After Math, The Fractal Murders, and Other Mathematical Murder Mysteries

Reviewed by Alex Kasman

After Math
Miriam Webster
Zinka Press, June 1997
280 pages (paperback), $12.95
ISBN 0-9647-1711-5

The Fractal Murders
Mark Cohen
Muddy Gap Press, May 2002
282 pages (paperback), $13.95
ISBN 0-9718986-0-X

The mystery genre, though not generally considered high literature, has been among the most popular for more than a century. Among the many mystery novels that have been published in recent years, two with titles that suggest a connection to mathematics may be of special interest to readers of the *Notices*: *The Fractal Murders* (2002) by Mark Cohen and *After Math* (1997) by Miriam Webster. In this article I will review these books and attempt to put them in context with an overview of the role of mathematics in murder mysteries.

Vilifying Mathematics—Early History

Most people would not think of mathematics as being a common theme in mystery writing, but it has a long and full history that runs all the way back to the earliest examples of the genre. The mystery in its present form is said to have begun with the writings of Edgar Allan Poe, and the first mystery story detective is his hero, Auguste Dupin.

Indeed, in the third Detective Dupin story, *The Purloined Letter* (1845), the detective engages in a discussion about mathematicians when trying to determine the identity of the criminal. Unfortunately, the first appearance of mathematics in the mystery genre is not something which reflects well on our field. Dupin argues that the clever criminal could not be a "mere mathematician," for if he was "he could not have reasoned at all." Dupin's friend defends mathematicians by pointing out that "the mathematical reason has long been regarded as the reason par excellence." But he is corrected by Dupin, who insists, "The mathematicians, I grant you, have done their best to promulgate the popular error to which you allude, and which is none the less an error for its promulgation as truth."

I therefore view it as an improvement that the next, and possibly most famous, mathematician in the mystery genre is known for his intellectual abilities. Sir Arthur Conan Doyle intended *The Adventure of the Final Problem* (1893) to be the last Sherlock Holmes story, with Holmes dying at the hands of the evil Professor Moriarty. A villain would have to be quite clever to be a worthy opponent for Sherlock Holmes. Perhaps it was to demonstrate the character's brilliance that Conan Doyle describes Moriarty as a professor of mathematics who won fame as a young man for his extension of the binomial theorem.

By popular demand, Conan Doyle brought Holmes back from the dead, and in the novel *The Valley of Fear* (1915) Holmes again encounters

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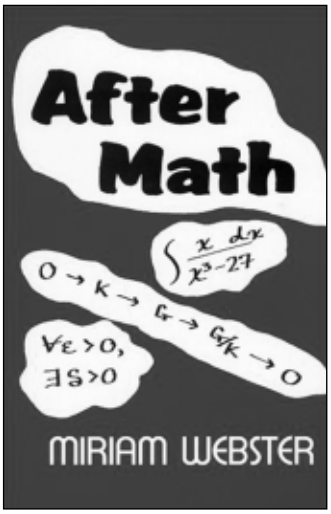


Professor Moriarty. In explaining to Watson why the man they both know to be a hateful underworld figure is considered to be a respected member of society, Holmes refers once more to Moriarty's mathematics. "Is he not the celebrated author of *The Dynamics of an Asteroid*, a book which ascends to such rarefied heights of pure mathematics that it is said that there was no man in the scientific press capable of criticizing it?" (Conan Doyle does not go any further into the details of Moriarty's mathematics, but Isaac Asimov's clever *The Ultimate Crime* (1976) postulates—with the support of accurate descriptions of the nonintegrability of the three-body gravitational problem and the role of the perturbation method in dynamical systems—that Moriarty's goal was to gain the ability to cause an asteroid to collide with the Earth for the purpose of blackmailing the world's governments out of huge sums of money.)

