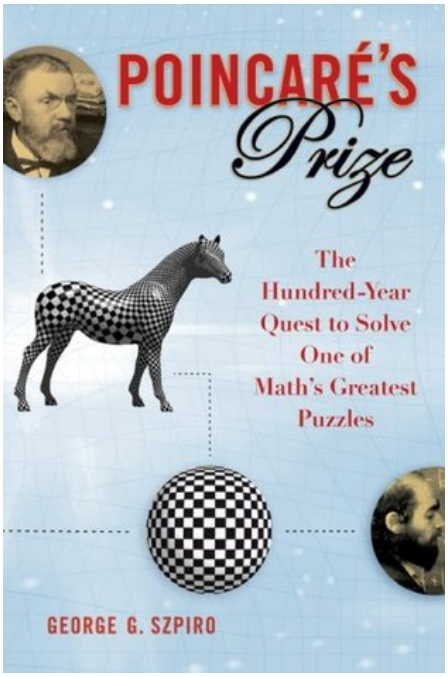

Poincare's Prize: The Hundred-Year Quest to Solve One of Math's Greatest Puzzles

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Poincare's Prize: The Hundred-Year Quest to Solve One of Math's Greatest Puzzles George G. Szpiro With a reclusive and eccentric hero, dramatic turns, and a million-dollar payoff, Poincaré's Prize is the stuff of great fiction. Amazingly, the story unveiled in it is true.

In the world of math, the Poincaré Conjecture was a holy grail. Decade after decade the theorem that informs how we understand the shape of the universe defied every effort to prove it. Now, after more than a century, an eccentric Russian recluse has found the solution to one of the seven greatest math problems of our time, earning the right to claim the first one-million-dollar Millennium math prize.

George Szpiro begins his masterfully told story in 1904 when Frenchman Henri Poincaré formulated a conjecture about a seemingly simple problem. Imagine an ant crawling around on a large surface. How would it know whether the surface is a flat plane, a round sphere, or a bagel- shaped object? The ant would need to lift off into space to observe the object. How could you prove the shape was spherical without actually seeing it? Simply, this is what Poincaré sought to solve.

In fact, Poincaré thought he had solved it back at the turn of the twentieth century, but soon realized his mistake. After four more years' work, he gave up. Across the generations from China to Texas, great minds stalked the solution in the wilds of higher dimensions. Among them was Grigory Perelman, a mysterious Russian who seems to have stepped out of a Dostoyevsky novel. Living in near poverty with his mother, he has refused all prizes and academic appointments, and rarely talks to anyone, including fellow mathematicians. It seemed he had lost the race in 2002, when the conjecture was widely but, again, falsely reported as solved. A year later, Perelman dropped three papers onto the Internet that not only proved the Poincaré Conjecture but enlightened the universe of higher dimensions, solving an array of even more mind-bending math with implications that will take an age to unravel. After years of review, his proof has just won him a Fields Medal--the 'Nobel of math'--awarded only once every four years. With no interest in fame, he refused to attend the ceremony, did not accept the medal, and stayed home to watch television.

Perelman is a St. Petersburg hero, devoted to an ascetic life of the mind. The story of the enigma in the shape of space that he cracked is part history, part math, and a fascinating tale of the most abstract kind of creativity.

Poincare's Prize: The Hundred-Year Quest to Solve One of Math's Greatest Puzzles Details

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From Reader Review Poincare's Prize: The Hundred-Year Quest to Solve One of Math's Greatest Puzzles for online ebook

James Swenson says

I picked up this book out of curiosity. When I wrote a Ph.D. thesis in algebraic topology, the Poincaré conjecture was the most significant open problem in the field. I wanted to know how the author would explain it to a popular audience.

Here's the statement of the conjecture: *Every simply-connected closed 3-manifold is homeomorphic to the 3-sphere.* See the problem? "Every" is the longest comprehensible word in the sentence. [The other familiar words, like "closed," do not have their standard meanings here.]

The author gave it a reasonable try: we should give him credit. He devotes just enough energy to exposition that the reader can feel that s/he understands what the Poincaré conjecture is like, and even a bit about Thurston's geometrization conjecture, which is the much more general theorem that was proved in 2006.

