Introduction

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This book offers a selection of texts on mathematics published during 2009 in a variety of professional and general-interest publications from several countries. The main goal of bringing together such diverse contributions is to make widely available representative texts on the role, importance, and dynamism of mathematics, applied mathematics, and mathematics instruction in contemporary society, as perceived by some of the notable writers on these topics. Our goal is to make accessible to a wide audience texts originally printed in publications that are often not available outside the scientific community or have limited distribution even inside it. We also intend to contribute to the dispersion of thinking on mathematics in the context of global competition in technical education, to illustrate the growing presence of mathematical subjects in the mass media, and to encourage even more and better writing of a similar sort.

Since the texts included here are not mathematics articles per se but writings on mathematics, the volume is not technical, as far as mathematical symbolism is concerned. It should appeal to a general audience but particularly to undergraduate and graduate students preparing for mathematical, scientific, and technical careers. The book is of special interest to mathematics and science teachers, as well as to instructors and researchers. But any person with a mathematical background equivalent to or better than high school mathematics will be able to read and understand most of the content. We hope the readers of this collection of texts will become familiar with some of the topics involving mathematics currently discussed in the specialized literature and with mathematical ramifications in the mass media.

Good writing on mathematics is important for at least three reasons. First, it is a means of intradisciplinary growth and can serve as a stimulant for starting on a research path in mathematics. Many professional mathematicians trace their passion for mathematics to some well-written slim

book they read in early adolescence—whether it was G. H. Hardy's *A Mathematician's Apology*, Poincaré's *Science and Hypothesis*, Pölya's *How to Solve It*, or Ekeland's *Mathematics and the Unexpected*. Such encounters with the meditative literature on mathematics become crucial biographical moments, able to light sparks in young minds. They succeed due to the openness of communicating mathematical ideas in accessible yet nontrivial ways. Although mathematicians find great company and friendship among themselves, over the twentieth century they rarely conveyed the beauty of their craft to outsiders in a sustained explanatory effort. This was an isolationist development, a retreat from the centuries-old tradition of extensive writing illustrated by great previous mathematicians. Over the last few decades, expository writing on mathematics gradually flourished again, while today the Internet is changing the nature of mathematical activity and the means of interacting between the mathematical community and the public at large. In this volume we include one text occasioned by such a shift (the article by Timothy Gowers and Michael Nielsen) and, in annual successors in this series, we will stay tuned for further developments and reactions.

Second, writing is crucial in *learning* and *teaching* mathematics. Most mathematicians rarely study mathematics only for personal pleasure. They also do it to instruct others, to transmit knowledge, and to stimulate curiosity, talent, and exploration. They do it with words, not just with symbols and figures. They *explain*, and the explanation is almost always discursive. In the common practice of teaching mathematics and publishing research on mathematics, the discursive part too often vanishes, wiped out by symbols. Most of our students—not to mention the nonspecialized public—are lost in the struggle to decipher a codelike message. Yet every student can learn mathematics better by reading and writing about it. If writing is included as a vital part of the mathematics instruction, it becomes an effective instrument for comprehending mathematics. But writing naturally follows reading; therefore in this book we are offering the first in an annual series of recent remarkable texts on mathematics.

Third, good writing on mathematics has a strategic role. Whether academics acknowledge it or not, their disciplines are engaged in a race for attracting interest and attention. In this competition, mathematics—a discipline requiring the mobilization of massive cognitive resources—is often shortchanged. A big part of the problem resides with the mathematics educators and instructors, who put too little effort into bridging their discipline to other learning domains. This reluctance is mirrored by nonmathematicians who use mathematics in their professions but fail to address the conceptual underpinnings of the mathematical tools they habitually employ. Good writing on mathematics can be instrumental in overcoming misperceptions between people trained strictly in sciences or strictly in

humanities. Furthermore, good writing on mathematics requires not only an understanding of the subject matter but also the talent to persuade the surveyors of an eminently abstract subject that mathematics is more than an exercise in mental skills, that it is a powerful instrument humans use to represent and to study both simple and complex phenomena.

Overview of the Volume

I started to make the selection for this book by consulting all the 2009 periodicals and collective volumes pertaining to writing on mathematics that were accessible to me in the Cornell University Library or through its interlibrary services. I perused and read many more publications than those represented in the final content of this anthology, but constraints of space or related to copyright influenced the final selection. I had to leave aside excellent texts that were too long, or were slightly too technical for the intended profile of the book, or posed insurmountable copyright problems. Also, as a general rule, I did not consider for selection book reviews and interviews.

