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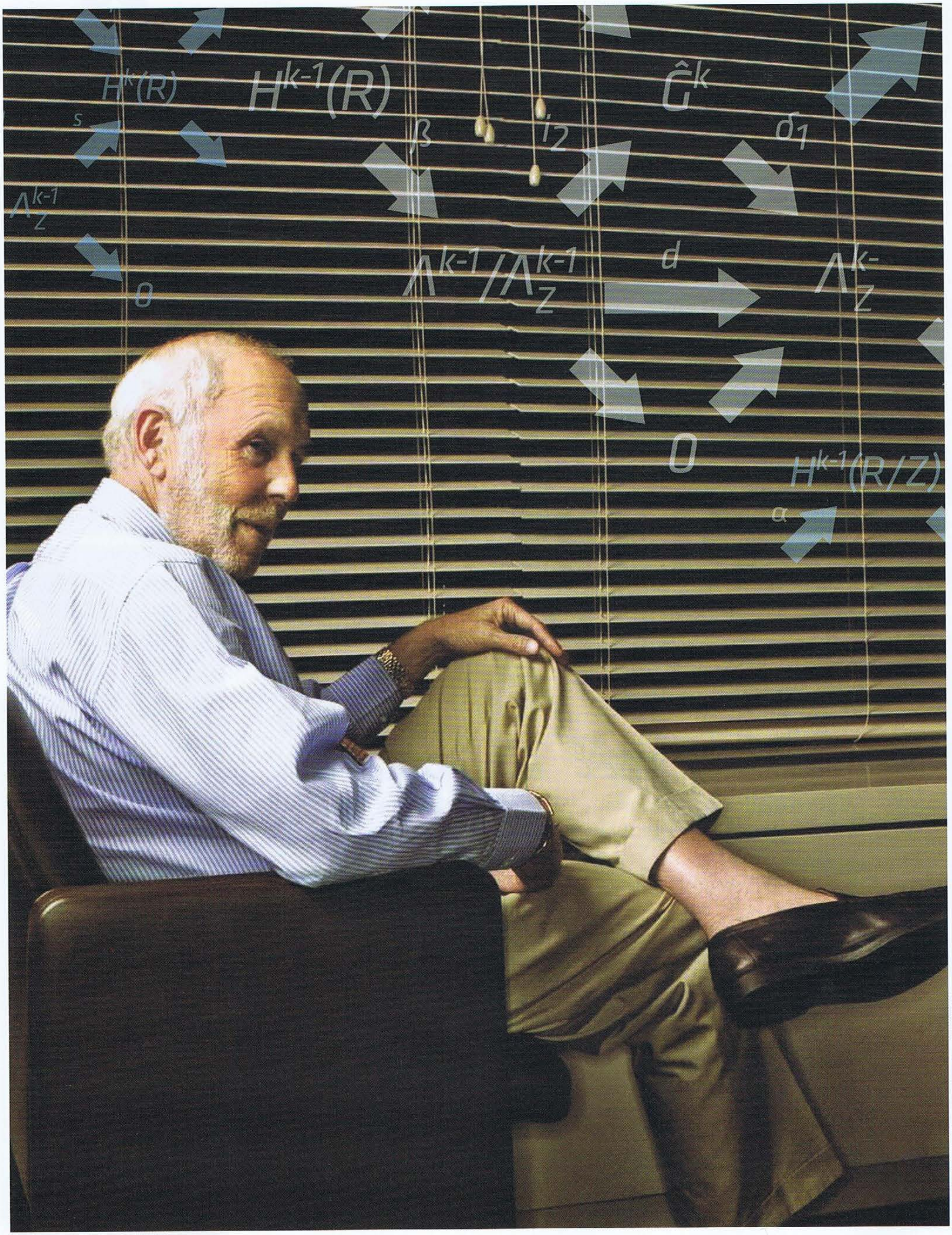
THE CODE BREAKER

Jim Simons's Renaissance Technologies, the world's largest hedge fund firm, is deciphering the secrets of global financial markets with its $35.4 billion in assets and a campus loaded with Ph.D.s. By RICHARD TEITELBAUM

PHOTOGRAPH BY BILL CRAMER; GRAPHICS BY POST TYPOGRAPHY

ON A HOT AFTERNOON in September, Renaissance Technologies LLC founder Jim Simons is too busy to take a phone call. It is, he says, from Cumrun Vafa, a preeminent Harvard University professor and expert on string theory, which describes the building blocks of the universe as extended one-dimensional particles. "Get another time when I can talk to him," Simons tells his assistant. Then he mentions that the next day, he'll be meeting with Thomas Insel, director of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$H^{k-1}(R/Z)$
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the National Institute of Mental Health, to discuss autism research. And he's slated that Saturday to host a gala honoring Math for America, or MFA, a four-year-old nonprofit he started that provides stipends to New York City math teachers.

"I'm undoubtedly involved in too many things at the same time," Simons says in his 35th-floor office in midtown Manhattan. "But you make your life interesting."

String theory, autism, math education: It's fair to ask how Simons, 69, manages his day job overseeing the world's biggest hedge fund firm. The answer, judging from the numbers, is very well.

Renaissance is on fire: Its Medallion Fund—which uses computers and trading algorithms to invest in world markets—returned more than 50 percent in the first three quarters of 2007. It had about $6 billion in assets as of July 1. Simons registered that performance as subprime and related markets were collapsing, sending two mortgage-related hedge funds run by Bear Stearns Cos. into bankruptcy. The turmoil pummeled the Goldman Sachs Global Alpha Fund, a rival to Renaissance's funds, which fell more than 25 percent during the same time. Morgan Stanley's computer jockeys lost $390 million in a single day in early August.

Medallion's returns are no anomaly. The fund, which trades everything from soybean futures to French government bonds in rapid fire, hasn't had a negative quarter since early 1999. From the end of 1989 through 2006, it returned 38.5 percent annualized, net of fees.