Sensibly, the author surrounds this material with a lot of biography. A lot of this is good, but we often get much too far afield: we do not need to know about Poincaré's spectacular grades in college (though it is interesting that he almost didn't get admitted to the school of his choice because of poor scores in drawing), nor about his short stint as an inspector of coal mines.

Sections on the work of Smale, Freedman, Hamilton, and Perelman are much better, and of course the coverage of the various priority controversies is enjoyable, in the same guilty vein as reality TV. The best passages are those in which we learn about the many failed attacks on the conjecture, and how those efforts, though unsuccessful, were generally fruitful in unexpected ways.

In the end, I was dissatisfied, mainly as a result of the sort of small things that add up fast. The banal observation that "[i]f scientists did not worry about who will [sic] be first, they would go about their research at a leisurely pace" does not benefit from the clash of tenses, nor from being repeated (pp. 143, 245). Then, too often, a passage that's intended seriously is interrupted by something cutesy -- the phrase "groupie requirements" (p. 104) for the hypotheses that define the structure of an abstract group is the most egregious. A few solecisms ("regretfully" used to mean "regrettably," and "judge's" (p. 248) where I think "judges'" is meant) drained some more of my good will.

A person who seriously wants to know what the Poincaré conjecture is like would do better to read the historical essay at the Clay Institute's website; a professional mathematician who wants an introduction might instead read John Milnor's precis. Otherwise, we might want to remember what Richard Feynman said in a similar context: "If I could explain it to the average person, it wouldn't be worth the Nobel Prize."

Neva says

I'm torn between 3 and 4 stars. Basically, it dragged in places. But if you're a lay reader who'd like a full understanding of Poincare's conjecture and what it takes to solve a famous, centuries-old problem, this is a great book. The author is a mathematician and good at making complicated concepts fairly easy to understand, and not going into too much detail when it's too complicated (e.g. visualizing 4 dimensional

manifolds embedded in higher dimensions). Plus, he gives a small overview of every major player's life (and there are a LOT of major players - shoulders of giants). Those overviews were often interesting, but Szpiro isn't the greatest biographer; his strength lies in explaining the mathematics. My dad gave me this book for Christmas and I'm only now finishing it, because in places it really bored me. Google "New Yorker Poincare" for a very interesting magazine article about the conjecture.

Marc says

I read the French translation of this book.

English summary

Too many (utterly) irrelevant anecdotes and not a single picture/illustration/graphics (the topic is after all differential GEOMETRY) hinder the reading, unless you already know something of the topic. I finished the book one week ago, and do not remember much of the story - and very little of the techniques which helped solve the problem. Just a few general ideas remain - about the dynamics of problem solving in the mathematical field. Though there are a few good pages, I would not recommend this book.

French review

C'est un mauvais livre.

Il y a des raisons à ce jugement lapidaire sur un ouvrage dont j'attendais beaucoup : un peu de lumière sur l'histoire de la conjecture de Poincaré et de sa résolution.

On se traine, c'est plein d'incidentes sans rapport avec le propos, et l'on finit par perdre réellement le sujet. C'est fâcheux, quand on parle de mathématiques, ou simplement quand on raconte une histoire. Qui plus est, les trop nombreux détails rapportées sur la vie des mathématiciens intervenant dans cette histoire sont bien pires que des anecdotes - qui peuvent être pittoresques ou savoureuses, n'apporteraient-elles rien au propos - ils sont sans intérêts, hagiographiques ou relèvent d'un curriculum dont on n'a, en vérité, que foutre. Au même niveau d'information pertinente, on aurait pu réduire le texte de moitié.

Ensuite, s'agissant de topologie, voire de géométrie différentielle, on aurait pu s'attendre à de nombreuses figures - après tout, la conjecture de Poincaré concerne les sphères, certes de toutes des dimensions, mais on sait parfaitement faire de la vulgarisation en revenant à des surface de dimension deux plongées dans un espace de dimension 3. Mais non. Cela aurait-il coûté trop cher en composition ? Aucune figure donc pour causer de trucs aussi abstrus que l'ensemble des lacets tracés sur une surface (derrière lequel se cache le groupoïde de Poincaré) ou les opérations chirurgicales sur les variétés. L'auteur se lance donc dans des descriptions, si, si. Sans être mathématicien ou un minimum connaisseur du domaine, je ne vois pas du tout comment on peut le suivre, ou même se figurer ce dont il parle.

