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## SELINA FITZGERALD

### Stalking the Riemann Hypothesis Penguin

In the early twentieth century, a massive undertaking to rid mathematics of all paradoxes and inconsistencies was underway. Known as Hilbert's program, it sought to provide an unshakable foundation for all of mathematics. Things seemed to be proceeding well until young Kurt Godel stunned the world by proving that Hilbert's goals were unobtainable, that contradiction was part of the warp and weave of any mathematical system. Yet what at the time seemed to be a fatal blow to mathematical consistency now forms the basis of modern logic. Godel's incompleteness theorems are often misunderstood to be a statement of the limits of mathematical reasoning, but in truth they strengthen mathematics, building it up to be more powerful than what had come before. In this third book in the Math Girls series, join Miruka and friends as they tackle the basics of modern logic, learning such topics as the Peano axioms, set theory, and diagonalization, leading up to an in-depth exploration of Godel's famous theorems. Along the way, visit other interesting and important topics such as trigonometry and the epsilon-delta definition of limits, and of course take on challenges from the enigmatic Mr. Muraki. Math Girls 3: Godel's Incompleteness Theorems has something for anyone interested in mathematics, from advanced high school students to college math majors and educators."

### The Hundred-Year Quest to Solve One of Math's Greatest Puzzles Penguin UK

Like masterpieces of art, music, and literature, great mathematical theorems are creative milestones, works of genius destined to last forever. Now William Dunham gives them the attention they deserve. Dunham places each theorem within its historical context and explores the very human and often turbulent life of the creator — from Archimedes, the absentminded theoretician whose absorption in his work often precluded eating or bathing, to Gerolamo Cardano, the sixteenth-century mathematician whose accomplishments flourished despite a bizarre array of misadventures, to the paranoid genius of modern times, Georg Cantor. He also provides step-by-step proofs for the theorems, each easily accessible to readers with no more than a knowledge of high school mathematics. A rare combination of the historical, biographical, and mathematical, Journey Through Genius is a fascinating introduction to a neglected field of human creativity. "It is mathematics presented as a series of works of art; a fascinating lingering over individual examples of ingenuity and insight. It is mathematics by lightning flash." —Isaac Asimov

*190 years from Riemann's Birth* Macmillan

Why is math so hard? And why, despite this difficulty, are some people so good at it? If there's some inborn capacity for mathematical thinking—which there must be, otherwise no one could do it—why can't we all do it well? Keith Devlin has answers to all these difficult questions, and in giving them shows us how mathematical ability evolved, why it's a part of language ability, and how we can make better use of this innate talent. He also offers a breathtakingly new theory of language development—that language evolved in two stages, and its main purpose was not communication—to show that the ability to think mathematically arose out of the same symbol-manipulating ability that was so crucial to the emergence of true language. Why, then, can't we do math as well as we can speak? The answer, says Devlin, is that we can and do—we just don't recognize when we're using mathematical reasoning.

*Prime Numbers and the Riemann Hypothesis* Bloomsbury Publishing USA

No number has captured the attention and imagination of people throughout the ages as much as the ratio of a circle's circumference to its diameter. Pi—or  $\pi$  as it is symbolically known—is infinite and,

in The Joy of pi, it proves to be infinitely intriguing. With incisive historical insight and a refreshing sense of humor, David Blatner explores the many facets of pi and humankind's fascination with it—from the ancient Egyptians and Archimedes to Leonardo da Vinci and the modern-day Chudnovsky brothers, who have calculated pi to eight billion digits with a homemade supercomputer. The Joy of Pi is a book of many parts. Breezy narratives recount the history of pi and the quirky stories of those obsessed with it. Sidebars document fascinating pi trivia (including a segment from the O. J. Simpson trial). Dozens of snippets and factoids reveal pi's remarkable impact over the centuries. Mnemonic devices teach how to memorize pi to many hundreds of digits (or more, if you're so inclined). Pi-inspired cartoons, poems, limericks, and jokes offer delightfully "square" pi humor. And, to satisfy even the most exacting of number jocks, the first one million digits of pi appear throughout the book. A tribute to all things pi, The Joy of pi is sure to foster a newfound affection and respect for the big number with the funny little symbol.