We might not be happy with Professor Moriarty as the "poster child" for mathematics in the world of mystery fiction, for although he is undeniably smart, he is also clearly quite evil. Unfortunately, the next novel on the chronological list of mathematical mysteries continues to suggest a connection between mathematics and evil tendencies. In fact, it goes beyond suggestions and states the connection baldly! *The Bishop Murder Case* (1929) by S. S. Van Dine is not terribly well known now, although it was quite popular in its day. The plot involves a series of murders in and around the house of a Columbia University mathematics professor. There is quite a lot of mathematics discussed, nearly all of it mathematical physics in the form of quantum theory or relativity. Moreover, nearly all of the characters are mathematicians. So, it is not much of a surprise to the reader when the murderer turns out to be a mathematician as well. However, a long monologue by detective Philo Vance, who seems to know quite a lot of mathematics, explains why it is not merely a coincidence that the murderer was a mathematician:

> In order to understand these crimes… we must consider the stock-in-trade of the mathematician, for all his speculations and computations tend to emphasize the relative insignificance of this planet and the unimportance of human life. …He deals in abstruse and apparently contradict'ry speculations which the average mind can not even grasp. …In this realm of the modern mathematician, curves exist without tangents. Neither Newton nor Leibnitz [sic] nor Bernoulli even dreamed of a continuous curve without a tangent—that is, a continuous function without a differential co-efficient. Indeed, no one is able to picture such a contradiction—it lies beyond the power of imagination. And yet it is a commonplace of modern mathematics to work with curves that have no tangents. …Is it surprising…that a man dealing in such colossal, incommensurable concepts… might in time lose all sense of relative values…? …In his heart he would scoff at all human values, and sneer at the littleness of the visual things about him.

In other words, according to Vance, immorality is the inevitable end result of mathematical research!

Even Dame Agatha Christie, the so-called "Queen of Crime", had occasion to use the character of the demented mathematics professor. The murderer in *The Bird with the Broken Wing* (1930) is David Keeley, "a most brilliant mathematician [who] had written a book totally incomprehensible to ninety-nine hundredths of humanity." Almost no motivation is given in the story for his crime of strangling a beautiful young woman with a string from her own ukulele. Perhaps, using either Poe's argument that mathematicians are irrational or van Dine's that they are evil, the fact that Keeley is a mathematician is supposed to render such explanations superfluous.

Solving Mysteries with Mathematics—Middle Ages

One has to consider much more recent mathematical mysteries to find examples in which the mathematician character is neither the murderer nor the victim, but the main protagonist. Erik Rosenthal's *Calculus of Murder* (1986) features a part-time instructor and researcher in the mathematics department at UC Berkeley whose other job serving subpoenas for his lawyer friends leads him to solve murder mysteries. This book presents a more realistic portrayal of mathematicians than any of the other books discussed so far. In fact, it is occasionally so realistic that I have trouble believing any reader would be interested. For instance:

> I awoke early the next morning to prepare for my calculus class, which ran from nine to eleven. We were studying techniques of integration, and I needed examples to illustrate the use of trigonometric substitutions. For most topics it suffices to choose several examples from the homework problems in the text and to do them for the first time in front of the class. Some trig substitutions,

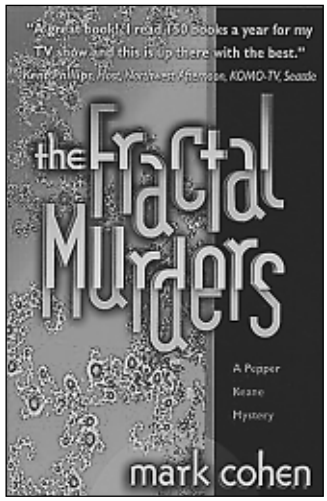
> however, can take an hour to complete and.…

The novel was followed up by a sequel in 1988 entitled, of course, *Advanced Calculus of Murder*.

