientific practice towards the constant collegial interaction beyond local contacts that we take for granted today.

Indeed, foreign travel has been a recurring theme in our survey of the nineteenth century world of mathematics—see Chapter 1. For well established or wealthy actors such as Guccia, Klein or Mittag-Leffler it was a natural part of their networking strategies. Young researchers on the other hand like Betti, Brioschi, Casorati (Section 1.1.5.3) undertook their journey in order to discover the world of mathematics. Sofya Kovalevskaya had to leave her home country in order to study in the first place, and then again to embark on her academic career—see Section 1.1.7. But all those journeys were private initiatives. Typically, at least for the younger participants, participating in international congresses, with the resulting contacts and exchanges, had to be arranged privately. The idea of helping promising young mathematicians by systematically granting them the opportunity to spend time at a suitable institution only gained ground between the World Wars, as a relatively late ingredient of the ongoing professionalization of science. On the national levels it typically expressed itself through newly founded National Research Councils. The international dimension, at first covering mostly Europe and the US, was opened up by American philanthropic initiatives.

[23] See the complete list of Guggenheim fellows in mathematics up until 1945 in [Siegmund-Schultze 2001], pp. 302–303; see also pp. 138–139.

5.2 The Institute for Advanced Study, Princeton

Like the activities of the IEB, the founding of the Institute for Advanced Study (IAS) at Princeton in 1930 was also the result of American capitalist philanthropy. Here too a model institution for worldwide science came into being.

> [T]he Institute holds a special symbolism for mathematicians. The Institute for Advanced Study began in 1930 through the vision of Abraham Flexner [1866–1959]. Flexner was a figure of considerable influence during the first half of the twentieth century. He made his mark in 1910 with a scathing exposé of the deficiencies in American medical education. Flexner's revelations called for drastic action. Over a decade-long period he served as the architect of a Rockefeller philanthropic initiative that dramatically upgraded American medical schools.
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> When Flexner retired from the Rockefeller Foundation, it was with the satisfaction that his career had been essential to the modernization of American medicine. Still, he had a distinctly different ambition that remained unfulfilled. As a long-time observer of higher education, Flexner was convinced that the United States should possess an exclusively graduate university with an ideal environment for research. There, a small faculty of geniuses would direct the studies of a few disciples while pursuing their own discoveries.
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> With the power to direct millions of dollars to selected universities and hospitals, Flexner had accumulated a stunning collection of contacts among academic, business, medical, and political leaders. When department store magnate Louis Bamberger [1855–1944] and his sister Carrie Fuld [1864–1944] began seeking advice on devoting their fortune to the creation of a new medical school, it was inevitable that their consultations would lead them to Abraham Flexner. Out of these discussions Bamberger and Fuld decided to endow a graduate university with the 63-year-old Flexner as director.[24]

Flexner worked hard—trips to Europe included—to recruit outstanding scientists with international visibility on the faculties of the first 'Schools' he was planning for the Institute. Even though Flexner was personally as clueless about mathematics as Alexander von Humboldt a century before him, he set his mind on building a School of Mathematics. Solomon Lefschetz from Princeton University recommended to go after "the younger group of geometers. It is the most vital and promising of mathematical groups in the U.S., the one with the highest national and international standing. It includes [Oswald] Veblen [1880–1960] and [James W.] Alexander [1888–1971] of Princeton, [G.D.] Birkhoff and [Marston] Morse [1892–1977] of Harvard and also myself." Furthermore, Lefschetz remarked: "Hermann Weyl is the only mathematician anywhere definitely above these names. But as he occupies the most distinguished mathematical chair in the world (in Göttingen) I do not see him giving it up."[25] Whereas Birkhoff decided to stay at Harvard, Veblen joined the new institution in 1932, and the topologist Alexander followed in 1933. John von Neumann (1903–1957) was also hired in 1933. Morse would join in 1935. In terms of international luminaries, Flexner landed a brilliant success with Albert Einstein who arrived in 1933. It was Adolf Hitler's regime which finally decided the hesitating

[24] See [Batterson 2006], p. ix.

[25] See [Batterson 2006], p. 59, for these quotes from Lefschetz.

Weyl to leave Göttingen for Princeton in the Fall of 1933; the Nazi rule not only clashed with Weyl's democratic convictions after the 17 years he had spent in Zürich, it also potentially threatened his Jewish wife, and children.[26]

Thus within a few years, this new institute was one of the strongest mathematical centers in the world, and we shall see in later chapters how prominent a role it would play on the international scene of mathematics. But it is not so much the individual IAS which interests us, and how it continued to hold its eminent place for global mathematics. If we discuss its founding here, it is because this was in fact the birth of a new type of research structure, which would subsequently serve as a blueprint for similar centers founded all around the globe since the end of World War II. So what was this institute like, once its structure had crystallized? How can the IAS, in particular its School of Mathematics, be described once it was set up and functioning; for instance, when it had moved from its first, provisional quarters in Princeton University, to Fuld Hall in 1939? The original idea of a graduate school never materialized, and was apparently abandoned early on: "From the beginning the faculty identified and hosted scholars who had already received their doctoral degrees. These visitors, who became known as members, typically remained at the Institute for a year."[27]

Here is a concise description of this new kind of research site whose very first example was the IAS's School of Mathematics: It is a (relatively) independent academic structure (even though it may have collaborative ties with local academic institutions, for instance universities, nearby). Its goal is to support fundamental research in mathematics (and possibly also other domains) at the highest level of intellectual inquiry. A rather small permanent faculty selected for their outstanding research record guides the work, and each year up to about seven times as many visiting members are invited to join the Institute, from universities and research institutions throughout the world. Every researcher, permanent or visiting, is free to pursue their personal research agenda. Seminars are organized, talks are given, which reflect ongoing work. In addition, the institute offers numerous informal occasions for exchange.[28]

We will call an institute that fits this mold a *Locally-grounded Transnational Research Site for mathematics*, or LGTRS for short. This is our adaption, specifically for the domain of mathematics, of a notion that historians-sociologists of (predominantly experimental) science have coined to capture important elements of the professionalization of scientific research in the second half of the twentieth century:

> Before World War I, the threat of cognitive fragmentation came from the massive and rapid introduction of additional specialties. Today this menace is linked to the existence of several representation systems inside almost every major scientific discipline. Within

[26] For many more details packed in an entertaining narrative, cf. [Batterson 2006].

