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The Emancipation of Mathematical Research Publishing in the United States from German Dominance (1878–1945)

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This article investigates the historical fine structure of the establishment of the American system of mathematical research publishing both quantitatively and qualitatively, with particular reference to German–American relations between 1878 and 1945. On the basis of mostly unpublished material, it focuses on the policies of the American Mathematical Society, the German publishing house Springer-Verlag, and the American Alien Property Custodian during World War II. The historical case study will offer a basis for conclusions about the processes of ''internationalization'' and ''modernization'' of mathematics in this century. © 1997 Academic Press

Statya analiziruet podem amerikanskoi sistemy matematiko-issledovatelskogo opublikovaniya mezhdu 1878 i 1945 g. v kontekste nemetsko–amerikanskikh matematicheskikh otnoshenii. V chastnosti issleduyutsya deistviya amerikanskogo matematicheskogo obshchestva, nemetskogo izdatelstva Springera i amerikanskoi gosudarstvennoi agentury APC, kot. organizovala perepechatku nemetskikh matematicheskikh zurnalov i knig vo vremya Vtoroi Mirovoi Voiny. Issledovaniya predstavlyaet material, kot. mozhet oblegchat diskussiyu o protsessakh 'internatsionalizirovaniya' i 'modernizatsii' matematiki v dvadtsatom veke. © 1997 Academic Press

Der Artikel untersucht quantitativ und qualitativ die historische Feinstruktur des Aufstieges des U.S.-amerikanischen Systems forschungsbezogener mathematischer Publikation. Die Untersuchung erfolgt vor allem vor dem Hintergrund der deutsch–amerikanischen mathematischen Beziehungen zwischen 1878 und 1945. Die Arbeit enthält zum großen Teil unveröffentlichtes Material. Besonderes Augenmerk wird den Strategien der American Mathematical Society, des deutschen Springer-Verlags und des amerikanischen Alien Property Custodian geschenkt. Letzterer organisierte während des Zweiten Weltkriegs den Nachdruck deutscher mathematischer Zeitschriften und Bücher. Das vorgestellte Material kann einer theoretischen Diskussion der Prozesse der ''Internationalisierung'' und ''Modernisierung'' der Mathematik im 20.Jahrhundert dienlich sein. © 1997 Academic Press

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INTRODUCTION

The key position of American mathematical culture within world mathematics today, reinforced by the recent political upheavals in Eastern Europe, and the dominance of German mathematics well into the 1920s are well known and indisputable facts. The mass exodus of European mathematicians to the U.S. during the period of Nazi rule is known as the single most important historical root of that shift of the center of gravity in mathematics.

There have been, however, only a few attempts thus far to quantify that shift and to analyze its historical fine structure. This article aims to do this relative to

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the development of the social infrastructure for mathematical research publishing in the U.S. It uses mostly unpublished materials, which allow for a tracing of the continuous and discontinuous features of the relevant developments and of the influences of a variety of political, economic and purely scientific factors. With respect to historical continuity, new documents will be presented concerning the policies of the American Mathematical Society (AMS) and the German publishing house of Springer-Verlag, both also major and global players in today's much more internationalized mathematical scene. As to historical discontinuity, the influences on mathematical communication of the two World Wars and of Nazi rule in Germany, especially with respect to German–American relations, will be analyzed. A particularly important event for the postwar developments was the creation of the republication program for German scientific literature during WWII by the Alien Property Custodian (APC). While the general policies of the APC have been analyzed in a recent book [32] by Richards, this paper goes into the relevant implications for mathematics. Thus, it presents material which may eventually permit a more theoretical investigation of the problem of ''modernization'' and ''internationalization'' of science and mathematics in this century; several more case studies along the lines of this paper will be needed, however, to achieve this sort of analysis.

As to quantitative figures, the article documents historical changes in the citations of German and American mathematical literature, gives lists of German and American monographs published in the two countries (Appendix 1), and emphasizes the dates of foundation of the most important journals in both countries.

Since scientific production and reception are intimately related to each other at any historical moment, the article will occasionally (most prominently in the case of the American republishing program during the Second World War) deal with the receptive side of international communication as well. Due to the favorable library conditions in the leading (but by no means all) American universities by 1900 at the latest, and due to the acknowledged role of Germany as a teacher of American mathematicians well into the 1920s, the *reception* of international mathematics was in America, unlike Germany in later years, a comparatively unproblematic issue.

Finally, this article restricts its attention to German–American relations, focusing primarily on the American developments. This is partly conditioned by the author's current broader research topic, and partly justified by the strong influence of the German example. This focus does not, however, preclude occasional reference to American–British relations,[1] since these had obvious ramifications for American mathematical publishing as a whole. Finally, this paper does not pretend to give a complete picture of the internal American developments, since it aims to illuminate the international dimension of mathematics.[2] Moreover, while the ''emergence of

[1] See, most notably, the important memo by G. H. Hardy of 1924, discussed below.

[2] For internal American developments, compare [2] and [28]. This paper delves even less into details of parallel developments in Germany, and so represents little more than a first step toward a true intercultural comparison. This will be carried out in a book currently in preparation by the author.

the American mathematical research community'' before and around 1900 has been admirably discussed by Parshall and Rowe [28], this article centers on the period between the two World Wars, when American mathematics gradually rose to international importance.

AMERICAN MATHEMATICAL RESEARCH PUBLISHING BEFORE THE FIRST WORLD WAR

In 1874, the astronomer Simon Newcomb deplored the backwardness of American science in an article entitled ''Exact Science in America.'' Newcomb was one of few Americans of international reputation in the sciences at that time. Later (1897–1898), he served also as a president of the American Mathematical Society. He had this to say on mathematics in the U.S. as of 1874:

> When we seek for published mathematical investigation in this country, we find an utter blank. Of mathematical journals designed for original investigations, such as we find in nearly every country in Europe, we have none and never have had any.... The writings of the great mathematicians ... are entirely inaccessible, except by private purchase, outside of New York, the Eastern States, and the city of Baltimore.... If the reader will visit the Royal Library at Berlin, he will find .... in the public reading room a set of Crelle's Mathematical Journal, the volumes of which are among the best thumbed there; and if, as he looks at them, he will reflect that our National Library does not possess the volumes at all, he will need no further illustration of the relative state of mathematical science in the two countries. [26, 206–207]

Newcomb points both to the lack of indigenous mathematical research journals in America[3] at that time and to insufficient libraries with respect to foreign mathematical work. Both conditions, that is, the state of *production* and the state of *reception* of world-class mathematics, did, above all, reflect the poor state of mathematical research in the U.S. at that particular moment in 1874.

Several mathematical journals of a more popular or derivative character had existed in the U.S. prior to 1878, such as the short-lived *Mathematical Miscellany* (1836–1839), *Mathematical Monthly* (1858–1860), and *The Analyst* (1874–1883) [28, 51]. Even astronomer Ormond Stone's *Annals of Mathematics* (founded 1884) did not really become research-oriented before its final move to Princeton in 1911 [28, 412]. Likewise, there was a certain tradition of mathematical textbook publishing in the U.S. at both the high school and college levels, which was partly modeled after French and British examples[4] and partly conditioned by the need of low paid teachers and college professors for supplementary income [43, 94–95]. By way of contrast, at the university level at least, there were only a few textbooks for mathematics in Germany before 1900.[5]

Totally lacking in the U.S. at the time of Simon Newcomb's scathing article of 1874, however, were media *specialized* to the publication of mathematical research, above all journals and advanced monographs. Famous memoirs by Benjamin Peirce

[3] Henceforth ''America'' is sometimes used as an abbreviation for United States of America.
[4] Cf. [2, 49], [30], and [35].
[5] Cf. [6, 46]. Duren remarks: ''The Germans wrote treatises, not textbooks'' [5, 401].

(1870), George W. Hill (1877), and Josiah W. Gibbs (1881/84) had to be privately printed and circulated [28, 31 and 46].

Newcomb would play a role in 1876 in the foundation of the first American ''research university,'' Johns Hopkins at Baltimore, and in the subsequent launching of the *American Journal of Mathematics* under the English mathematician James Joseph Sylvester in 1878 [28, 88–94].

In a circular to the American mathematical community, Sylvester and his co-founders of the *American Journal* (Newcomb, Henry A. Rowland, and William E. Story) stressed the example of the German *Journal für die reine und angewandte Mathematik* (*Crelle's Journal*). They pointed—somewhat misleadingly[6]—to the financial support it received by the ''enlightened government of Prussia'' [28, 90]. However, no government funds could be secured for the *American Journal* nor did the founders find a publisher willing to take on the risk of such a highly specialized journal. In the case of the *American Journal,* the trustees of the (private) Johns Hopkins University were finally persuaded to fund this pioneering effort. Nevertheless, the events accompanying the foundation of the journal foreshadowed several problems mathematical publishing in the U.S. would repeatedly face in the decades to come. Insufficient public and private support regularly forced the American mathematical community to take on all of the financial responsibilities for its publishing. This became a crucial point both in the foundation (in 1894) and the subsequent growth in membership of the American Mathematical Society (AMS).[7]

The publication policies of the *American Journal* during the first decades of its existence were at the same time internationalist and provincial: both Sylvester and Newcomb, his successor as editor in 1884, felt that a high percentage of foreign contributions would facilitate the entrance of American mathematicians into the international mainstream of mathematical research. In the six volumes issued under Sylvester's charge, foreign, mostly British, contributions[8] composed on average 25% of the papers published. What characterized the *American Journal* even more than its foreign contributors, however, was its high percentage of Hopkins and Hopkins-connected authors. Also during Sylvester's editorship, an average of 45% of each volume came from those who taught at, were Fellows of, or had received Ph.D.s from the Johns Hopkins University in Baltimore [28, 412].

