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# Professor Louis Nirenberg, Deserving Winner of the First Chern Medal

by M.L. Ball

Photo: Dan Creighton

**Leslie Greengard, Louis Nirenberg, Peter Lax, and Fang Hua Lin at a special celebration on October 25th.**

The Chern Medal, awarded every four years at the International Congress of Mathematicians, is given to "an individual whose accomplishments warrant the highest level of recognition for outstanding achievements in the field of mathematics."[1]

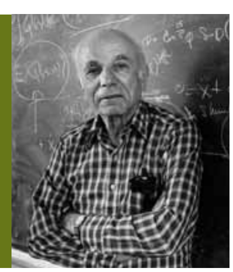
How marvelously fitting that Louis Nirenberg, a Professor Emeritus of the Courant Institute, would be the Medal's first recipient.

Awarded jointly by the International Mathematical Union (IMU) and the Chern Medal Foundation, the Chern Medal was created in memory of the brilliant Chinese mathematician, Shiing-Shen Chern. In announcing the award, the IMU stated that "Nirenberg is one of the outstanding analysts and geometers of the 20th century, and his work has had a major influence in the development of several areas of mathematics and their applications."

When describing how it felt to receive this great honor, Nirenberg commented, "I don't think of myself as one of the top mathematicians, but I'm very touched that people say that. I was of course delighted – actually doubly delighted because Chern was an old friend for many years, so it was a particular pleasure for me. Most of his career was at Berkeley and I spent a number of summers there."

The celebration of the Courant Institute's 75th Anniversary commenced with an article about the history of Courant — the Institute and the man — in our Spring/Summer 2010 issue. To continue the celebration, and also to commemorate the 100th anniversary of his birth, we present an article about Fritz John, "one of the Courant Institute's most beloved luminaries."

**(Photo on Right) Fritz John**



## In this Issue:

**The front of the Chern Medal features a portrait of Shiing-Shen Chern at age 73. The reverse side displays the generalized Gauss-Bonnet theorem, proved by Chern in 1944. (Used with permission of the IMU).**

After Chern's death in 2004 at the age of 93, his daughter May Chu established the Chern Foundation. The monetary award is mainly funded by Jim Simons, former Professor and Chairman of the mathematics department at Stony Brook University, who then went on to found the private investment firm, Renaissance Technologies. "He and Chern did some very important work together," Nirenberg said. "He then left academics, went into the financial world and made a lot of money. He couldn't come to the International Mathematics Congress [held in Hyderabad, India] but he sent a video of himself talking with another mathematician about Chern. It was extremely nice. And Chern's daughter was there."

The $500,000 cash prize is divided into two parts: $250,000 to the medal winner and $250,000 to be donated to an organization of the recipient's choice to support research, education, or other mathematical programs. "I'll be giving it to the Courant Institute. So it's a wonderful thing," said Nirenberg.

The President of India, Shrimati Pratibha Devisingh Patil, awarded the seven ICM medals: four Fields Medals, the Gauss Prize, the Nevanlinna Prize, and the Chern Medal.

For Nirenberg, the Chern Medal is the latest commendation in a career that has spanned more than sixty years and garnered many of the world's foremost mathematics honors. In 1959, he was awarded the American Mathematical Society's Bôcher Prize; in 1987, the Canadian Mathematical Society's Jeffrey-Williams Prize; and in 1994, the AMS Steele Prize for Lifetime Achievement. In 1982, Nirenberg and Vladimir Arnold shared the first Crafoord Prize in mathematics, established by the Royal Swedish Academy of Sciences in areas not covered by the Nobel Prizes. And in 1995, Nirenberg received the National Medal of Science, America's highest honor for contributions to science.

Originally from Hamilton, Ontario, Canada, Nirenberg was introduced to the Courant Institute by Ernst Courant's wife Sarah, whom Nirenberg had known in Montreal. On the occasion of her visit to Richard Courant, Nirenberg asked her to ask Courant to suggest where he might apply to graduate school in theoretical physics. Courant suggested that he come to NYU to get a master's in math and then perhaps go on to physics. After being interviewed by Courant and Friedrichs, Nirenberg came to NYU in September 1945. "And then I just stayed," Nirenberg said. "I've been here almost all my life."

Although James Stoker was Nirenberg's advisor, he actually spent more time with Friedrichs. "When I first came to Courant, Friedrichs was the main research person when I was a graduate student, so he was certainly where the action was," explained Nirenberg.

"Friedrichs really influenced me more than anybody else. I went to him for a problem and he suggested one, and I thought about it for several months but didn't get anywhere. Then Stoker suggested something in geometry so I started to work on that, and he became my advisor. But while I was working on my thesis, I spoke more to Friedrichs than to Stoker. He wasn't my advisor but I considered him my *sensei*, as the Japanese say – my master."

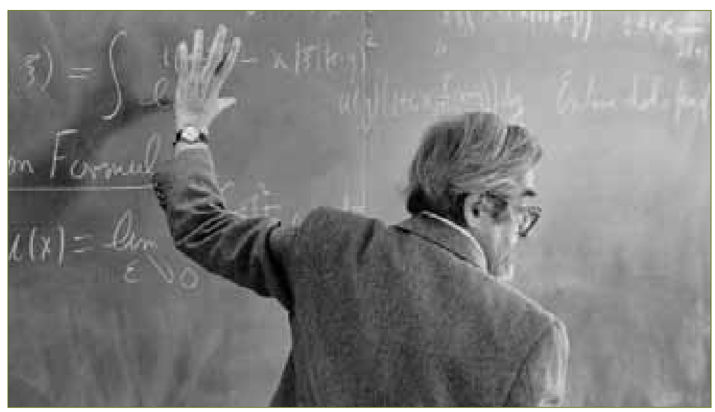
Nirenberg added, "There was a student of Richard Courant's from Göttingen, Hans Lewy, who was a friend for many years. A number of my papers were related to work by him. I very much liked his taste in mathematics and I worked on problems related to things he had done. I'm a problem solver; sometimes I don't like a proof and I start to think of ways to prove it differently, and that often leads to something new."