In a second phase I contacted competent people and asked for advice. This led to several deletions and additions; my debts for the latter are mentioned individually in the acknowledgments.

I purposefully covered all aspects of mathematics as a social enterprise, deliberately avoiding exclusivist compartmentalization. Mathematics is so vast that people working in some areas of it are ignorant of developments animating other areas. This volume is meant to facilitate a better awareness of the issues outstanding in various aspects of mathematics and to inform about reliable sources that can guide further research and interdisciplinary contacts. In doing so I made no attempt to sanitize the selection by avoiding controversial subjects. On the contrary, several of the texts in this collection are overt invitations to dissent.

For convenience, I divided the contents into six thematic sections, but the boundaries are not rigid, and there is considerable affinity among texts across themes.

MATHEMATICS ALIVE

In the first section of the volume I grouped several articles written from widely different perspectives, to illustrate the dynamism and the flexibility of the discourse on mathematics. These texts could have belonged just as well in later sections (or even in more than one), but in the present grouping they show that writing on mathematics, far from being arid or stultifying, is versatile, adaptive, and alive.

Chandler Davis argues that truth in mathematics has various strengths and that accepting this notion makes mathematics pertinent and relevant. He notes that mathematical theories worth their name are more than collections of truths; they concern the nature of conceptual relatedness, not only its existence.

Melvyn Nathanson discusses several difficulties in finding perfect, beautiful, insightful proofs for mathematical results and gives reasons for valuing these qualities over deductive proofs exclusively concerned with formal validity.

Branko Grünbaum details several errors of enumeration in the geometry of the polyhedra. He shows that some reside in logical flaws and proved surprisingly enduring, despite extended scrutiny of this subject over many centuries.

Keith Devlin points out that past mathematicians often solved problems by trial and error, but such experimentation disappeared when they published the results. Nowadays, with the advent and ever more widespread use of computers, distinctions between formal mathematical proofs and proofs by experimentation are likely to become blurred.

Henryk Woźniakowski describes the context and the parameters of employing mathematics to study the complexity of continuous problems generated by systems with partially available information.

Answering yet another "What is . . . mathematics?" question, Tim Johnson locates the origins of financial mathematics in the development of probability as abstract measure theory by the Russian mathematician Andrey Kolmogorov in the first part of the twentieth century. Johnson continues by sketching a brief list of the virtues and the dangers of using mathematics in finance.

Finally, in a piece with an amusing title, David Wagner invites us to give credit to the forbidden language of mathematics. Wagner argues that by turning to taboos and examining them, we escape the conformity inherent in the normative ways of practicing and teaching mathematics.

MATHEMATICIANS AND THE PRACTICE OF MATHEMATICS

Myriad stereotypes circulate about mathematicians and the work they do—so many, in fact, that one wonders why and how mathematicians *do* what they do. I selected for this section a few contributions that challenge stereotypical views of mathematics.

Freeman Dyson draws on his long familiarity with the work of past mathematicians and recalls his personal acquaintance with mathematicians prominent during the twentieth century, to observe that some were better

at identifying broad, unifying concepts in mathematics, while others savored solving particular problems. He considers both styles equally valuable and necessary.

Robert Thomas discovers ludic aspects of mathematics and their virtues, but also the limitations of conceiving of the mathematical activity as a game. He thinks that communicating well is an essential part of doing mathematics, since—unlike in playing games—mathematicians are allowed to disobey strict rules as long as they can make a compelling case for doing so.

Timothy Gowers and Michael Nielsen describe a novel experiment in mathematical research: opening it up to the world, making it available for everybody to see, engage, and enjoy. The Polymath Project they present proposed finding an elementary solution to a particular case of a combinatorial problem; the result was a more effective collaboration than the initiators had expected. As we look into the future of mathematics as an activity, this experiment might well constitute a consequential breakthrough.