[6] As Eccarius points out, Crelle's application to the Prussian king, Friedrich Wilhelm III, for funds met with a flat denial in 1826 [7, 12]. It was only in 1848 that the Prussian ministry of culture gave some modest support [7, 14].

[7] As Parshall and Rowe point out [28, 404], the failure of E. H. Moore to secure funds from his own University of Chicago for the publication of the papers read at the 1893 Mathematical Congress of the World's Columbian Exposition in Chicago [23] stimulated the New York Mathematical Society (founded 1888) to rename itself the American Mathematical Society (in 1894) after it had pledged financial support to the publisher. In the 1920s, the call for increased membership of the AMS was at least partly motivated by the desperate need of the Society's publications for membership fees. See below.

[8] Most significant were algebraic papers such as those by Arthur Cayley and Percy MacMahon. Rudolf Lipschitz (in the first volume) was the only prominent German mathematician to contribute to the *American Journal* in its first two decades, if one neglects German mathematicians permanently or temporarily working in the U.S., such as Oskar Bolza, Heinrich Maschke, and Eduard Study.

This situation led finally to the foundation of the *Transactions of the American Mathematical Society* under the Chicago mathematician, Eliakim Hastings Moore, in 1899. In that new period of growing research-consciousness among American mathematicians, the *Transactions* pursued quite a different editorial policy, limiting foreign contributions to about 10% and not claiming more than 22% for articles from Chicago [28, 413]. The preference given to American contributions and the growing self-confidence of American mathematics are illustrated by discussions within the editorial staff on a manuscript submitted by the German geometer, Hans Beck, to the *Transactions* in 1910. One editor (probably William F. Osgood) wrote to Maxime Bôcher: ''The paper is well written and is interesting, and if it had come from an unknown American doctor, I have no doubt that we should have accepted it without hesitation.... The weak point about the paper is that it is not a distinctly strong foreign contribution. We shall have exceeded our 10% limit in this volume which we have set for foreign contributions, if Runge's paper materializes'' [HUA1]. Finally, however, the American editors felt compelled to print Beck's article, since it had been submitted more than seven months prior and because a belated rebuttal ''would be at best to acknowledge to the author that we, i.e., *we Americans,* had not dealt sufficiently with the paper'' [HUA1].[9]

The discussions showed at the same time that the leading American mathematicians were anxious to secure ''distinctly strong foreign contributions'' and not to alienate prominent European authors. In fact, unlike the *American Journal,* prominent German mathematicians such as David Hilbert, Paul Gordan, Alfred Pringsheim, and Issai Schur contributed to the first volumes of the *Transactions,* thereby testifying to their increased interest in American mathematics.

For the period until World War I, Daniel Kevles gives figures for publications by American scientists and mathematicians in leading European journals [16, 149]. According to Kevles's data, the ''productive groups'' of chemists, mathematicians, and physicists around 1900 published between one sixth and one fifth of their papers abroad. In the half century from 1865 until World War I, physicists and mathematicians published approximately 30% of their foreign papers in journals of German-speaking countries (Germany, Austria, and Switzerland), while chemists published an even higher 80% [16, 165]. There was a tendency, however, among American mathematicians, at least after World War I, to ''save'' their best contributions for their own national periodicals. This is most clearly evidenced in the case of George David Birkhoff's publications after 1913.[10] But even before World War I, the few American contributions of international importance (by William F. Osgood, E. H. Moore, Oswald Veblen, and James Alexander) appeared in American

[9] Beck's paper, ''Ein Seitenstück zur Möbiusschen Geometrie der Kreisverwandtschaften,'' appeared in **11** (1910), 414–448. Its appearance may have been stimulated by the fact that Runge's paper, announced in the discussions among the editors, did not materialize.

[10] Perhaps this contributed to a growing ''isolation from European mathematics'' as characterized by William L. Duren [5]. See below. Birkhoff's famous ''Proof of Poincaré's Geometric Theorem'' appeared in the *Transactions of the AMS* in January 1913, and Birkhoff published all further important work in America.

journals.[11] So Kevles's conclusion that American scientists before World War I published their most important papers abroad seems doubtful, at least for mathematics. Also, a quantitative study by Fenster and Parshall [8] makes the selection of the "62 most active members of the American mathematical community 1891–1906" on the basis of their publications in *American* outlets.

By and large, however, German mathematics remained the teacher of American mathematics until World War I.[12] One strong indication of the dominance of German mathematical culture in comparison to its American counterpart is the *Bulletin of the AMS,* where reviews of German books and reports on the meetings of the Deutsche Mathematiker-Vereinigung—much more so than of similar events in Britain and France—figured prominently in almost every issue.[13] Thomas S. Fiske, in his presidential address before the AMS in 1904, stressed the importance of securing "more adequate financial support" for the American journals. Fiske hinted at the example of European countries in this respect, where "it is not unusual for the government to give financial support to such publications" and suggested the translation of the new German mathematical encyclopedia,[14] which had been initiated by Felix Klein in 1898: "It is quite possible that in some cases direct translation from foreign languages would be highly beneficial.... An English translation of the new German encyclopedia of mathematics would probably do much to spread throughout this land of seventy-five million inhabitants a knowledge of, and an interest in, advanced mathematics" [9, 11].

ECONOMIC AND POLITICAL PROBLEMS AFTER WORLD WAR I: A 1924 MEMO BY G. H. HARDY

Because of the early promising developments in American mathematical journals, especially the publication of the *Transactions of the American Mathematical Society* in 1900, Kevles concludes that "on the eve of World War I, mathematics was probably the best developed of the three disciplines practiced in the United States" [16, 157]. If one may question the general validity of Kevles's assumption and restrict it rather to pure mathematical research,[15] there is no doubt about the

[11] Compare, for example, E. H. Moore, "A Doubly-Infinite system of Simple Groups," in [23, 208–242]; William F. Osgood, "Non-uniform Convergence and the Integration of Series Term by Term," *American Journal of Mathematics* **19** (1897), 155–190; and James W. Alexander and Oswald Veblen, "Manifolds of n Dimensions," *Annals of Mathematics,* 2nd ser., **14** (1913), 163–178. Maxime Bôcher's dissertation of 1891, published as a book in Germany in 1894, seems to be an exception in this respect. (See Appendix 1).

[12] See [28], where among many other things, the names of the most prominent American mathematicians, such as Osgood and Bôcher, who took their doctorates in Germany, are listed.

[13] Goldstine [10, 170] considers the listing in the *Bulletin* of the lectures to be given in Göttingen as a clear sign of "European dominance in mathematics and physics" in those years. In 1891, Frank N. Cole, secretary of the AMS for the period 1895–1920, supported the foundation of the *Bulletin* as an outlet for "the presentation in a clear and intelligible form of the pure mathematics of the present German school" [2, 50].

[14] A full translation of the German *Encyclopedia* would never materialize.

[15] This owes especially to the relative inhomogeneity of the American mathematical culture at that time with respect to applications, reviewing, and school mathematics.

significantly higher degree of independence of American mathematics from its German master after World War I. In addition, the political estrangement resulting from the war would show in the diminishing presence of American contributions in German journals in the years to come. While 18% of foreign contributions in the leading German journal, *Mathematische Annalen,* between 1899 and 1914 had come from American authors (thereby even surpassing the portion of Austro-Hungarian authors), it was just 8% between 1920 and 1943, when the Americans were clearly out-distanced by Soviet authors who boasted 20% [42, 34–35]. Similar developments, if on a considerably lower level as to the numbers of foreign authors involved, showed in the *Jahresbericht der DMV* and in the *Zeitschrift für angewandte Mathematik und Mechanik* [42, 29 and 96].

Considerable problems as to the scientific infrastructure of American mathematics remained to be solved, however. Immediately after World War I, some American mathematicians tried to capitalize on the recently forged alliance between basic science and the federal government, which had led to the foundation of the National Research Council (NRC) in 1916. A Committee on Bibliography of the AMS, founded in December 1918 under Raymond C. Archibald, hoped for federal funds to use for the formation of a "great series of Year Books published through the Smithsonian Institution."[16] This was planned in order to break the monopoly of the German reviewing journal, *Jahrbuch über die Fortschritte der Mathematik* [38].

While American mathematicians felt a growing independence from Europe in research,[17] they still saw the need to gain independence with respect to the publication system as well. During and shortly after the war, nationalistic emotions accompanied these endeavors. For instance, group theorist George A. Miller wrote in the August 1918 issue of *Science:* "Our students should not have to feel that the great majority of the best expository works relating to their subject are to be found only in the language of a people of low ideals imbued with a morbid desire to dominate the world at any cost" [21, 117]. Although the history of German–American mathematical relations after World War I reveals at least latent nationalism on both sides, such nationalism did not surface as blatantly as in the relations between, for example, German and French mathematicians. That this nationalism would be rather moderate does not come as a surprise, in view of the emotional ties that older American mathematicians had to Germany. Moreover, the absence of a past of political confrontations also dampened nationalistic feelings.

The longing for independence from Europe in mathematical publishing was thus not primarily the result of a particular anti-German bias. It rather paralleled broader

[16] [38, 312]. See also [39].