Widely known for his work in partial differential equations, Nirenberg said that when he is working on problems in other subjects, the basis is always partial differential equations. "I've worked on problems in complex analysis, geometry, fluid dynamics…but it's always partial differential equations. I even collaborated on two papers on problems coming from economics, I didn't understand the economics background, but I just worked on them as mathematics problems," he explained.

When asked his opinion on the relationship between pure and applied mathematics, Nirenberg firmly aligns himself with the ideas of Richard Courant, believing that there should continue to be collaboration between the two.

Understandably, Nirenberg's passion for mathematics is evident in his descriptions of his work, but equally apparent is his affection for the worldwide mathematics community. "It's a wonderful family, it's something marvelous," he said, beaming. "You go to Europe, Japan, China, India, and you're with other members of the family. You're immediately at home with them – it's a wonderful thing. I have many good friends in mathematics."

He added, "Another unusual thing about mathematics is that when you point out to a mathematician that something he or she is proving is wrong, nobody takes offense. It's not meant as an insult; it's just a normal way of talking. In fact, people bring me proofs they're working on that they want me to criticize, to catch mistakes. Years ago, I was very good at that – catching mistakes. I've lost that – not only have I lost it, I now make many mistakes! Luckily I'm working with other people, so if I don't find the mistake, they do."



Although Nirenberg retired in 1999, he still comes into his office one or two days a week. "I talk to people, I go to seminars, but I work at home," he said. "The field is still a great joy, even though I spent the summer working very hard on two problems and didn't get anywhere. But still it's fun to do."

His secret to solving problems? "It's important to be stubborn," he said. "You can't give up; you have to be persistent. Most of the time, I'd say 95% of the time, you're really stuck. But sometimes the material you've done while you're stuck helps when you finally do resolve the problem. And then sometimes you never get unstuck."

"The whole thing is fun, enormous fun," he added happily. "It's also frustration, because you're stuck so much. That's where the stubbornness comes in."

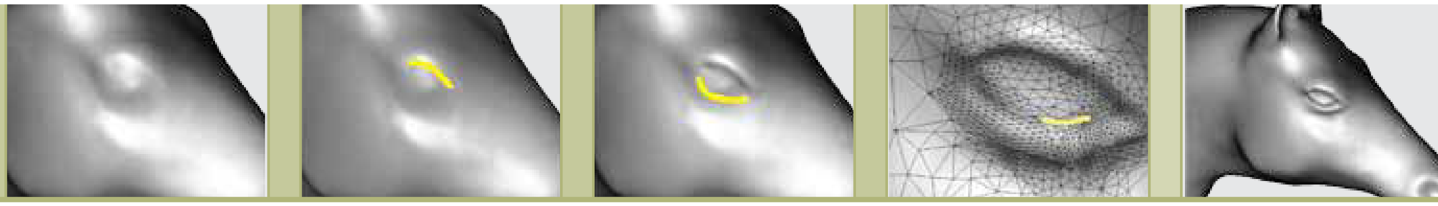
As evidenced by the Chern Medal, that stubbornness has certainly paid off. Hearty congratulations, Professor Nirenberg. ■

[1] International Mathematical Union website, www.mathunion.org

Computer Science Professor **Denis Zorin**'s Work

# From the Lab to the Everyday World

by M.L. Ball



**This sequence of images shows how a user can refine a 3D object by drawing. With just a few strokes the eye is painted on the image of the head of a horse; the shape of the original mesh is changed automatically to match the changes to the image.**

At first glance, Professor of Computer Science Denis Zorin's work focuses on two areas that seem unrelated: complex fluid simulation and geometric modeling. But as Prof. Zorin described it, "There are actually common points between these two extremes. The unifying theme that connects them is developing computer techniques to deal with 3-dimensional shapes."

In fact, joining two seemingly disparate fields is emblematic of Zorin's thinking. "I've always liked geometric areas of math and one of the motivations for me to work on these problems is that they involve significant geometric components," he said. "On the other hand, I'm a computer scientist so I like to figure out efficient algorithms that can be turned into software used to solve practical problems. In my work, I use geometric insight to develop new algorithms."

In his work on fluids, Zorin concentrates on flows with deformable particles, such as blood cells and vesicles. "Vesicles are little bubbles that form spontaneously in fluids and play a very important role in all sorts of engineering applications and biology," he explained. "What we're trying to do is simulate how a fluid flows even if a very large portion of it is occupied by these cells. We're also looking at how it flows in confined environments, like a blood vessel. We're mostly targeting blood cells as our application. We're not quite there yet in terms of approximating real blood cells, but that's one of our goals."

When asked how his interest in fluids originated, Zorin replied, "I started working on them with a joint grant along with Mike Shelley and Charlie Peskin, who was doing a lot of work on blood flow but on a larger scale. We were focusing on small scale phenomena. The numerical techniques we started developing are based on the fast multipole method invented by Leslie Greengard and Vladimir Rokhlin. I had the pleasure of working with very talented postdocs and students—in particular, George Biros (now faculty at Georgia Tech), Lexing Ying (currently at the University of Texas), and my current postdoc, Shrvan Veerapaneni."

Zorin's other area of concentration, geometric modeling, aims to develop tools for building computer models of 3D shapes. Such tools are broadly used in manufacturing to develop models of products from cars to shoes, as well as in computer animation and special effects to create virtual characters and environments. One example of this is interactive modeling, something that overlaps with the work of Olga Sorkine, a fellow faculty member in the Computer Science Department's Vision, Learning and Graphics Group.

"We're trying to create techniques for designing or modifying shapes in an intuitive and flexible way," Zorin said. "For example, in one of our recent projects with a Ph.D. student, Yotam Gingold, we developed a set of algorithms that makes it possible to take the image of a 3-D model and directly change its appearance, using virtual brushes to paint different types of strokes. These changes in appearance are then automatically converted to changes in the shape. So if you want the cheeks on a face to look slimmer or more rounded, you can simply paint over a view of the model making lateral areas darker or brighter, and the system computes those necessary shape changes."