[27] See [Batterson 2006], p. x.

[28] Some of the formulations of this paragraph are slightly adapted clippings from the website [URL 08]. The approximate factor of 7 linking the number of permanent faculty and invited members corresponds to the current situation at the IAS. It is cited here as an indication only; I will not just use any precise value in order to rule out a potential LGTRS.

> a given field, scientists choose between numerous alternative ways of representing their phenomena. . . . Some groups emerge within disciplines whose principal loyalty lies with their chosen representation rather than the field. This dramatically affects the pattern of work since scientists sharing a representation system often forge more meaningful and stable intellectual relations with colleagues of the same representation than they do with their specialty or home-laboratory. Moreover, effective use of a new representation to solve a particularly thorny problem, or strategies to gain legitimacy for a novel representation system spur scientists to band together for a period as they shift for a short while their research to a new site. . . . Today, scientists have ample opportunities to seize advantages lying outside their laboratories without the need to transfer to a new laboratory, agency or nation. Most research agencies provide funding and sometimes encouragement for short stays in an alternative laboratory. . . .
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> In the 19th century scientific travel was a form of ambassadorship or assumed the form of brief laboratory visits intended as fact-finding missions. In the 20th century, however, scientists travel either to cooperate with colleagues or to carry out gritty research that is better done with resources located away from their customary base of operation. The logic of LGTRS is hence thoroughly functional.
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> This leads to the emergence of new ties. Scientists' bonds with their institutional base is supplemented by an additional network consisting of individuals and laboratories scattered around the globe. In some instances, involvement with transnational groups, projects, and institutions becomes overriding, thereby neutralizing affiliation with the home-setting. Here, the local/national coordinate system is countered by the appeal of LGTRS. . . .
>
> Yet, to portray the relations between LGTRS and nation-based research as antagonistic would be to misunderstand this recent and crucial phenomenon. LGTRS are not a professional, cognitive or educational alternative to national science. They constitute an incremental resource as scientists attempt to expand and multiply strategies and techniques for problem-solving. The LGTRS dovetail the local, regional and national endeavors. Scientists operate simultaneously and on the three planes in complete comfort and without the slightest sense of contradiction or alienation. The salient feature of this new aspect of research practice and organization is oscillatory movement of individuals away from and going back to their home-base. Centrifugal and centripetal trajectories succeed one another as required by the research projects.[29]

This analysis clearly takes into account the importance of experimental devices such as a Hadron Collider, a supermagnet or the like. It nonetheless also describes very well the crucial changes that have affected professional mathematical research as of the middle of the twentieth century. These novel features, which were first realized at the Institute for Advanced Study and may today seem banal (at least in the countries that are fully integrated into the world mathematical community), were intrinsically international.

> The ambience in Princeton, which is still fairly cosmopolitan, was even more so in 1937. The Institute for Advanced Study did not yet have its own buildings; the University provided it with comfortable facilities in the old Fine Hall, to which Veblen had devoted so much care, but guests such as I were left to their own devices as far as housing went. Such stays are fruitful, but the experience has become such a common one that any remarks I could make would be superfluous. As planned, I gave a series of lectures on the topic of my future

[29] See [Crawford et al. 1992], pp. 28–30.

> paper in the Journal de Liouville[30], and it was no small boost to my ego to see Hermann Weyl among those who attended regularly. Through contact with Alexander, I tried to find out more about "combinatorial topology"... [31]

Flexner's original plan of a graduate school of mathematics for the IAS was fairly close to the kind of institutes that the Rockefeller Foundation helped building through its *International Education Board*. Already in this respect, and in spite of the narrow, elitist interpretation of the word *education* upheld by the IEB, neither the Rockefeller institutes nor the initial layout for the IAS were projects in the style of an LGTRS. The Göttingen Mathematical Institute financed by the IEB was an integral part of Göttingen University and actually contained a generous class room for graphical methods (*Zeichensaal*) open to students of all levels.

The *Institut Henri Poincaré*, on the other hand, in some ways resembled an LGTRS. In spite of initial difficulties in view of the economic situation, nine chairs were finally integrated into the plan for the IHP.[32] While graduate teaching did take place in its lecture halls, the most visible and novel roles of the IHP in the interwar years was to host regular seminars, and to welcome mathematicians from many different countries, albeit usually for one or several lectures rather than for a prolonged stay.[33]

We will pick up the global history of the LGTRS model after World War II in Section 8.3 below.

[30] This alludes to the paper *Généralisation des fonctions abéliennes*, labeled [1938a] in [Weil 1980].

[31] See [Weil 1992], p. 117.

[32] See [Siegmund-Schultze 2001], pp. 157–168.

[33] See [Siegmund-Schultze 2001], pp. 168, as well as the list of international lecturers at IHP on probability and statistics in [Siegmund-Schultze 2001], pp. 173.