[17] Archibald, who took over from Cole as AMS secretary in 1921, wrote retrospectively about the early 1920s, thereby characterizing the late 1930s even more: "By the end of the period mathematical America was very different from what it had been thirty years before. It had made many notable contributions to knowledge and developed a vigorous individuality, for all time freed of foreign domination" [2, 51].

"isolationist" tendencies in the American society of the 1920s.[18] The Archibald Committee declared in 1920: "An attempt to improve existing publications, by more extensive international cooperation on the part of Americans, seemed neither feasible nor desirable" [38, 314]. By and large, however, "isolationist tendencies" were probably less typical of the leading American scientists and mathematicians than of American society as a whole in the years to come [14].

These considerations aside, the postwar aspirations of American scientists and mathematicians with respect to enlarged governmental support for (the particularly expensive) *secondary systems of mathematical information* (reviewing journals, encyclopedias) went unrealized for the most part. This was not surprising given the fact that even the NRC fellowships for young scientists and mathematicians were not government-funded but were paid by the Rockefeller family.

There were even signs of moral and financial support by Americans for the German publication system in the sciences and in mathematics, which was under much pressure in the first years after the war due to inflation and the political "boycott" of German science. Some of this support was channeled through agencies such as Rockefeller's various foundations and organizations like the Emergency Society for German and Austrian Science and Art to the Notgemeinschaft der Deutschen Wissenschaft in Berlin [44, 103]. That not all of this American support was solely altruistic becomes clear, for instance, from the following letter, written in 1931 on behalf of the Emergency Society to Max Mason, mathematician and president of the Rockefeller Foundation, by the German-American anthropologist, Franz Boas: "I believe it is not necessary to emphasize the importance of the continued contact between American and German science and the serious situation that will result from discontinuance of the use of American scientific results by German scientists" [RAC1]. In 1924, Boas had supported the acquisition of the German reviewing journal *Jahrbuch über die Fortschritte der Mathematik* by American libraries [BAK1]. Especially in the case of mathematical reviewing journals, Americans continued to appreciate the service which the German community gave to world mathematics [38, 317–318].

On the other hand, American science and American libraries profited from the wrecked economic conditions in Europe, and especially in Germany in the early 1920s. The librarian of the AMS and of the Brown University mathematics library, Raymond C. Archibald, went repeatedly to Europe during the summers to make cheap acquisitions, particularly for the university.[19] As early as 1922, however, Archibald saw signs of an economic recovery in German science, especially with respect to publications. Writing to his colleague at Brown and AMS secretary, Roland G. D. Richardson, Archibald observed that "[i]t seems that a revolving

[18] At least with respect to high school mathematics, W. L. Duren finds "isolation from European Mathematics" in the 1920s [5, 405]. Compare also the decline of the number of American publications in German journals discussed above.

[19] Cf. [40]. In a letter to his colleague, R. G. D. Richardson in 1922, Archibald is enthusiastic about the "wonderful bargains" he got in several bookstores in Leipzig and adds that "[i]t is nice to meet such people as Liebisch and Neuberg who do not know the market value of their wares" [BUA1].

fund for publication of high class scientific works has been available here for some time,'' and he advised not overdoing American support to German mathematics: ''On the whole then, I do not think that the Amer.Math.Soc. should show any undue favors to Germans in connection with the sale of its publications'' [BUA1]. Four years later, in 1926, in a report on his trip to Europe as an adviser to the Rockefeller agency, the leading American mathematician George David Birkhoff would comment that ''publication [in Germany] has gone on, actually at an increased rate,'' while conditions in this respect in Belgium and France particularly were ''far from satisfactory'' [HUA3, p. 5]. Moreover, the situation of the AMS itself with respect to mathematical publications was far from ideal in the 1920s. By and large, the AMS had, once again, to rely on its own rather meager resources for publishing. In this regard, there were some analogies to the contemporaneous situation in England and clear differences from the conditions in Germany. This is convincingly revealed in a memorandum, submitted by the leading English mathematician, Godfrey H. Hardy, to the Rockefeller International Education Board (IEB) in April 1924. Hardy applied for support for the foundation of a new English mathematical journal[20] and wrote that:

> Of all the difficulties that mathematics has to face at the moment, perhaps the greatest is this problem of publication. It is great everywhere, but it assumes a special form in England and America, because it is there only that the chief mathematical journals are published by societies. In Germany, for example, the *Mathematische Annalen* and *Mathematische Zeitschrift* (the two absolutely first class journals) are owned by the publishing firm of Springer, who are, I believe, prepared to sink a good deal of money in them in the interests of science and the reputation of their house. The *Acta Mathematica* is subsidised by the Scandinavian Government, and the *Fundamenta Mathematicae* by the Polish. In England the only journal, of a mathematical character, and at all first rate, is our *Proceedings.* [RAC2, p. 2]

Hardy also stressed the importance of soliciting foreign contributions to the national journals. Such solicitation had been impeded in the past due both to the war and to the limited space in those journals:

> It is common ground (I hope and think) that the status of both English and American mathematics has improved very greatly during the last 20 years, and, in many ways, everything is favorable for a further big advance. But, in order to do this, it is essential that we should be able to encourage foreign cooperation in every way. It is reasonable to insist on a very high standard from a French or German contributor; but every first rate contribution from outside raises our standard and status, keeps our own men in touch with the latest developments, and supplies them with a flood of ideas. [RAC2, p. 4]

About the time of Hardy's 1924 memo, Princeton's Oswald Veblen, who cooperated with Hardy,[21] asked the International Education Board for financial support to American journals, thereby referring to the ''conditions in the world at large (which) make it very desirable that our American periodicals should open their columns to mathematicians of foreign countries. It has hitherto been impossible to do this on any scale, because the American contributions would thereby be forced to

[20] From 1926, the *Journal of the London Mathematical Society* appeared with support from the IEB.
[21] They temporarily exchanged their professorships in Princeton and Oxford.

wait even longer than they do now'' [AAMS1].[22] As late as 1932 AMS secretary Richardson motivated the need for the foundation of a new American mathematical journal using arguments similar to Veblen's.[23]

In 1924 as well as in 1932 [34, 8] rising printing costs, which had been high in the U.S. even before WWI [25, 147], prevented both an expansion of American mathematical journals and the printing of advanced monographs. The AMS, which was responsible for the *Transactions,* the *Bulletin,* and the *Colloquium* series, had to spend almost all its membership fees on printing. The particular problems of mathematical printing, which had also been stressed in Hardy's memo,[24] added to the difficulties. Thus, printing was a major stimulus for enlarging the membership figures from 750 in 1922 to about 1900 in 1932 [34, 8; 2, 29]. In 1934, the Society introduced page charges for articles to be defrayed by the universities from which the respective authors came [2, 35]. The aspirations within the AMS for extending its publication facilities remained largely unbroken in the 1930s and 1940s, although around 1930 in some more conservative quarters of the Society, fears were articulated that American mathematicians might publish too much material of dubious quality [4, 92].

In the early 1920s, costs could be limited by printing mathematical books and journals, among them all official AMS publications, in Germany and especially with Lütcke & Wulff in Hamburg. In the case of the *Transactions,* which had been originally printed in America, the AMS even transferred its printing temporarily to Hamburg [33, 204]. When inflation ended in Germany in 1924, however, the advantages of printing abroad gradually ceased.[25] Since printing was still cheaper in Germany even in the late 1920s, the transfer of printing to the U.S. during that period of time [2, 31–32] is another sign of the Americans' aspirations for independence in publishing, which would prove so well-founded and foresightful after 1933. The printing subsidies of the Rockefeller General Education Board for the AMS publications between 1925 and 1934, which were, as Richardson put it, ''to be applied to defraying the extra cost of printing the journals in this country'' [33, 205], contributed to those aspirations for national scientific independence. The

[22] Veblen was obviously referring to nationalist and isolationist tendencies, as revealed in the ''boycott'' against German science.

[23] Richardson to G. D. Birkhoff, 9 March 1932 [BUA2]. Richardson hoped for the creation of another journal in connection with the newly founded Institute for Advanced Study (IAS) in Princeton, which was in negotiations with Birkhoff about a possible call at that time. Although it did not appear in Princeton, the publication (since 1935) of the *Duke Mathematical Journal,* which had been proposed by the AMS as early as 1927 [2, 17], would ease the situation considerably. This journal would print the papers of many immigrants.

[24] Hardy wrote in his memo of 1924 that ''[t]he 'printing bill' assumes an importance to a mathematical society which does not quite reach for any other society, because (a) mathematical printing involves the absolute maximum of cost and (b) because it is their *only* heavy expenditure. We have no laboratories, and no materials to buy beyond books, periodicals, paper, and ink. There are only two things we want, leisure and money to print'' [RAC2, p. 5].

[25] The *Bulletin of the AMS* **31** (1925) was printed in Hamburg, while volume **32** (1926) was produced by the *Collegiate Press,* Menasha, Wisconsin.

last and decisive impulse for the transfer of printing to the U.S. was, of course, the political events in Germany in 1933, which forced the editors of the *Annals of Mathematics* and of the *Colloquium* series to turn to indigenous printing firms.[26] IAS director, Abraham Flexner, wrote to Albert Einstein on 15 April, 1933, concerning the *Annals:* "The journal has hitherto been printed in Hamburg, but under the existing circumstances it will have to be printed in the United States, which will insure more prompt publication" [EP].