More surprising than those returns is Simons's life story. At an age when hedge fund pioneers such as Michael Steinhardt have long since stopped managing other people's money, Simons is building on Medallion's success. He's adding funds and strategies and accumulating assets, which totaled $35.4 billion as of Sept. 28.

In August 2005, Simons started Renaissance Institutional Equities Fund, or RIEF, which invests in U.S. stocks. Through Sept. 30, it has returned 12.8 percent annualized. Unlike Medallion, which turns over its holdings dozens of times each year, RIEF keeps its positions for months or longer. Simons said at the time of the fund's inception RIEF could theoretically manage as much as $100 billion. In December 2006, he limited new investments in the fund to $1.5 billion a month. As of Sept. 30, 2007, it had $25.6 billion in assets. In October, Simons started Renaissance Institutional Futures Fund, or RIFF, to invest in commodities. It's up 5.2 percent for the month. He says Renaissance's research shows the new fund can manage as much as $50 billion. Along with RIEF, it will promote cross-fertilization of ideas inside Renaissance, Simons says. "Challenge is good," he says. "It opens one's eyes to new possibilities."

WHEN NOT IN MANHATTAN, Simons runs his empire from a 15-foot (4.6-meter) by 20-foot office in Renaissance's gated and guarded campus off Route 25A in East Setauket on New York's Long Island, some 50 miles (80 kilometers) east of the Empire State Building. With most of the trading automated, there's little of the hurly-burly of a typical hedge fund firm. Along with routine personnel and marketing tasks, Simons makes time for the researchers and programmers who stop by his office to discuss mathematical and statistical issues they've encountered as they work on new trading strategies.

More than 200 employees, of whom about a third have Ph.D.s, work in East Setauket. Another 100 are based in Manhattan, San Francisco, London and Milan. "He creates an environment where it's easy to be creative and works hard to keep the bullshit level to a minimum," says former managing director Robert Frey, who worked at Renaissance from 1992 to 2004.

Even without the new commodities fund, Renaissance's assets have more than doubled in a year from about $16 billion on Sept. 30, 2006. That growth has catapulted Renaissance past such titans as Daniel Och's Och-Ziff Capital Management Group LLC, Ray Dalio's Bridgewater Associates Inc. and David Shaw's D.E. Shaw & Co. to become the world's largest hedge fund manager, according to data compiled by Hedge Fund Research Inc. and Bloomberg. Medallion's 3.9 percent return during August, though that fund too was whipsawed by volatility, bolstered Simons's reputation as the silver-bearded wizard of quantitative investing. In quant funds, mathematicians and computer

'ALL THE QUANTS IN THE WORLD ARE TRYING TO FOLLOW IN JIM'S FOOTSTEPS,' SAYS LO OF MIT'S LAB FOR FINANCIAL ENGINEERING.

scientists mine enormous amounts of data from financial markets looking for correlations among stocks, bonds, derivatives and other instruments. They search for predictive signals that will foretell whether, say, a palladium futures contract is likely to rise or fall.

"There are just a few individuals who have truly changed how we view the markets," says Theodore Aronson, principal of Aronson + Johnson + Ortiz LP, a quantitative money management firm in Philadelphia with $29.3 billion in assets. "John Maynard Keynes is one of the few. Warren Buffett is one of the few. So is Jim Simons." Aronson credits Renaissance with validating the entire field of quantitative investing and proving that the freedom accorded to hedge fund managers to short stocks, borrow money and invest in myriad instruments can produce results that far outstrip typical market returns.

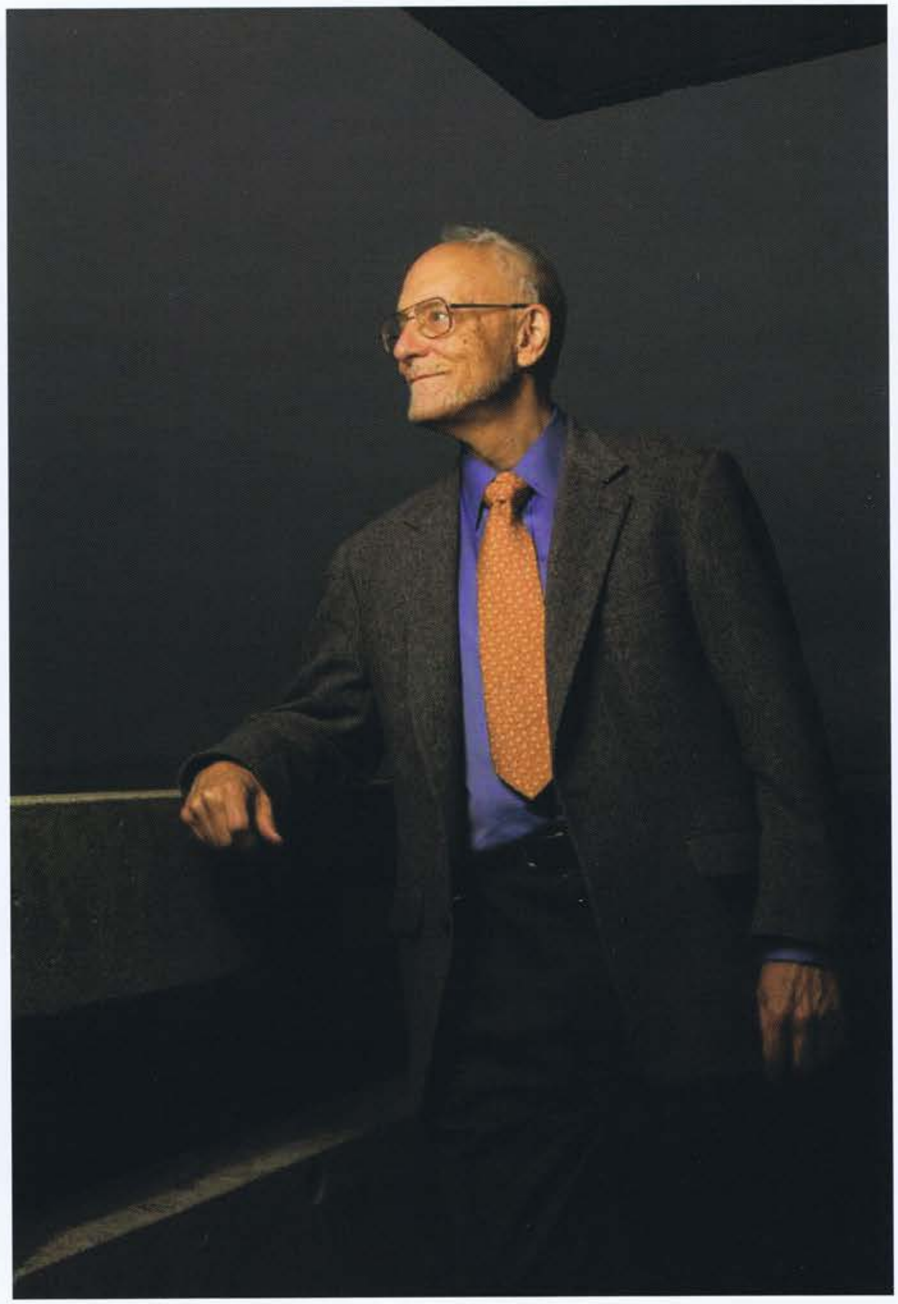
Simons, standing just under 5 feet 10 inches tall and weighing 185 pounds (84 kilograms), has trod an unlikely path. A former code cracker for the U.S. National Security Agency, in 1968 he became chairman of the mathematics department at Stony Brook University, part of the New York state university system. He built the department into what David Eisenbud, former director of the Mathematical Sciences Research Institute in Berkeley, California, calls one of the world's top centers for geometry. In 1977, frustrated with a math problem and eager for change, he abandoned academia to start what would become Renaissance, hiring professors, code breakers and statistically minded scientists and engineers who'd worked in astrophysics, language recognition theory and computer programming.