Certes, on en sait un petit peu plus en sortant de ces pages roboratives (et pour un bon nombre, inutiles) qu'en y entrant (ce qu'est une conjecture, et qu'il faut parfois des années et des efforts dans tous les sens, souvent très spécialisés, pour la résoudre, par exemple), mais la moisson est pauvre, et l'on en retient de toute façon trop peu, que ce soit en terme d'histoire des maths ou même du domaine décrit. Fort décevant.

Chris says

Longer than it needed to be.

Matt McClure says

George Szpiro has written a fine book introducing the lay audience to the Poincaré Conjecture. In short, Szpiro writes lucidly and simplistically but much to his detriment. Rather, this book would benefit, I think, from a glossary, diagrams, and consistent use of terminology, all of which would render unnecessary the paragraph-long, hand-wavy explanations of core concepts of advanced topics in topology, knot theory, and differential geometry. Szpiro also has a tendency of veering off-topic and writing circuitously, which is exhausting.

This book is best read not for the mathematics it attempts to explain but rather the biographies of the many mathematicians presented therein. Readers unfamiliar with the legendary conjecture will at least walk away with appreciation of the field as well as some knowledge of great mathematicians, historical and contemporary, including Poincaré himself.

Poincaré's Prize is recommended for casual reading about a very important topic in mathematics history. If a more serious attempt to understand the conjecture is desired, then consulting academic resources, not all of which are super advanced, is advised. In fact, this book would may serve as a nice supplement to those readings.

John Park says

For those who see higher mathematics as a spectator sport. Szpiro tells the story of efforts to prove Poincaré's Conjecture of 1904, which says roughly (I think) that any object without a hole in it is topologically equivalent to a (hyper)sphere. Prizes were offered: proof or counterexample? Careers were spent on the problem.

For one or two dimensions it's trivial (the latter in fact being our familar world of two-dimensional surfaces embedded in three-space); in five or more, there's enough room to perform manipulations that will construct a proof. For four dimensions the Conjecture was finally proved in 1982. Three-dimensional surfaces turned out to be the hardest situation.

Finally in 2002, Grigory Perelman, a reclusive young Russian with some education in the US, posted three papers on the internet arXive site, creating a not-so-minor earthquake in the mathematical world. When the dust had settled a little it was accepted that he had indeed proved the Conjecture by an ingenious new method ("Ricci flow"), and produced a more general result as well. He was invited to the US to talk about his proof. He came, he talked, he was cordial and friendly and helpful. Then he refused offers of academic positions, returned to Russia, retired from his academic institution, declined both a prize medal and the million dollar award that went with it, and vanished into obscurity.

There's barely enough material here to fill a small book, even with Szpiro's often ingenious efforts to explain large chunks of mathematics. He has filled out the pages by giving biographies of almost everyone in

sight—some only a paragraph long. The stream of names produces a bit of mental overload and a rather choppy read. Perelman and Poincaré himself are probably the most interesting personalities, and some of the names were familiar from other contexts—in the case of (Sir) Christopher Zeeman, because I believe I once attended a talk he gave—but many seem deservedly obscure.

Other than bits of misplaced humour and a tendency to editioralise Szpiro's style is clear and engaging.

Two and a half stars.

Ethan Weker says

An insightful and intriguing telling of the story of the Poincare Conjecture. The descriptions are excellent, but for such a visual concept, it's unfortunate that there are no images (drawings or graphics) anywhere throughout the book. When I first took topology in college, it was an analysis based class, and I missed out on the beautiful imagery that would have made me fall in love with it. This book has the verbal imagery, but it would seem to be such a small but meaningful addition to include full color plates, especially for a book geared towards novices and laypersons.

Rossdavidh says

This is the (true) story of a French mathematician making a bit of a mistake, a bunch of French and German and American mathematicians trying and failing to fix it, for a century, until they set up a foundation to award $1,000,000 to anyone who solved it. So then a Russian finishes the job, and naturally he turns down the money.

