Mathematical Understanding Of Nature Essays On Amazing Physical Phenomena And Their Understanding By Mathematicians

From rainbows, river meanders, and shadows to spider webs, honeycombs, and the markings on animal coats, the visible world is full of patterns that can be described mathematically. Examining such readily observable phenomena, this book introduces readers to the beauty of nature as revealed by mathematics and the beauty of mathematics as revealed in nature. Generously illustrated, written in an informal style, and replete with examples from everyday life, Mathematics in Nature is an excellent and undaunting introduction to the ideas and methods of mathematical modeling. It illustrates how mathematics can be used to formulate and solve puzzles observed in nature and to interpret the solutions. In the process, it teaches such topics as the art of estimation and the effects of scale, particularly what happens as things get bigger. Readers will develop an understanding of the symbiosis that exists between basic scientific principles and their mathematical expressions as well as a deeper appreciation for such natural phenomena as cloud formations, halos and glories, tree heights and leaf patterns, butterfly and moth wings, and even puddles and mud cracks. Developed out of a university course, this book makes an ideal supplemental text for courses in applied mathematics and mathematical modeling. It will also appeal to mathematics educators and enthusiasts at all levels, and is designed so that it can be dipped into at leisure.

Why do some children seem to learn mathematics easily and others slave away at it, learning it only with great effort and apparent pain? Why are some people good at algebra but terrible at geometry? How can people who successfully run a business as adults have been failures at math in school? How come some professional mathematicians suffer terribly when trying to balance a checkbook? And why do school children in the United States perform so dismally in international comparisons? These are the kinds of real questions the editors set out to answer, or at least address, in editing this book on mathematical thinking. Their goal was to seek a diversity of contributors representing multiple viewpoints whose expertise might converge on the answers to these and other pressing and interesting questions regarding this subject. The chapter authors were asked to focus on their own approach to mathematical thinking, but also to address a common core of issues such as the nature of mathematical thinking, how it is similar to and different from other kinds of thinking, what makes some people or some groups better than others in this subject area, and how mathematical thinking can be assessed and taught. Their work is directed to a diverse audience -- psychologists interested in the nature of mathematical thinking and abilities, computer scientists who want to simulate mathematical thinking, educators involved in teaching and testing mathematical thinking, philosophers who need to understand the qualitative aspects of logical thinking, anthropologists and others interested in how and why mathematical thinking seems to differ in quality across cultures, and laypeople and others who have to think mathematically and want to understand how they are going to accomplish that feat.

These are case studies of student teams using VMT to work on problems in the mathematical domain of combinatorics. The version of VMT used here included a generic whiteboard for sketching graphical representations. Data from these sessions was analyzed by a number of researchers in addition to the VMT project members.The essays in this volume were co-authored with close colleagues.

Circles Disturbed brings together important thinkers in mathematics, history, and philosophy to explore the relationship between mathematics and narrative. The book's title recalls the last words of the great Greek mathematician Archimedes before he was slain by a Roman soldier--"Don't disturb my circles"--words that seem to refer to two radically different concerns: that of the practical person living in the concrete world of reality, and that of the theoretician lost in a world of abstraction. Stories and theorems are, in a sense, the natural languages of these two worlds--stories representing the way we act and interact, and theorems giving us pure thought, distilled from the hustle and bustle of reality. Yet, though the voices of stories and theorems seem totally different, they share profound connections and similarities. A book unlike any other, Circles Disturbed delves into topics such as the way in which historical and biographical narratives shape our understanding of mathematics and mathematicians, the development of "myths of origins" in mathematics, the structure and importance of mathematical dreams, the role of storytelling in the formation of mathematical intuitions, the ways mathematics helps us organize the way we think about narrative structure, and much more. In addition to the editors, the contributors are Amir Alexander, David Corfield, Peter Galison, Timothy Gowers, Michael Harris, David Herman, Federica La Nave, G.E.R. Lloyd, Uri Margolin, Colin McLarty, Jan Christoph Meister, Arkady Plotnitsky, and Bernard Teissier.

