

## James Stewart and the House That Calculus Built

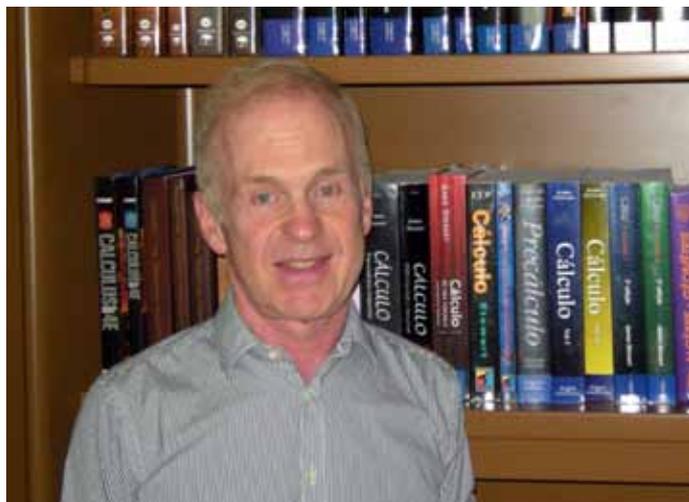
By Ivars Peterson

The name James Stewart ought to be familiar to many thousands of calculus students and their instructors. In North America, Stewart's books outsell all other calculus textbooks combined.

Now, Stewart's name is also associated with his new home, a spectacular structure of graceful curves, wood, and glass that has put his Toronto neighborhood on the international architectural map. Named Integral House, the innovative building melds with the side of a wooded ravine. Its five floors encompass an airy performance space, where chamber groups have already performed to audiences of as many as 150 people.

A Canadian, Stewart grew up in Toronto. In high school, he was interested in all subjects, including languages, history, and English. He also played the violin and had a passion for music. Stewart's grade 11 math teacher at Earl Haig Collegiate, Ross Honsberger, sparked his interest in mathematics.

"He was not your typical math teacher," Stewart says. "He



Mathematician and author James Stewart stands in front of a selection of the many editions of his calculus textbooks.

was always going off on digressions. In grade 11, he presented the proof on the board that the rational numbers are countable and that the real numbers aren't. I don't know what my fellow students thought, but I thought that was fascinating."

Unable to make up his mind about which direction to take, Stewart followed the advice of his high school guidance counselor to pursue science, and he went into the demanding mathematics, physics, and chemistry program at the University of Toronto. At the end of his second year, however, he came very close to switching from mathematics to music.

"In the end, I decided not to because I thought it would be better to be a mathematician whose hobby is music than a musician whose hobby is mathematics," Stewart says.

Interested in specializing in analysis, Stewart went to Stanford University for his master's degree. "At that time, virtually the entire math faculty at Stanford consisted of analysts," he says. "And there was the appeal of California weather."

Stewart came back to the University of Toronto to do his PhD with Lionel Cooper. Cooper, however, was slated to leave Toronto for a



From the street, only two levels of the five-level house are visible, including a top floor sheathed in curved, frosted glass. After five years of construction, the \$24 million house still isn't quite finished.

position at the University of London. “From the time I got the subject of my PhD thesis to the time I defended it was one year; I wanted to finish up before he left,” Stewart says. “I never worked so hard in my life.” He then followed Cooper to London to do two years of postdoctoral work.

While in London, Stewart came back to the serious study of the violin. “This pull between music and mathematics came into play again,” Stewart says. “When I got my first job at McMaster University, in addition to playing chamber music, I was asked to become concertmaster of the McMaster Symphony. I also ended up playing for some years professionally in the Hamilton Philharmonic Orchestra.”

Music wasn’t Stewart’s only serious pursuit. At McMaster, he had a full research program in harmonic analysis and supervised several PhD theses. He was also passionate about teaching. “I knew I loved teaching from the moment I stepped into a classroom,” Stewart says.

Stewart never considered writing a textbook until two of his calculus students suggested the idea, remarking that his notes on the blackboard were better than the textbook they were using. “It was their idea, and it changed my life,” Stewart says.