*Gamma* Prime Obsession Bernhard Riemann and the Greatest Unsolved Problem in Mathematics The book shows how the art of mathematical imagining is not as mysterious as it seems. Drawing on a variety of artistic resources the author reveals how anyone can begin to visualize the enigmatic 'imaginary numbers' that first baffled mathematicians in the 16th century.

*Prime Obsession* Bloomsbury Publishing USA

In 1859 Bernhard Riemann, a shy German mathematician, gave an answer to a problem that had long puzzled mathematicians. Although he couldn't provide a proof, Riemann declared that his solution was 'very probably' true. For the next one hundred and fifty years, the world's mathematicians have longed to confirm the Riemann hypothesis. So great is the interest in its solution that in 2001, an American foundation offered a million-dollar prize to the first person to demonstrate that the hypothesis is correct. In this book, Karl Sabbagh makes accessible even the airiest peaks of maths and paints vivid portraits of the people racing to solve the problem. Dr. Riemann's Zeros is a gripping exploration of the mystery at the heart of our counting system.

### The Riemann Hypothesis Souvenir Press

Henri Poincaré was one of the greatest mathematicians of the late nineteenth and early twentieth century. He revolutionized the field of topology, which studies properties of geometric configurations that are unchanged by stretching or twisting. The Poincaré conjecture lies at the heart of modern geometry and topology, and even pertains to the possible shape of the universe. The conjecture states that there is only one shape possible for a finite universe in which every loop can be contracted to a single point. Poincaré's conjecture is one of the seven "millennium problems" that bring a one-million-dollar award for a solution. Grigory Perelman, a Russian mathematician, has offered a proof that is likely to win the Fields Medal, the mathematical equivalent of a Nobel prize, in August 2006. He also will almost certainly share a Clay Institute millennium award. In telling the vibrant story of The Poincaré Conjecture, Donal O'Shea makes accessible to general readers for the first time the meaning of the conjecture, and brings alive the field of mathematics and the achievements of generations of mathematicians whose work have led to Perelman's proof of this famous conjecture.

### Imagining Numbers Walker

Prime Obsession taught us not to be afraid to put the math in a math book. Unknown Quantity heeds the lesson well. So grab your graphing calculators, slip out the slide rules, and buckle up! John Derbyshire is introducing us to algebra through the ages and it promises to be just what his die-hard fans have been waiting for. "Here is the story of algebra." With this deceptively simple introduction, we begin our journey. Flanked by formulae, shadowed by roots and radicals, escorted by an expert who navigates unerringly on our behalf, we are guaranteed safe passage through even the most

treacherous mathematical terrain. Our first encounter with algebraic arithmetic takes us back 38 centuries to the time of Abraham and Isaac, Jacob and Joseph, Ur and Haran, Sodom and Gomorrah. Moving deftly from Abel's proof to the higher levels of abstraction developed by Galois, we are eventually introduced to what algebraists have been focusing on during the last century. As we travel through the ages, it becomes apparent that the invention of algebra was more than the start of a specific discipline of mathematics—it was also the birth of a new way of thinking that clarified both basic numeric concepts as well as our perception of the world around us. Algebraists broke new ground when they discarded the simple search for solutions to equations and concentrated instead on abstract groups. This dramatic shift in thinking revolutionized mathematics. Written for those among us who are unencumbered by a fear of formulae, *Unknown Quantity* delivers on its promise to present a history of algebra. Astonishing in its bold presentation of the math and graced with narrative authority, our journey through the world of algebra is at once intellectually satisfying and pleasantly challenging.