Zorin is also working on how to build a 3-D shape from just a single picture. "In collaboration with Yotam and Takeo Igarashi from the University of Tokyo, we are creating a tool that allows a designer to add some simple annotations to a 2-D sketch so that a 3-D object can be reconstructed," he said.

Something that Zorin finds very satisfying is when a clear, simple concept has big implications on the final result. "There may be a continuous path that starts from a differential geometry concept," he said. "It may be a relatively simple one but it can have an enormous effect on how quickly or reliably you can do things when you have to do an actual computation.

"For instance, I worked with Eitan Grinspun—my former postdoc who is now a professor at Columbia—on cloth simulation, as well as on more general simulation of various thin deforming objects," Zorin said. "One of our projects started with a simple fact relating curvature and the Laplace-Beltrami operator, but it quickly led to a major efficiency gain: the part of the simulation that formerly took up most of the time now takes almost no time. In this instance, it was a very short path from a formula all the way to industrial applications. This idea was quickly adopted both in academic research—our article got a most-cited paper award—and picked up by developers in industry. You don't always have good luck like this," Zorin said laughingly.

Another of Zorin's older projects that is now being applied to the everyday world deals with defining smooth shapes. "A particular technique for computing smooth shapes starting from a coarse mesh was the subject of my Ph.D. thesis," Zorin explained. "It sounds like a simple thing to do but getting all the technical details right is not easy. It was an idea invented in the late 1970s, but it was mostly only of academic interest until the mid-90s when it really took off. Then, there was rapid progress in applications, first in computer graphics and then animation. Later in the early 2000s, I helped to integrate the technique into a major computer-aided design system called CATIA. To me that's quite exciting because you get to combine a beautiful theory or abstract concept with something that has a direct route to applications," he said.

Originally from Moscow, Zorin came to the Courant Institute in 1998, having earned his Ph.D. at Caltech. "I'm quite happy here," he said. "It's a good place for me because of the close connection between computer science and math; I also enjoy living in New York."

"When I first started here at Courant," he recalled, "I was mostly applying geometric algorithms to computer graphics, which I'm still very interested in and still work on. Over the last ten years, many new faculty members working in computer graphics and computer vision have joined the Computer Science Department, forming the Vision Learning and Graphics Group. The group is now quite large with many diverse directions of research. It's very exciting!"

For the rest of us, seeing what's coming next from Professor Zorin will be equally exciting. ■

# Paul Garabedian Passes Away at 82

Paul was one of the outstanding mathematicians of his time. As a pure mathematician, he made fundamental contributions to the theory of partial differential equations and to the theory of functions of a complex variable. As an applied mathematician, his astonishing calculation of shockless airfoils has had a major impact on modern aircraft design, and his studies of plasma stability are central to the problem of designing fusion reactors.

**Paul Garabedian died on Thursday, May 13th, 2010 at his home in Manhattan. He was 82 years old.**

While growing up in an academic family, Paul did not attend school until it was time to go to college. He did his undergraduate studies at Brown, after which he attended Harvard for his graduate degrees, receiving a PhD in 1948 under Lars Valerian Ahlfors, on the subject of "Schwarz's Lemma and the Szegö Kernel Functions." He subsequently spent one year teaching at the University of California, Berkeley and nine years at Stanford.

Paul joined NYU's Courant Institute in 1959, and was a member of the faculty for fifty-one years. A few years after his arrival at Courant, Paul published his first book, Partial Differential Equations (1964), which continues to be used worldwide. He advised twenty-seven PhD students (all but four at Courant), and was the Director of the Division of Computational Fluid Dynamics at Courant for 32 years (1978-2010). Of the Institute, he said: "My gosh this is a place with lots of strange people around… but I feel very comfortable here, so I must be one of them."

During the 1950s, Paul was a pioneer in the use of computing to solve important scientific and engineering problems. He showed, for example, that proper shielding would permit high altitude vehicles (including intercontinental ballistic missiles) to reenter the atmosphere without burning up. During the 1960s and 1970s, Paul and his students and coworkers developed codes to study supercritical wing technology because of the development of aircraft designed to fly near the speed of sound. The basic principle involved concerns the suppression of boundary layer separation by shifting shock waves that occur on the wing toward the trailing edge and making the shock waves as weak as possible. The mathematical technique he used was so sophisticated that, for a time, it was ignored by the aeronautics community. When finally tested, however, it revolutionized the industry. The resulting wing increases lift, fuel efficiency and the speed of aircraft, and the ideas that flowed from this work influence much of commercial aircraft design today. A NASA Award and a NASA Certificate of Recognition acknowledged this research, which resulted in three books with longtime collaborator Frances Bauer (whom he met during his undergraduate studies at Brown, while she was a graduate student), former PhD student David Korn, and Antony Jameson.

Paul started working on problems related to fusion energy in the 1970s – a potential method for power generation that is carbon-free and would avoid the possibility of nuclear accidents and the problem of nuclear waste storage. One of the difficulties in making the technology practical concerns the need to confine an ionized gas (a plasma), and one of the main methods for doing this involves controlling the gas with magnetic fields. Paul used the techniques he had developed for problems in classical fluid dynamics and extended them to study this magnetic confinement problem, first working on free boundary models to understand plasma physics experiments carried out at Los Alamos National Laboratory and the Max-Planck Institute for Plasma Physics in Germany. Over the years, the sophistication of the plasma modeling tools in Paul's research group grew, resulting in the NSTAB suite of computer codes which are used to study plasma equilibrium, transport, and stability. Paul's ideas have played an important role in the theory underlying fusion reactor design. In characteristic fashion, he was vocal in describing what he saw as flaws in tokamak systems, such as the International Thermonuclear Experimental Reactor (ITER) currently under construction in France. Equally characteristic, he proposed alternatives to follow ITER that might be able to resolve those same problems.

Paul was actively pursuing his research up until his death, publishing one paper each in 2009 and 2010 with former PhD student & collaborator Jeff McFadden (now at NIST). In a 2005 Society for Industrial and Applied Mathematics (SIAM) oral interview, Paul remarked to Philip Davis: "I was a child prodigy. I still am a child prodigy, but there are very few people who know that."