"It appears to us that the universe is structured in a deeply mathematical way. Falling bodies fall with predictable accelerations. Eclipses can be accurately forecast centuries in advance. Nuclear power plants generate electricity according to well-known formulas. But those examples are the tip of the iceberg. In Nature's Numbers, Ian Stewart presents many more, each charming in its own way.. Stewart admirably captures compelling and accessible mathematical ideas along with the pleasure of thinking of them. He writes with clarity and precision. Those who enjoy this sort of thing will love this book."—Los Angeles Times

This edited volume of 13 new essays aims to turn past discussions of natural kinds on their head. Instead of presenting a metaphysical view of kinds based largely on an unempirical vantage point, it pursues questions of kindedness which take the use of kinds and activities of kinding in practice as significant in the articulation of them as kinds. The book brings philosophical study of current and historical episodes and case studies from various scientific disciplines to bear on natural kinds as traditionally conceived of within metaphysics. Focusing on these practices reveals the different knowledge-producing activities of kinding and processes involved in natural kind use, generation, and discovery. Specialists in their field, the esteemed group of contributors use diverse empirically responsive approaches to explore the nature of kindhood. This groundbreaking volume presents detailed case studies that exemplify kinding in use. Newly written for this volume, each chapter engages with the activities of kinding across a variety of disciplines. Chapter topics include the nature of kinds, kindhood, kinding, and kind-making in linguistics, chemical classification, neuroscience, gene and protein classification, colour theory in applied mathematics, homology in comparative biology, sex and gender identity theory, memory research, race, extended cognition, symbolic algebra, cartography, and geographic information science. The volume seeks to open up an as-yet unexplored area within the emerging field of philosophy of science in practice, and constitutes a valuable addition to the disciplines of philosophy and history of science, technology, engineering, and mathematics.

This book argues that we can only understand transformations of nature studies in the Scientific Revolution if we take seriously the interaction between practitioners (those who know by doing) and scholars (those who know by thinking). These are not in opposition, however. Theory and practice are end points on a continuum, with some participants interested only in the practical, others only in the theoretical, and most in the murky intellectual and material world in between. It is this borderland where influence, appropriation, and collaboration have the potential to lead to new methods, new subjects of enquiry, and new social structures of natural philosophy and science. The case for connection between theory and practice can be most persuasively drawn in the area of mathematics, which is the focus of this book. Practical mathematics was a growing field in early modern Europe and these essays are organised into three parts which contribute to the debate about the role of mathematical practice in the Scientific Revolution. First, they demonstrate the variability of the identity of practical mathematicians, and of the practices involved in their activities in early modern Europe. Second, readers are invited to consider what practical mathematics looked like and that although practical mathematical knowledge was transmitted and circulated in a wide variety of ways, participants were able to recognize them all as practical mathematics. Third, the authors show how differences and nuances in practical mathematics typically depended on the different contexts in which it was practiced: social, cultural, political, and economic particularities matter. Historians of science, especially those interested in the Scientific Revolution period and the history of mathematics will find this book and its ground-breaking approach of particular interest.

The year's finest mathematical writing from around the world This annual anthology brings together the year's finest mathematics writing from around the world. Featuring promising new voices alongside some of the foremost names in the field, The Best Writing on Mathematics 2018 makes available to a wide audience many pieces not easily found anywhere else—and you don't need to be a mathematician to enjoy them. These essays delve into the history, philosophy, teaching, and everyday aspects of math, offering surprising insights into its nature, meaning, and practice—and taking readers behind the scenes of today's hottest mathematical debates. James Grime shows how to build subtly mischievous dice for playing slightly unfair games and Michael Barany traces how our appreciation of the societal importance of mathematics has developed since World War II. In other essays, Francis Su extolls the inherent values of learning, doing, and sharing mathematics, and Margaret Wertheim takes us on a mathematical exploration of the mind and the world—with glimpses at science, philosophy, music, art, and even crocheting. And there's much, much more. In addition to presenting the year's most memorable math writing, this must-have anthology includes an introduction by the editor and a bibliography of other notable pieces on mathematics. This is a must-read for anyone interested in where math has taken us—and where it is headed.

This book explains exactly what human knowledge is. The key concepts in this book are structures and algorithms, i.e., what the readers "see" and how they make use of what they see. Thus in comparison with some other books on the philosophy (or methodology) of science, which employ a syntactic approach, the author's approach is model theoretic or structural. Properly understood, it extends the current art and science of mathematical modeling to all fields of knowledge. The link between structure and algorithms is mathematics. But viewing "mathematics" as such a link is not exactly what readers most likely learned in school; thus, the task of this book is to explain what "mathematics" should actually mean. Chapter 1, an introductory essay, presents a general analysis of structures, algorithms and how they are to be linked. Several examples from the natural and social sciences, and from the history of knowledge, are provided in Chapters 2–6. In turn, Chapters 7 and 8 extend the analysis to include language and the mind. Structures are what the readers see. And, as abstract cultural objects, they can almost always be seen in many different ways. But certain structures, such as natural numbers and the basic theory of grammar, seem to have an absolute character. Any theory of knowledge grounded in human culture must explain how this is possible. The author's analysis of this cultural invariance, combining insights from evolutionary theory and neuroscience, is presented in the book's closing chapter. The book will be of interest to researchers, students and those outside academia who seek a deeper understanding of knowledge in our present-day society.