British mystery author Cory Desmond's novels *The Catalyst* (1991) (published in England as *The Strange Attractor*), *The Mask of Zeus* (1992), and *The Dobie Paradox* (1994) follow the misfortunes and murder investigations of Professor John Dobie, described on the book jacket as "Columbo with a chair in mathematics." These books contain some pleasantly insightful quotes about mathematics. For instance, in *The Mask of Zeus* Dobie thinks to himself:

> It's funny…(but also sad), how many people imagine that mathematics consists of interminably applying fixed formulae to clearly defined problems and so 'working them out'. Because it's not like that at all. Half the time you don't even know what you're looking for until you've found it. A great deal more than half the time you spend looking at a blank sheet of paper and chewing the end of a pencil—the blunt end, hopefully—while you're trying to see what the bloody problem *is*. You know it's there all right but no, you can't grasp it, you just can't quite perceive how to formulate it…Mathematician's block.…

False stereotypes of mathematicians continue to appear with regular frequency in these novels where the detective is a mathematician. For instance, *The Catalyst* informs us that mathematicians are terrible chefs. However, having the protagonist be a mathematician opens up an interesting possibility, namely, that mathematical knowledge and skill will be useful in solving the mystery. Rosenthal's calculus instructor must solve the differential equation $y' = ky$ at one point in his investigation in order to work out a bit of forensics. Of course, we would hope that this calculation could be done by our students and would not require a Ph.D. in mathematics. Perhaps the author hoped that by keeping it at this level the "average reader" could get something out of the derivation of the equation as a model of the absorption of arsenic and the relatively simple algebraic operations (separation of variables, antidifferentiation, etc.) that lead to its solution. In contrast, Desmond's Professor Dobie uses mathematics so advanced that it is beyond even the author. The description of Dobie's use of mathematics to solve the mystery of his wife's murder is both laughable and frustrating, as the author mixes a variety of mathematical topics in a rather implausible way. In particular, after Dobie enters all of the information he knows about the murder into a computer, he explains that he now has a "syllogistic series…expressed in terms of Lorenzian equations." Then, after looking at what must be fractal images generated by the computer, he is able to conclude that the probability of another murder occurring soon is very high. This hodge-podge combination of logic, chaos theory, and probability is not just what he uses to solve murder mysteries but his area of mathematical research in general. As he explains, the goal is to obtain "a mathematical representation of the whole of physical reality. A set that includes all conceivable sets. In fact, that's theoretically unachievable because of the Lorenz effect, but by seeing where and why we fail we can track down all those strange attractors a little more closely."



Of course, one does not actually need to be a professional mathematician to use mathematics in the solution of a mystery. Another subcategory of mathematical mystery is the sort in which mathematics is required to find the solution. Both Poe's *The Gold-Bug* (1843) and Conan Doyle's *The Musgrave Ritual* (1893) use some simple mathematics to locate a buried treasure. Several of Rex Stout's incredibly popular Nero Wolfe mysteries feature some mathematical content. In *The Zero Clue* (1952) a murdered mathematician leaves a message indicating the identity of his killer (recognized only by Wolfe, of course) that requires knowledge of archaic mathematical notation. Though trivial, the mathematics in each of these instances is at least reasonably applied. In John Reese's story *The Symbolic Logic of Murder* (1960) boolean algebra and biblical mnemonics are used to solve the mystery in what I am afraid is a rather unconvincing way. It is therefore notable that *Who Killed the Duke of Densmore?* (1994) by mathematician Claude Berge makes use of nontrivial mathematics in a seemingly reasonable way to solve a murder mystery. In this story, written for the Oulipo French literary group, Hajós's theorem on the discrete graphs representing the intersections of a set of intervals is applied to the accounts of a group of witnesses who each were at the murder scene for different intervals of time.

Two books recently reviewed in the *Notices* could also be considered mathematical mysteries. *Conned Again, Watson* by Colin Bruce (reviewed November 2002, pages 1258–9) brings Sherlock Holmes back to life once again and uses him to explain some interesting and often useful bits of mathematics, and Denis Guedj's *The Parrot's Theorem* (reviewed March 2002, pages 317–8) centers an overview of the history of mathematics around the library of

a murdered mathematician. However, both of these merely use the trappings of the mystery genre to sugar-coat their didactic intentions.

It would be remiss of me not to mention *Maths à Mort*, the October 2002 reprinting of Margot Bruyère's novel originally published under the name *Dis-moi qui tu aimes (je te dirais qui tu hais)*. This mathematical murder mystery takes place in Paris at the Institut des Hautes Études Scientifiques (IHÉS). Since the author worked at the IHÉS for sixteen years and since a quote from Jacques Dixmier on the back cover praises the book, I assume that it is very good. Unfortunately, my limited abilities in reading French prevent me from being able to say any more.

