ture Database. Scholars and others around the globe daily access this resource, which lists fifteen thousand signatures of scientific instrument makers over the past five centuries. A few years ago, this web page received more hits than any other at the museum, testifying to its merits. I know Ephraim Chambers and Noah Webster would be very proud.

Those friends who wish to honor the memory of Madge and Rod Webster can do so by supporting the Adler collections at https://adlerplanetarium.wufoo.com/forms/give-to-the-adler/.

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HANS WUßING, 1927– 2011

Hans Wußing was the most important historian of mathematics of the German Democratic Republic and a Professor at the Karl Sudhoff Institute for the History of Medicine and Sciences in Leipzig until 1992. He was born on 15 October 1927 in the little Saxonian town of Waldheim. His parents came from local wealthy families, but his father had to earn a living as an accountant because the economic crisis of the 1920s had ruined them. After primary and secondary school (1936–1942), World War II caught Hans in its claws—as it did many teenagers of his generation. From 1946 to 1947 he went back to school to obtain a high school degree. After completing his education as a high school teacher of mathematics, physics, and chemistry (1947–1952) and acquiring his doctoral degree with a thesis on embedding finite groups (1957), written under the supervision of Walter Schnee (1885–1958), he turned to history. His *Habilitation* was a profound study of three disciplines (algebra, number theory, and geometry) that contributed to the axiomatic foundation of abstract algebra. In a sense, the mathematical results of these developments were captured in Bartel van der Waerden's (1903–1996) *Moderne Algebra* (Springer, 1930–1931), while their histories unfolded in Wußing's *Genesis des abstrakten Gruppenbegriffs* (Deutscher Verlag der Wissenschaften, 1969).

Genesis is Wußing's most important contribution to the history of mathematics. Its translation into English in 1984 and its unchanged reprint in 2007 speak clearly to its formidable character as a major milestone in the history of mathematics. Mathematicians found the book highly readable and appealing because it dealt with one of the most important new domains in twentieth-century mathematics. Their appreciation reflects Wußing's mathematical expertise. Wußing's history of the abstract group concept was a history written by a mathematician.

Historians of mathematics appreciated his book, for their part, because it was the very first substantial historical analysis of any domain of modern mathematics. Likewise, they felt inspired by the author's conviction that one of the historian's tasks was that of an archaeologist: he had to dig deep into the trail left behind by generations of mathematicians in order to find the roots of something that had become a gorgeous tree by the time the historian began his search. Wußing called these two states of mathematical life the *implicit* and the *explicit* forms. While this perspective of implicit/explicit is not shared by all historians of mathematics today, for many of the young historians of modern mathematics who began their research in the 1970s Wußing's ideas and working methods proved fruitful and attractive. In addition to his published thesis, a paper called "Zur Entwicklungsgeschichte naturwissenschaftlicher Begriffe" (*NTM: Schriftenreihe für Geschichte der Naturwissenschaften, Technik und Medizin*, 1970, 7:15–29) played an important role. In this text, Wußing reflected on the possibilities of developing a Marxist conceptual history (*marxistische Begriffsgeschichte*). This paper, together with the book, inspired historians of mathematics like Herbert Mehrtens and Erhard Scholz to follow similar themes and approaches in their histories of manifolds, lattice theory, and crystallography.[1]

The impact of Wußing's book and related papers resulted from at least four factors: the novelty of the subject matter and the mathematical solidity and historical depth of his analysis; the effort to theorize about how historical processes and social relationships could be depicted, analyzed, and understood; the effort to contribute to a Marxist historiography of mathematics and science; and Wußing's institutional position and power as the first—and, for a long time, the only—professor for history of mathematics and science in the German Democratic Republic.

Wußing motivated three of his doctoral students (Walter Purkert, Karl-Heinz Schlote, and Reinhard Siegmund-Schultze) to study topics

Photograph is courtesy of the Universitätsarchiv Leipzig.