This volume focuses on the importance of historical enquiry for the appreciation of philosophical problems concerning mathematics. It contains a well-balanced mixture of contributions by internationally established experts, such as Jeremy Gray and

Jens Hoyrup; upcoming scholars, such as Erich Reck and Dirk Schlimm; and young, promising researchers at the beginning of their careers. The book is situated within a relatively new and broadly naturalistic tradition in the philosophy of mathematics. In this alternative philosophical current, which has been dramatically growing in importance in the last few decades, unlike in the traditional schools, proper attention is paid to scientific practices as informing for philosophical accounts.

What do modern academic economists do? What currently is mainstream economics? What is neoclassical economics? And how about heterodox economics? How do the central concerns of modern economists, whatever their associations or allegiances, relate to those traditionally taken up in the discipline? And how did economics arrive at its current state? These and various cognate questions and concerns are systematically pursued in this new book by Tony Lawson. The result is a collection of previously published and new papers distinguished in providing the only comprehensive and coherent account of these issues currently available. The financial crisis has not only revealed weaknesses of the capitalist economy but also highlighted just how limited and impoverished is modern academic economics. Despite the failings of the latter being more widely acknowledged now than ever, there is still an enormous amount of confusion about their source and true nature. In this collection, Tony Lawson also identifies the causes of the discipline’s failings and outlines a transformative solution to its deficiencies. Amongst other things, Lawson advocates for the adoption of a more historical and philosophical orientation to the study of economics, one that deemphasizes the current focus on mathematical modelling while maintaining a high level of analytical rigour. In so doing Lawson argues for a return to long term systematic and sustained projects, in the manner pursued by the likes of Marx, Veblen, Hayek and Keynes, concerned first and foremost with advancing our understanding of social reality. Overall, this forceful and persuasive collection represents a major intervention in the on-going debates about the nature, state and future direction of economics.

The question ``What am I doing?'' haunts many creative people, researchers, and teachers. Mathematics, poetry, and philosophy can look from the outside sometimes as ballet en pointe, and at other times as the flight of the bumblebee. Reuben Hersh looks at mathematics from the inside; he collects his papers written over several decades, their edited versions, and new chapters in his book Experiencing Mathematics, which is practical, philosophical, and in some places as intensely personal as Swann's madeleine. --Yuri Manin, Max Planck Institute, Bonn, Germany What happens when mid-career a mathematician unexpectedly becomes philosophical? These lively and eloquent essays address the questions that arise from a crisis of reflectiveness: What is a mathematical proof and why does it come after, not before, mathematical revelation? Can mathematics be both real and a human artifact? Do mathematicians produce eternal truths, or are the judgments of the mathematical community quasi-empirical and historically framed? How can we be sure that an infinite series that seems to converge really does converge? This collection of essays by Reuben Hersh makes an important contribution. His lively and eloquent essays bring the reality of mathematical research to the page. He argues that the search for foundations is misleading, and that philosophers should shift from focusing narrowly on the deductive structure of proof, to tracing the broader forms of quasi-empirical reasoning that star the history of mathematics, as well as examining the nature of mathematical communities and how and why their collective judgments evolve from one generation to the next. If these questions keep you up at night, then you should read this book. And if they don't, then you should read this book anyway, because afterwards, they will! --Emily Grosholz, Department of Philosophy, Penn State, Pennsylvania, USA Most mathematicians, when asked about the nature and meaning of mathematics, vacillate between the two unrealistic poles of Platonism and formalism. By looking carefully at what mathematicians really do when they are doing mathematics, Reuben Hersh offers an escape from this trap. This book of selected articles and essays provides an honest, coherent, and clearly understandable account of mathematicians' proof as it really is, and of the existence and reality of mathematical entities. It follows in the footsteps of Poincare, Hadamard, and Polya. The pragmatism of John Dewey is a better fit for mathematical practice than the dominant ``analytic philosophy''. Dialogue, satire, and fantasy enliven the philosophical and methodological analysis. Reuben Hersh has written extensively on mathematics, often from the point of view of a philosopher of science. His book with Philip Davis, The Mathematical Experience, won the National Book Award in science. Hersh is emeritus professor of mathematics at the University of New Mexico.