Two Recent Novels

Having completed our historical foray into mathematics and mystery writing, we can now focus attention on two exemplary works. *The Fractal Murders* and *After Math* are both mathematical murder mysteries that I can highly recommend. They have several things in common. They are both entertaining examples of the mystery genre in which the murder victims are mathematicians. They both were published by small publishing houses.[1] Also, they both present a more sophisticated approach to mathematics and a more realistic view of mathematicians than the average fictional portrayals, which generally include numerous false stereotypes and inaccuracies. However, in other ways the books are drastically different.

I must confess that I am a very prejudiced reader, often forming an opinion about a book after having read only the first paragraph or even the first sentence. I had already decided that I was going to enjoy reading *After Math* from reading its opening sentences. The mystery of the novel concerns the murder of mathematics professor Ray Bellwether and begins:

> Immediately upon his demise, Ray Bellwether's priorities changed drastically. His concern for the reputation of the Department evaporated. His pride in his own modest fame dwindled to nothing. The paternal love he had borne his fractious students abated. And his love of mathematics, the love of a lifetime, became a vague bubbly affection, its object uncertain.

This surreal and humorous opening sets the tone for the novel, which despite some supernatural flights of fancy has an appealing honesty. Not only is the author honest in her descriptions of the feelings of mathematics professors and graduate students, but, borrowing from Anthony Trollope and Kurt Vonnegut, she even casually mentions her own role as the author, not hiding from the reader that the book is her fictional creation. The story told is interesting enough, and the occasional mathematical insights were valuable, but the author's unique style certainly added to my enjoyment of it.

In contrast, I was not especially fond of the opening sentences of *The Fractal Murders*:

> I was having a bad day. I had gotten behind Ma and Pa Kettle on the road down the mountain and by the time I was able to pass them I was almost to Boulder. I blew past them, then blew my nose. I'd been fighting the Sinus Infection From Hell for a week.

Unfortunately, when I read the first chapter as a free download from the author's website, the crude "hard-boiled detective" tone convinced me not to buy the book. It was only when the author sent me a printed copy that I read further, and I'm glad that I did. Even though the book continues to read like a pulp detective novel from the 1930s, the character of Pepper Keane gets "fleshed out", and the mystery becomes quite engrossing. I almost missed him and his sinus infection when I was done. Apparently, I was not the only one to enjoy the book, since it was a *Book Sense 76* Top Ten Mystery Selection for fall of 2002. Moreover, I have learned that a mystery division of AOL Time Warner has purchased the rights to *The Fractal Murders* and plans to release a hardcover copy of the book in summer 2004.

In *The Fractal Murders* detective Pepper Keane is hired by Professor Jayne Smyers to investigate the mysterious deaths of a number of her colleagues in the field of fractal geometry.[2] Cohen deserves praise for presenting a mathematician character who defies the standard literary stereotypes of mathematics professors by being an attractive woman and by being an otherwise normal person who just happens to be a professional mathematician. (Still, in keeping with the traditional cliché of the genre, the gritty detective and his attractive female client develop a romantic relationship.)

In several ways, Pepper Keane's life story parallels that of the author, Mark Cohen. Both were military judge advocates. However, unlike Keane, who works as a private investigator in Boulder, Cohen practices law in nearby Nederland. Commenting on

[1] *Muddy Gap Press was actually incorporated by Mark Cohen specifically for the purpose of publishing his novel, and so far it has not published any other books.*

[2] *This plot is surprisingly similar to the plot of* Death Qualified: A Mystery of Chaos *(1992). However, I am not inclined to recommend that book either for its story or its presentation of mathematics, so I will not say anything about it except to point out this coincidence.*

the fact that many mathematicians, including fractal guru Benoit Mandelbrot, have read *The Fractal Murders*, he says, "The irony here is beyond belief in that I took most of my math classes on a pass/fail basis." Considering that he does not appear to have had any real training as a mathematician, Cohen has certainly done his mathematics homework in preparing for the book. He describes himself as a "math buff" and tells me that he studied symbolic logic in graduate school, but he includes small touches that suggest a greater knowledge of mathematics.