The last two texts in this section are similar, yet different. Philip J. Davis and Alicia Dickenstein, in separate contributions, write about mathematical reverberations in the work of a poet (Paul Valéry) and a physicist (Albert Einstein). Davis, following the Valéry exegete Julie Robinson, explains that the ubiquity of mathematical notes in the poet's famous *Cahiers* is far from accidental; instead, they betray Valéry's notion that mathematics succeeds in weeding out the opacity, vagueness, and ambiguity of ordinary language. Dickenstein's note traces the story of Einstein's first page of the original printing of his seminal 1905 article on the theory of relativity. That page, apparently lost through the mishandling of a paper copy in the process of reprinting, happened to contain Einstein's unambiguous (and early) recognition of important mathematicians as predecessors in the formulation of the general theory of relativity. This recovery, partly based on archival material, is not only valuable in itself but supports a line of counterarguments to a sizable, controversial, and conspiratorial literature claiming that Einstein was indebted, without acknowledgment, to the mathematical methods perfected by some of his mathematical predecessors.

MATHEMATICS AND ITS APPLICATIONS

Applied mathematics permeates our lives, even when we do not notice it. Without it we would have no Internet, no scanner at store counters, no airplane flights or space exploration, no global warming measurements, and of course no baseball statistics.

Walter Willinger, David Alderson, and John C. Doyle reconsider the relevance of mathematical modeling as an explanatory means for understanding

the Internet. In a compelling piece they caution that scale-free network models ignore the idiosyncrasies and ambiguities characteristic of domain-specific data collection.

Brian Hayes discusses alternatives for solving the difficulties encountered in manipulating the ever-increasing gigantic numbers that pop up in computing, finance, and astronomy. The currently used floating-point methods are inconvenient for several reasons, most problematic being the overflow of digits. Hayes ponders the advantages and disadvantages of three other possibilities: the tapered floating point, logarithm replacement, and level-index systems.

Theodore P. Hill looks at the problem of timing. *When* is the best time to act (or cease acting) in circumstances of variable uncertainties, from economic competition, to war, to marriage, to betting, and beyond. He describes optimal strategies for stopping in situations where only partial information is available. Hill also gives a few examples of stopping problems that are simple to formulate and to understand, yet they remain unsolved.

Barry A. Cipra notes that applied mathematics increasingly uses topological ideas in the form of homology, a mathematical "mechanism" that makes sense globally of meaningless data gathered locally. Using homology, information recorded and transmitted by randomly distributed sensors can be analyzed with respect to matters concerning coverage, constraints, uncertainty, and optimization.

MATHEMATICS EDUCATION

Mathematics education is a rapidly expanding area of research that is riddled by controversial topics. In the United States the discontent is so widespread (touching many of the people who have a stake in mathematics instruction, including teachers, mathematicians, parents, students, and local and federal governments) that it seems to be the sole unifying issue among the participants in this social enterprise with wide-ranging consequences.

In an insightful essay, Anne Watson situates school mathematics in the broader context of the transition from adolescence to adulthood, underscoring both the tensions and the possibilities it holds. Her student-centered vision, enhanced by Vygotsky's ideas concerning close adult support in students' learning, echoes Dewey's century-old calls for transforming education into an institution that prepares youngsters for becoming informed and responsible members of communities.

Kathleen Ambruso Acker, Mary W. Gray, and Behzad Jalali present the legal, practical, and implicitly ethical ramifications of accommodating the learning space to the requirements of students with disabilities. This subject is rarely discussed with respect to mathematics instruction in higher

education but is present with increasing frequency in court disputes involving colleges and universities.

David Pimm and Nathalie Sinclair discuss different styles of mathematical writing, another topic seldom thought about by many professional mathematicians and educators. The authors note that writing in mathematics is generally impersonal and contains implicit assumptions not always assumed by the reader or made plain to the learner.

In her solo text chosen for this volume, Nathalie Sinclair further elaborates on aesthetic aspects of mathematics. She examines the alternative elitist and frivolous perspectives on the axiological role of aesthetics in mathematics learning and relates them to pressing factors of concern in mathematics education, including student motivation, interest, creativity, and self confidence.

In a provocative article critical of the mathematics textbook industry, Ann Kajander and Miroslav Lovric review several sources of misconceptions that can be tracked to the sloppiness pervasive in some manuals. Among such sources they identify (by considering just the notion of "tangent") colloquial language, unwarranted generalizations, ignorance of the context, careless figures and diagrams, oversimplifications, and ill-defined concepts.

From the excellent, newly published yearbook of the National Council of Teachers of Mathematics I selected for this volume the instructive contribution by Howard Iseri on using paper models to explore the curvature of various surfaces. Iseri skillfully places the problem in historical context and suggests student-friendly ways for teaching the notion of curvature of both Euclidean and non-Euclidean surfaces.