Wow! This is a powerful book that addresses a long-standing elephant in the mathematics room. Many people learning math ask ``Why is math so hard for me while everyone else understands it?'' and ``Am I good enough to succeed in math?'' In answering these questions the book shares personal stories from many now-accomplished mathematicians affirming that ``You are not alone; math is hard for everyone'' and ``Yes; you are good enough.'' Along the way the book addresses other issues such as biases and prejudices that mathematicians encounter, and it provides inspiration and emotional support for mathematicians ranging from the experienced professor to the struggling mathematics student. --Michael Dorff, MAA President This book is a remarkable collection of personal reflections on what it means to be, and to become, a mathematician. Each story reveals a unique and refreshing understanding of the barriers erected by our cultural focus on ``math is hard.'' Indeed, mathematics is hard, and so are many other things--as Stephen Kennedy points out in his cogent introduction. This collection of essays offers inspiration to students of mathematics and to mathematicians at every career stage. --Jill Pipher, AMS President This book is published in cooperation with the Mathematical Association of America.

Vladimir Arnold (1937-2010) was one of the great mathematical minds of the late 20th century. He did significant work in many areas of the field. On another level, he was keeping with a strong tradition in Russian mathematics to write for and to directly teach younger students interested in mathematics. This book contains some examples of Arnold's contributions to the genre. "Continued Fractions" takes a common enrichment topic in high school math and pulls it in directions that only a master of mathematics could envision. "Euler Groups" treats a similar enrichment topic, but it is rarely treated with the depth and imagination lavished on it in Arnold's text. He sets it in a mathematical context, bringing to bear numerous tools of the trade and expanding the topic way beyond its usual treatment. In "Complex Numbers" the context is physics, yet Arnold artfully extracts the mathematical aspects of the discussion in a way that students can understand long before they master the field of quantum mechanics. "Problems for Children 5 to 15 Years Old" must be read as a collection of the author's favorite intellectual morsels. Many are not original, but all are worth thinking about, and each requires the solver to think out of his or her box. Dmitry Fuchs, a long-term friend and collaborator of Arnold, provided solutions to some of the problems. Readers are of course invited to select their own favorites and construct their own favorite solutions. In reading these essays, one has the sensation of walking along a path that is found to ascend a mountain peak and then being shown a vista whose existence one could never suspect from the ground. Arnold's style of exposition is unforgiving. The reader--even a professional mathematician--will find paragraphs that require hours of thought to unscramble, and he or she must have patience with the ellipses of thought and the leaps of reason. These are all part of Arnold's intent. In the interest of fostering a greater awareness and appreciation of mathematics and its connections to other disciplines and everyday life, MSRI and the AMS are publishing books in the Mathematical Circles Library series as a service to young people, their parents and teachers, and the mathematics profession.

"This collection of 39 short stories gives the reader a unique opportunity to take a look at the scientific philosophy of Vladimir Arnold, one of the most original contemporary researchers. Topics of the stories included range from astronomy, to mirages, to motion of glaciers, to geometry of mirrors and beyond. In each case Arnold's explanation is both deep and simple, which makes the book interesting and accessible to an extremely broad readership. Original illustrations hand drawn by the author help the reader to further understand and appreciate Arnold's view on the relationship between mathematics and science."--

When this book was first published, more than five years ago, I added an appendix on How the Pythagoreans discovered Proposition 11.5 of the 'Elements'. I hoped that this appendix, although different in some ways from the rest of the book, would serve to illustrate the kind of research which needs to be undertaken, if we are to acquire a new understanding of the historical development of Greek mathematics. It should perhaps be mentioned that this book is not intended to be an introduction to Greek mathematics for the general reader; its aim is to bring the problems associated with the early history of deductive science to the attention of classical scholars, and historians and philos ophers of science. I should like to conclude by thanking my translator, Mr. A. M. Ungar, who worked hard to produce something more than a mechanical translation. Much of his work was carried out during the year which I spent at Stanford as a fellow of the Center for Advanced Study in the Behavioral Sciences. This enabled me to supervise the work of transla tion as it progressed. I am happy to express my gratitude to the Center for providing me with this opportunity. Arpad Szabo NOTE ON REFERENCES The following books are frequently referred to in the notes. Unless otherwise stated, the editions are those given below. Burkert, W. Weisheit und Wissensclzaft, Studien zu Pythagoras, Philo laos und Platon, Nuremberg 1962.

Mathematical Understanding of NatureEssays on Amazing Physical Phenomena and Their Understanding by MathematiciansAmerican Mathematical Soc.

An anthology of the year's finest writing on mathematics from around the world, featuring promising new voices as well as some of the foremost names in mathematics.