"All the quants in the world are trying to follow in Jim's footsteps because what he's built at Renaissance is truly extraordinary," says Andrew Lo, director of the Massachusetts Institute of Technology Laboratory for Financial Engineering and chief scientific officer of quant hedge fund firm AlphaSimplex Group LLC. "I and many others look up to him as a tremendous role model."

The tendency for fund managers to try to emulate Simons may become more curse than blessing in the years ahead. As the selloffs in July and August showed, many quant funds are chasing the same investments. For example, as of June, Renaissance and rival AQR Capital Management LLC had four of the same top 10 stock holdings: Johnson & Johnson, Lockheed Martin Corp., International Business Machines Corp. and Chevron Corp.

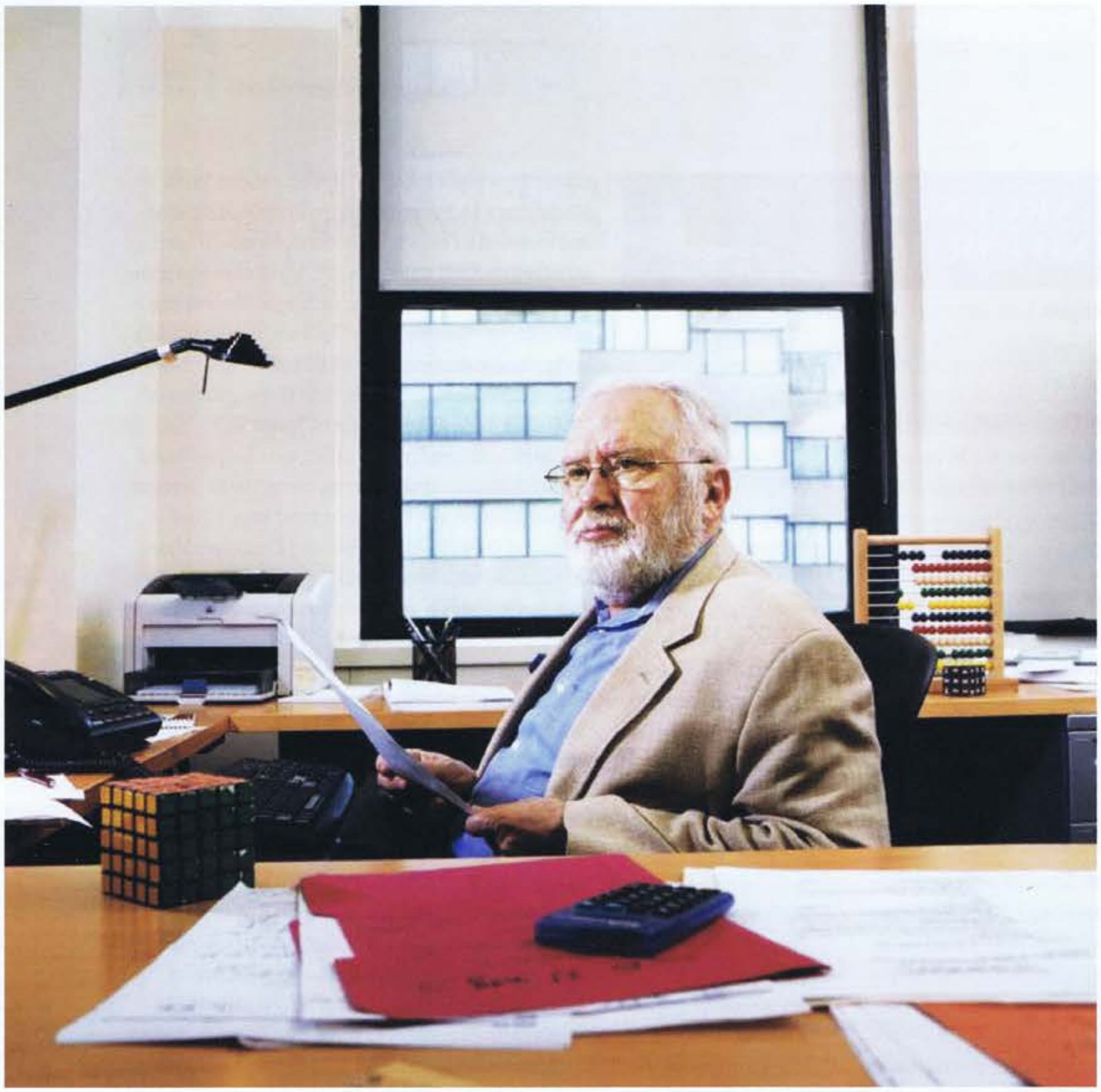
The overlap became problematic as the subprime contagion spread beyond housing-related stocks, bonds, collateralized debt obligations and commercial paper, forcing some funds to lighten their holdings precisely as demand was drying up.