Among his many honors, Paul received the Birkhoff Prize (awarded by the American Mathematical Society (AMS) and SIAM for an outstanding contribution to "applied mathematics in the highest and broadest sense"), the Theodore von Karman Prize awarded by SIAM, the National Academy of Sciences Award in Applied Mathematics and Numerical Analysis, and the Boris Pregal Award from the New York Academy of Sciences. He was a member of the National Academy of Sciences, the American Academy of Arts & Sciences, and a fellow of SIAM and the American Physical Society. Although only one quarter Armenian, he was proud of his heritage, and a hero to the Armenian mathematical community.

A scientific conference in his honor was held at the Courant Institute on December 4th, 2010. ■

# For **Christina Sormani**, the Courant Institute Has Always Been One Big Family

by M.L. Ball

**(1996) Christina Sormani, the day she received her doctorate from the Courant Institute. To her right is her mother, Peggy Markey Sormani, and to her left is her father, Michael Sormani.**

## When someone's parent is a mathematician, chances are that he or she will consider entering the field also. When both parents are mathematicians, the possibility becomes a probability.

When someone's parent is a mathematician, chances are that he or she will consider entering the field also. When both parents are mathematicians, the possibility becomes a probability. And when one's father, mother, and uncle are all mathematicians, as well as Courant Institute graduates, it begins to feel like the family business.

Such is the case with CUNY Professor of Mathematics and Courant Institute alumna Christina Sormani. Christina's father, Michael Sormani, earned his Ph.D. at Courant under Kurt O. Friedrichs – Friedrichs's next-to-last student, in fact. Her mother, Peggy Markey Sormani, completed a masters at Courant, taking courses with Louis Nirenberg. And her uncle, George Sormani, also earned his Ph.D. at Courant, under Arthur Peters.

When asked if it was inevitable that she would follow the family path to Courant, Christina answered, "Yes. I always felt I was supposed to go into math. I went to NYU for my undergrad because Courant was here. I had heard of Prof. Nirenberg, Prof. Morawetz, and Prof. Lax as a child. Prof. Nirenberg lived on the Upper West Side near us, so we'd see him sometimes and my dad would say, 'There's Professor Nirenberg!' "

Christina's parents met as undergrads at Queens College CUNY. "My dad was a math major and my mom was a physics major, and they met because he took physics classes," she explained. "My dad was in analysis and studied pseudo differential operators. My mom had a physics masters but then could not gain admission into a Ph.D. program in physics. I don't know if it was sexism or not, but she didn't get admitted, so she came to Courant for a masters in mathematics. Her favorite classes were with Prof. Nirenberg."

Many years later, Christina also took a class with Prof. Nirenberg and was astonished at his memory. She recalled, "He looked at me one day and said, 'Weren't you here 25 years ago under a different name?' I answered, 'Peggy Markey?' For him to recognize me as my mom's daughter was incredible. Then he said, 'But your last name's different.' He didn't remember my dad because my dad had been Prof. Friedrichs's student, but my mom took several classes with him."

According to Christina, the Courant Institute has historically been one of the best places for women in math, largely due to the attitude toward women in Germany before World War II. The group that founded Courant had already worked with women mathematicians in Germany at a time when few American universities had female research mathematicians and almost none had women math professors. In contrast, at Courant, Cathleen Morawetz was a research mathematician and a math professor.

Professor Morawetz was an important inspiration for Christina because Morawetz had four children and had succeeded as a mathematician and a mother. When Christina began having children a few years after completing the doctorate, she sought out Professor Morawetz for advice. "She recommended never stopping doing mathematics while the children are small but to avoid spending time on other professor activities, like teaching and service," Christina said. "I've tried to follow this advice. She was very helpful when I sought her out and talked to me at some length in the lounge at Courant."

Being the child of Courant mathematicians not only influenced Christina to attend Courant but also shaped the type of student she would become once there – training that can be traced all the way back to Kurt Friedrichs. "Professor Friedrichs was a classic German professor, so the German style of advising became my image of how you're supposed to behave toward your advisor," she said. "As a child, I knew that your math Ph.D. advisor was the lord and you did anything he ever suggested."

Christina described Prof. Friedrichs as "a very precise guy who would set very scheduled times for students to meet with him, and you couldn't see him at a different time. Even his adult son would wait to see him."

She added, "If you had a proof, you did not say 'I've proven this.' You typed up your proof – he would not check it unless it was typed – you made sure it was perfect, you handed it to him, and it could not have a mistake. That was how I was brought up, and I treated my own advisor, Jeff Cheeger, that way. I think he was kind of shocked!"

Being her father's daughter also came to the fore when Christina was choosing her advisor. "I was one of the better students in the class, so I went to Prof. Cheeger and asked him to be my advisor," she remembered. "He said to me, 'Have you read these books?' And he showed me five books. I said, 'No, I haven't read them.' And he said, 'Well, read them.' So I did. It took me about four months but I read them, did all the problems, and then went back to him and said, 'I've read these four, but I don't really like this one. Can I read something else instead?' He didn't believe I had really read them all, so he quizzed me. I then proceeded to prove things on the blackboard directly from the books. So he said, 'Okay, you can be my student.'

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"This is where having the father that I had comes into play," she explained. "He told me that you obey your advisor **unquestioningly**. When Prof. Cheeger told me to read five books, I read them and I read them carefully, because my dad always said, 'When your advisor asks you to do something, you do it to the letter and you do it better and you better be ready for him to grill you.' I will add that Prof. Cheeger's hair started turning grey when he was my advisor – everyone points this out to me," she said jokingly.

As well as being her advisor, Jeff Cheeger was also instrumental in drawing her to geometry. "I was planning to do fluid dynamics when I went to Courant, but then I took a class with Prof. Cheeger in my second year and was converted to differential geometry," she said. "He was presenting his own proofs – his own work was in the textbook. So I got a sense of what it would be like to work with him."