Traditionally, vocational mathematics and precollege mathematics have been separate in schools. But the technological world in which

today's students will work and live calls for increasing connection between mathematics and its applications. Workplace-based mathematics may be good mathematics for everyone. High School Mathematics at Work illuminates the interplay between technical and academic mathematics. This collection of thought-provoking essays--by mathematicians, educators, and other experts--is enhanced with illustrative tasks from workplace and everyday contexts that suggest ways to strengthen high school mathematical education. This important book addresses how to make mathematical education of all students meaningful--how to meet the practical needs of students entering the work force after high school as well as the needs of students going on to postsecondary education. The short readable essays frame basic issues, provide background, and suggest alternatives to the traditional separation between technical and academic mathematics. They are accompanied by intriguing multipart problems that illustrate how deep mathematics functions in everyday settings--from analysis of ambulance response times to energy utilization, from buying a used car to "rounding off" to simplify problems. The book addresses the role of standards in mathematics education, discussing issues such as finding common ground between science and mathematics education standards, improving the articulation from school to work, and comparing SAT results across settings. Experts discuss how to develop curricula so that students learn to solve problems they are likely to encounter in life--while also providing them with approaches to unfamiliar problems. The book also addresses how teachers can help prepare students for postsecondary education. For teacher education the book explores the changing nature of pedagogy and new approaches to teacher development. What kind of teaching will allow mathematics to be a guide rather than a gatekeeper to many career paths? Essays discuss pedagogical implication in problem-centered teaching, the role of complex mathematical tasks in teacher education, and the idea of making open-ended tasks--and the student work they elicit--central to professional discourse. High School Mathematics at Work presents thoughtful views from experts. It identifies rich possibilities for teaching mathematics and preparing students for the technological challenges of the future. This book will inform and inspire teachers, teacher educators, curriculum developers, and others involved in improving mathematics education and the capabilities of tomorrow's work force.
Richard Stanley's work in combinatorics revolutionized and reshaped the subject. His lectures, papers, and books inspired a generation of researchers. In this volume, these researchers explain how Stanley's vision and insights influenced and guided their own perspectives on the subject. As a valuable bonus, this book contains a collection of Stanley's short comments on each of his papers. This book may serve as an introduction to several different threads of ongoing research in combinatorics as well as giving historical perspective.

This book is a collection of essays on the reception of Leibniz’s thinking in the sciences and in the philosophy of science in the 19th and 20th centuries. Authors studied include C.F. Gauss, Georg Cantor, Kurd Lasswitz, Bertrand Russell, Ernst Cassirer, Louis Couturat, Hans Reichenbach, Hermann Weyl, Kurt Gödel and Gregory Chaitin. In addition, we consider concepts and problems central to Leibniz’s thought and that of the later authors: the continuum, space, identity, number, the infinite and the infinitely small, the projects of a universal language, a calculus of logic, a mathesis universalis etc. The book brings together two fields of research in the history of philosophy and of science (research on Leibniz, and the research concerned with some major developments in the 19th and 20th centuries); it describes how Leibniz’s thought appears in the works of these authors, in order to better understand Leibniz’s influence on contemporary science and philosophy; but it also assesses that reception critically, confronting it in particular with the current state of Leibniz research and with the various editions of his work.

This collection of essays spans pure and applied mathematics. Readers interested in mathematical research and historical aspects of mathematics will appreciate the enlightening content of the material. Highlighting the pervasive nature of mathematics today in a host of different areas, the book also covers the spread of mathematical ideas and techniques in areas ranging from computer science to physics to biology.

Collection of the most interesting recent writings on the philosophy of mathematics written by highly respected researchers from philosophy, mathematics, physics, and chemistry Interdisciplinary book that will be useful in several fields—with a cross-disciplinary subject area, and contributions from researchers of various disciplines

Hermann Weyl (1885-1955) was one of the twentieth century's most important mathematicians, as well as a seminal figure in the development of quantum physics and general relativity. He was also an eloquent writer with a lifelong interest in the philosophical implications of the startling new scientific developments with which he was so involved. Mind and Nature is a collection of Weyl's most important general writings on philosophy, mathematics, and physics, including pieces that have never before been published in any language or translated into English, or that have long been out of print. Complete with Peter Pesic's introduction, notes, and bibliography, these writings reveal an unjustly neglected dimension of a complex and fascinating thinker. In addition, the book includes more than twenty photographs of Weyl and his family and colleagues, many of which are previously unpublished. Included here are Weyl's exposition of his important synthesis of electromagnetism and gravitation, which Einstein at first hailed as "a first-class stroke of genius"; two little-known letters by Weyl and Einstein from 1922 that give their contrasting views on the philosophical implications of modern physics; and an essay on time that contains Weyl's argument that the past is never completed and the present is not a point. Also included are two book-length series of lectures, The Open World (1932) and Mind and Nature (1934), each a masterly exposition of Weyl's views on a range of topics from modern physics and mathematics. Finally, four retrospective essays from Weyl's last decade give his final thoughts on the interrelations among mathematics, philosophy, and physics, intertwined with reflections on the course of his rich life.