Besides the financial aspect, the peculiarities of printing mathematical texts created problems for American firms due to their comparative lack of experience in that field.[27] The quality of printing in Germany, and especially at the Springer publishing house, had set high standards which were repeatedly acknowledged by American mathematicians.[28]

As late as the 1930s and 1940s, some German mathematicians, among them immigrants such as Richard Courant and Hermann Weyl, were doubtful about the quality of production and marketing for scientific publications in the United States (see below). Printing costs remained a problem for the AMS in the years to come.

THE PROBLEM OF "ADVANCED MONOGRAPHS"

One pressing need of U.S. mathematics since its turn to research-consciousness around 1900 had been the lack of specialized, advanced monographs. Some American mathematicians published abroad, partly in Germany, while Runge's book of 1912 seems to be the rare example of an original monograph published by a German in the U.S. (cf. Appendix 1). In 1910, in a report of the American Subcommittee of the International Commission on the Teaching of Mathematics, the "inadequate" financial situation of American professors was cited as one of the reasons for the lack of really advanced monographs:

> His only resource may be to write a textbook in one or more of the four elementary subjects in which there are large college classes. Hence we see issued year after year a large number of such books, the majority of which resemble one another like peas in a pod, and contribute little or nothing to mathematical progress. Rarely does the mathematician have both time and knowledge to write—for such fame and glory as there may be in it—the unremunerative advanced mathematical textbook or treatise so much needed in the English language. [43, 94–95]

A second reason for the lack of advanced monographs was the undeveloped state of commercial scientific publishing in the United States.[29] Following the war, rising

[26] As late as 1930, Solomon Lefschetz's "Topology" (*Colloquium XII*) was printed by Lütcke & Wulff. Veblen discussed the matter of printing the *Colloquia* in America in a letter to Caroline Seely, dated 9 May, 1933 [BUA3].

[27] Edgar R. Lorch, who, as John von Neumann's assistant at the IAS in Princeton, was in 1933 responsible for the *Annals,* reported in 1989 on his frequent trips to the printing firm near Princeton "to teach the printers how to set up subscripts, superscripts, etc." [18, 158].

[28] Compare, for example, Francis D. Murnaghan's review of Leon Lichtenstein's *Grundlagen der Hydrodynamik,* Berlin: Springer-Verlag 1929, in the *Bulletin of the AMS* **36** (1930), 778.

[29] This had also been deplored by the German-American psychologist, Hugo Münsterberg, in 1909 [24, 81–82].

production costs (as described above) caused the further deterioration of this situation.

Veblen[30] wrote a letter to the chair of the Division of Physical Sciences of the National Research Council (NRC) in 1922, stating that ''the United States has published fewer advanced mathematical books than any other country of similar wealth and culture'' [HUA2]. Veblen then gave the numbers per year of advanced mathematical monographs in America by American authors in the following list:

1914	1915	1916	1917	1918	1919	1920	1921
10	6	5	8	4	1	2	1

He concluded that ''[t]he publication of advanced mathematical books has practically ceased since the war'' [HUA2].

Veblen, in his letter, motivated the need for advanced monographs by means of their coordinating function relative to mathematical research, most of which was found in journals: ''The publication of research in the journals accumulates a mass of material which if not digested and incorporated in books would bring science to a stop in sheer bewilderment at its own riches'' [HUA2].

Veblen led an NRC committee that produced a memorandum [HUA2] in 1922 entitled ''A revolving fund for scientific books,'' which, while originally destined for all the sciences, was to become one of several[31] initiatives for stimulating the publication of advanced mathematical books in the United States. What is of particular interest here is the broad reference in the memo to the European, especially the German example (see Appendix 2). The memo refers to the fact that ''the present high cost of manufacture of books is halting the publication of such books throughout the entire world'' [HUA2, memo, p. 1]. Veblen's committee therefore applied to the NRC for a small self-regenerating fund (the ''revolving fund'') which would try to save at least those manuscripts of advanced monographs which were ''commercially feasible by a small margin,'' that is, those which were *almost* profitable. With respect to Germany, the memo hints at the positive implications of German scientific publishing for the prestige of Germany and the German language. It concludes by declaring that the creation of a ''revolving fund'' is a ''patriotic duty'' and the publication of American advanced scientific monographs is an ''entirely legitimate and beneficial form of national propaganda'' [HUA2, memo, p. 4] (cf. Appendix 2).

From Veblen's letter to the NRC, quoted above, it is clear that the memo, which had certainly been written by Veblen, merely ''played'' with the nationalist feelings of some Americans. In Veblen's words: ''It would seem to me that the contrast of what is happening in those countries with what is happening in America ought to

[30] Veblen was nominee of the AMS for the NRC in 1920–1923. See [2, 15].

[31] Other initiatives were the AMS *Colloquium* series and the *Carus Mathematical Monographs,* the latter in connection with the Mathematical Association of America. Cf. [19, 138–139].

stir some of the springs of action in our patriots and nationalists'' [HUA2, letter to H. G. Gale]. Finally, the NRC (with money from Rockefeller) granted the creation of a modest ''revolving fund'' of $1500, which was, however, destined for mathematics exclusively and thus obviously honored Veblen's particular merits and underscored the particularly tight conditions in mathematics. Luther P. Eisenhart's *Transformation of Surfaces* thus appeared in 1923 with the following remark on the title page: ''Published with the cooperation of the National Research Council.'' This book was still printed in Hamburg. The revolving fund was still in existence in 1938 but apparently had not supported the publication of more than four books up to that time [2, 159].

At any rate, even toward the end of the 1920s the AMS needed subsidies for printing advanced monographs. In an eight-page *Report on the Present Status of Publication in the Mathematical Field,* dated 20 February, 1929, AMS secretary Richardson applied to Rockefeller's General Education Board, which usually channeled its money to the AMS through the NRC: ''A Revolving Book Fund needed to aid in the publication of advanced mathematical treatises of which there is great dearth in the English language.... Suggestion $1500'' [RAC3, p. 6]. This situation did not immediately improve in the 1930s, although the borders between textbooks and advanced, specialized monographs became increasingly blurred during the course of the 1930s with growing specialization in mathematics and the rise of axiomatics. As a matter of fact, foundation-oriented books such as Bartel L. van der Waerden's *Moderne Algebra* (1930–1931) and Andrei N. Kolmogorov's *Grundbegriffe der Wahrscheinlichkeitsrechnung* (1933) can be alternatively labeled as introductory (for students) and as research-oriented, as these books reordered and fundamentally penetrated the existing body of mathematical knowledge.

In an interesting essay, Paul Halmos gave a list of ''some books of auld lang syne'' [13], which he found most impressive during his days as a student of mathematics in the United States in the 1930s. Since Halmos was a student at that time, the 26 books which he cites have to be judged primarily as textbooks, if rather advanced university-level ones. Among these texts, seven have an author from the German cultural domain: Richard Courant's *Differential and Integral Calculus* (1936), Felix Hausdorff's *Grundzüge der Mengenlehre* (1914), Konrad Knopp's *Funktionentheorie* (1930), Edmund Landau's *Grundlagen der Analysis* (1930), Carl L. Siegel's *Transcendental Numbers* (1949), Constantin Carathéodory's *Vorlesungen über reelle Funktionen* (1917), and Bartel L. van der Waerden's *Moderne Algebra* (1930–1931).[32] Of the other 19 books, all but four have American authors. Moreover, 19 of the 26 books had been published in English, including two translations from the German language. Six appeared in German and were not available in translation before 1945. Just one single book appeared in a language other than English or German, namely, Stefan Banach's *Théorie des opérations linéaires* (1932).

[32] I include here the books by van der Waerden and Carathéodory, but exclude, of course, Kolmogorov, although written in German.

Halmos's list tells something about the still considerable standing of German mathematical literature and of the German language[33] within the education of graduate students in the United States of the 1930s. A closer look reveals that four out of the seven books from the German cultural domain (Hausdorff, Carathéodory, van der Waerden, Siegel) and, in addition, Kolmogorov's *Wahrscheinlichkeitsrechnung* could be labeled as research monographs as well, at least at the time of their first appearance. On the other hand, the book by Courant, which of all the books mentioned came closest to a textbook in the German sense, was not properly adapted to the needs of American undergraduate students, as Courant himself admitted.[34]

So it was, above all, the German tradition in mathematical research which was still influential and reached American graduate students as late as in the 1930s without intermediate translation or commentary.

THE EMANCIPATION OF AMERICAN RESEARCH JOURNALS

1. The "Time Lag" between German and American Journals

Between the two World Wars a number of new mathematical journals were founded in different countries, thereby partly reflecting the rise of national mathematical schools. Among them were journals of a more general character, such as the German *Mathematische Zeitschrift* (1918–), the English *Journal of the London Mathematical Society* (1926–), the Dutch *Compositio Mathematica* (1934–), and the American *Duke Mathematical Journal* (1935–). In addition, specialized journals such as the Polish set-theoretic and topology-oriented *Fundamenta Mathematicae* (1920–) and the number-theoretic *Acta Arithmetica* (1935–1939, 1958–), as well as the American *Annals of Mathematical Statistics* (1930–) and *Journal of Symbolic Logic* (1936–), were founded in that period of time.

The leading German and American mathematical journals of a more comprehensive character before 1945 were, on the German side:

Journal für die reine und angewandte Mathematik ("*Crelle,*" 1826–),
Mathematische Annalen (1869–),
Mathematische Zeitschrift (1918–), and
Zeitschrift für angewandte Mathematik und Mechanik (*ZAMM,* 1921–);

and on the American side:

American Journal of Mathematics (1878–),
Annals of Mathematics (1884–),
Transactions of the American Mathematical Society (1900–),

[33] German was still an official requirement for graduate students in mathematics in the 1930s.