Although Jeff Cheeger proved to be a brilliant advisor, he would spend hours in his office concentrating so intensely on his work that he wouldn't even hear people knocking. Routinely, Christina would sit outside his office for hours hoping he'd open the door. "Every now and then I'd catch him on the elevator, or follow him through the streets, talking math the whole time," she said. "The other professors were surprised – this was not typical Courant behavior."

To illustrate, she told the story of the Unabomber, Ted Kaczynski, being apprehended while she was a grad student at Courant. "Every day in the 13th Floor lounge – a key part of what makes Courant an exceptional place because it's where mathematicians interact and communicate – a group of professors would sit at a long table, talking about mathematics and life," she recalled. "You would see Professors Varadhan, Lax, Morawetz, Nirenberg, Fang-Hua Lin, Percy Deift…the whole crowd. Of course, Prof. Cheeger was never there.

"One day I intercepted him in the elevator and began to talk to him about something I'd worked on, which intrigued him enough to invite me to the 13th floor to get a coffee – a first! So we went and sat at the table with all the other mathematicians and he started talking to me with pencil and paper. I don't think he even noticed them. One of the professors finally said to him, 'Jeff, weren't you a postdoc at Berkeley in the same building as Ted Kaczynski?' To which Prof. Cheeger replied, 'Oh I never saw him – he was always in his office with the door shut.' "

At the same time Prof. Cheeger was advising Christina, he was surrounded by a group of younger faculty and postdocs: Gang Tian, Toby Colding, and Bill Minicozzi. Cheeger collaborated with all of these young mathematicians. "And they all went on to greatness," said Christina.

Colding and Minicozzi went on to become world famous co-authoring geometers, jointly winning the 2010 Oswald Veblen Prize for their work on minimal surfaces. (Misha Gromov received the Veblen Prize in 1981, Gang Tian in 1996, and Cheeger in 2001.)

Grisha Perelman, who visited for a term during this period, interacted with Professor Cheeger on Ricci curvature, an area both were working on at the time. "Later on," Christina said, "Perelman applied techniques involving Ricci curvature to solve the century old Poincaré Conjecture."

While at MIT, Gang Tian won the Veblen prize in 1996, the year Christina graduated from Courant. She remembered, "When Tian accepted the honor, he said, 'I would also like to thank my colleagues at the Courant Institute of Mathematical Sciences for providing me with an excellent environment for my research. It is one of the most stimulating places for mathematical research.' "

Prof. Tian was the first of these young professors to play an important role in Christina's career. "When Prof. Tian went to MIT," she said, "he invited me to give a talk at the Differential Geometry Seminar. That was very helpful to me because if a professor leaves an institute and still supports the students there, that's a really nice thing."

Prof. Tian also connected Christina with Prof. Shing-Tung Yau, a Fields medalist at Harvard, which led to a postdoc for her there. "When I spoke at MIT, Professor Yau was in the audience," she said. "Afterward, Prof. Tian introduced me to Prof. Yau and I bowed quickly, which was exactly the right thing to do. It helps that I have a Chinese husband; I know all the Chinese gestures of respect because I do them to his father. So coming from a background of showing extreme respect to your professor – my family's culture, stemming from Friedrichs – to the Chinese culture of respect… that has worked really well," she said.

Bill Minicozzi was also helpful to Christina. "He went to Johns Hopkins and gave me a postdoc there, partly because he used to be at Courant and already knew my work. So there were a lot of mathematical connections. It's really nice that Courant Institute has so many postdocs who end up as professors around the country and support the students afterwards," she said.

When asked to describe one thing that is truly special about the Courant Institute, Christina stated, "It's the way mathematicians communicate with each other and work together. As the doctoral students and postdocs leave Courant, they retain that spirit, continuing to work together as they move on to other universities and institutes around the world."

Just like one big happy family. ■

# Alumni Spotlight Anil Singh

Anil Singh, Bachelors in Electronics Engineering, Institute of Technology, Banaras Hindu University; M.S. in Information Systems '02, NYU's Courant Institute

In 2002, Anil Singh (M.S. in I.S. '02) completed his Master's and founded Hanu Software. The shared year is no coincidence: Singh's first client for Hanu Software was the same company with which he completed his M.S. project course while at the Institute. In fact, people Anil met at Courant, especially Prof. Arthur Goldberg, inspired him to start his entrepreneurial journey. Eight years later, Hanu Software (www.HanuSoftware.com) — a global consulting and services company that provides high-quality, high-value software development and business process outsourcing services to independent software vendors (ISVs) and enterprises — has more than 120 employees across US, UK and India. Hanu is proud to have New York University as its customer and has developed many software solutions over the years. ■

# Clever Danes

by **Dennis Shasha**, Professor of Computer Science

As we saw in our discussion of The Tolls of Elsinore in the Spring 2010 puzzle, shippers who brought cargos via Elsinore had to pay taxes based on the value of these cargos, and it could be to their advantage to understate this value. But the king sent inspectors to the ships to foil this misreporting. Some shippers figured out that they could do even better by bribing the two inspectors who came on board. The King heard that among his eight inspectors at least three were corrupt. The King reasoned that the corrupt inspectors knew one another and that only if both inspectors entering a ship were corrupt would they take the bribe.

So the King arranged with some shippers he trusted to put the inspectors to the test. The trusted ship captains would offer bribes to the inspectors and would then report the cheating pairs to the King. The King thought he would first figure out who was cheating, before punishing anyone.

The King needs some mathematical help. He first asks you to to instruct the inspector general to arrange the inspection teams so a different pair visits each ship. For example, Nils and Bjorn might go to the first ship, Nils and Anders to the second, and Bjorn and Anders to the third. Besides those three, the inspectors are Dagmar, Ejnar, Gudrun, Harald, and Christofferson.

**Warm-Up:** How many different ships would be needed to ensure that every distinct pair of inspectors goes to some ship?

**Solution to warm-up:** The number of distinct pairs from eight people is “8 choose 2” or 28. One way to figure this out from first principles is to observe that if there were two people, then there is only one pair. With three people, the third person could be paired with either of the first two so there is 1 + 2. With four people, the fourth person could be paired with any of the first three, so 1 + 2 + 3. With 8 people, we have 1 + 2 + 3 + 4 + 5 + 6 + 7 = 28.