(fields, algebras, and functional analysis) closely related to his own work. Their theses reinforced the interest of historians of modern mathematics in the work done at Leipzig. Olaf Neumann, a mathematician in the German Democratic Re- public with strong historical interests, held views on the history of algebra that were clearly related to Wußing's, albeit at times with a critical distance.[2] Historians of modern mathematics out- side the German Democratic Republic, besides

Scholz and Mehrtens, cooperated closely with Wußing or incorporated his ideas and methods critically in their own work—among them Luboš Nový, Leo Corry, and Jeremy Gray.[3] Of these, Corry in particular modified and rejected some of Wußing's judgments regarding details and particular issues.[4] In general, though, the leading historians of modern mathematics of my generation and older (Corry included) expressed their profound and continued appreciation for Wußing's *Genesis* when I spoke to them in January 2012 at the Mathematical Research Institute, Oberwolfach (Germany), about the subject. Thus I can confidently claim that *Genesis des abstrakten Gruppenbegriffs* is a work that has held its place for forty years as a trusted history of a major mathematical domain. Not many historians of mathematics or science can lay claim to a work that commands such respect. Young colleagues, working from different methodological positions and with different questions, have recently contested parts of Wußing's story—in particular Caroline Ehrhardt and Frédéric Brechenmacher.[5]

Wußing's theoretical reflections arose from his profound belief in the need for a socialist society. This conviction, to which he subscribed in principle until his death (though not without modification), resulted from his traumatic experiences in his youth. At the age of fifteen he was called upon to serve in a support unit (Luftwaffenhelfer) of the German air force. He barely escaped being buried alive during a raid by the Allied forces. At the end of the war he was drafted as a regular soldier and ended up as a British POW. In March 1946 he was discharged and returned home to his family in Waldheim. With him he brought a deep adversity to war and fascism, feelings that were strengthened during his last school years (1946–1949). His wife Gerlinde (whom he married in 1952) shared these feelings. She confirmed what I remembered from my occasional political discussions with Hans: fascism and war were the two decisive events that set his outlook and determined his adherence to Marxist beliefs and goals. His constant references not merely to authorities, but to society and its development at large, as the primary context for scientific development were not mere lip service, even when these points of reference did not always motivate him to pursue directly related lines of research. An example is his book on group theory.

Despite the somewhat incongruent historiographical claims in the introduction to that book, Wußing was recognized early on as one of the very few historians of mathematics with an interest in social history. An important reason for this recognition was his above-mentioned paper on his ideas of how to build a Marxist history of concepts. The three central terms of this paper ("intension," "extension," and "ostension") represent the content, scope, and domain of application of a mathematical or scientific concept, notion, or term. Wußing believed that a Marxist historian of science had to go beyond the study of content alone and investigate the scope and domain of application of a concept as well. The basis for this methodological stance was the idea that it was possible and necessary to discover the laws or regularities that shaped any given society and its sciences. Wußing stated explicitly that description of a conceptual development fell short of the historian's task. At the very least, she or he had to investigate the concept's emergence and, if possible, its adequacy for responding to the demands posed by society to science in a given period. Though only a short-term excursion into the realm of historiography, the interesting aspect of these and a few earlier papers of a similar kind is their indication of Wußing's efforts to create within a fixed framework of fundamental beliefs a conceptual language that would allow reflections on phases of stability (he called that the equivalence of the historical and the logical) and instability (disturbances of the equivalence) in mathematical or scientific conceptual practice. This was also the time when Wußing and his colleagues Wolfgang Schreier (history of physics) and Irene Strube (history of chemistry) discussed Thomas Kuhn's *Structure of Scientific Revolutions*, and, given my memory of their later reports on these discussions, it seems plausible to assume that the triad of intension, extension, and ostension, together with the focus on periods of a disturbed equivalence relation between the historical and the logical, responded in some degree to Kuhn's ideas of normal science and paradigm shift, which the three viewed critically.