The descriptions of actual mathematics in *The Fractal Murders* are bolder and more accurate than what is to be found in the majority of mathematical fiction. For instance, although the words "fractals" and "chaos theory" have been thrown around quite freely in fiction since the early 1990s, all they typically say is that there are pretty pictures that seem quite complicated and are somehow produced mathematically. Here, however, we have Professor Smyers describing fractals as embodying a type of geometry, even going so far as to include the notion of fractal dimension. (Not only does she use a comparison of the fractal dimensions of the coastlines of Great Britain and Norway as an example, but we learn that one of her papers is entitled *Fractal dimension: Some thoughts on alternatives to Hausdorff-Besicovitch*.) Moreover, Cohen includes other little details that indicate some sort of familiarity with modern mathematical culture. When one of Professor Smyers's students helps Pepper Keane search the mathematical literature, she explains that she used "MSN" to do the search. When Keane indicates that he doesn't know what this is, she explains, "MathSciNet; it's the standard search engine for mathematical works." (Usually when I read mathematical fiction, I know for certain when the author's description has strayed from reality. However, the confident graduate student character left me wondering: Do the "cool" mathematicians really call MathSciNet "MSN"?)

It will not give away the ending for me to explain that the murders turn out to have been motivated by a new application of fractals to the prediction of the stock market. The use of *intrinsic time* (a change of variables in financial time series in which time is scaled by market activity) in the explanation of this application is a further example of the mathematical detail that Cohen includes in the novel. Of course, the descriptions are necessarily vague, and one may question the entire thesis that fractal geometry could provide tools that would be so successful in predicting the stock market, but a suspension of disbelief is often required for the appreciation of mathematical fiction just as it is in science fiction.

The only thing that really bothered me as a mathematician in *The Fractal Murders* was a slight to the memory of a great mathematician. At one point, Keane and his friend Scott McCutcheon (a character based on a friend of Cohen's who did graduate work in physics) are looking at suspects who use the names of famous mathematicians. Inquiring about the namesake of one, Keane asks "Who the hell was Karl [sic] Gauss?" Scott's reply is "He was a statistician." This strikes me as unfair to this incredible mathematician, who had such diverse influences across the discipline; it is like answering the question "Who was Thomas Edison?" with "He ran a lightbulb factory in New Jersey."

In the case of *After Math*, the basis for the murders is not some far-fetched application of mathematics but the intentional misuse of statistics to support industrial destruction of the environment. The book reasonably explains how a clever mathematician could choose his methods and data carefully enough to support any argument and to fool anyone who was not an expert in statistics. This more believable underlying motive is just one example of the more realistic view of mathematics contained in this book.

It may be a little strange to describe *After Math* as being more *realistic* than *The Fractal Murders*. After all, this novel features the ghost of the murdered Professor Bellwether as a principal character and follows Professor Horace Plinth on astral journeys to an imaginary realm where he works out mathematical proofs. But these are instances of poetic license. More important is the way in which Webster accurately captures the *feeling* of a real mathematics department. For, although Cohen's portrayal of mathematics is very good for an outsider, the author of *After Math* has the intimate viewpoint of the mathematical community that one can get only from the inside. Whereas Cohen acknowledges the help and advice of mathematics professor James Meiss of the University of Colorado with advising him on mathematics, the author of *After Math* has a Ph.D. in mathematics herself and even a publication listed on "MSN".

The writer using the droll pseudonym "Miriam Webster" is actually Amy Babich. Her 1992 publication in the *Proceedings of the AMS* is relevant to this review not only because it is indicative of her mathematical ability and knowledge. In that paper she defines mathematical objects that she entertainingly names "*Scrawny* Cantor Sets". This lighthearted and creative approach to mathematics is taken to its full potential in her first novel. From a poet whose dreams are haunted by giant stone monoliths in the shape of Maxwell's equations to the romantic implications of the exact sequence $0 \to K \xrightarrow{i} G \xrightarrow{j} G/K \to 0$, *After Math* demonstrates Webster's ability to take a subject that she knows well and push it into the realm of art. The result is a caricature of the world of mathematics that rings

even truer than Cohen's stereotype-breaking *noir* realism.