It has just occurred to me that reading about mathematicians is kind of like reading about grand master chessplayers. They are smart, utterly focused, and eccentric as all getout. They're not even eccentric in the same way, and they fight a lot. Bobby Fischer would feel right at home.

So, things begin with Henri Poincaré, a Frenchman who was expert in so many fields it is difficult to just call him a 'mathematician'. However, even when doing jobs such as investigating the root cause of a coal mine disaster, he applied a rigorous approach to the evidence at hand that took something from his math background.

Eventually, he ends up famous and well-regarded throughout Europe. At the height of his career, he publishes a paper on the topic of topology. It's contents are fairly abstruse, but not enough to prevent a Danish mathematician named Heegaard from poking a hole in it (for his Ph.D. thesis, no less). Poincaré publishes an addendum. And another. And another. He eventually ends up publishing five addendum's to the original paper, and in the last one makes his famous conjecture.

Which means, really, that he wasn't done, because a Conjecture isn't a theorem (it isn't proven). But give the guy some slack, he was about to die (of old age and natural causes), and he knew it. Besides, we now know it would be about a century before the entire math world could finish the job, so it's a good thing he didn't wait until he had it all.

The gist of it is, the idea that any sphere, or anything you could mush a clay sphere into without tearing a hole or gluing anything onto it, can have a rubber band put around it along any axis, and then that rubber band could be slid along it until it comes to a single point. Who cares? I have no idea; topologists do.

The fun part is that it ends up leading to a disease, 'poincaritis', which is a plague on the field for generations. A promising, productive young mathematician will get it into his head that he will be the one to prove the famous conjecture. He becomes reclusive, his output plummets, he contributes nothing to the field, and several decades later he dies, remembered primarily as a waste of potential.

There were some notables who managed to contain their affliction, of course, and do other good work. But this went on long enough that some began working on disproving the conjecture conclusively, on the grounds that if it were provable, surely it would have been by now. This went no better.

Eventually, a Russian fellow named Perelman, who had studied advanced math in both Russia and several universities in the U.S., published a proof which built on the work of Hamilton (an American), and furnished a proof of the Poincaré Conjecture. The manner in which he announced it was relatively low-key, posting it to an Internet site called arXiv. Then, after spending about a year or so traveling around explaining his (apparently quite complex) proof to people around the world, he disappeared back to St. Petersburg. He was unwilling to come to accept the Fields Medal (the highest honor in math, equivalent to a Nobel prize), or even to claim the million dollar prize that the Clay Mathematics Institute is ready to award him.

In the end, the reader has to take at least a minute to ask, why do we care? Well, there are a few reasons:
1) the whole century-long process shows that the ability of any person or group of people to predict when a given problem will be solved, is much lower than we tend to think. Poincaré might not have published without the Conjecture proven, if he had not thought he was nearly out of time. This is something any university, government, or inter-governmental body should take note of: the problem is not solved until it is all the way solved, and until that happens, you have no idea how long it may take
2) the entire process for how results are published needs to change. The mania with being the one to get credit for solving a famous problem, probably lost us the contributions of many otherwise brilliant minds, afraid to share too much of what they were doing for fear of someone else pulling a "Perelman" (to their Hamilton) and taking the credit. There is an analogy to the current problems with copyright and patent law
3) those mathematicians, they are one wacky crew. If you like reading about vicious political struggles between oddballs, this is your book.

Christopher says

This scattershot, utterly disorganized account is, for the reader, an exercise in frustration.

It's a darn shame, too, because the historical account he's desperately trying to cobble together seems like it could be pretty fascinating. I get the sense that a truly heroic editor *might* have been able to salvage a readable book out of this, but in this case they appear to have thrown up their hands in despair and run away.

Dan says

I wanted to learn about Perelman, the unusual Russian genius: he proved a hundred-year old mathematical

conjecture many had spent decades on, then spurned both the highest honors in mathematics and a million dollars. I learned that he published on arxiv without peer review, but did reach out to mathematicians to make sure they understood enough of his proof before vanishing back to Russia and quitting mathematics. So, I learned, but not a whole lot more, because no one is public about why he feels mistreated by and dislikes mathematicians so much.