A second important text dealt with the idea of science as a productive force ("Zur gesellschaftlichen Stellung der Mathematik und Naturwissenschaften in der industriellen Revolution," in *Studien zur Geschichte der Produktivkräfte*, ed. K. Lärmer [Akademieverlag, 1979], pp. 55–68). It was part of a research project on the history of the productive forces in Germany between 1800 and 1945, headed by scholars of the Academy of Science in Berlin.[6] It brought together a great number of academics from many different disciplines, ranging from economics to history of transportation and even history of science. Wußing led the group of historians of science and mathematics, one of the many examples of organizing research in the humanities and social sciences as big science. In the postscript to the *Social History of Nineteenth-Century Mathematics*, Mehrtens pointed to this text of 1979 as one inspira-

tion for the emerging social history of mathematics in the West.[7] Umberto Bottazini said in January 2012 that he too had seen Wußing primarily as an inspiration for engaging with a social history of mathematics.

Wußing's third major research activity was concerned with Renaissance algebra in Germany. Together with Wolfgang Kaunzner, Wußing published an edition and commentary of Adam Ries's *Coß* (*Coß von Adam Ries* [Teubner, 1992]). He wrote a biography of Adam and turned then to the *Coß* of Adam's son Abraham (*Adam Ries* [Teubner, 1989, 1992; 3rd rev. and enlarged ed., Edition am Gutenbergplatz Leipzig, 2009]). He showed that Abraham's work substantially surpassed that of his father (*Die Coß von Abraham Ries* [Erwin Rauner Verlag, 1999]).

Wußing was also an active writer on other topics. During his entire career as a university professor and in the years of his retirement, he spent much time and energy producing books for students and other readers interested in the history of mathematics and the sciences. In collaboration with his colleagues, Wußing wrote a textbook for university students titled *Vorlesungen zur Geschichte der Mathematik* [Deutscher Verlag der Wissenschaften, 1979; 2nd ed., 1989; rpt., Harri Deutsch Verlag, 2008; Spanish trans., 1998]). The analogous textbook on the history of physics was produced by a group of authors headed by Wolfgang Schreier (Deutscher Verlag der Wissenschaften, 1988). The history of chemistry fell victim to the massive changes in academia, book production, and almost every other domain of life in what became East Germany.[8] Another publication project revived one of Wußing's older ideas: to write a popular history of the sciences and mathematics with sumptuous illustrations, a history in images. It appeared in 1987 under the modest title *Geschichte der Naturwissenschaften*, younger sibling of the earlier *Geschichte der Technik*, published as a joint venture by Editions Verlag, Leipzig, and Aulis Verlag, Cologne. In addition, Wußing was one of the editors of the Teubner series "Ostwald's Klassikers," one of the founding editors of Teubner's "Biographien bedeutender Naturwissenschaftler" (he contributed three repeatedly reprinted biographies of Carl Friedrich Gauss, Isaac Newton, and Adam Ries), the cofounder of Birkhäuser's "Science Networks—Historical Studies," and the editor of biographical dictionaries (*Biographien bedeutender Mathematiker* [Volk und Wissen, 1975]; *Fachlexikon Forscher und Erfinder* [Harri Deutsch Verlag, 1992]). He coauthored surveys like *4000 Jahre Algebra: Geschichte, Kulturen, Menschen* (Springer, 2003) and a history of science and math-

ematics organized around stamps, which he loved and collected avidly throughout his life (*Wissenschaftsgeschichte en miniature: Neun Kapitel aus der Entwicklung der Mathematik und der Naturwissenschaften* [Deutscher Verlag der Wissenschaften, 1989]). His last work was the two-volume *6000 Jahre Mathematik* (Springer, 2008, 2009). These popular scientific projects and publications were arrogantly dismissed as nonacademic and of little worth in 1990/1991, when swarms of mostly West German academics arrived at East German universities and the Academy of Science to "evaluate" an academic culture they often were unfamiliar with and rarely showed much desire to get to know. Wußing, who retired in 1992, was free from the new strictures (economics, politics, and ideology) that replaced the old constraints (ideology, politics, and economics) and could thus ignore this condescending judgment. Producing well-written and correct popular books on any academic topic is an art and a challenge. Wußing tried his best to live up to it.