This book argues against the view that mathematical knowledge is a priori, contending that mathematics is an empirical science and develops historically, just as natural sciences do. Kitcher presents a complete, systematic, and richly detailed account of the nature of mathematical knowledgeand its historical development, focusing on such neglected issues as how and why mathematical language changes, why certain questions assume overriding importance, and how standards of proof are modified.

This new volume on logic follows a recognizable format that deals in turn with the topics of mathematical logic, moving from concepts, via definitions and inferences, to theories and axioms. However, this fresh work offers a key innovation in its ‘pyramidal’ graph system for the logical formalization of all these items. The author has developed this new methodology on the basis of original research, traditional logical instruments such as Porphyrian trees, and modern concepts of classification, in which pyramids are the central organizing concept. The pyramidal schema enables both the content of concepts and the relations between the concept positions in the pyramid to be read off from the graph. Logical connectors are analyzed in terms of the direction in which they connect within the pyramid. Additionally, the author shows that logical connectors are of fundamentally different types: only one sort generates propositions with truth values, while the other yields conceptual expressions or complex concepts. On this basis, strong arguments are developed against adopting the non-discriminating connector definitions implicit in Wittgensteinian truth-value tables. Special consideration is given to mathematical connectors so as to illuminate the formation of concepts in the natural sciences. To show what the pyramidal method can contribute to science, a pyramid of the number concepts prevalent in mathematics is constructed. The book also counters the logical dogma of ‘false’ contradictory propositions and sheds new light on the logical characteristics of probable propositions, as well as on syllogistic and other inferences.

"... The exposition is not only clear, it is friendly, philosophical, and considerate even to the most naive or inexperienced reader. And it proves that the philosophical orientation of an author really can make a big difference. The mathematical content is intensely classical. ... Edwards makes it warmly accessible to any interested reader. And he is breaking fresh ground, in his rigorously constructive or constructivist presentation. So the book will interest anyone trying to learn these major, central topics in classical algebra and algebraic number theory. Also, anyone interested in constructivism, for or against. And even anyone who can be intrigued and drawn in by a masterly exposition of beautiful mathematics." Reuben Hersh This book aims to promote constructive mathematics, not by defining it or formalizing it, but by practicing it, by basing all definitions and proofs on finite algorithms. The topics covered derive from classic works of nineteenth century mathematics---among them Galois' theory of algebraic equations, Gauss's theory of binary quadratic forms and Abel's theorem about integrals of rational differentials on algebraic curves. It is not surprising that the first two topics can be treated constructively---although the constructive treatments shed a surprising amount of light on them---but the last topic, involving integrals and differentials as it does, might seem to call for infinite processes. In this case too, however, finite algorithms suffice to define the genus of an algebraic curve, to prove that birationally equivalent curves have the same genus, and to prove the Riemann-Roch theorem. The main algorithm in this case is Newton's polygon, which is given a full treatment. Other topics covered include the fundamental theorem of algebra, the factorization of polynomials over an algebraic number field, and the spectral theorem for symmetric matrices. Harold M. Edwards is Emeritus Professor of Mathematics at New York University. His previous books are Advanced Calculus (1969, 1980, 1993), Riemann's Zeta Function (1974, 2001), Fermat's Last Theorem (1977), Galois Theory (1984), Divisor Theory (1990) and Linear Algebra (1995). Readers of his Advanced Calculus will know that his preference for constructive mathematics is not new.

The year's finest mathematical writing from around the world This annual anthology brings together the year’s finest mathematics writing from around the world. Featuring promising new voices alongside some of the foremost names in the field, The Best Writing on Mathematics 2020 makes available to a wide audience many articles not easily found anywhere else—and you don’t need to be a mathematician to enjoy them. These writings offer surprising insights into the nature, meaning, and practice of mathematics today. They delve into the history, philosophy, teaching, and everyday aspects of math, and take readers behind the scenes of today’s hottest mathematical debates. Here, Steven Strogatz reveals how calculus drives advances in virology, Paul Thagard argues that the power of mathematics stems from its combination of realistic and fictional qualities, and Erica Klarreich describes how Hao Huang used the combinatorics of cube nodes to solve a longstanding problem in computer science. In other essays, John Baez tells how he discovered the irresistible attractions of algebraic geometry, Mark Colyvan compares the radically different explanatory practices of mathematics and science, and Boris Odehnal reviews some surprising properties of multidimensional geometries. And there’s much, much more. In addition to presenting the year’s most memorable writings on mathematics, this must-have anthology includes a bibliography of other notable writings and an introduction by the editor. This book belongs on the shelf of anyone interested in where math has taken us—and where it is headed.