I also learned something of the history and shape of the conjecture, which was fun.

As is commonly true, Perelman didn't do all the work. Many mathematicians built the building, coming up with the form of the math and the conjecture itself, proving it for higher dimensions, setting out various lines of attack. Perelman built the capstone to the building, and admits as much.

I also read a bunch about topology, but hardly understood it. I've never liked topology, and it leaked out my ears faster than it went in.

Romain says

J’ai gardé un très agréable souvenir d’une lointaine lecture du livre de Simon Singh Le dernier théorème de Fermat. Ce souvenir m’est revenu en mémoire lorsque chez mon libraire, en passant devant la section scientifique, j’ai aperçu La Conjecture de Poincaré sur la table des suggestions. Je n’ai pas hésité une seconde et me suis emparé du volume sans même jeter un oeil à la quatrième de couverture. Le nom de Poincaré parle à tout le monde car nous avons en mémoire le patronyme de l’ancien président de la république. La confusion n’est pas si grande car Raymond Poincaré, le président, était le cousin d’Antoine, l’ingénieur et mathématicien, dont il est question dans ce livre. Comme beaucoup de génies il fut très prolifique bien qu’il eut la réputation de prendre des raccourcis. Certaines parties des démonstrations lui paraissaient tellement évidentes qu’il ne prenait pas la peine de les traiter en profondeur. Ce comportement — vous le constaterez en lisant ce livre — lui a parfois joué des tours.

La conjecture dont il est question faisait partie des sept “problèmes du prix du millénaire” qui sont censés être des défis mathématiques insurmontables. Contrairement au théorème de Fermat qui est assez simple à énoncer et à comprendre, la conjecture de Poincaré l’est beaucoup moins pour le profane que je suis. Elle concerne un domaine particulier des mathématiques connu sous le nom de topologie algébrique et plus particulièrement un objet appelé sphère de dimension trois. J’avoue bien humblement ne pas avoir tout compris aux diverses explications mathématiques et aux — malheureuses — tentatives de vulgarisation entreprises par l’auteur. Il faut dire que la géométrie n’a jamais été mon fort en deux dimensions alors lorsqu’il s’agit d’évoluer dans des dimensions supérieures à trois, je jette vite l’éponge. Mais, j’ai trouvé que l’intérêt du livre ne résidait pas là — heureusement pour moi. J’ai pris beaucoup de plaisir à suivre l’histoire de cette conjecture au fil des années. Découvrir le nombre de savants qui ont planché sur ce problème est assez impressionnant — si l’on arrivait à comptabiliser le nombre d’heures passées, le total serait faramineux.

Il faut dire que George Szpiro rend cette aventure scientifique agréable et fait preuve d’un certain talent pour nous faire découvrir tous ces hommes — la parité n’existe pas dans le domaine des mathématiques — grâce à de petites notices biographiques très instructives et distrayantes. Le ton employé par l’auteur est presque enjoué ce qui n’est pas choquant si l’on considère que les mathématiques, en plus d’être une science très sérieuse, peuvent aussi parfois ressembler à un jeu pour de grands enfants.

Si vous n’avez pas de solides connaissances en mathématiques et que vous souhaitez tout de même lire ce livre, il vous faudra accepter — je le crains — de ne pas tout comprendre. J’avoue que c’est un peu gênant à la longue, mais l’expérience vaut quand même le coup même si ce livre reste bien moins abordable que celui de Simon Singh que je conseille, quant à lui, sans réserve. http://www.aubonroman.com/2014/04/la-...

Jason says

The writing is mediocre, and in particular, the author should work on trying to be cute less often. There were too many attempts at neat turns of phrase or jokes that completely fell flat. Write well, but don't call attention to yourself.

More importantly, though, the mathematical descriptions were lacking! I know it's a hard subject, but if I couldn't follow what was going on mathematically, I don't know how people without a math major under their belts could. If this were more of a human drama story, then the mediocre math would be fine, but the human drama doesn't really get started until the last fifty pages or so, with petty squabbles over priority and disses in print and journal publication procedures.