"All these quant funds are using similar models, looking to buy something cheap and sell something dear," says Sol Waksman, founder of Barclay Hedge Ltd., a consulting firm based in Fairfield, Iowa. While expensive securities are by their nature easily traded—liquid, in industryspeak—the cheap securities hunted by most quantitative managers aren't, Waksman says. After all, the reason they're cheap is that nobody wants them. "Once you try and sell a low-liquidity stock, by definition there is no one to buy it," Waksman says. Overpriced stocks rose in August as hedge funds bought shares to cover their short positions, and cheap stocks



Elwyn Berlekamp led Renaissance's Medallion fund to a 55.9 percent gain, net of fees, in 1990.

JASON GROW



Irwin Kra is executive director of Simons's Math for America, which funds New York City math teachers.

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plummeted as managers rushed to raise cash.

Renaissance is under increasing pressure to stay ahead of the pack—and to keep its secrets under wraps. Save current employees and a few former ones, nobody knows precisely how the firm makes its millions. Medallion stopped taking new money from outside investors in 1993 and returned pretty much the last of their capital 12 years later. Today, the fund is run almost exclusively for the benefit of Renaissance staff. The wise-cracking Simons himself is mum on virtually all of its details.

What can he say about Medallion's trading strategy?

"Not much," Simons says with a chortle, and then takes a drag on one of the Merit cigarettes he often smokes.

What kind of instruments does it trade?

"Everything."

How many different strategies does it use?

"A lot."

Simons says his Ph.D.s laugh when they read the far-fetched theories about what their fund might be doing. One chat room participant speculated that Renaissance uses audio hookups to futures exchanges and analyzes the noise from the pits with voice-recognition software.

"All of us in the quant business have conjectures and hypotheses but very little data," MIT's Lo says. "So we like to speculate about what Renaissance could possibly be doing. They are so far ahead of everybody else that it's both challenging as well as exciting to engage in that kind of idle speculation."

For his part, Simons says he once explored whether sunspot activity affects the markets. He doesn't say what he found.

Interviews with former Medallion fund managers and with investors, rivals and quantitative scientists provide a glimpse into how the fund is run. So do annual reports, marketing materials and court documents: Ever secretive, Renaissance is suing in New York State Supreme Court two of its former Ph.D.-level researchers who were fired in 2003 after refusing to sign noncompete contracts. The firm accuses Alexander Belopolsky and Pavel Volfbeyn of appropriating trade secrets. Belopolsky and Volfbeyn deny the charges. In a July decision, the two briefly described three strategies that Renaissance had explored. One involved swaps, which are contracts to exchange interest or other payments; another used an electronic order matching system that anonymously links buyers and sellers; and a third made use of Nasdaq and New York Stock Exchange limit order books, which are realtime records of unexecuted orders to buy or sell a stock at a particular price.

With his myriad positions in different markets, Simons likens his approach to the extensive farming he once practiced in Colorado, using center pivot irrigation to grow wheat on thousands of

World's Largest Hedge Fund Firms

		Assets under management, in billions*
1	**Renaissance Technologies,** East Setauket, New York	$35.4
2	**JPMorgan Chase,**** New York	33.0
3	**Goldman Sachs,** New York	32.5
4	**Bridgewater Associates,** Westport, Connecticut	31.0
5	**D.E. Shaw,** New York	29.0
6	**Farallon Capital Mgmt.,** San Francisco	28.8
7	**Och-Ziff Capital Mgmt. Group,** New York	28.6
8	**Paulson & Co.,** New York	23.6
9	**Citigroup Alternative Investments,** New York	19.3
10	**Barclays Global Investors,** San Francisco	18.9
11	**ESL Investments,** Greenwich, Connecticut	18.0
12	**Tudor Investment,** Greenwich, Connecticut	17.7
13	**Orbis Investment Advisory,** London	17.3
14	**Lansdowne Partners,** London	17.0
15	**Harbinger Capital Partners,** New York	16.4
16	**Citadel Investment Mgmt. Group,** Chicago	16.0
17	**SAC Capital Advisors,** Stamford, Connecticut	15.0
18	**Caxton Associates,** New York	14.2
19	**Atticus Capital,** New York	13.5
20	**Maverick Capital,** Dallas	13.0

*As of Sept. 28. Figures may include related assets in separate accounts. **Includes Highbridge funds.
Sources: Bloomberg, Hedge Fund Research

acres. "Every little stalk of wheat was not doing so great, but most of them were, so you're working on statistics," Simons says. By contrast, he says, the traditional focused investing practiced by Warren Buffett is akin to intensive farming, in which each individual plant really counts. "It's two completely different ends of the spectrum," Simons says.