Finally, in this section, Uri Leron and Orit Hazzan discern four different ways of distinguishing between intuitive and analytical thinking. They do it by placing mathematical thinking in a broader cognitive context that considers general theories of human learning.

HISTORY AND PHILOSOPHY OF MATHEMATICS

The history of mathematics and the philosophy of mathematics deserve separate sections but, for reasons of space, I grouped together several contributions from these two fields.

Judith V. Grabiner traces the unlikely circumstances of an eminent analyst, Joseph-Louis Lagrange, venturing into the fundaments of geometry with the illusion that he "proved" the parallel postulate. Grabiner shows that the incident and the paper that resulted from Lagrange's delusion, far from deserving laughs, allow reconstruction of the worldview held by the leading eighteenth-century scientists—one fundamentally different from ours.

Similarly, Harold M. Edwards recovers the algorithmic/constructivist meaning in Leopold Kronecker's mathematics, observing that not only for Kronecker but also for other distinguished past mathematicians (notably Evariste Galois and Niels Abel), mathematics meant something else than is generally implied today. Alluding to the latest advances in computational mathematics, Edwards asks whether a reconsideration of the definition of real numbers based on a logical foundation is in order.

Carlo Cellucci discusses Gian-Carlo Rota's place in the philosophy of mathematics as reflected by Rota's references to the questions surrounding the existence of mathematical objects, mathematical definitions, and proof in mathematics, as well as the relation between mathematics and the philosophy of mathematics.

Philip L. Bowers gives an engaging first-person account of the metamorphoses, over the last three decades, of problems related to circle coverings of a surface in various geometries and their interdependence on the changing role of topological considerations in geometry.

Mark Colyvan observes that inconsistent mathematical theories have worked for long periods of time, and still do. He then examines in detail this apparent oddity, contributing to the ongoing debate concerning the conditions that lead to the failure of mathematical models in applications.

Andrzej Pelc analyzes the role of informal proofs (which he simply calls proofs) and formal proofs (or logical derivations) in forming and consolidating confidence in mathematical results, as accepted by the mathematical community.

MATHEMATICS IN THE MEDIA

These days mathematical encounters await us wherever we turn—in architecture, arts, playgrounds, video games, movies, sports, politics, fashion, environment, the culinary arts, and countless other spheres of endeavor. This ubiquity is reflected in the media. Out of an enormous number of possible references, I selected a small sample of mathematical exploits that appeared in publications of general interest—not always in the usual places!

Erica Klarreich reports on the Kervaire conjecture, a result concerning the topological structure of manifolds of high dimension. The conjecture states that a large class of shapes in dimensions higher than 126 are fundamentally related to spheres. Although a few particular cases remain unsolved, the proof is important for combining topology with differential topology and for settling the quandary in an unexpected way.

In one of her periodical columns, Julie Rehmeyer traces the prehistory of the statistical Student's *t*-test, invented by William Gosset, to small-sample problems that preoccupied Darwin, long before Gosset.

Steven Strogatz plays with variations of Romeo and Juliet's love story to illustrate the explanatory power and limitations of mathematics in selecting a spouse. He shows that sophisticated mathematical notions, like that of differential equations, can be employed to describe a large variety of real-life phenomena.

Samuel Arbesman takes us to the movies to unscramble fine mathematical points in the twists of the plots: game theory strategies, the mathematics of networks, and mathematical epidemiology all come to help. Is watching movies enhanced by mathematical knowledge? With verve and conviction, Arbesman leaves no doubt it is.

Following countless anterior writers on the number harmony embedded in human creativity, Vijay Iyer discovers the joy of tracing proportions of consecutive numbers of the Fibonacci sequence in architecture and music.

Nick Paumgarten describes a living project, the idea of a mathematics museum in Manhattan. While taking the author on a midtown tour, the group of mathematicians who plan the museum offer a humorous account of the ubiquity of mathematics.

Other 2009 Writings on Mathematics

Inevitably, the content of this volume is unfairly parsimonious, leaving out many meritorious texts. Practical considerations—and, perhaps, personal bias—played an important role in selection. To alleviate some of the injustice done to the writings that did not make the final cut for various reasons, I offer a brief review of the 2009 literature on mathematics, with no pretension of completeness.