The author seems to try to get human drama flowing in the early pages, as *every single mathematician mentioned* gets a few paragraphs of biographical information, but dozens of snippets of encyclopedia-type information do not add up to an interesting story.

Finally, does the author have a point? I couldn't find one. I guess the argument is that it's just a biography of a math problem, but good biographies have, if not necessarily something as full-blown as a thesis, at least a point. And I fail to see the point of this book.

Ami Iida says

The problem of Poincare expected has been solved?by a number of mathematicians
for more than one century.

Othello says

Fantastic book! Earlier this year, I went through the "Perelman phase", during which I read a couple of books on this reclusive Soviet/Russian mathematician who solved one of Mathematics' great problems and then refused the huge monetary prizes that followed. To many, that would seem like sheer stupidity. To me, that seemed philosophical - something like the "do your duty, but don't expect any reward" message of the Bhagavad Geeta. I wanted to know more about this Perelman guy.

The first book was by Masha Gessen, and this was the second one. George Szpiro is an Israeli professor who has written a few books on popular subjects on Mathematics. This book is about Poincare's problem, and Perelman is introduced towards the end. Szpiro starts off with the life and times of Henri Poincare, who was a very meticulous mining engineer. The conjecture that bears his name was proposed in or around 1900, and Szpiro details the numerous attempts to prove it. I am not a mathematician by education and I wouldn't have

understood the complex topology equations if they were there in the book. But I find it surprising that Poincare's conjecture was proved quite easily for higher dimensions, and the major amount of time and energy was spent in proving it for 3 dimensions! I mean 3-dimensions should be more intuitive since we see/live/breathe in it every day, right?

In any case, I loved Szpiro's casual writing style and his sense of humor. His accounts of R.H. Bing and Papakyriakopoulos are really funny as well. Thurston, Smale and Hamilton were three American topologists who finally made big dents in the decades long attempts to prove the conjecture. Hamilton's "Ricci Flow" was the stroke of a genius and he could've proved the conjecture, if he hadn't got stuck on the "singularities". That's where Perelman chimed in. He started off with Ricci flow and came up with the proof of Thurston's geometrization conjecture, of which Poincare's conjecture is a special case.

Perelman's quirks were in the news around the time the book was published, and near the end of the book, Szpiro made a few guesses about him. Szpiro guessed that Perelman would refuse the Clay Institute's 1 million USD Millennium prize, and that was proved correct later on. To the guy who did so much for the advancement of Mathematics without expecting any reward, he has my highest respect!

And to Szpiro - thanks for the lucid and enlightening read.

Robert says

Briefly. I would rate this book more highly if it had some illustrations of the core topological material. It is after all a book for a general audience without much background in topology and topological pictures can be really cool. I thought the flow, historical and biographical background were excellent. The story is well told (I still have to read other sources to comment on the accuracy and tone) complete with the unfortunate background of competitiveness and another historic round of priority disputes. The apparent attempt of the Chinese establishment to hijack this result is even more amazing than its routine disregard for patents and copyrights is annoying and costly. I did not like some of the author's cutesy takes on terminology such as "groupie requirements" and many of his metaphors and analogies even allowing for the legitimate need not to overload the reader with real mathematical jargon. I have to sympathize and bear with the difficulties of describing higher dimensional spacial issues and the nature of the intricacies of classifying topological objects. It is not clear to me that this can be done much better at this level. Even the basic problem itself requires a four dimensional setting.

The book demonstrates that the romantic era of great unsolved math problems will be finally end when someone solves the Goldbach conjecture (every even number a sum of two primes) now that Fermat's Last Theorem and the Four Color Conjecture are in the bag. There are at least two recent popular books out about the Riemann Hypothesis (another Millenium prize problem and survivor from the Hilbert list), but the statement of that problem: "The non-trivial zeroes of the zeta function have real-part = one-half", probably says nothing to anybody who hasn't had some graduate level math or read one of the books where any conscientious high school graduate (or less) can readily understand what the Fermat "Last Theorem" or Four Color problems ask. The problems now outstanding that might be considered "famous" are all of this character that takes a considerable trip outside of ordinary experience just to understand what the problem statement means. That's progress!