#### **The Riemann Hypothesis** Race Point Publishing

*Physical Laws of the Mathematical Universe: Who Are We?* sets off from the first page on an arduous and ambitious journey to define and describe a comprehensive depiction of reality that embraces the rigors of physics, the elegance of mathematics, and the intricacies of human perception. Neeti Sinha brings to bear her extensive education and research as she pursues an explanation that unites these often disparate disciplines in service of a nuanced description of the wonders of the whole universe. In the course of its exploration of this topic, *Physical Laws of the Mathematical Universe: Who Are We?* unites insights from the fields of mathematics and physics in light of human perception to explain the contours of the universe and the origins of its parallel forms. The work also demonstrates how major scientific conundrums find their resolution when one adopts a holistic perspective. Finally, the author uncovers the profound foundations of human appreciation for truth and beauty in the aesthetics that bind together physics and mathematics. If you look at your life and the world and wonder about their true nature, then *Physical Laws of the Mathematical Universe: Who Are We?* will accompany you on a journey that may test the limits of your understandings of the universe while opening to your gaze vistas you previously had not imagined.

#### **Poincaré's Prize** GRIN Verlag

This book introduces interested readers to one of the most famous and difficult open problems in mathematics: the Riemann Hypothesis. Finding a proof will not only make you famous, but also earns you a one million dollar prize. The book originated from an online internet course at the University of Amsterdam for mathematically talented secondary school students. Its aim was to bring them into contact with challenging university level mathematics and show them why the Riemann Hypothesis is such an important problem in mathematics. After taking this course, many participants decided to study in mathematics at university.

#### **Riemann's Zeta Function** Birkhäuser

Quanta Magazine's stories of mathematical explorations show that "inspiration strikes willy-nilly," revealing surprising solutions and exciting discoveries. If you're a science and data nerd like me, you may be interested in "Alice and Bob Meet the Wall of Fire" and "The Prime Number Conspiracy" from Quanta Magazine and Thomas Lin. - Bill Gates These stories from Quanta Magazine map the routes of mathematical exploration, showing readers how cutting-edge research is done, while illuminating the productive tension between conjecture and proof, theory and intuition. The stories show that, as James Gleick puts it in the foreword, "inspiration strikes willy-nilly." One researcher thinks of quantum chaotic systems at a bus stop; another suddenly realizes a path to proving a theorem of number theory while in a friend's backyard; a statistician has a "bathroom sink epiphany" and discovers the key to solving the Gaussian correlation inequality. Readers of *The Prime Number Conspiracy*, says Quanta editor-in-chief Thomas Lin, are headed on "breathtaking intellectual journeys to the bleeding edge of discovery strapped to the narrative rocket of humanity's never-ending pursuit of knowledge." Quanta is the only popular publication that offers in-depth coverage of the latest breakthroughs in understanding our mathematical universe. It communicates mathematics by taking it seriously, wrestling with difficult concepts and clearly explaining them in a way that speaks to our innate curiosity about our world and ourselves. Readers of this volume will learn that prime numbers have decided preferences about the final digits of the primes that immediately follow them (the "conspiracy" of the title); consider whether math is the universal language of nature (allowing for "a unified theory of randomness"); discover surprising solutions (including a pentagon tiling proof that solves a century-old math problem); ponder the limits of computation; measure infinity; and explore the eternal question "Is mathematics good for you?" Contributors Ariel Bleicher, Robbert Dijkgraaf, Kevin Hartnett, Erica Klarreich, Thomas Lin, John Pavlus, Siobhan Roberts, Natalie Wolchover Copublished with Quanta Magazine