As runners-up for the book I considered numerous other articles, perhaps twice as many as the number of texts finally included. For instance, the publications of the Mathematical Association of America (both in print and online) are a treasure trove of good writing on mathematics. At various points during the selection I pondered whether to include one or another of the many articles published in *Math Horizons*, the MAA's *Focus*, or the monthly columns posted online—but most of them, at least for 2009, proved too technical for the book I had in mind, perhaps better suited for an anthology of remarkable mathematics writing (as distinct from one of writings on mathematics). As this annual series continues, all publications and authors consistently dedicated to mathematical subjects or engaged in debates concerning mathematics will be fairly represented.

There are many texts worth mentioning. For brevity, I will consider only books in the rest of this introduction—with the few exceptions of relatively new and yet little-known periodicals. Readers who wish to help improve

my task in future volumes are encouraged to use the contact information provided at the end of this introduction.

Several beautifully illustrated volumes on mathematics appeared in 2009. The most notable is *Mathematicians: An Outer View of the Inner World*, a volume unique in content and graphical presentation. It contains 102 one-page autobiographical capsules written by some of the most renowned mathematicians alive, each essay facing the full-page portrait of its author—with photographs taken by Mariana Cook. A similar volume in graphic aspect, with each page of text facing the corresponding illustration, but organized historically by mathematical milestones, is *The Math Book* by Clifford Pickover. And a second edition of *Symmetry in Chaos*, by Michael Field and Martin Golubitsky, was also published in 2009.

Daina Taimina, who first crocheted a surface approximating a hyperbolic plane in the early 1990s (thus starting a phenomenon that has spread in many art galleries around the world as well as in mathematics classrooms), gives an excellent account of her craft in *Crocheting Adventures with Hyperbolic Planes*. In a similar vein, several articles published in the *Journal of Mathematics and the Arts* explore connections between handicrafts, mathematics, and the teaching of mathematics; most notable are the contributions authored respectively by Sarah-Marie Belcastro and Eva Knoll (see complete references at the end). The Bridges Organization (http://www.bridgesmathart.org/), dedicated to exploring the connections between mathematics and the arts, published its twelfth volume, edited by Craig Kaplan and Reza Sarhangi, with the title *Bridges Banff*. And Michele Emmer edited the sixth volume of the *Mathematics and Culture* series. Finally, I notice the publication of the new *Journal of Mathematics and Culture*.

The literature on mathematics and music has grown fast over the last decade, in periodical publications and in monographs. The year 2009 was particularly good. In *Mathematics and Music*, David Wright looks at the common foundations of the two subjects in a friendly, easy-to-follow format. Barry Parker takes a complementary perspective by analyzing the physics of music in *Good Vibrations*. A slightly more technical book exploring intimate connections not only between mathematics and music but also mathematical reverberations of natural phenomena is the massive *Mathematics of Harmony*, by Alexey Stakhov.

Mathematics education is now a vast field of research, rich in literature. I mention just a few of the many books and journals published in 2009. Caroline Baumann edited a collection of recent policy documents concerning mathematics education. Under the auspices of the National Council of Teachers of Mathematics, a group chaired by Gary Martin issued *Focus in High School Mathematics*. The International Commission for Mathematics Instruction published two new collective studies, *The Professional Education*

and Development of Teachers of Mathematics, edited by Ruhama Even and Deborah Loewenberg Ball, and *Challenging Mathematics in and beyond the Classroom*, edited by Edward Barbeau and Peter Taylor. In the series Studies in Mathematical Thinking and Learning two volumes are notable, *Mathematics Teachers at Work*, edited by Janine Remillard and associates, and *Mathematical Literacy*, by Yvette Solomon. And another remarkable volume, in the Routledge Research in Education series, is *Mathematical Relationships in Education*, edited by Laura Black and associates. An extensive examination of contextual mathematics learning for small children is *Numeracy in Early Childhood*, by Agnes Macmillan. And a relatively new journal, *Investigations in Mathematics Learning*, is now in its second year of publication.

Several books on the history of mathematics appeared in 2009. Eleanor Robson and Jacqueline Stedall edited the massive *Oxford Handbook of the History of Mathematics*. William Adams published the second edition of his focused *Life and Times of the Central Limit Theorem*, while Ivor Grattan-Guinness authored *Routes of Learning*, a fascinating account of mathematical encounters throughout history and cultural history. An eclectic account of the origins of mathematical concepts and their various non-mathematical connotations over the centuries is Robert Tubbs's *What Is a Number?*

Bridging the history and the philosophy of mathematics is the volume *Development of Modern Logic*, edited by Leila Haaparanta. Similarly at the intersection of several thinking domains is the anthology of writings by Hermann Weyl, *Mind and Nature*, and the volume *The Big Questions*, by Steven Landsburg. In the Elsevier series Handbooks in the Philosophy of Science, Andrew Irvine edited the comprehensive *Philosophy of Mathematics*. And David Bostock published his one-author introduction with the same title, *Philosophy of Mathematics*.

