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John von Neumann: Selected Letters
Edited by Miklós Rédei. Providence, RI (American Mathematical Society, London Mathematical Society). History of Mathematics, vol. 27, 2005. ISBN 0-8218-3776-1. 301 pp. $59

John (Janos, Johannes) von Neumann certainly ranks as one of the greatest polymaths, not just of the 20th century, but of all time. His published mathematical work comprises 150 articles (almost completely contained in the nearly 3800 printed pages of the six volumes of his *Collected Works*) as well as four books on a large and diverse array of fields. These range from logics and axiomatics for topics in mathematics and physics, operator theory, groups, rings, and continuous geometry, to the theory and development of electronic computers and their applications, to practical problems of all kinds. In addition to this, his work spanned everything from game theory, economic behavior, and human intelligence to the treatment of specific problems in astrophysics, hydrodynamics, and meteorology.

The present volume has been edited by his countryman Miklós Rédei, who also provides some helpful "Introductory Comments" in order to explain the contents of the letters and their personal, scientific and historical background. Preceded by a foreword from Marina von Neumann Whitman, which contributes a personal view of her father, the correspondence as carefully reproduced here basically covers the American period of von Neumann's life. Consequently the original language is mostly English, with only a few letters having been (well) translated from German and Hungarian by the editor. Unfortunately perhaps, the arrangement of the letters does not follow either historical or topical order—which scientists and historians among the readers probably might have preferred—but is strictly alphabetical according to the name of the recipient.

The contents of the letters fully reflect von Neumann's wide scope of scientific work and activities, as well as his personal interests in the second half of his career. In a set of "early" letters, von Neumann immediately expounded the seminal importance of Kurt Gödel's contribution to mathematical logic (even before it was completed), which was to destroy the hope of providing a strict axiomatic foundation for mathematics in David Hilbert's sense. Five valuable letters to Gödel from 1930 to 1935 are reproduced, as well as a letter to the German philosopher Rudolf Carnap (1931) on "Gödel's theorem" and a request to Abraham Flexner, the director of the Institute for Advanced Study in Princeton (1939), to secure a U.S. visa for Gödel, by then an Austrian refugee.

Of course, the central topics of von Neumann's own mathematical work are also addressed in some detail, for instance, by a packet of six letters from 1935 dealing with the "logic of quantum mechanics," addressed to his collaborator Garrett Birkhoff. Von Neumann conducted a more scattered correspondence with other colleagues and collaborators, such as the Frenchman J. Dixmier (on Hilbert spaces, 1953), the Japanese Kodi Husimi (on foundations of quantum mechanics, 1937), the student I. Halperin (on operators, 1939–1940), and Irvin Kaplanski (on Banach

algebras, 1950). During the 1930s he exchanged many letters with the important American mathematicians Marshall Stone and Oswald Veblen on a variety of questions, mathematical and otherwise; to the latter he also provided impressions derived from visits to Europe (Germany and Hungary in 1933, England and France in 1935, and Hungary again in 1938).

Particular emphasis in this collection has been placed on correspondence illuminating von Neumann's great efforts in the development of computers and computing in the widest sense, in which he became involved while visiting England during World War II. Becoming a consultant for the first electronic machine ENIAC in 1944, he developed military and civil programs for the use of such computers and also discussed the various possibilities of application, for example in letters to Louis L. Strauss (1945) and to the chemists Alston Housholder and Cuthbert Hurd (1948–1950). In the "La Salina Operation Problem" he showed how to operate 18 tankers between La Salina, Las Piedras, and Aruba most economically (letter to M.T. Moore, 1953). On the other hand, he gave a list of topics to Richard Burington of the U.S. Navy Bureau of Ordnance (1951) in which computers might be essential for problems of military importance. Further, he advocated the installation of computer departments or sections at American universities—see his exchange with Norbert Wiener of MIT (1945–1946) and the letter to Vannevar Bush on the corresponding plans at Harvard (1949). Another aspect of applying his mathematical genius to practical computational problems led him to formulate the foundations of game theory in a book (*Theory of Games and Economic Behavior*, 1944) written with the economist Oskar Morgenstern, to which one letter (1953) refers.

Throughout his life von Neumann discussed, corresponded, and collaborated with physicists, as is reflected by letters to Hans Bethe on shock waves (1941), Jean-Louis Destouches on the structure of physical theories (1952), Paul Dirac on the spinning electron (1934), Pascual Jordan on the latter's new theories (1950), Edwin Kemble on operators in quantum mechanics (1930s), H.P. Robertson on the quasi-ergodic hypothesis (1932), Erwin Schrödinger in connection with the latter's "Cat's paradox" (1936), and Edward Teller on superconductivity (1947). Principally because of his fundamental work on the mathematical foundations of quantum mechanics (summarized first in his famous book of 1932 and continued beyond), the great mathematician was considered by the best physicists as a close and welcome colleague, although once, after he had claimed to be able to prove a particular problem, Wolfgang Pauli apparently remarked: "Surely, Herr von Neumann, if physics were just proving something, you would be a great physicist" [Heisenberg, 1963, 356]. Finally, several excerpts from the lifelong exchange with his Budapest physics professor Rudolf Ortvay are reproduced, in which the former pupil discusses his situation in Princeton (1934), the current work of Max Born and Dirac in Great Britain (1938), and also contemporary political problems in Europe (1939).