#### **The Joy of Pi** Penguin

In August 1859 Bernhard Riemann, a little-known 32-year old mathematician, presented a paper to the Berlin Academy titled: "On the Number of Prime Numbers Less Than a Given Quantity." In the middle of that paper, Riemann made an incidental remark "a guess, a hypothesis. What he tossed out to the assembled mathematicians that day has proven to be almost cruelly compelling to countless scholars in the ensuing years. Today, after 150 years of careful research and exhaustive study, the question remains. Is the hypothesis true or false? Riemann's basic inquiry, the primary topic of his paper, concerned a straightforward but nevertheless important matter of arithmetic "defining a precise formula to track and identify the occurrence of prime numbers. But it is that incidental remark "the Riemann Hypothesis" that is the truly astonishing legacy of his 1859 paper. Because Riemann was able to see beyond the pattern of the primes to discern traces of something mysterious and mathematically elegant shrouded in the shadows "subtle variations in the distribution of those prime numbers. Brilliant for its clarity, astounding for its potential consequences, the Hypothesis took on enormous importance in mathematics. Indeed, the successful solution to this puzzle would herald a revolution in prime number theory. Proving or disproving it became the greatest challenge of the age. It has become clear that the Riemann Hypothesis, whose resolution seems to hang tantalizingly just beyond our grasp, holds the key to a variety of scientific and mathematical investigations. The making and breaking of modern codes, which depend on the properties of the prime numbers, have roots in the Hypothesis. In a series of extraordinary developments during the 1970s, it emerged that even the physics of the atomic nucleus is connected in ways not yet fully understood to this strange conundrum. Hunting down the solution to the Riemann Hypothesis has become an obsession for many "the veritable "great white whale" of mathematical research. Yet despite determined efforts by generations of mathematicians, the Riemann Hypothesis defies resolution. Alternating passages of extraordinarily lucid mathematical exposition with chapters of elegantly composed biography and history, *Prime Obsession* is a fascinating and fluent account of an epic mathematical mystery that continues to challenge and excite the world. Posited a century and a half ago, the Riemann Hypothesis is an intellectual feast for the cognoscenti and the curious alike. Not just a story of numbers and calculations, *Prime*

*Obsession* is the engrossing tale of a relentless hunt for an elusive proof "and those who have been consumed by it.

#### **The Renaissance World of Leonardo Da Vinci** Wiley

For 150 years the Riemann hypothesis has been the holy grail of mathematics. Now, at a moment when mathematicians are finally moving in on a proof, Dartmouth professor Dan Rockmore tells the riveting history of the hunt for a solution. In 1859 German professor Bernhard Riemann postulated a law capable of describing with an amazing degree of accuracy the occurrence of the prime numbers. Rockmore takes us all the way from Euclid to the mysteries of quantum chaos to show how the Riemann hypothesis lies at the very heart of some of the most cutting-edge research going on today in physics and mathematics.

#### **Prime Numbers** Courier Corporation

A fascinating journey into the mind-bending world of prime numbers Cicadas of the genus *Magicada* appear once every 7, 13, or 17 years. Is it just a coincidence that these are all prime numbers? How do twin primes differ from cousin primes, and what on earth (or in the mind of a mathematician) could be sexy about prime numbers? What did Albert Wilansky find so fascinating about his brother-in-law's phone number? Mathematicians have been asking questions about prime numbers for more than twenty-five centuries, and every answer seems to generate a new rash of questions. In *Prime Numbers: The Most Mysterious Figures in Math*, you'll meet the world's most gifted mathematicians, from Pythagoras and Euclid to Fermat, Gauss, and Erdős, and you'll discover a host of unique insights and inventive conjectures that have both enlarged our understanding and deepened the mystique of prime numbers. This comprehensive, A-to-Z guide covers everything you ever wanted to know—and much more that you never suspected—about prime numbers, including: \* The unproven Riemann hypothesis and the power of the zeta function \* The "Primes is in P" algorithm \* The sieve of Eratosthenes of Cyrene \* Fermat and Fibonacci numbers \* The Great Internet Mersenne Prime Search \* And much, much more

#### **Physical Laws of the Mathematical Universe: Who Are We?** Princeton University Press

Academic Paper from the year 2021 in the subject Mathematics - Analysis, grade: 2.00, language: English, abstract: It is demonstrated in this work that we may construct an infinite number of strips in the complex plane having the same 'dimensions' as the Critical Strip and which are devoid of Riemann zeros except on the line of symmetry. It is shown that the number of zeros on each line is infinite, indeed, there is a Riemann zero at infinity. It is posited that a form of the Riemann conjecture is verified in each strip. It is shown that each integer in the infinite set of the integers has an associated Riemann zero and that the imaginary parts of the complex number at which the zeros are located are proportional to the 'local' asymptote to the prime counting function. A connection between the prime counting function and the zeta function is established. A limited distribution of the Riemann zeros corresponding to their respective prime numbers is constructed and it is seen that, at least over this range, the two are correlated, albeit non-linearly. It is demonstrated that the imaginary part of the complex number locating a Riemann zero may, for any integer that can be articulated, be obtained by a few keystrokes of a hand calculator.