[34] In December 1936 Courant sent the two volumes of his *Differential and Integral Calculus* to Warren Weaver of the Rockefeller Foundation commenting on it with the following words: "It is the English edition, considerably changed from the German original of lectures I have given in Göttingen. I am fully aware of the fact that these lectures are in a way starting at too advanced a level to be fitted as a basis for a general course at American universities" [CP5].

Duke Mathematical Journal (1935–), and
Quarterly of Applied Mathematics (1943–).

In addition, the journals of the two leading national academies frequently carried important mathematical contributions:

Sitzungsberichte der Preussischen Akademie der Wissenschaften (1882–), and
Proceedings of the National Academy of Sciences (1915–).

Finally, the communications of the two national mathematical societies merit mention:

Jahresbericht der Deutschen Mathematiker-Vereinigung (1890–);
Bulletin of the American Mathematical Society (1895–).

The articles they carried were primarily of a general, introductory character and rarely included new results.

All these journals were ''national'' in the sense that their editorial staffs consisted almost exclusively of representatives of the two respective national communities—very much unlike the situation of journals such as the *Mathematische Annalen* today. By way of contrast, the editorial boards of some journals published in smaller countries, such as the Swedish *Acta Mathematica* and the Dutch *Compositio Mathematica,* comprised from the beginning mathematicians from other countries.

The dates of foundation of these national German and American mathematical journals reveal the ''time lag'' in the development of the two mathematical cultures, which was palpable until the 1930s and resulted, for instance, in a 22-year difference in the respective creations of the two national journals for applied mathematics (cf. below).

What was different between the two World Wars was the lack in Germany of new specialized mathematical journals of importance comparable to the American *Annals of Mathematical Statistics* (1930) and *Journal of Symbolic Logic* (1936).[35] In this particular respect, the American mathematical culture was obviously more ''modern'' than the German one, ''modernity'' taken in the sense of the emergence of relatively independent subdisciplines.[36] That the emergence of those journals was intimately connected to the different structure of the American science system becomes even more obvious if one takes into account that both statistics and logic were mainly of European origin and were now being transplanted to the U.S. due in no small measure to the mass exodus of European mathematicians.

[35] Ivor Grattan-Guinness commented on the foundation of the *Journal of Symbolic Logic:* ''Since that time America has been a leading country for logic, and saw the founding in 1936 of the Association for Symbolic Logic. This organisation is still the only international organisation for the subject, and its *Journal of Symbolic Logic,* also founded in 1936, was the first journal devoted exclusively to logic and related topics'' [11, 500].

[36] With respect to the economic infrastructure of publication, however, the German system seems to have been more ''modern'' than its American counterpart at that time.

The foundation in 1935 of the *Duke Mathematical Journal,* which published many papers by immigrants, reflected, above all, the increase in mathematical research activity in the U.S. Likewise, Solomon Lefschetz of the *Annals of Mathematics* reported a ''terrific crowding of our publication'' (Appendix 3) at that time, while, simultaneously, in Germany there was a lack of qualified manuscripts in the leading journals [37, 113].

One particular feature of the American system of mathematical research publishing was the lack of a journal for applied mathematics. A solution was only found during World War II, when the emergency situation finally showed the need for applications most convincingly. The story of the creation, in 1943, of the *Quarterly of Applied Mathematics* cannot be told in full detail here.[37] Suffice it to say that there were unsuccessful attempts within the AMS as early as 1929 to found a journal for applied mathematics, for example by reorganizing the MIT *Journal of Mathematics and Physics,* and that these efforts failed due mainly to economic conditions in the depression [2, 17–18]. The foundation of the *Quarterly* at Brown University was influenced by immigrants such as W. Prager and Theodor von Kármán, who originally pointed to the role model of the German *Zeitschrift für angewandte Mathematik und Mechanik.* To the former editor of that journal, Richard von Mises, then at Harvard, Kármán wrote in 1940:

> I got the impression that it would be quite a promising venture and was surprised to understand from Birkhoff that he apparently would help to support it. In general, he is not very much in favor of ideas imported from Europe. My only worry is that it will be very difficult to secure the international character of the Journal in the present condition because a great part of our future members of the International Editorial Board are living already in the Nazi domination. [KP]

Indeed, the war did not allow the *Quarterly* to become an international journal in the first years of its existence.

2. Citations of German and American Papers as Indicative of Changes in the Relative Strengths in Mathematical Research

An article [1] on ''Periodicals for mathematicians,'' published in 1929 by the American librarian Edward S. Allen, allows conclusions concerning the relative strength of mathematical research in Germany and the U.S. towards the end of the 1920s.

Allen and his collaborators investigated the three most important American and six leading foreign mathematical journals with respect to the total number and chronological distribution of citations of other mathematical periodicals given in those nine journals in the same year, 1928. From these figures, Allen made a rank-ordered list of the 30 leading mathematical periodicals for the year 1928. This procedure, of course, admittedly had an ''American bias,'' which Allen motivated

[37] The author is currently working on a larger project, including the interesting historical problem of the ''late arrival of applied mathematics in the U.S.''

by his intention to "be helpful to American librarians" [1, 592].[38] The selection of the three most important American journals, *Transactions, Annals,* and *American Journal,* was unproblematic. For the "six leading foreign periodicals," Allen chose those journals which were most frequently cited by the three American journals.[39] Allen excluded the German *Crelle's Journal* which, like the *Mathematische Annalen,* came out as one of the six most cited, since he wanted to have six foreign journals from *different* countries. This means a second, if rather slight bias, this time anti-German. That the last-mentioned bias, however, was not a real one, becomes clear from *Crelle's* ranking in the overall list; there the journal comes in only ninth. That means *Crelle* had been overestimated by the three leading American journals, due certainly to the great portion of papers cited that were published in *Crelle* prior to 1908 when many Americans had studied in Germany. On the other hand, the *Mathematische Zeitschrift,* which came in sixth on the overall list, had been underestimated by the three leading American journals, indicative perhaps of a certain divergence of German and American mathematical interests (especially in topology and abstract algebra) in the 1920s.

In Allen's ranked list of the 30 leading mathematical periodicals, the German journals, with respect to the two most important criteria, are still (for the year 1928) internationally dominant. The two criteria are, of course, the total number of citations of the German journals and their ranking in the list. The total number of references to the five German mathematical journals which appear in the list are

$$(250 + 79 + 63 + 29 + 22) = 443 \text{ citations.}$$

The second place in this respect goes to the U.S., with the five appearing American journals drawing

$$(131 + 78 + 62 + 58 + 57) = 395 \text{ citations.}$$

The difference between the two countries becomes even clearer if one ignores the 22 references to the *Jahresberichte der DMV* and the 78 references to the *Bulletin of the AMS,* which were mostly not research-related.

A somewhat different picture emerges, however, if one goes into the distribution of citations as to the time of publication. With respect to those papers cited, which appeared after 1919, there are

$(124 + 79 + 10 + 13 + 15) = 241$ citations of German papers and
$(82 + 58 + 42 + 33 + 53) = 268$ citations of American papers in the ranking list.

[38] Allen showed consciousness of the methodological restrictions of his study and motivated the inclusion of foreign journals to the database: "If there were any one-sidedness, any excessive inbreeding in American mathematics, the use of American references only as a guide for librarians would merely tend to perpetuate them" [1, 593].

[39] These were the *Proceedings of the London Mathematical Society, Mathematische Annalen, Journal de Mathématique* (*Liouville*), *Rendiconti del Circolo matematico di Palermo, Acta Mathematica,* and *Fundamenta Mathematicae.*

As to the place in the ranking list, the *Mathematische Annalen* was still unrivaled in 1928 with 250 references, with the Polish *Fundamenta Mathematicae* (201) and the American *Transactions* (131) following at second and third. The three most frequently cited German journals (*Annalen, Mathematische Zeitschrift,* and *Crelle*) drew 392 references as compared to 271 citations for the three leading American journals (*Transactions, Annals,* and *American Journal*). Even a restriction to citations of work, which appeared after 1919, does not change the overall picture considerably, at least with respect to the *Mathematische Annalen,* if one agrees that the first place for the *Fundamenta* in this period has something to do with an outburst of "fashionable" set-theoretic work in the 1920s and is therefore not typical for mathematics as a whole. As to "fashions" in mathematics, Allen expressly emphasized the importance of the German *Sitzungsberichte der Preussischen Akademie der Wissenschaften,* the absence of which in the list of the 30 leading journals he explained as an "accident of the interests of mathematicians publishing in 1928" [1, 594].

In a ranking list for 1942–1944 which was also based on the citation method, the *Mathematische Annalen* came in only second, while *Mathematische Zeitschrift* and *Crelle* with their sixth and eighth places ranked approximately as in 1928 [17, 266].