Medallion's farm stand sports quite a markup: The firm generally charges a 5 percent management fee and 36 percent of profits compared with the industry standards of 2 percent and 20 percent. With virtually no outside investors in Medallion, Simons and Renaissance employees are paying the tab—and reaping the rewards. RIEF investors can select from four share classes with varying and far less expensive fee structures.

Though Simons dislikes talking about it, Renaissance has built him a tidy fortune. U.S. Securities and Exchange Commission documents show he controls 25–50 percent of Renaissance, having spread the rest of the firm's ownership among employees. So Simons's share of the performance fees earned by RIEF and Medallion was roughly between $375 million and $750 million in 2006, according to data compiled by Bloomberg. With Medallion's 44.3 percent return in 2006, if Simons had invested $2 billion in the fund, he would have garnered an $885 million profit. He declines to comment on his investment. According to Bloomberg calculations, Simons ranks No. 3 among the world's hedge fund managers with $1.01 billion in firm-wide performance fees during the first three quarters of 2007. (See "The Money Makers," page 51.)

Chief Scientist Henry Laufer, who helped build the Medallion trading system, owns 10–25 percent of Renaissance, the SEC document says. Chief Financial Officer Mark Silber and Executive Vice Presidents Peter Brown and Robert Mercer each own 5–10 percent. Simons's son Nathaniel, 41, who manages the Meritage fund of funds out of San Francisco, owns less than 5 percent, as does Renaissance trading desk manager, Paul Broder.

At the core of Renaissance's success—and the wealth Simons is creating—is his own mathematical mind-set. Outside the financial markets, he's best known for the Chern-Simons theory, which he co-developed with Chinese-American mathematician Shiing-Shen Chern in 1974. In simple terms, the theory provides the tools, known as invariants, that mathematicians use to distinguish among certain curved spaces—the kinds of distortions of ordinary space that exist according to Albert Einstein's general theory of relativity. Chern-Simons is viewed as important partly because it has proven useful in explaining aspects of another field: string theory. This describes the building blocks of the universe as vibrating one-dimensional extended particles called strings. "It turns out these things we invented, Chern-Simons invariants, had their real applications to physics, about which I knew nothing," Simons told the International Association of Financial Engineers in May.

SIMONS SAYS HE'S ALSO PROUD of the work he did in differential geometry at the Institute for Defense Analyses' research and development center in Princeton, New Jersey. In 1968, he published a paper in the *Annals of Mathematics* called "Minimal Varieties in Riemannian Manifolds." The paper helped him win the American Mathematical Society's Oswald Veblen Prize in Geometry in 1976. The prize is named for the Princeton University geometrician who became the first professor of the Institute for Advanced Study.

Simons's most enduring legacy may be as a

'ONE CAN PREDICT THE COURSE OF A COMET,' SIMONS SAYS, 'MORE EASILY THAN ONE CAN PREDICT THE COURSE OF CITIGROUP'S STOCK.'

philanthropist as he builds on the mathematics and science that have shaped his life. In his New York office, Simons gets up and walks across the room to grab a newspaper clipping. It's an article about the administration of President George W. Bush planning to add $50 billion to the defense budget. "Just a little extra; give them an extra $50 billion," Simons says, his voice rising in anger. "Well, for $2 billion, we could revolutionize math education in the U.S."

He's referring to what he considers paltry funding for a key provision of the America Competes Act, which was signed into law on Aug. 9. The act includes a federal program to bolster math and science education based on the pilot project Simons has bankrolled with more than $25 million of his money: MFA.

Simons says America's economic competitiveness is at stake. A 2003 study of 15-year-olds by the Program for International Student Assessment found the U.S. trailing 23 Organization for Economic Cooperation and Development countries, including No. 1 Finland, in math literacy at that age level. The U.S. was ahead of just five countries, among them Greece, Turkey and Mexico.

Simons places the blame for poor high school math scores largely on unqualified teachers. Because of low pay, good math and science teachers tend to get sucked into the private sector—and the rate is accelerating. "Students, up and down the line from affluent to impoverished, are being cheated," Simons says.

MFA pays full scholarships for math teachers to earn their master's degrees in education at designated graduate schools. Then, it pays a stipend of $90,000 over five years of teaching as a subsidy. Fellows and other experienced teachers are eligible to apply for a master fellowship program, which provides a stipend of $50,000 over four years. MFA is rolling out the program in Los Angeles and San Diego in 2008.

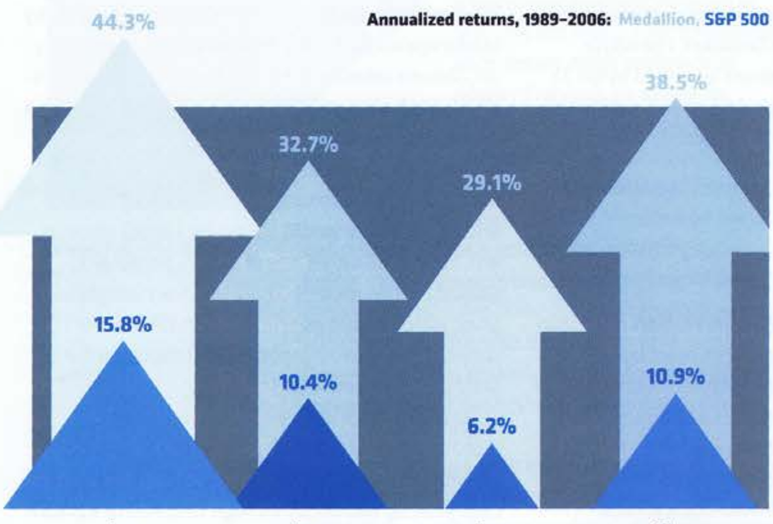
Simons has donated tens of millions of dollars to math and science endeavors worldwide, including Stony Brook University and MSRI. In 2005, he kicked in $13 million with other Renaissance employees to keep the Relativistic Heavy Ion Collider operating at the Brookhaven National Laboratory in Upton, New York, after the U.S. Energy Department cut funding. The collider creates hot, dense matter similar to that which is believed to have existed in the first 10 microseconds, or millionths of a second, of the universe's existence after the big bang.