The King decides that this would require too many honest captains, so he drops the requirement that every pair visits at least one ship. He asks you whether fewer ships might be sufficient to detect any number of cheating inspectors from three on up. The ships arrive and are inspected one by one, and the inspector general assigns the inspection teams as the ships arrive (and after previous inspections are completed). As a matter of justice, cheaters must be caught in the act of cheating.

*1.* How much better can you do (i.e. with what minimum number of ships can you guarantee to find the cheaters) if there are at least three cheaters?

   Hint: As you’ll see, it’s easier to find cheaters when there are more of them.

*2.* Suppose that the cheaters realize they are being put to the test. Each cheater resolves to cheat if and only if he is with another cheater and neither of them took a bribe on the last ship either of them visited (which may or may not be the same ship). At the start, every cheater is eager to cheat to pay off the last night’s gambling debts.

How many ships would you need then?

Hint: You can do with barely any more.

For the solution, email: courant.alumni@nyu.edu

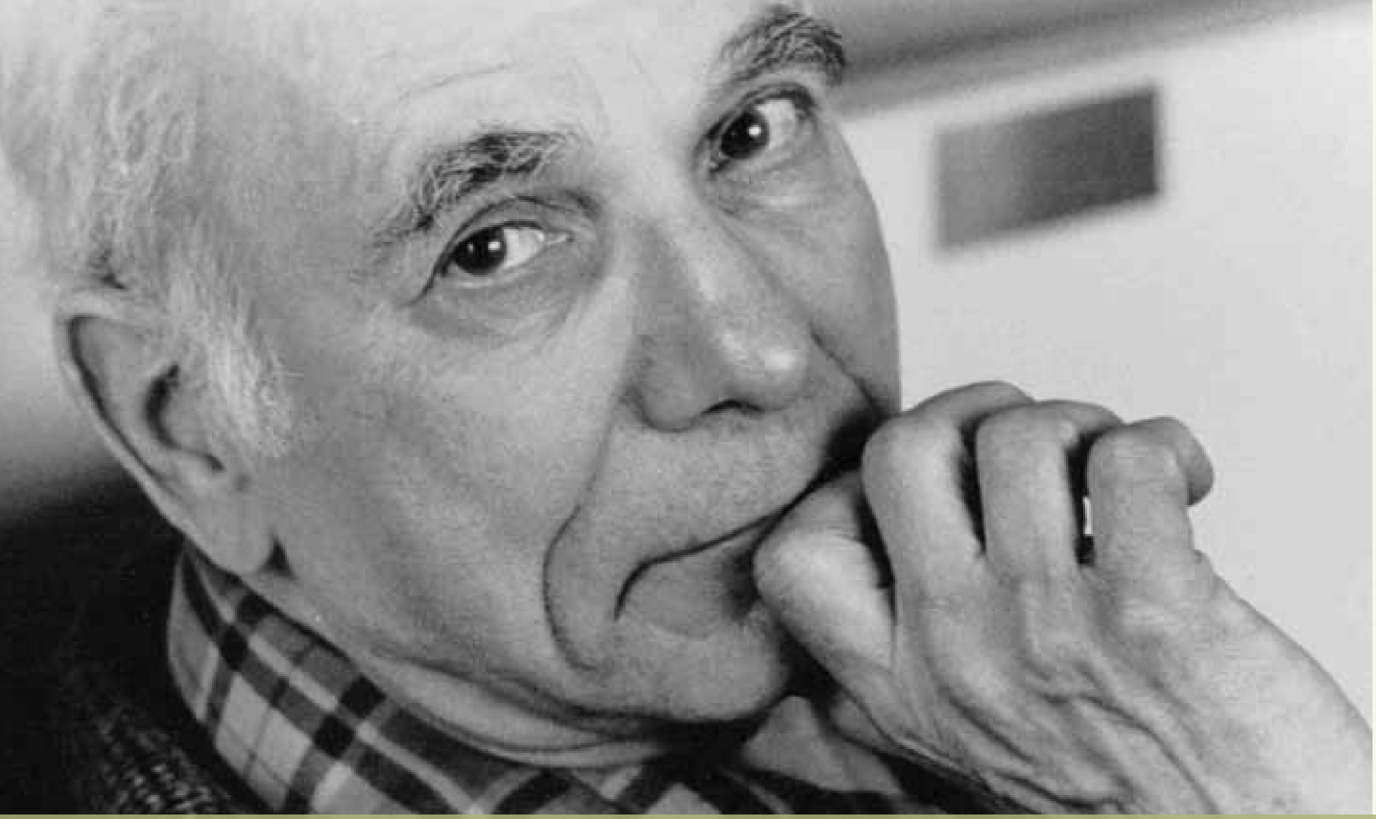


Photo: Fritz John, taken by his son, Thomas John

# 100 Years *After* His Birth, Fritz John Remains One of Courant Institute's Most Beloved Luminaries

by M.L. Ball

## "Mathematicians work for the begrudging admiration of a few colleagues."

So was Fritz John fond of saying, according to Courant Institute Professor Emeritus Cathleen Morawetz. But in his case, happily this does not ring true—neither for his work nor the man himself.

Born 100 years ago in Berlin on June 14, 1910, Fritz John's life was every bit as fascinating as his accomplishments. Highly proficient in math from an early age, he excelled at analytic geometry, formal differential calculus, and spherical trigonometry. Urged by his high school mathematics teacher to attend the University of Göttingen, he arrived there in 1929 almost penniless, where he was befriended by Richard Courant, the director of the Mathematics Institute at the time.

In the fall of 1931, Fritz John's fiancée, Charlotte Woellmer, whose funds were just as strapped as his, transferred as a mathematics student from Berlin to Göttingen. At the end of January 1933, Hitler took over the government and German universities were progressively purged of non-Aryans. That fall, as things were getting more and more oppressive, Richard Courant accepted an invitation for a year's stay in Cambridge. He also was partially supporting Fritz and Charlotte, still studying at Göttingen.