Among other remarkable books on mathematics published in 2009 are *The Calculus of Friendship*, by Steven Strogatz, a moving account of the decades-long correspondence between the author and his high school calculus teacher; *A Mathematical Nature Walk*, by John Adams, an excellent compendium of questions and answers about mathematical facts found in nature; *Professor Stewart's Hoard of Mathematical Treasures*, a new collection of mathematical curiosities by the prolific Ian Stewart; and *Homage to a Pied Puzzler*, a collected volume edited by Ed Pegg Jr. and associates and dedicated to the foremost writer on entertaining (yet serious) mathematics, Martin Gardner. Also, in *Mythematics*, Michael Huber connects in an intriguing way some of the better-known myths of the Greek mythology to mathematical problems.

Most books on applied mathematics are highly technical, addressing professionals specialized in the respective disciplines and thus beyond the scope of this brief literature review. Somewhat more accessible is *Mathematical*

Methods in Counterterrorism, a volume edited by Nasrullah Memon and collaborators. Given the widespread use of statistics in sports, a useful book is Wayne Winston's *Mathletics: How Gamblers, Managers, and Sports Enthusiasts Use Mathematics in Baseball, Basketball, and Football*. We commonly use mathematics to solve practical problems, including physics problems, but in *The Mathematical Mechanic*, Mark Levi takes the opposite approach, solving mathematical problems by employing physical thinking. Also mentionable as an excellent example of applying the elementary logic of set theory to moral theory is Gustaf Arrhenius's contribution in the volume *Intergenerational Justice*.

Several newspapers of large circulation publish periodically pieces on mathematics, hosted by regular columnists or by invited contributors. This is an encouraging development. For instance, among many other authors, Carl Bialik publishes articles in the *Wall Street Journal*, Steven Strogatz posts insightful pieces for the *New York Times* online edition, and Masha Gessen sends excellent comments to a number of publications.

Mathematics entered cyberspace during the 1990s; by now the trend is maturing, with increasingly sophisticated software enriching the visual experience. The most convenient addresses for keeping up with mathematics in the media are the lists of occurrences updated daily on the homepages hosted by the American Mathematical Society (http://www.ams.org/mathmedia/) and the Mathematical Association of America (http://mathdl.maa.org/mathDL?pa=mathNews&sa=viewArchive). Mathematical Web sites, either sites with plain mathematical content or daily blogs maintained by professional mathematicians, are ever more numerous. They contribute to the fast circulation of ideas and original contributions, methods of research, and even contentious problems. They are so diverse that it is impossible to rank them or even to mention "the best" out there. In the last part of this introduction I commend the reader's attention to several Internet pages with unfailingly high presentation standards. No hierarchical ordering is intended. Further suggestions from the readers of this book are welcome.

John Baez, a mathematical physicist at the University of California, Riverside, maintains an excellent Web page focused on mathematical applications (http://math.ucr.edu/home/baez/TWF.html). Terence Tao of the University of California, Los Angeles, writes a research blog highly popular among mathematicians (http://terrytao.wordpress.com/); he includes wise advice on writing. A group of Berkeley mathematics PhD students maintain the Secret Blogging Seminar (http://sbseminar.wordpress.com/). A comprehensive blog on mathematics education is maintained by Reidar Mosvold, associate professor of mathematics education at the University of Stavanger in Norway (http://mathedresearch.blogspot.com/). The reader who is looking for a more complete list of sources can

consult the following URL address: http://www.ncatlab.org/nlab/show/Online+Resources.

This cursory enumeration of remarkable writings on mathematics intelligible to a large readership and published during 2009 gives a measure of the lively scene animating the literature on mathematics and suggests the multifaceted character of mathematics as a mode of thought.

I hope you, the reader, find the same value and excitement in reading the texts in this volume as I found while searching, reading, and selecting them. For comments on this book and to suggest materials for consideration in future volumes, I encourage you to send correspondence to: Mircea Pitici, P.O. Box 4671, Ithaca, NY 14852, or to write electronically (bestmathwriting@gmail.com).

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