Simons's other major push: research into autism, a disorder marked by repetitive behavior and impairment in social communication and language. In 2005, he hired Gerald Fischbach, former dean of the faculties of health sciences at Columbia University in New York, to serve as scientific director for the Simons Foundation. The foundation funds a variety of math and science-related projects. Simons's wife, Marilyn, 57, is president. Their daughter Audrey, 21, displays some symptoms of Asperger's syndrome, a milder disorder that bears similarities to autism.

Under Fischbach, the foundation is building a database of DNA samples and clinical information from thousands of families across the U.S. with affected children. Scientists will use the data to identify genes that may contribute to autism. The foundation is also attracting scientists from outside the field, such as geneticist Michael Wigler of

SHINING RETURNS

The Medallion Fund's 17-year performance was more than triple that of the S&P 500.



Years ended on Dec. 31. Blended return for nonemployee investors, net of fees and charges.
Source: Renaissance report

Gerald Fischbach serves as scientific director for the Simons Foundation, which funds autism research.

flurry of recent activity. He pauses before answering. "There was some connection between losing Nick and my desire to get as busy as I could," he says.

Scientific exploration underpins all of Simons's work. "What motivates me?" he says. "I'm ambitious and I like to do things well. I love to create something that really works. We have lots and lots and lots of strategies, and each new one gives me a lot of pleasure, to see something new that works."

The laws of the financial markets present a special challenge, Simons says. Unlike the laws governing physics or chemistry, they tend to change over time. "One can predict the course of a comet more easily than one can predict the course of Citigroup's stock," he says. "The attractiveness, of course, is that you can make more money successfully predicting a stock than you can a comet."

Cold Spring Harbor Laboratory in New York. Fischbach says that, in the past, autism research has had trouble luring top talent because of its complexity.

Simons splits his week between two homes. His Manhattan apartment is in the same limestone building as another investor-turned-philanthropist, George Soros, 77. In Setauket, the white, gambrel-roofed house Simons has lived in for 31 years has broad picture windows overlooking the herons that populate the shimmering waters of Conscience Bay.

FOR ALL OF HIS ACHIEVEMENT and material success, Simons's life has been beset by the kind of tragedy that few parents can fathom—the death of not one but two of his five children in separate accidents. In 1996, his son Paul, 34, was struck by a car and killed while riding a bicycle near Simons's Setauket home. In 2003, 24-year-old son Nick drowned while on a trip to Bali. Simons grimaces when asked whether Nick's death played a role in his

Investments, philanthropy, academia—it all traces to a life steeped in math. James Harris Simons was born in 1938, the only child of Marcia and Matthew Simons. He grew up in Brookline, Massachusetts, a Boston suburb designed partly by landscape architect Frederick Law Olmsted. Early on, Simons asked complicated mathematical questions. At about age 3, he was shocked to learn that a car could run out of gasoline. Why? By Simons's reckoning, a car would go through half a tankful, then half of what remained and then half of that, and so on: There would always be a small amount left. He'd discovered one of Zeno's paradoxes, named for the ancient Greek pre-Socratic philosopher, which would puzzle mathematicians for centuries. "Those were sophisticated thoughts for a little guy," Simons says, laughing.

At high school in Newton, Massachusetts, Simons blew through the equivalent of advanced placement math and went on to MIT. In his freshman year, he was cocky enough to enroll in a graduate level class. "The course said no requirements," he says. At MIT, Simons worked hard and played

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hard—mostly late-night poker. By 1 a.m., he and friends would pile into his Volkswagen Beetle and head off to Jack & Marion's delicatessen in Brookline for $1.25 chicken in a basket. Simons recalls how two renowned MIT mathematicians, Isadore Singer and Warren Ambrose, would sit down, order food and work into the wee hours on math problems.

"I just thought it was kind of a great life," Simons says. "Here they were, grown-ups, eating in this deli, late, late at night, just working away. That seemed wonderful to me." Singer, still an MIT professor, would become a close personal friend.

In June 1958, after just three years, Simons collected his bachelor's degree in mathematics from MIT, returning that September for his first year of graduate school. He then headed west to the University of California, Berkeley, to complete his Ph.D. in math. There, Simons dabbled in commodities—using his and his then wife Barbara's wedding gift money to make a $500 killing in soybeans.

Simons's thesis adviser—Bertram Kostant, now professor emeritus at MIT—was skeptical about him pursuing the proof that would form the basis of his dissertation, "On the Transitivity of Holonomy Systems." It dealt with the geometry of multidimensional curved spaces and related to work by Singer and Ambrose. "He solved it in a remarkably short period of time, under two years," Kostant says. "Jim's an original guy. He likes to go off in his own direction."

James Ax, who died in 2006, was the first manager of the Medallion fund.

After UC Berkeley, Simons won a three-year teaching position at MIT. He left after a year to become an assistant math professor at nearby Harvard. He stayed in touch with two poker-playing MIT classmates, Colombian nationals Edmundo Esquenazi and Jimmy Mayer. In 1958, Simons and Mayer had celebrated their graduation by buying Lambretta motor scooters and driving to Bogotá from Boston. In 1964, the three cobbled together money with Simons's father to start a Colombian vinyl-floor-tile factory. It would eventually prove a lucky move, providing the younger Simons with a stake to build his empire.

Simons was growing restless at Harvard. He was eager to earn more money—and frustrated by some of the math he was working on. The Institute for Defense Analyses offered a better-paying solution: Simons could spend half of his time on math at the nonprofit's Princeton center and half breaking codes for the NSA.