About the same time, in 1943, the chair of the *Deutsche Mathematiker-Vereinigung,* Wilhelm Süss, warning against the danger of an international isolation of German science and mathematics, had the following to say at a conference of German university presidents in Salzburg in occupied Austria:

> To be sure, our scientific emigrants have provided the enemy with a considerable influx of potential. But even without this, the development in various scientific fields has been unfortunate for us. We have lost our former advantages and are, in some instances, now behind the enemy-countries. In order to prove this I will go into the situation in mathematics and physics. . . .
>
> From all mathematical journals of the world of 1937 . . . all citations have been counted and ordered according to countries and years. Of all papers cited in 1937 which were published until 1870 about 46% were written by German authors, 20% by English and only 1% by American mathematicians. For the period 1931—1935 the numbers are 28, 13, and 25, and meanwhile the development may well have become even more unfortunate for us. [37, 5, my translation]

All three citation counts mentioned in this chapter point to a gradual decline of the international reception of articles in German mathematical journals up to roughly 1940, even if one takes into account the very different motivations of the people (Allen and Süss) who did those investigations. Obviously, the wheel had turned full circle in the three quarters of a century since Simon Newcomb's article of 1874.

GROWING INTERNATIONALIZATION IN MATHEMATICAL PUBLISHING AROUND 1930 AND NAZI INTERFERENCE—SPRINGER'S AMERICAN POLICIES[40]

Around 1930, there were many signs worldwide of an increasing internationalization in scientific publishing, partly in response to the rise of relatively young national schools, such as the community of American mathematicians. The German publish-

[40] A full account of Springer's policies toward America will be given elsewhere, because the attitudes of American mathematicians are the main focus of this article.

ing house Springer took full account of this trend towards internationalization, and in particular the use of the English language, in founding two new publications in the 1930s: the reviewing journal *Zentralblatt für Mathematik und ihre Grenzgebiete* (*ZM,* 1931–) and the *Ergebnisse der Mathematik* (1932–), a collection of shorter, specialized monographs. Both the *Zentralblatt* and the *Ergebnisse* were edited by Otto Neugebauer, first in Göttingen but beginning in 1934 from Copenhagen. In a letter in 1931 to Richard Courant of Göttingen, Neugebauer expressed his confidence in being able to convince the Americans of the *Zentralblatt's* qualities and to secure their willingness to collaborate: ''Veblen is going to come to Germany and will try to reach an agreement with us. Personally I am very much in favor of the idea of an American branch of the *Zentralblatt''* [38, 318, translation by the author]. Americans—Oliver D. Kellogg, Jacob Tamarkin, and later Veblen—were nominated as co-editors.

In border fields of mathematics, such as applications in mechanics, the need for internationalization was perhaps even more manifest. In 1932, Springer's confidant Courant discussed with Stephen Timoshenko of Ann Arbor the possibility of editing Springer's *Ingenieurarchiv* ''henceforth on an international basis'' [CP1], by adding Americans to the editorial board and publishing articles in German and English with abstracts in the other language.[41]

At the same time, around 1930, Springer had to counteract certain tendencies in the U.S. to ''boycott'' his publications due to the traditionally high prices of Springer's books and journals. Finally, an agreement was reached with American libraries at a conference in Chicago in October 1933. Following an account given by Ferdinand Springer, the way toward this settlement had been prepared by Courant's trip to America in 1932.[42] However, as late as 1935, Courant saw obstacles to the distribution of German monographs in the U.S. In a letter to Springer in 1935 Courant wrote that ''[p]erhaps the main problem is the absence of any organized system of distribution. Students have no chance to purchase German mathematical books, and if, then only at very high prices'' [SVA2, my translation]. If there was much continuity in Springer's policies toward the American market before and after the Nazis came to power, the political events in 1933 made the need for internationalization even more obvious to Springer and Courant. In 1934, the latter discussed the possibility with respect to the *Mathematische Annalen* ''to give it more the character of an international journal'' [SVA1].

As we have seen above, these efforts came too late, at least with respect to the *Annalen,* and the *Annals of Mathematics* took over (Appendix 3). As we have likewise seen, the printing of American mathematical books and journals was given to indigenous firms. Events such as the politically enforced dismissal in 1935 of the

[41] This project did not materialize. However, at about the same time (1933), Teubner from Leipzig published the second edition of Eugen Jahnke and Fritz Emde's well-known ''Funktionentafeln mit Formeln und Kurven'' as a German–English bilingual book.

[42] [31, 160] and [CP2].

Jewish editor of Springer's influential *Naturwissenschaften,* Arnold Berliner, led to a diminished willingness of some Americans to cooperate with Springer, as Courant explained in a letter to van der Waerden in Leipzig [CP3].

Taking these tendencies into account, Courant, who even as an emigré to the U.S. remained Springer's confidant, tried to convince the publisher to put prominent American mathematicians such as George D. Birkhoff and Marston Morse on the editorial board of the famous *Grundlehren* series: ''This could be very helpful to counteract certain developments in the American system of mathematical publishing, which are currently under way'' [CP4].

These policies of internationalization, however, worked better for the other Springer series, the *Ergebnisse,* than for the *Grundlehren.* While Springer's *Grundlehren* series (1921–) comprised elaborate, sometimes encyclopedic mathematical monographs on broader topics, the *Ergebnisse* (i.e., ''results'') focused on more specialized topics of more recent origin in a shorter presentation. It is therefore understandable that the *Grundlehren* were not so much in need of foreign contributions as were the *Ergebnisse.* In fact, the only monograph by an American author in the 52 volumes of the *Grundlehren* series until 1945 was Kellogg's *Foundations of Potential Theory* of 1929, which was also the first and only volume in this series to be published in English until the war.[43]

By way of contrast, six out of the 23 volumes in the *Ergebnisse* series which appeared before the end of the war were written by American authors, all of them between 1933 and 1937 and only one of them (Veblen's *Projektive Relativitätstheorie* of 1933) not in English (see Appendix 1).

That so many American authors would turn to the internationally renowned Springer publishing house even after 1933 speaks not only to Springer's standing, to the rise of American mathematics, and to the pervasiveness of the English language, but also, it would seem, to the still restricted possibilities for the publication of advanced monographs in the U.S. in the 1930s. As Hallion reports [12, 213–215], William F. Durand even had problems finding a publisher for his influential six-volume *Aerodynamic Theory: A General Review of Progress Under a Grant of the Guggenheim Fund for the Promotion of Aeronautics* (1934–1936), despite the availability of Guggenheim money. American publishers declined ''due to a feeling of uncertainty as to prospective sales'' [12, 214], and Durand had to turn to Springer for publication.

Indeed, the reservations of private American publishers relative to printing advanced mathematical monographs seem to have lasted well into the 1930s, as G. D. Birkhoff's address to the AMS semicentenary in 1938 indicates:

> Thus far ... the commercial publishing houses of the country have not contributed much towards the publication of important advanced mathematical texts. In this respect they suffer

[43] One may speculate whether this exception to the rule was made possible through Hilbert's influence. Kellogg, Hilbert's former student, had arranged for Hilbert to receive treatment for anemia at the hands of Kellogg's colleague at Harvard, George R. Minot [HP].

> by comparison with progressive European publishers, who take pride in the publication of significant mathematical books. The University Presses of the country have partly made up for this lack. [3, 279]

At least in the commercial publication of advanced monographs, or so it would seem, the European publishers, and above all Springer in Berlin, still enjoyed global dominance.[44]

As to the cooperation of American mathematicians with the *Zentralblatt* and with the *Ergebnisse* series, it was, by and large, equally objective and reasonable until 1938 [38]. In 1938, however, antisemitic pogroms shattered Nazi Germany and marked a *political* turning point not only in German–American relations as a whole but also in scientific respects. The editor of the *Zentralblatt* and of the *Ergebnisse,* Otto Neugebauer, unwilling to tolerate antisemitic interference in his work, left Copenhagen for Providence, Rhode Island, where he would found the *Mathematical Reviews* in 1940 [38]. While still in Springer's service, he had written a letter to the publisher on 11 October, 1938, expressing pessimism about the future of the *Ergebnisse:* ''Most countries have now founded new series and journals and their authors are practically obliged to write exclusively for them. In addition there are other difficulties of a more personal character'' [SVA3, my translation]. Both the ''personal'' difficulties and the development of autonomous infrastructures for mathematical publications in several countries paralleled, it would seem, tendencies of political and economic isolationism in the 1930s. This conclusion can also be drawn from a similar letter which the emigrant, Richard Courant, wrote to Harvard's G. D. Birkhoff on behalf of the *Grundlagen* series. As mentioned above, Birkhoff had served as editor of the *Grundlehren* for the ''English speaking countries.'' This, however, had obviously not promoted the recruitment of the influential English-speaking authors, including Birkhoff, in whom Springer was most interested.[45] Courant, in his letter on 19 November, 1938, informed Birkhoff of his resignation as editor of the *Grundlehren* and indirectly suggested Birkhoff's resignation as well:

> I also think, from a less personal viewpoint the explicit emphasis on the ''Englische Sprachgebiet'' in the titlepages is no longer appropriate. The hopes to develop the series in this direction have faded. Contracts were cancelled and plans dropped concerning authors such as Brauer, Szegö, Poritzky, Wintner, Bateman.[46] Also a new edition of Kellogg's book was practically rejected. On the other hand literary projects in mathematics in this country have

[44] As late as 10 July, 1945, Courant wrote in a letter to Hermann Weyl that it was ''not at all clear that the German method of a more or less closely organized series would do in this country.... These matters ... are closely connected with the 'political structure' of American mathematics'' [WP1].

[45] There were political impediments in Hitler's Germany even to recruiting non-Jewish foreign authors, especially if they did not have indubitable superiority over possible alternative German authors (compare [17]). In Birkhoff's case, Springer had hoped to win the leading American mathematician as an author for a book on celestial mechanics, which finally did not materialize, apparently due to a lack of interest on Birkhoff's part. See [SVA4].