Wußing was one of the leading representatives of the German Democratic Republic in international bodies and at conferences. He was a full member of the International Academy of the History of Science, Paris (1981), and the Sächsische Akademie der Wissenschaften, Leipzig (1984), an officer of the board of the IUHPS (Second Vice President), and served in various capacities in his own country. In 1993 he received the Kenneth O. May Prize for History of Mathematics. For many years he was one of the chief editors of *NTM*, the journal for the history of *Naturwissenschaften*, *Technik*, and *Medizin*. An evaluation of his role as a science organizer needs to be postponed until access to archival material becomes possible. Three things are already clear, however: Wußing was the main force behind the introduction of history of mathematics, physics, chemistry, and biology for student teachers as an obligatory field of study; he welcomed foreign visitors and thus organized much-needed international exchanges; and, while committed to his state and to the concept of hierarchies, he never—as far as I am aware—abused his powers to the detriment of his colleagues nor enforced ideological or other constraints on his collaborators beyond what was unavoidably necessary.

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NOTES

1. Herbert Mehrtens, *Die Entstehung der Verbandstheorie* (Hildesheim: Gerstenberg, 1979); Erhard Scholz, *Geschichte des Mannigfaltigkeitsbegriffs von Riemann bis Poincaré* (Basel: Birkhäuser, 1980); and

Scholz, *Symmetrie—Gruppe—Dualität: Zur Beziehung zwischen theoretischer Mathematik und Anwendungen in Kristallographie und Baustatik des 19. Jahrhunderts* (Basel: Birkhäuser; Berlin: Deutscher Verlag der Wissenschaften, 1989).

2. Olaf Neumann, "Zur Genesis der algebraischen Zahlentheorie," *NTM*, 1980, *17*(1):32–48, (2):38–58; and Neumann, "Divisibility Theories in the Early History of Commutative Algebra and the Foundations of Algebraic Geometry," in *Episodes in the History of Modern Algebra (1800–1950)*, ed. Jeremy J. Gray and Karen Hunger Parshall (Providence, R.I.: American Mathematical Society; London: London Mathematical Society, 2007), pp. 73–106.

3. Luboš Nový, *Origins of Modern Algebra* (Leiden: Noordhoff; Prague: Academia; 1973); Leo Corry, *Modern Algebra and the Rise of Mathematical Structure* (1996; Basel: Birkhäuser, 2004); and Jeremy Gray, *Linear Dfferential Equations and Group Theory from Riemann to Poincaré* (Boston/Basel: Birkhäuser, 1986; 2nd ed., 2000).

4. Corry, *Modern Algebra and the Rise of Mathematical Structure,* e.g., pp. 43, 62, 67, 336, 338.

5. Caroline Ehrhardt, *La fabrication d'une icône des mathématiques: Biographie intellectuelle et mémoire collective d'Évariste Galois* (Paris: Éditions de l'EHESS, 2011); and Frédéric Brechenmacher, "Histoires de pratiques algébriques, XIXe–XXe siècles" (Habilitation, Paris, Oct. 2011).

6. Rudolf Berthold, ed., *Geschichte der Produktivkräfte in Deutschland von 1800 bis 1945, in drei Bänden,* Vol. 1 (Berlin: Akademieverlag, 1990); Hans-Heinrich Müller, ed., *Geschichte der Produktivkräfte in Deutschland von 1800 bis 1945, in drei Bänden,* Vol. 2 (Berlin: Akademieverlag, 1985); and Berthold and Müller, eds., *Geschichte der Produktivkräfte in Deutschland von 1800 bis 1945, in drei Bänden,* Vol. 3 (Berlin: Akademieverlag, 1988).

7. Herbert Mehrtens, H. J. M. Bos, and Ivo Schneider, eds., *Social History of Nineteenth-Century Mathematics* (Basel: Birkhäuser, 1981), p. 260.

8. As far as I remember, Irene Strube, Rüdiger Stolz, and Horst Remane, *Geschichte der Chemie, ein Überblick von den Anfängen bis zur Gegenwart* (Berlin: Deutscher Verlag der Wissenschaften, 1986), was not part of this publication project.