In 1967, the IDA's president, General Maxwell Taylor, former chairman of the Joint Chiefs of Staff, wrote an article for the *New York Times Magazine* in favor of the Vietnam War. Soon after, Simons penned a note to the editors. "Some of us at the institution have a different view," he wrote. "The only available course consistent with a rational defense policy is to withdraw with the greatest possible dispatch."

Maxwell eventually fired Simons, who was then 29, married and a father of three. Stony Brook University President John Toll wanted a star to build the school's math department. In 1966, the university had made a splash by luring Nobel Prize–winning physicist Chen Ning Yang from the Institute for Advanced Study. Simons would hire stars for the math department.

Stung by his firing from the IDA, Simons threw himself into the task. "Having just sort of been knocked around a little bit, I liked the idea of being my own boss," he says. Simons negotiated all of the elements of a math position to lure great geometers to a young school: salary, class load, leave policy and research support. "He'd figure what you needed and get it for you," Toll, 84, says. "He did an outstanding job of building the department at Stony Brook."

AMONG THE FUTURE STARS Simons lured were Detlef Gromoll from the University of Bonn; Jeff Cheeger from the University of Michigan; and Mikhael Gromov, who'd taught at Leningrad University. All had published in prestigious journals. "It was viewed as one of the two or three best geometry groups in the world," says Irwin Kra, who succeeded Simons as math department chairman and is executive director at MFA. One of Simons's other hires was a Bronx, New York–raised math professor from Cornell University: James Ax.

Simons dabbled again in commodities while at Stony Brook. The Colombian factory investment had made some profit. Simons and his partners invested about $600,000 of it with Charles Freifeld, a former math student of his from Harvard. During seven months in 1974, Freifeld increased the investment 10-fold, after fees, as sugar futures more than doubled. The $600,000 was now $6 million, Freifeld says.

Simons suddenly had money—but he was at a

COURTESY KEVIN KEATING

crossroads. He had separated from his wife Barbara. As the '70s wore on, he grew frustrated with a math problem related to the Chern-Simons theory. "It was driving me crazy," he says. Simons met Marilyn Hawrys, a graduate student in economics at Stony Brook who helped take care of Simons's children and would become his second wife.

Simons left Stony Brook in 1977 and started Monemetrics, a predecessor to Renaissance, in a strip mall across from the Setauket train station. He wanted someone to trade currencies and commodities and turned to an old friend, a fellow code cracker from the IDA: Leonard Baum. Baum was coauthor of the Baum-Welch algorithm, which is used to determine probabilities in, among other things, biology, automated speech recognition and statistical computing. Simons's idea was to harness the mathematical models that Baum was writing to trade currencies. "Once I got Lenny involved, I could see the possibilities of building models," Simons says.

Baum never traded using the models. In the late '70s and early '80s, Baum was making too much money on fundamental trading. Such trading involves betting based on, say, whether British Prime Minister Margaret Thatcher would let the pound rise. In an era of one-way markets, it was much easier than using models. "The dollar was very weak; all you had to do was short the dollar and you'd make a lot of money," Simons says.

Simons brought in Ax to look over Baum's efforts. Ax declared that not only would the models work with the currencies Baum had written them for, they could be applied to any commodity future—wheat, crude oil, you name it, Simons says.

Simons set up Ax with his own trading account, Axcom Ltd., which eventually gave birth to Medallion. Ax died of colon cancer in 2006 at age 69.

In Axcom's early days, professionals were skeptical about the kind of systematic trading Ax was doing. Still, he was brilliant and a natural at understanding probability, having shared the American Mathematical Society's Frank Nelson Cole Prize in Number Theory in 1967. "He had the ability to see patterns in trading data," says Brian Keating, 36, the younger of Ax's two sons. "People in the business thought it was magic, or nonsense."

Ax was also sometimes difficult to work with. "Most of times things went well," says Kevin Keating, 39, Ax's older son, who talked with his father about his days at Axcom. "But when they didn't, they'd butt heads."

During the 1980s, Ax and his researchers improved on Baum's models and used them to explore correlations from which they could profit. If a futures contract opened sharply higher versus its previous close, they would short it; if it opened sharply lower, they would buy it, says Sandor Straus, a former manager for Medallion who now runs his own investment firm, Merfin LLC, in Walnut Creek, California.

The stuff wasn't complicated, and it worked. In 1985, Ax persuaded Simons to let him move Axcom to Huntington Beach, California, to escape a painful divorce and enjoy year-round boating. By 1988, investors wanted to invest directly in Axcom. Simons and Ax started a hedge fund and christened it Medallion in honor of the math awards that they had won.

Ax's signals soon seemed to short-circuit. Peak-to-trough losses by April 1989 had mounted to about 30 percent. Ax had accounted for such a drawdown in his models and pushed to keep trading. Simons wanted to stop to research what was going on. "Both were talking to their lawyers," Straus says. Ax, in fact, threatened to sue. Simons pulled rank, and Ax left. He went on to write a screenplay and poems in addition to working on problems involving the mathematical foundations of quantum mechanics with Princeton University professor Simon Kochen, with whom Ax shares the Cole prize.

Simons turned to Elwyn Berlekamp to run Medallion from Berkeley, California. A consultant for Axcom whom Simons had first met at the IDA, Berlekamp had bought out most of Ax's stake in Axcom. He worked with Straus, Simons and another consultant, Laufer, to overhaul Medallion's trading system during a six-month stretch. In 1990, Berlekamp led Medallion to a 55.9 percent gain, net of fees—and then returned to teaching math at UC Berkeley. "I got a lot more pleasure talking to academics than financial types," says Berlekamp, who is now professor emeritus. "Most people in this business are pretty dollar-centric. It makes for a dull life."

Ax was gone. Berlekamp was gone. Medallion's

Renaissance Man

Simons's career includes a mix of academic, philanthropic and investment ventures.