#### **The Most Mysterious Figures in Math** Springer

Now in its second edition, this textbook provides an introduction and overview of number theory based on the density and properties of the prime numbers. This unique approach offers both a firm background in the standard material of number theory, as well as an overview of the entire discipline. All of the essential topics are covered, such as the fundamental theorem of arithmetic, theory of congruences, quadratic reciprocity, arithmetic functions, and the distribution of primes. New in this edition are coverage of p-adic numbers, Hensel's lemma, multiple zeta-values, and elliptic curve methods in primality testing. Key topics and features include: A solid introduction to analytic number theory, including full proofs of Dirichlet's Theorem and the Prime Number Theorem Concise treatment of algebraic number theory, including a complete presentation of primes, prime factorizations in algebraic number fields, and unique factorization of ideals Discussion of the AKS algorithm, which shows that primality testing is one of polynomial time, a topic not usually included in such texts Many interesting ancillary topics, such as primality testing and cryptography, Fermat and Mersenne numbers, and Carmichael numbers The user-friendly style, historical context, and wide range of exercises that range from simple to quite difficult (with solutions and hints provided for select exercises) make *Number Theory: An Introduction via the Density of Primes* ideal for both self-study and classroom use. Intended for upper level undergraduates and beginning graduates, the only prerequisites are a basic knowledge of calculus, multivariable calculus, and some linear algebra. All necessary concepts from abstract algebra and complex analysis are introduced where needed.

#### **A Resource for the Afficionado and Virtuoso Alike** National Geographic Books

*The Mystery of the Prime Numbers* uses an innovative visual approach to communicate some surprisingly advanced mathematical ideas without any need for formulas or equations. The issue of prime numbers acts as a gateway into some truly strange philosophical territory whose relevance extends well beyond mathematics. The series *Secrets of Creation* is in three volumes: *Secrets of Creation Volume 1 The Mystery of the Prime Numbers*, *Secrets of Creation, Volume 2 The Enigma of the Spiral Waves*, *Secrets of Creation, Volume 3 Prime Numbers, Quantum Physics and a Journey to the Centre of Your Mind*

#### **From Pythagoras to Riemann** Crown Forum

A NEW YORK TIMES NOTABLE BOOK The Babylonians invented it, the Greeks banned it, the Hindus worshipped it, and the Christian Church used it to fend off heretics. Today it's a timebomb ticking in the heart of astrophysics. For zero, infinity's twin, is not like other numbers. It is both nothing and everything. Zero has pitted East against West and faith against reason, and its intransigence persists in the dark core of a black hole and the brilliant flash of the Big Bang. Today, zero lies at the heart of one of the biggest scientific controversies of all time: the quest for a theory of everything. Within the concept of zero lies a philosophical and scientific history of humanity. Charles Seife's elegant and witty account takes us from Aristotle to superstring theory by way of Egyptian geometry, Kabbalism, Einstein, the Chandrasekhar limit and Stephen Hawking. Covering centuries of thought, it is a concise tour of a world of ideas, bound up in the simple notion of nothing.

#### **On the Riemann Hypothesis** Nova Science Publishers

Presents the history of the invention of computers, describing the collaboration of John von Neumann and his colleagues as they worked together to create the first computer, an event which led to the hydrogen bomb and the birth of the digital age.

#### **Number Theory** National Academies Press

For mathematicians or others who wish to keep up to date with the state of the art of geometrical problems, this collection of problems that are easy to state and understand but are as yet unsolved covers a wide variety of topics including convex sets, polyhedra, packing and covering, tiling, and combinatorial problems. Annotation copyrighted by Book News, Inc., Portland, OR.

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