In July of that year, Fritz John received his doctorate from Göttingen (the last non-Aryan to do so) with a thesis entitled *Determining a function from its integrals over certain manifolds*. Ten days later, he and Charlotte were married. That same year, Courant managed to secure a scholarship for John at St. John's College, Cambridge, enabling the newlyweds, in January 1934, to emigrate to England and to safety.

"My father always felt that Richard Courant saved his life by getting him out of Germany," recalled Fred John, Fritz's son, "and I fully believe that was the case. He always felt indebted to Courant after that."

After a year and a half in England, the Johns made their way to America. In a short work entitled "*Memories of Student Days in Göttingen*," Fritz John wrote, "In the fall of 1935 I was offered and accepted a position in the United States [an assistant professorship at the University of Kentucky], which became my adopted country." He stayed in Kentucky until 1946, barring the period 1943-45, when he worked for the Ballistic Research Laboratory at the Aberdeen Proving Ground in Maryland.

Heidi A. Howard, Professor of Mathematics at Florida State College, offered these memories of John's years at the University of Kentucky. "My grandmother, Prof. Aughtum Howard, was a student of his when he was there. I will forever be grateful to Fritz John for taking a chance on a pioneering woman in the field of mathematics. She completed her Ph.D. in 1942, the first woman to receive this degree from there."

Prof. Howard continued, "One of my earliest recollections of my childhood was watching my grandmother teach calculus at Eastern Kentucky University, and at the age of three being introduced to the class as the newest student. That event had an impact on my personal and professional life which is a direct result of Fritz John's nurturing my grandmother's mathematical career."

In 1946, Fritz John left Kentucky to join the Mathematics Department at New York University. He continued there for the remainder of his career, retiring in 1981.

During his years at the Institute, Fritz John was a close friend of Richard Courant's as well as a colleague, co-publishing *Communications on Pure and Applied Mathematics* with Courant in 1965, a major undertaking.

**Fritz John with colleague Monroe Donsker on a balcony of Warren Weaver Hall.**

In Constance Reid's book *Courant*, Richard Courant's wife Nina described how much she loved observing conversations between her husband and Fritz John, saying "I could feel their eagerness to learn from each other. There was a kind of peaceful agreement and mutual respect between them which I never saw between people in other fields."

Similar words of praise come from Klaus Peters, one of Fritz John's publishers, first at Springer Verlag, then at Birkhäuser. When asked to speak of the significance of John's mathematical contributions on the occasion of his 100th birthday, Peters said, "I was introduced to Fritz John by Richard Courant. The warm welcome extended to me by Fritz soon developed into a friendship and routine that made Fritz and Charlotte's home my *Stützpunkt* (base) for visits to New York and the New Rochelle mathematical community. What made the visits to their house and the conversations so unforgettable and rewarding was the rare combination of uncompromising honesty and genuine empathy, enriched by the experience of a personal history that reflected some of the tragedies of our times and their intelligent response to these circumstances."

Princeton University Professor of Mathematics Sergiu Klainerman, one of Fritz John's graduate students at the Courant Institute, remembers John as being "very nice but somewhat reserved. I didn't talk to him much at all until I finished my thesis," he said. "After that, we became very good friends. He invited me to his house many times, and we talked a lot about all sorts of things. It was particularly interesting to talk to him because I came from Romania, a Communist country, and he came from Germany. We had different positions but we loved to argue, both of us."

Initially, Prof. Klainerman was a student of Courant Institute Professor Emeritus Louis Nirenberg. "During my second year," he explained, "Nirenberg gave me a problem connected to something that Fritz John was interested in, and I got very excited. I left the problem I was working on, and spent all my time on this new subject. After a few months of assiduous work, I was able to prove a result, which to my luck, Fritz John thought surprising. My thesis was signed by both Louis Nirenberg and Fritz John since the problem was assigned by Nirenberg but also involved John."

Prof. Klainerman and John eventually wrote a paper together—*Almost Global Existence to Nonlinear Wave Equations in Three Space Dimensions*—published in 1984. "It was something I was working on by myself but since many of the original ideas came from him, I felt we should write the paper together, and he agreed. I am proud to be part of a very small group of John's collaborators," Prof. Klainerman said.

Another member of this small group is Louis Nirenberg, who co-authored *On Functions of Bounded Mean Oscillation* with Fritz John in 1961. "I was the first person he co-authored a paper with," Prof. Nirenberg said. When asked to describe John, Prof. Nirenberg said that he was "a very original thinker and a wonderful mathematician. He didn't follow other people's paths. He just created his own way and then other people followed his paths."

As with Prof. Klainerman, it was Fritz John's love of discussion and debate that also endeared him to Courant Institute Professor of Mathematics Jalal Shatah. "I came to Courant in 1983 as a postdoc and knew Fritz until his death," he said. "He was already retired but kept his office on the 13th Floor. He and I were working in very similar areas so immediately after my arrival we started to converse. He used to come to the Institute twice a week after his retirement and we would go to lunch once a week to Bobst Library, where we had conversations about mathematics, about his early days at the Institute, about his days in Germany. We became very close friends."

Born in Lebanon, Prof. Shatah explained that although they came from very different backgrounds, they had no problem becoming friends. "Fritz John loved history. We would spend hours and hours discussing ancient history, modern history, recent history—anything from the Babylonians to World War II to World War I to the Holy Roman Empire. This was a passion of his and we talked about it very often during our visits. There was no subject that was off limits in our discussions, including religion, the Middle East, Germany and the Nazis. He was a great conversationalist—there are not many of them," he observed.

Prof. Shatah went on to describe Fritz John as "a gentleman's gentleman, very kind to everyone. To put this in context, I met him in 1983 when I was 25 or 26 and he was 73. He treated me with complete respect, as a colleague. He did not make me feel that he was a giant mathematician and I was a lowly postdoc. On the contrary, we used to have these very long lunches together among two equals. I never felt in any way that I was inferior to Fritz, and that was a wonderful feeling."

John "had an excellent sense of humor, very dry," Prof. Shatah remembered. "He could be very sharp, very sarcastic, but had a very good sense of humor.