2005
Helps raise $13 million to keep Brookhaven ion collider working.

2004
Starts Math for America to fund and train New York City math teachers.

1993
Hires language technology experts Peter Brown and Robert Mercer from IBM.

1988
Co-founds Medallion Fund; stops new investments from outsiders five years later.

1976
Wins Oswald Veblen Prize in Geometry.

1974
Publishes Chern-Simons theory with mathematician Shiing-Shen Chern.

1968
Named chairman of Stony Brook University's math department.

1967
Fired from Institute for Defense Analyses for anti-war statements.

1964
Invests with father and college friends in Colombian floor tile company.

1960
Wins $500 speculating on soybean futures with wedding gift money.

Source: Jim Simons

revamped trading system remained. Straus took the reins. Medallion returned 39.4 percent in 1991, 34 percent in 1992 and 39.1 percent in 1993, according to Medallion annual reports.

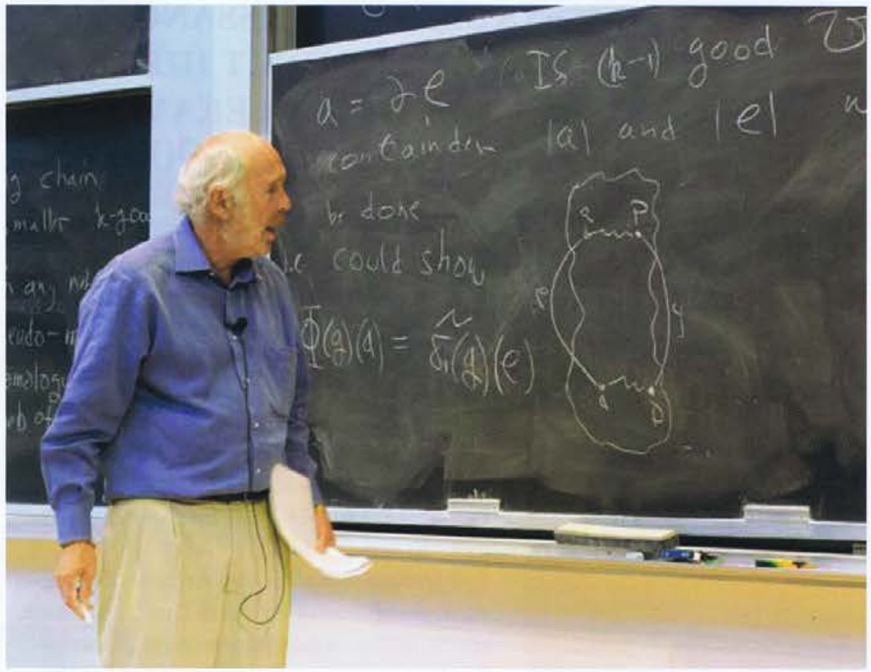
Back on Long Island, Simons was gathering an A-team of math brains. Laufer, a former Stony Brook professor, joined full time as research chief in late 1991. Frey, a trader from Morgan Stanley's Analytical Proprietary Trading group, the pioneering black-box quant desk, came in 1992. Nick Patterson, another cryptologist from the IDA, joined in 1993. That year, Simons also hired Brown and Mercer, two language technology experts from the IBM Thomas J. Watson Research Center.

The nastier that stock or bond markets turned, the better Medallion seemed to perform. In 1994, as the Federal Reserve raised its federal funds target rate six times to 5.5 percent from 3 percent, Medallion returned 71 percent for the year. The Bloomberg/Effas long-term U.S. government bond index lost 6.7 percent that year. In 1995, Simons moved most of Renaissance's California operations to Long Island. The firm needed computing power to model the data Renaissance was harnessing, and Simons bought it: From 1994 to 2000, Renaissance's total CPU power grew by a factor of 50. Data bandwidth in and out of Renaissance headquarters rose by a factor of 45, according to a Medallion annual report.

THE YEAR 2000, during which the Standard & Poor's 500 Index tumbled 10.1 percent, proved Medallion's best to date. It gained 98.5 percent, net of fees. By the end of that year, Renaissance had 148 employees—and the fund had a 43.6 percent annualized return over 11 years, net of fees, according to an annual report. It hasn't had a down quarter since.

Performance such as that feeds the hedge fund industry's insatiable curiosity. Rivals search for the signals underpinning Renaissance's returns. One set of clues came in the New York State Supreme Court decision in July, which the court heavily redacted. It cites three strategies tested at the firm, including one using limit order book data. MIT's Lo says that a fund firm could look at such data and identify a large sell order for, say, $15 a share when a stock was trading at $15.05. The fund could short the stock at $15.01 and benefit if the stock hit the $15 trigger. "There's going to be tremendous downward pressure on the stock," Lo says.

DAVID EISENBUD



Former employees say observers may gain as much insight into Renaissance's performance by scrutinizing a more obvious factor: Simons has succeeded in building a pretty good business model.

First, it's a firm run by and for scientists. "I've always said Renaissance's secret is that it didn't hire MBAs," says Berlekamp, who blames the herdlike mentality among business school graduates for poor investor returns. Programming and modeling are treated as the heart of the firm's advantage—not an expense. "If you needed a lot of computer power, the decision was based on whether you needed it, not the budget," says Peter Weinberger, former chief technology officer at Renaissance and now a software engineer at Google Inc.

Decisions are made quickly and feedback is constant. "One of the things about Renaissance is that there's a feeling of urgency," says Frey, who left to teach applied mathematics and statistics at Stony Brook in 2004. "We always believed that there was a wolf at the door, that somebody would get there before we did."

From Simons on down, the company encourages openness, whether it's about market signals that show where a security might be headed or about technology or trading. Simons says new employees are encouraged to troll computer files detailing Renaissance's past strategies, successful or not. "If Simons's door was open, you could walk in," Weinberger says. That would go for everyone from secretaries on up. For his part, Simons says he's proud of Renaissance's low personnel turnover. The firm is

Jim Simons, shown at a Berkeley, California, lecture, has started two new hedge funds since mid-2005.