[46] The reference is perhaps to Henry Bateman's *Partial Differential Equations of Mathematical Physics,* Cambridge: Cambridge Univ. Press, 1932; reprint ed., New York: Dover, 1944.

> taken shape which, under all circumstances, would have made it difficult for Springer to get the hoped for foothold. But, although such considerations might have called for a change anyway, at present they are only of secondary importance to me. [HUA4]

Nazi interference had finally forced the American mathematical community into almost complete independence.

BEGINNING GOVERNMENTAL SUPPORT: THE ALIEN PROPERTY CUSTODIAN REPUBLICATION PROGRAM

Primary systems of scientific information (articles and books) can hardly be separated from secondary systems (reviewing journals, data bases, reprint services, and libraries) since an optimal flow of scientific information can only be secured by a smooth collaboration of both systems of information. After World War II, governments in all industrial nations have increasingly tended to subsidize the extremely expensive secondary systems of scientific information [38, 308]. While in Germany there was an older tradition of state support for secondary systems (reviewing journals and encyclopedias) even in the basic sciences, which was reinvigorated during the 1920s ''boycott of German science,'' temporary hopes of American mathematicians for increased federal money failed at about the same time.[47] In the case of both secondary and primary systems of information, Americans had to rely largely on support from private foundations or universities.

As to reviewing journals, Americans had soon realized the superior tradition in Germany and the problems of manpower and costs which would result from an American journal in that field. Americans thus took responsibility only rather reluctantly and rather late, in 1938, as discussed above. At the same time, however, Americans realized the peculiar ''international organizing and synthesizing influence in mathematics'' [38, 323] of reviewing journals and pursued the foundation of the *Mathematical Reviews* (1940) vigorously.

In the field of encyclopedias, German mathematics retained its leading role until the end of the 1930s. George A. Miller, who had argued in a nationalist mood against German leadership in publications during World War I, referred in 1940 to the second edition of the German *Enzyklopädie der mathematischen Wissenschaften* in the following terms: ''The revised volume to which we referred above enables the German mathematicians to retain now the leading position among the mathematicians of the world with respect to mathematical encyclopedias'' [22, 290].

As to library conditions, Americans got on rather well in peacetime, partly due to the superior economic possibilities of American universities compared to those in Germany.[48] Following the outbreak of the War in Europe in September 1939, however, American librarians feared losing access to German publications [32, 77].

[47] Recall especially Fiske's quote above with respect to the German encyclopedia. The Research Information Service of the National Research Council, founded in 1917, was mainly responsible for technical and chemical information [27, 160–161].

[48] For complaints about library conditions in Germany as compared to the U.S., see [29]. Recall, too, Archibald's missions to Europe during German inflation, as mentioned above. Nevertheless, Amerian libraries were quite uneven in their holdings.

In that year, more than half of American money for foreign scientific literature was still being spent on German publications [32, 54].

The war caused a dramatic reversal of the U.S. government's attitudes towards scientific publishing. In March 1942, President Roosevelt reactivated the Alien Property Custodian (APC) within the Department of Justice, which had been created during World War I in connection with the Trading with the Enemy Act of 1917 [32, 85].[49] The renewed APC seized and licensed for American publication all enemy-produced items that were normally copyrighted, including books, journals, musical compositions, and movies. Officially, the APC declared that the sole criterion for licensing—under which arrangement the Custodian received the royalties normally accruing to the holder of the copyright—was that the republication be in the public interest.

The acquisition of foreign literature via neutral countries was organized by the Interdepartmental Committee for the Acquisition of Foreign Publications (IDC), founded in June 1942 with the Office of Strategic Services (OSS). American publishers were found, which reprinted foreign scientific books and journals,[50] using primarily the new photo-offset technology. Journals tended to be restricted to those volumes published during the war. Toward the end of the war, in November 1944, the APC sent circulars to selected American research libraries announcing the availability of reprints of 116 continental journals, principally German and Austrian [32, 87]. The selection of journals had been made partially with the assistance of scientists, among them mathematicians. AMS secretary Richardson, for example, was organizing a summer school for applied mathematics at Brown University and proposed in 1943 the addition of four more German journals for applied mathematics[51] since "applied mathematics is relatively much more important than it was two years ago" [BUA4]. However, war-related research does not seem to have figured prominently in the republication program of the APC. Also, regulations of secrecy did not play a major role [32, 88]. For mathematics this is clear given the publication of an article entitled "The Alien Book Republication Program" in the *American Mathematical Monthly* in February 1944 [41].

For mathematics, in addition to the three German journals for applied mathematics mentioned above, the war issues of the following six journals were reprinted, four of them German [32, 141–149]: *Bulletin des sciences mathématiques, Journal de mathématiques pures et appliquées, Journal für die reine und angewandte Mathematik* (*Crelle*), *Mathematische Annalen, Mathematische Zeitschrift,* and *Zentralblatt für Mathematik.*

As in the case of journals, scientific titles dominated in the reprinting of books

[49] The APC had seized those German chemical patents that became crucial in the development of the American chemical industry after World War I [27, 16].

[50] These were usually without translations.

[51] These were *Zeitschrift für angewandte Mathematik und Mechanik* (ZAMM), *Ingenieurarchiv, Luftfahrtforschung,* and the *Jahrbuch der deutschen Luftfahrtforschung.* Except for the latter, all of these journals were included in the final APC list of November 1944. See [32, 141–149], where that list is reproduced.

over narrowly applied or technical topics, with chemistry taking the lion's share. Sarkowski argues [36, B 100–102] that mathematics (3.8% of the books as compared to 56.4% for chemistry with the main publisher Edwards) was rather underrepresented in the APC program for books. However, several mathematical books were reprinted with APC licence by American publishers even after the war.[52] Chelsea, for example, published 25 titles of the *Ergebnisse* series between 1947 and 1956.

Among American mathematicians, the APC policies did not meet with unanimous approval. This owed partly to the fact that copyrights of some American authors were affected, in so far as they had published abroad before the war.[53] Particular problems occurred for those immigrants who had not yet obtained American citizenship at the time of the APC program. Richard von Mises had co-edited with Philipp Frank *Die Differential- und Integralgleichungen der Mechanik und Physik* (1925–1927), and Mary S. Rosenberg was to reprint it. Von Mises offered to take care of the rights of all concerned American authors "who want me to do so" [SzP].

The War Policy Committee of the AMS refused to advertise APC reprints in its periodicals and upheld this refusal even for the Frank and von Mises volume, which—with some justification—could be labeled war-related. In February 1944, AMS secretary John R. Kline wrote to Neugebauer, then the editor of the *Mathematical Reviews:* "With your consent, it is my intention to write to the Dover Publications, telling them we are not taking any advertisements for German books which have been reprinted under the authority of the Alien Property Custodian. I do not like the whole procedure" [AAMS2].[54] The AMS was even less enthusiastic about reprinting books on pure mathematics such as Hilbert and Bernays's *Grundlagen der Mathematik* [AAMS3].

The decision of the War Policy Committee of the AMS was obviously motivated by fears of a possible loss of autonomy in view of both government interference

[52] This caused some controversies between Springer and American publishers after the war, but was, at the same time, beneficial to the persistence of German scholarship in American minds.

[53] The American Arnold Dresden wrote to Hungarian-born Tibor Radó in Columbus, Ohio on 30 July, 1943:

> You have probably noticed that a number of publishers, among them Dover and Mrs. Mary Rosenberg who seem to be strangers in the field of mathematics, are announcing reprints, under licence issued by the Alien Property Custodian, of books originally published in Germany. This creates a peculiar problem for American authors of such books, since apparently Alien Property Custodian does not always take into consideration the American authorship.... The result of my inquiry is that an American can notify the Alien Property Custodian that he wants to reserve himself the granting of permission to reprint his work in this country. If so notified, the APC will not issue a license without the authors' consent. [WP2]

Radó had published the *Ergebnisse* volume *On the Problem of Plateau* in 1933. Cf. Appendix 1.

[54] Neugebauer, however, did not agree with the proposal of Kline and the War Policy Committee and answered on 16 February, 1944: "It seems to me ... that we should not refuse the advertisement contract and handle the matter on a purely business-like basis" [AAMS2].

and private interests of publishers, some of which did not even have a recognized tradition in mathematical publishing (recall the discussion above).[55] In addition, there was a long tradition of skepticism among American scientists towards government interference into basic science in the U.S., which was present as late as 1950 in the discussion on the foundation of the National Science Foundation [15]. Interestingly enough, immigrants such as Neugebauer and Courant were less concerned in this respect, probably at least partly owing to their need as immigrants to take an even firmer position against Germany, and, possibly, due to a longer experience with government involvement in science.[56]

All in all, the APC program secured the continued awareness of American mathematicians of German research work in pure (and some fields of applied) mathematics during the war, while German mathematicians, at the same time, became increasingly isolated with respect to foreign literature.[57]

The APC program was one of several war-related initiatives which stimulated a period of growing influence of the government on basic science in the U.S. The Interdepartmental Committee for the Acquisition of Foreign Publications (IDC), which had organized the acquisition of foreign literature beginning in 1942, was followed by the Publication Board. The latter, created by President Truman in 1945, seized and analyzed secret scientific and technical documents from occupied Germany [32, 126]. The work of the Publication Board proved important for postwar industrial and scientific developments in the U.S. and confirmed the growing involvement of the Federal government in the American system of scientific and technical information after World War II.[58]

SUMMARY AND CONCLUSION

The history of mathematical research publishing in the United States reveals both the ubiquity of the German example and the considerably different political and economic infrastructure of American mathematics, which the latter partly shared with British mathematics. On the one hand, the German example was the main point of reference for American mathematicians in their efforts to improve the national system of mathematical research publishing and to reach national independence in the field. On the other hand, the lack of governmental support and the undeveloped state of commercial scientific publishing up until the end of

[55] In a parallel war-related book publication program in Germany, the mathematicians themselves, unlike their American colleagues, initiated the relevant developments [20, 339–340]. Although not in this program, the Germans pirated English literature as well, as acknowledged by Kamke [AAMS4].