Indeed, as a native Hungarian who had started his career in Germany, von Neumann followed scientific and political events, especially those in central Europe, very closely. Not only did he write detailed reports about the situation in Europe, besides those mentioned above to Stone and Veblen, but also he passed on to Frank Aydelotte, then director of the Princeton Institute for Advanced Study, news obtained through Peter Debye about the German uranium project (1940). From the very beginning he was concerned with the fascist governments established in Germany and elsewhere, and he anticipated the subsequent involvement of the United States in the war in Europe. When he arrived in America, at barely 30 years old, he more than satisfied the requirements for an immigration visa to the United States. He rendered important services to his new home country, notably as a consultant on the Manhattan Project, for which he was honored with the highest awards (see his letters to Louis L. Strauss, 1946, and R.E. Duncan, 1947). In the 25 years remaining until his untimely death, he actually widened his enormously versatile and inventive skills to become the most complete mathematical genius of that period. Nevertheless, as he would eventually admit: "The total subject of mathematics is clearly too broad for any of us. I do not think that any mathematician since Gauss has covered it uniformly and fully, even Hilbert did not, and all of us are of considerably lesser width (quite apart from the question of depth) than Hilbert." (See letter to H.D. Kloosterman, 1953, on p. 168.) He had never forgotten the man to whom he owed so much, nor his "scientific education in the German speaking part of the World" and the beginning of his "scientific career in German universities" (see letter to Wilhelm Blaschke, 1935, on p. 70).

Despite these admittedly sketchy and incomplete remarks, the reader should be left in no doubt that this fine volume of selected letters will be of great interest to mathematicians, scientists, educators, and in particular those interested in the history of the fields to which John von Neumann contributed so much. In the future, this reviewer would like to

see the publication of a more extended edition of his correspondence, especially one augmented—if possible—by the letters from his early Hungarian and German period.

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Musings of the Masters: An Anthology of Mathematical Reflections
Edited by Raymond G. Ayoub. Washington, DC (The Mathematical Association of America). 2004.
ISBN 0-88385-549-6. 288 pp. $49.95

The title of the book under review raises the questions: which masters, and what sort of reflections? Raymond Ayoub, the editor, chose to restrict the selections in his book to articles by eminent mathematicians from the last century, which involve "humanistic" topics and which are accessible to the general reader without technical mathematical prerequisites.

So who are Ayoub's "masters"? The mathematicians chosen include a few illustrious examples who came into their mathematical primes at the beginning of the 20th century or before (Hilbert, Hardy, Poincaré), while most choices are concentrated on mathematicians who did the bulk of their important work in Europe and the United States between the two World Wars. The inventory of masters is thus a traditional, Western list (Birkhoff, von Neumann, Wiener, Weyl), with only a single woman included (Cartwright). While there is a considerable diversity of opinion about matters mathematical and philosophical in the book, the reader should keep in mind this relative narrowness in the selection of authors included.

Over half of the selections took their original form as public addresses to various meetings and congresses. This is unsurprising, considering that such forums are a natural place to find a professional mathematician willing to abandon the careful rigor of technical mathematical prose for the speculative musings here. Moreover, the rhetoric of such public addresses actually helps to draw in the general reader, even if the subject matter is subtle or difficult.

The editor interprets "humanistic" topics widely, and the diversity of the subject matter is one of the charms of the book. He has grouped the articles into four sections, entitled Mathematics and the Intellect, Mathematics and Human Understanding, Mathematics and Society, and Miscellaneous; these work reasonably well, but it is easy to imagine alternatives, depending on the themes one wishes to emphasize. Indeed, below we will take a brief leapfrog trip across sections and articles, to give a flavor of the topics covered in the book.

Each of the 17 selections has two prefaces. The first preface is a biographical note; these are gracefully and generously written, with pertinent family details and a description of the author's professional career. Consistent with the aim of keeping the book accessible to the general reader, there is little specific detail about the mathematics of these authors, but I think that even the mathematically unprepared reader might have forgiven a little more detail here. The second preface provides some editorial commentary and background for the article itself; Ayoub is particularly adept (and fearless) at painting some of the larger philosophical background in broad strokes, while trying with some success to avoid the jargon of technical philosophy.