Before he had a chance to start writing a calculus text, two Hamilton high school teachers asked Stewart to collaborate with them on a series of high school math books. “I found it to be a useful apprenticeship,” Stewart says. “Together we wrote grades 10, 11, 12 textbooks that came to be used in a lot of high schools.”

With a working knowledge of what students are supposed to know when they enter calculus, Stewart felt that he could start writing a calculus textbook. “I thought I could write one in three years,” Stewart says. “Instead, it took me seven years — seven really, really intense years — while I continued with my teaching and research. With the writing, I spent 13 hours a day, 364 days a year at work during those



*Designed by the Toronto architectural duo of Brigitte Shim and Howard Sutcliffe, Integral House incorporates an airy space in which chamber groups and soloists can perform to audiences of as many as 150 people. Angled, wooden fins divide the curved glass walls into segments, giving viewers strikingly different perspectives on the wooded ravine outside as they move from place to place.*

seven years. Once I had started, I had to finish it.”

When it was published in 1987, the resulting book sold fewer than 20,000 copies in its first year, but the numbers grew in each subsequent year. By 1992, in the second year of the second edition, Stewart’s *Calculus* had become the best-selling calculus textbook. “I basically wrote the book to use in my own classes,” Stewart says. “I had no idea it would catch on.”

Stewart finds it difficult to pinpoint why his book and subsequent iterations have proved so successful. “I think one reason for the success is accuracy,” Stewart says. “I’m a fanatic for accuracy. There can be no wrong answers.” He also mentions the close attention that he pays to his students, and he remarks that in school he was as strong in English as he was in mathematics. “But mostly, it’s a mystery to me,” he concedes.

His publisher has kept him busy producing new editions and variants — an edition of *Calculus* in which transcendental functions are introduced near the begin-



*Graceful curves define the stairways leading to the performance space and to lower levels, where Stewart has his office, a modest, art gallery, and a small swimming pool. Photograph by Ed Burtynsky. Courtesy of James Stewart.*

ning; a version that helped bring calculus reform ideas into the mainstream; another aimed at engineering students that integrates vectors into the material from the start; and *Essential Calculus*, a somewhat condensed iteration.

“I haven’t had a break since the first book,” Stewart says. At present, he is preparing the seventh edition of his original *Calculus* book and collaborating on two other books: applied calculus for business and economics students and a “reform” college algebra book that is heavily data driven.

Stewart is also toying with the idea of eventually writing a book about mathematics and music, focused on the theme of why mathematicians tend to be musical. He has given talks on the topic to a variety of audiences, bringing his violin along to demonstrate analogies between form in music and structure in mathematics.

Although Stewart is now an emeritus professor at McMaster, he has continued to teach occasionally at the University of Toronto. He is particularly excited about introducing a course in problem solving, something he had done earlier at McMaster.

“When I was a graduate student at Stanford, I fell under the spell of George Pólya, who was retired but used to come in and give

these problem-solving talks,” Stewart says. “He had all of us — teachers and students alike—literally sitting on the edges of our seats with mathematical excitement, presenting data, asking us to make conjectures.”

Nonetheless, writing is at the core of Stewart’s working life, and it has proved lucrative for him. He has earned enough to help fund the James Stewart Mathematics Centre at McMaster, contribute to a variety of projects and causes, and, after renovating four homes during his earlier years, to dream of building a house of curves, wood, and glass, with all the little touches that he could wish for.

Now, Stewart has a spectacular house in which to think, write, entertain, and perform — the result of a project that evolved from a simple wish, even a kind of naiveté, into an innovative architectural wonder.

“I’ve set out to do two major things in my life, but I didn’t think of them as major at the time,” Stewart muses. “I just thought, ‘My two students suggested that I write a calculus book; I think I’ll write a calculus book.’ Look what happened. And then I thought, ‘It would be nice to build a brand-new house.’ I naively went about interviewing architects, and look what happened.” The complete interview with James Stewart is available online at [www.maa.org/news/061809stewart.html](http://www.maa.org/news/061809stewart.html). 🌱

*Photographs by Ivars Peterson.*



*Even the door handles in Integral House have a custom curvature.*