[56] Recall the letter of Neugebauer to Kline, quoted above, and see Courant to the German Erich Kamke, 21 March, 1949 [AAMS4].

[57] Compare [37] and a letter written by the chair of the German Mathematicians' Association (DMV) to the responsible functionary at the German Research Council on 4 July, 1944: "Unfortunately, I do not know any titles of mathematical papers in American and English journals of recent years. So I would strongly welcome photocopies of the tables of contents of those journals for the years 1943 and 1944" [BAK2, my translation].

[58] An evolutionary line leads from the Publication Board to the National Technical Information Service (NTIS), founded in 1971 [32, 126].

the 1930s forced American mathematicians to look for other sources of support, especially philanthropic foundations.

Yet, for all its success in the creation of mathematical journals and in the transference of mathematical printing to the U.S., American mathematics remained comparatively weak in the field of the publication of advanced mathematical monographs until the 1930s. While the American system of mathematical publishing appeared more ''modern'' with respect to the creation of specialized journals, such as the *Annals of Mathematical Statistics* (1930–) and the *Journal of Symbolic Logic* (1936–), the German system was more ''modern'' with respect to state funding and commercial publishing.

The German system of mathematical research publishing remained strong until the end of the 1930s, due partly to the still greater versatility of German mathematical culture (especially as regards applications) and partly to its reinvigoration by the market-oriented Springer publishing house in the 1920s. Thus, the German publication system concealed somewhat the waning strength of German mathematics, especially after the emigrations of the 1930s. Increasing political interference by the Nazi regime around 1938, however, also promoted the international isolation of German mathematics in the field of publishing. This isolation had existed prior to 1938 in relation to oral communication (traveling) and to library conditions.

As to their scientific policies, Americans used contributions by European, and especially British mathematicians, to the *American Journal of Mathematics* after 1878 as a stimulus for American research. They also restricted foreign contributions to 10% in the *Transactions of the AMS* following its publication in 1900, and yet were anxious finally to secure strong foreign papers for their journals from the 1920s on. Americans intimately collaborated with German publications such as German reviewing journals and the *Ergebnisse* series as long as there was no equivalent for them in the U.S. The growing use of the English language in these foreign publications in the 1930s, as well as the increasing citation of the leading American journals, gave proof to the rise of American mathematical research to international importance.

The Second World War marked the beginning of a massive governmental involvement in scientific, and especially mathematical publishing, in the U.S. Originally met with doubts on the part of mathematicians, the republication program of the Alien Property Custodian paved the way for a closer collaboration between mathematicians and the government in several fields after the war.

Finally, the *conclusion* may be drawn that the American mathematical community did not fully ''emancipate'' itself from German ''dominance,'' as suggested in the title of this article. Rather, the American system of mathematical communication was—via Springer and the influence of immigrants—very much shaped according to German patterns. On the other hand, ''German dominance'' in mathematics had never been so strong, even in the last century, as to preclude patterns of independent American policies, for example, relative to journals. The American mathematical culture of today may thus serve as an example of ''internationalized science'' not only by virtue of its worldwide influence but also judging from its historical origins.

APPENDIX 1

Mathematical Monographs by German and American Authors Originally Appearing in the Opposite Country[59]

(a) *U.S. Authors in Germany in German.*

Maxime Bôcher, *Über die Reihenentwickelungen der Potentialtheorie,* Leipzig: Teubner, 1894.

William Fogg Osgood, *Lehrbuch der Funktionentheorie,* Leipzig: Teubner, 1906.

Oswald Veblen, *Projektive Relativitätstheorie,* Ergebnisse der Mathematik, vol. 2, no. 1. (1933).

(b) *U.S. Authors in Germany in English.*

Leonard Eugene Dickson, *Linear Groups with an Exposition of the Galois Field Theory,* Leipzig: Teubner, 1901.

Ernest J. Wilczynski, *Projective Differential Geometry of Curves and Ruled Surfaces,* Leipzig: Teubner, 1906.

Arthur G. Webster, *Partial Differential Equations of Mathematical Physics,* Leipzig: Teubner, 1927.

Oliver D. Kellogg, *Foundations of Potential Theory,* Grundlehren der Mathematik, vol. 31 (1929).

Tibor Radó, *On the Problem of Plateau,* Ergebnisse der Mathematik, vol. 2, no. 2 (1933).

Cyrus C. MacDuffey, *The Theory of Matrices,* Ergebnisse der Mathematik, vol. 2, no. 5 (1933).

Dirk J. Struik, *Theory of Linear Connections,* Ergebnisse der Mathematik, vol. 3, no. 2 (1934).

Oscar Zariski, *Algebraic Surfaces,* Ergebnisse der Mathematik, vol. 3, no. 5 (1935).

Tibor Radó, *Subharmonic Functions,* Ergebnisse der Mathematik, vol. 5, no. 1 (1937).

(c) *German authors in the U.S. in English.*

Felix Klein, *Lectures on Mathematics.* The Evanston Colloquium, New York: Macmillan, 1894.

Carl Runge, *Graphical Methods: A Course of Lectures Delivered in Columbia University,* New York: Columbia University Press, 1912; German ed., Leipzig: Teubner, 1915.

[59] This list may be incomplete.

APPENDIX 2

Excerpt (Concluding Remarks) from a Memorandum (Probably by O. Veblen) to the National Research Council (Washington) 1922, Entitled "A Revolving Fund for Scientific Books" [HUA2, 3–4]

> ... *The example of Germany:* There is another aspect of the question which will appeal to public spirited citizens on patriotic as well as on scientific grounds. This can best be made clear by recalling what was done by certain German publishers during the period before the War. To cite only one example, the publishing house of Teubner (whether with or without government backing) maintained such a list of publications in the mathematical sciences that it was regarded as an international institution. The works which it published were by no means wholly of German origin for they included a large number of important works translated from other languages into German; also books published in English.[60] Furthermore it often happened that, when a book was translated into German the author revised and improved it to such an extent that the German edition was regarded as preferable to the original.[61] In some cases books by foreign authors were published in German without ever appearing in the author's tongue.[62]
>
> This policy had two important effects: (1) It stimulated scientific work in Germany and kept scientists in touch with the advances made in all countries; (2) It increased German prestige, spreading knowledge of the German language abroad and fostering the idea that Germany was the center of scientific activity. For example, many Italian mathematical works were known to Americans only through German translations, and American works reached Italy in the same way. There are to this day a number of Americans who prefer to read every English book in their German translations.
>
> *A patriotic duty.* The question therefore arises why we should not seize the present opportunity to gain for our country and for our language the prestige and the central position which have heretofore been German to such a high degree. It would be an entirely legitimate and beneficial form of national propaganda, and one to which no one could object, for everyone profits by the advance of knowledge.

APPENDIX 3

From a Letter, Dated November 1, 1935, Written by Solomon Lefschetz, AMS President (1935–1936) and Editor of Annals of Mathematics, to Warren Weaver, The Rockefeller Foundation, [RAC5] (Request Declined)

> Dear Weaver,
>
> ...
>
> I should like to raise with the Foundation the question of the continuation of the grant until July 1936.... A fundamental new factor has injected itself into the situation, namely the progressive breakdown of scientific, and particularly, mathematical publication in Germany. It appears that ... both major German publications have considerably reduced the number of pages published per year. Moreover, many authors do not wish to contribute any further to German publications and as their sole new European outlet they have only the publication,

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[60] Cf. Dickson and Wilczynski in Appendix 1.

[61] Two cases in point were Oskar Bolza's *Vorlesungen über Variationsrechnung* (Leipzig: Teubner, 1909), which was a considerably enlarged version of his American *Calculus of Variations* of 1904, and Leonard Eugene Dickson's *Algebren und ihre Zahlentheorie* (Zürich: Füssli 1927), which differs considerably from Dickson's *Algebras and Their Arithmetics (Chicago: University of Chicago Press, 1923).*

[62] Cf. William Fogg Osgood's *Lehrbuch der Funktionentheorie* of 1906 and, ironically, also Veblen's *Projektive Relativitätstheorie* of 1933 (Appendix 1).

Compositio Mathematica, which publishes approximately the equivalent of one number of the *Annals of Mathematics* per year. As the *Annals* is known to be entirely independent of any society connections and very liberal in its policy, foreign authors seeking journals in which to publish their papers in the United States have favored us far more than the other American journals. Owing to this, the *Annals of Mathematics* has received within the last two years, a large number of exceptional papers from abroad resulting in a terrific crowding of our publication. As I stated it to you previously, for months past we have been unable to accept any but the very best material. Of course this has resulted in a great improvement of our standard, putting us in the very front rank of world mathematical journals but it has presented a most difficult financial problem to the Editors ... Whatever the Rockefeller Foundation could do for us in this juncture would be most welcome.

Sincerely yours

(signed) S. Lefschetz.

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