This classic guide contains four essays on writing mathematical books and papers at the research level and at the level of graduate texts. The authors are all well known for their writing skills, as well as their mathematical accomplishments. The first essay, by Steenrod, discusses writing books, either monographs or textbooks. He gives both general and specific advice, getting into such details as the need for a good introduction. The longest essay is by Halmos, and contains many of the pieces of his advice that are repeated even today: In order to say something well you must have something to say; write for someone; think about the alphabet. Halmos's advice is systematic and practical.

Schiffer addresses the issue by examining four types of mathematical writing: research paper, monograph, survey, and textbook, and gives advice for each form of exposition. Dieudonne's contribution is mostly a commentary on the earlier essays, with clear statements of where he disagrees with his coauthors. The advice in this small book will be useful to mathematicians at all levels.

First Published in 1996. Routledge is an imprint of Taylor & Francis, an informa company.

Advances in Mathematics Education is a new and innovative book series published by Springer that builds on the success and the rich history of ZDM—The Inter- tional Journal on Mathematics Education (formerly known as Zentralblatt für - daktik der Mathematik). One characteristic of ZDM since its inception in 1969 has been the publication of themed issues that aim to bring the state-of-the-art on c- tral sub-domains within mathematics education. The published issues include a rich variety of topics and contributions that continue to be of relevance today. The newly established monograph series aims to integrate, synthesize and extend papers from previously published themed issues of importance today, by orienting these issues towards the future state of the art. The main idea is to move the ?eld forward with a book series that looks to the future by building on the past by carefully choosing viable ideas that can fruitfully mutate and inspire the next generations. Taking ins- ration from Henri Poincaré (1854–1912), who said “To create consists precisely in not making useless combinations and in making those which are useful and which are only a small minority.

The year's finest writing on mathematics from around the world This annual anthology brings together the year's finest mathematics writing from around the world. Featuring promising new voices alongside some of the foremost names in the field, The Best Writing on Mathematics 2015 makes available to a wide audience many articles not easily found anywhere else—and you don’t need to be a mathematician to enjoy them. These writings offer surprising insights into the nature, meaning, and practice of mathematics today. They delve into the history, philosophy, teaching, and everyday occurrences of math, and take readers behind the scenes of today’s hottest mathematical debates. Here David Hand explains why we should actually expect unlikely coincidences to happen; Arthur Benjamin and Ethan Brown unveil techniques for improvising custom-made magic number squares; Dana Mackenzie describes how mathematicians are making essential contributions to the development of synthetic biology; Steven Strogatz tells us why it’s worth writing about math for people who are alienated from it; Lisa Rougetet traces the earliest written descriptions of Nim, a popular game of mathematical strategy; Scott Aaronson looks at the unexpected implications of testing numbers for randomness; and much, much more. In addition to presenting the year’s most memorable writings on mathematics, this must-have anthology includes a bibliography of other notable writings and an introduction by the editor, Mircea Pitici. This book belongs on the shelf of anyone interested in where math has taken us—and where it is headed.

What is the nature of mathematical knowledge? Is it anything like scientific knowledge or is it sui generis? How do we acquire it? Should we believe what mathematicians themselves tell us about it? Are mathematical concepts innate or acquired? Eight new essays offer answers to these and many other questions. Written by some of the world's leading philosophers of mathematics, psychologists, and mathematicians, Mathematical Knowledge gives a lively sense of the current state of debate in this fascinating field.

This collection of 39 short stories gives the reader a unique opportunity to take a look at the scientific philosophy of Vladimir Arnold, one of the most original contemporary researchers. Topics of the stories included range from astronomy, to mirages, to motion of glaciers, to geometry of mirrors and beyond. In each case Arnold's explanation is both deep and simple, which makes the book interesting and accessible to an extremely broad readership. Original illustrations hand drawn by the author help the reader to further understand and appreciate Arnold's view on the relationship between mathematics and science.