Without doubt, my favorite part of *After Math* was the description of Horace Plinth, a respected and famous seventy-three-year-old mathematician, and his method of "doing research":

> He would begin reading a mathematical treatise (he had never, in his life, managed to read one to the end); and before long he would be in Dreamland, where very often (such was his luck) he would run into something very interesting indeed. (Interesting mathematically—for what is more interesting than mathematics?) His task then would be to find his way back to so-called reality (as he liked to put it), or at least to some familiar region of mathematics. Professor Plinth would drift *toward* the mathematical object in question without conscious effort or volition. But on the way *back*, he would pay attention to the path. For the description of this path was what he would bring back from his journey, into the light of day and the scrutiny of his colleagues. The description of the path back to reality would be a mathematical proof.

Whether reading this has affected the way I prove theorems or captures some subtle aspect of the process of mathematical discovery, I find myself thinking of this description when I am working on my own research and now consider it to be rather accurate. (However, I generally have much more trouble finding my way back than the brilliant Professor Plinth.)

Fortunately for Bellwether, who is compelled to solve the mystery of his own murder, he is able to communicate with Professor Plinth on one of these astral journeys. However, Plinth fears he might not be of much help. As he explains, "I used to read detective stories, but I never tried to guess who did it; I liked to be surprised. I'm not even any good at *chess*, Ray. I'd be a complete washout as a detective."

Despite Plinth's doubts and although *After Math* is certainly an unorthodox mystery, it does reach a traditional mystery genre ending. The reader can proceed confident that the mystery will be solved and justice served, this time with a lot of help from the mathematics department's graduate students.

A Golden Age of Mathematical Fiction

In contrast to Detective Dupin's claim that mathematical reasoning and real-world reasoning are completely distinct, I find that the process of solving a murder mystery (at least the type commonly presented in fiction) is in many ways similar to that used to solve a real mathematical mystery (the kind that results in publication in a mathematical journal). They share many things: the initial challenge of the enigma, the use of logic in an attempt to resolve it, and finally the thrill of the solution.

There are several different corollaries to this observation, the first being that it is natural to use a mathematician as a detective in a mystery, as do Desmond and Rosenthal in their novels. The second corollary is that mathematicians, presumably people who enjoy solving the mysteries that arise in mathematics, may have a tendency to enjoy fictional murder mysteries as well. Most interesting to me, however, is the possibility that the people who enjoy reading mysteries, even if not mathematicians themselves, are the sort of people who would appreciate mathematics.

A large and always growing list of the works of mathematical fiction, including more mysteries than I have mentioned in this review, can be found on-line at `http://math.cofc.edu/kasman/MATHFICT/`. Studying that list of over 350 stories, plays, movies, and novels reveals that we are now living in a sort of "golden age" for mathematical fiction. Fiction is now being "marketed" to an apparently large audience of nonmathematicians who know just a bit of mathematics but enjoy reading about mathematics in a fictional setting. Perhaps as a result of the intrinsic attractiveness of fractals, the dramatic true stories of John Nash and Andrew Wiles, and the surprising success of the film *Good Will Hunting*, the general public seems more interested than ever in seeing mathematics in fiction.

The mystery novels reviewed here should appeal to both a mathematical audience and the public at large. Miriam Webster's comedic *After Math* is prescribed for mathematicians seeking an imaginative but accurate parody of mathematical culture, and Mark Cohen's *The Fractal Murders* is appropriate for anyone wishing to see mathematics discussed by a cynical yet honorable, flawed yet respectable hero in the mode of Raymond Chandler's Philip Marlowe. These books demonstrate that not only are many works of mathematical fiction finding broad popularity but moreover that the quality of the mathematics and the portrayal of mathematicians have greatly improved.