"Also, he loved his wife Charlotte tremendously," he said. "When my wife and I would visit them in their house in New Rochelle, they would always sit in the same two chairs, very close to one another, and we would sit on two chairs opposite them. Fritz almost always held Charlotte's hand; she would have her hand on the armrest and he would put his hand over hers. The visit would always include lunch, and afterwards Charlotte would get up and go into the kitchen. She would then look at Fritz and say to him in her very thick German accent, 'Would you like anything else, Daddy?' She always called him that. After he died, we went to see her and she had taken away his chair and there was only her chair left. After his death, she felt very lonely," Prof. Shatah said.

At a memorial service for Fritz John at the Courant Institute in 1994, seven months after his death, Fred John had this to say of his father: "A number of characteristics seem to provide the overriding sense of my father's nature. One, certainly, is the gentleness that marked his approach to life. He spoke softly, rarely raised his voice, hardly ever got angry. I often interrupted his work, but he never seemed to mind, was happy to see me, answer my questions, never seemed impatient to get back to the train of thought I had interrupted."

When asked recently about his father, Fred John commented that he was an avid traveler and made many trips, usually planned around mathematical conferences. "When we were younger, in the 1950s, there were even extended trips to Europe," he said.

"We did not have the typical American experience growing up," he continued. "The milieu was very European, a function of the mathematical community all around us, both at the Institute and in New Rochelle where a number of Courant professors lived. In the 1950s and 60s, the international mathematical community was still small enough so that everyone knew each other. When foreign mathematicians would visit the Institute, they would be invited out to our house to visit. I didn't fully appreciate how unusual a life it was until I was older," he said.

"Also, he loved nature deeply," Fred recalled. "He loved breaking and clearing trails on our Adirondack property. On our trips to Europe, we always walked and if there were mountains, we hiked," he said.

"In his own way, he lived life to the fullest," he said, "and it was an exciting life."

Resoundingly, more than a few of us agree. ■

# The Center for Mathematical Talent

Thanks to a generous grant of $708,468 from the Alfred P. Sloan Foundation, the Center for Mathematical Talent (CMT) was launched this September 2010 at the Courant Institute. The CMT seeks to identify and nurture young mathematical talent in pre-college students. Its signature programs will serve as templates for programs across the country. The Center will build on relationships that the Courant Institute has with many local schools. Some of these have resulted from "Courant Splash" (cSplash) – a one-day festival for high school students offering activities in mathematics and computer science. It will also build on relationships with the New York Mathematical Circle (NYMC) and the New York City Interscholastic Mathematics League (NYCIML), which offer after-school activities for mathematically gifted students, seminars for math teachers, and math competitions for area schools.

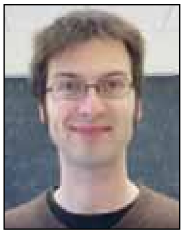
"There are so many gifted, talented, and promising kids in New York City, but too few have access to programs that can help them realize all they can achieve in science and mathematics," said Daniel L. Goroff, program director at the Alfred P. Sloan Foundation. "This new center will reach out broadly to students who may otherwise be too underserved or under-confident to develop their full potential." ■

The Faculty

## Recent Arrivals

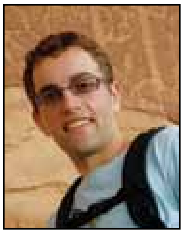
Selin Kalaycioglu

**Selin Kalaycioglu**'s primary areas of research are computational group theory and representation theory of finite groups. In addition she is interested in undergraduate mathematics education and she is one of the authors of "Functions Modeling Change: A Preparation for Calculus." She is from Turkey and was formerly a roller derby player.



Pierre Germain

**Pierre Germain** obtained his PhD from the École Polytechnique, and has been a visitor at Princeton University, and a postdoc at the Courant Institute and ETH Zurich. His primary research interests lie in PDEs, particularly fluid mechanics and nonlinear wave equations. He also works in harmonic analysis.



Aleksandar Donev

**Aleksandar Donev** is interested in the modeling of complex natural systems at the atomistic and mesoscopic levels. Of particular interest are coarse-grained particle, stochastic continuum and multi-scale (hybrid) methods for fluctuating hydrodynamics, as well as jamming and packing. He was previously an Alvarez postdoctoral fellow at LBNL and a Lawrence fellow at LLNL, and was a graduate student in the PACM program at Princeton University.

We are also pleased to announce that **David Sontag,** currently a Postdoc at Microsoft Research New England, will be joining the Institute as an Assistant Professor of Computer Science in September 2011 and **Tim Austin,** who is completing a two year Clay Fellowship at Brown, will be joining as an Assistant Professor of Mathematics in September 2012. Full profiles will be forthcoming in their respective arrival years.

# The Generosity of Friends

## Donations from friends and alumni of the Courant Institute greatly assist our educational and research missions.

Your donations to the Courant Annual Fund are more important than ever. This unrestricted income supports students and their conference travel, enhances the activities of our student clubs, and helps fund the cSplash and WinC outreach programs. The Annual Fund provides matching funds to secure grants from other sources, enables the Institute to invite distinguished speakers for both technical and public lectures, and assists in creating improved public spaces in both Warren Weaver Hall and the Broadway building.

Please join the Courant Director's Circle with a donation of $1,000 and above. This entitles you to join special events at the Institute, including a Circle only event in the fall, and the exclusive Director's Toast before the holiday party. Your donation will help support a truly extraordinary range of scientific and educational initiatives. ■

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The Courant Institute has an official Facebook page and two Linked In pages, which alumni are encouraged to join to stay connected to the CIMS community and informed about special events and activities.

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Courant Institute of Mathematical Sciences Network

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NYUniverse is an online community launched by NYU Alumni Relations, with networking and other resources for alumni.

## Your News in the CIMS Newsletter

The Courant Institute invites all Alumni to keep colleagues and friends up-to-date on life events. All items submitted (such as career achievements and family milestones) will be considered for publication in the Newsletter or online. Please send the details to alumni.news@cims.nyu.edu.