One of the traditional ways mathematical ideas and even new areas of mathematics are created is from experiments. One of the best-known examples is that of the Fermat hypothesis, which was conjectured by Fermat in his attempts to find integer solutions for the famous Fermat equation. This hypothesis led to the creation of a whole field of knowledge, but it was proved only after several hundred years. This book, based on the author's lectures, presents several new directions of mathematical research. All of these directions are based on numerical experiments conducted by the author, which led to new hypotheses that currently remain open, i.e., are neither proved nor disproved. The hypotheses range from geometry and topology (statistics of plane curves and smooth functions) to combinatorics (combinatorial complexity and random permutations) to algebra and number theory (continuous fractions and Galois groups). For each subject, the author describes the problem and presents numerical results that led him to a particular conjecture. In the majority of cases there is an indication of how the readers can approach the formulated conjectures (at least by conducting more numerical experiments). Written in Arnold's unique style, the book is intended for a wide range of mathematicians, from high school students interested in exploring unusual areas of mathematics on their own, to college and graduate students, to researchers interested in gaining a new, somewhat nontraditional perspective on doing mathematics. In the interest of fostering a greater awareness and appreciation of mathematics and its connections to other disciplines and everyday life, MSRI and the AMS are publishing books in the Mathematical Circles Library series as a service to young people, their parents and teachers, and the mathematics profession. Titles in this series are co-published with the Mathematical Sciences Research Institute (MSRI).

This volume provides a valuable contribution to our knowledge of eighteenth- and nineteenth-century intellectual life inside and outside Germany. —Prof. Karl S. Guthke, Harvard University This elegant collection of essays ranges across eighteenth and nineteenth-century thought, covering philosophy, science, literature and religion in the ‘Age of Goethe.’ A recognised authority in the field, Nisbet grapples with the major voices of the Enlightenment and gives pride of place to the figures of Lessing, Herder, Goethe and Schiller. These eleven essays range widely in their compass of thought and intellectual discourse, dealing incisively with themes including the philosophical implications of literature and the relationship between religion, science and politics. The result is an accomplished reflection on German thought, but also on its rebirth, as Nisbet argues for the relevance of these Enlightenment thinkers for the readers of today. The first half of this collection focuses predominantly on eighteenth-century thought, where names like Lessing, Goethe and Herder, but also Locke and Voltaire, feature. The second has a wider chronological scope, discussing authors such as Winckelmann and Schiller, while branching out from discussions of religion, philosophy and literature to explore the sciences. Issues of biology, early environmentalism, and natural history also form part of this volume. The collection concludes with an examination of changing attitudes towards art in the aftermath of the 'Age of Goethe.' The essays in this volume have been previously published separately, but are brought together in this collection to present Nisbet's widely-acclaimed perspectives on this fascinating period of German thought. It will be of interest to scholars and students of the intellectual life of Europe during the Enlightenment, while its engaging and lucid style will also appeal to the general reader.

What is life? For four centuries, it has been believed that the only possible scientific approach to this question proceeds from the Cartesian metaphor -- organism as machine. Therefore, organisms are to be studied and characterized the same way "machines" are; the same way any inorganic system is. Robert Rosen argues that such a view is neither necessary nor sufficient to answer the question. He asserts that life is not a specialization of mechanism, but rather a sweeping generalization of it. Above all, Rosen argues that renouncing mechanism does not mean abandoning science. A radical alternative is proposed, drawn equally from experience in biology, physics, and mathematics; an alternative which draws attention to a new class of complex systems, which are radically different from mechanism.

Bob Hale and Crispin Wright draw together here the key writings in which they have worked out their distinctive neo-Fregean approach to the philosophy of mathematics. The two main components in Frege's mathematical philosophy were his platonism and his logicism -- the claims, respectively, that mathematics is a body of knowledge about independently existing objects, and that this knowledge may be acquired on the basis of general logical laws and suitable definitions. The centralthesis of this collection is that Frege was -- his own eventual recantation notwithstanding -- substantially right in both claims. Where neo-Fregeanism principally differs from Frege is in taking a more optimistic view of the kind of contextual explanation (proceeding via what are now commonly calledabstraction principles) of the fundamental concepts of arithmetic and analysis which Frege considered and rejected. On this basis, neo-Fregeanism promises defensible and attractive answers to some of the most important ontological and epistemological questions in the philosophy of mathematics. In addition to fourteen previously published papers, the volume features a new paper on the Julius Caesar problem; a substantial new introduction mapping out the programme and the contributions made to it by the various papers; a postscript explaining which issues most require further attention; and bibliographies both of references and of further useful sources. The Reason's Proper Study will be recognized as the most powerful presentation yet of the neo-Fregean programme; it willprove indispensable reading not just to philosophers of mathematics but to all who are interested in the fundamental metaphysical and epistemological issues on which the programme impinges.