'Reads more like a delicious page-turning novel'
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THE MAN WHO SOLVED THE MARKET

HOW JIM SIMONS LAUNCHED THE QUANT REVOLUTION

Gregory Zuckerman

A *NEW YORK TIMES* AND *SUNDAY TIMES* BESTSELLER

THE MAN WHO SOLVED THE MARKET

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Publishers Weekly

ABOUT THE AUTHOR

Gregory Zuckerman is a special writer at the *Wall Street Journal*. He writes about business subjects like financial trades, hedge funds and private-equity firms, and about innovation and cutting-edge science. He's a three-time winner of the Gerald Loeb Award, the highest honour in business journalism. Zuckerman is the author of bestselling books *The Greatest Trade Ever*, *A Shot to Save The World* and *The Frackers*, and he appears regularly on CNBC, Fox Business and the BBC. He lives in New York.

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How Jim Simons Launched the Quant Revolution

Gregory Zuckerman

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CONTENTS

Introduction = xiii

Prologue = 1

PART ONE
Money Isn't Everything = 7

Chapter One = 9
Chapter Two = 23
Chapter Three = 43
Chapter Four = 67
Chapter Five = 87
Chapter Six = 105
Chapter Seven = 121
Chapter Eight = 137
Chapter Nine = 161
Chapter Ten = 181
Chapter Eleven = 197

PART TWO
Money Changes Everything = 219

Chapter Twelve = 221
Chapter Thirteen = 245
Chapter Fourteen = 267
Chapter Fifteen = 287
Chapter Sixteen = 307
Epilogue = 323

Acknowledgments = 327
Appendices = 331
Notes = 335
Index = 345

To Gabriel and Elijah
My signals in the noise

CAST OF CHARACTERS

James Simons	Mathematician, code breaker, and founder of Renaissance Technologies
Lenny Baum	Simons's first investing partner and author of algorithms that impacted the lives of millions
James Ax	Ran the Medallion fund and developed its first trading models
Sandor Straus	Data guru who played key early role at Renaissance
Elwyn Berlekamp	Game theorist who managed the Medallion fund at a key turning point
Henry Laufer	Mathematician who moved Simons's fund toward short-term trades
Peter Brown	Computer scientist who helped engineer Renaissance's key breakthroughs
Robert Mercer	Renaissance's co-CEO, helped put Donald Trump in the White House
Rebekah Mercer	Teamed up with Steve Bannon to upend American politics
David Magerman	Computer specialist who tried to stop the Mercers' political activities

A TIMELINE OF KEY EVENTS

1938 Jim Simons born

1958 Simons graduates MIT

1964 Simons becomes code breaker at the IDA

1968 Simons leads math department at Stony Brook University

1974 Simons and Chern publish groundbreaking paper

1978 Simons leaves academia to start Monemetrics, a currency trading firm, and a hedge fund called Limroy

1979 Lenny Baum and James Ax join

1982 Firm's name changes to Renaissance Technologies Corporation

1984 Baum quits

1985 Ax and Straus move the company to California

1988 Simons shuts down Limroy, launches the Medallion fund

1989 Ax leaves, Elwyn Berlekamp leads Medallion

1990 Berlekamp departs, Simons assumes control of the firm and fund

1992 Henry Laufer becomes full-time employee

1993 Peter Brown and Robert Mercer join

1995 Brown, Mercer achieve key breakthrough

2000 Medallion soars 98.5 percent

2005 Renaissance Institutional Equities Fund launches

2007 Renaissance and other quant firms suffer sudden losses

2010 Brown and Mercer take over firm

2017 Mercer steps down as co-CEO

INTRODUCTION

You do know—no one will speak with you, right?"

I was picking at a salad at a fish restaurant in Cambridge, Massachusetts, in early September 2017, trying my best to get a British mathematician named Nick Patterson to open up about his former company, Renaissance Technologies. I wasn't having much luck.

I told Patterson that I wanted to write a book about how James Simons, Renaissance's founder, had created the greatest moneymaking machine in financial history. Renaissance generated so much wealth that Simons and his colleagues had begun to wield enormous influence in the worlds of politics, science, education, and philanthropy. Anticipating dramatic societal shifts, Simons harnessed algorithms, computer models, and big data before Mark Zuckerberg and his peers had a chance to finish nursery school.

Patterson wasn't very encouraging. By then, Simons and his representatives had told me they weren't going to provide much help, either. Renaissance executives and others close to Simons—even those I once considered friends—wouldn't return my calls or emails. Even archrivals begged out of meetings at Simons's request, as if he was a Mafia boss they dared not offend.

Over and over, I was reminded of the iron-clad, thirty-page nondisclosure agreements the firm forced employees to sign, preventing even retirees

from divulging much. I got it, guys. But come on. I'd been at the *Wall Street Journal* for a couple of decades; I knew how the game was played. Subjects, even recalcitrant ones, usually come around. After all, who doesn't want a book written about them? Jim Simons and Renaissance Technologies, apparently.

I wasn't entirely shocked. Simons and his team are among the most secretive traders Wall Street has encountered, loath to drop even a hint of how they'd conquered financial markets, lest a competitor seize on any clue. Employees avoid media appearances and steer clear of industry conferences and most public gatherings. Simons once quoted Benjamin, the donkey in *Animal Farm*, to explain his attitude: "'God gave me a tail to keep off the flies. But I'd rather have had no tail and no flies.' That's kind of the way I feel about publicity."[1]

I looked up from my meal and forced a smile.

This is going to be a battle.

I kept at it, probing defenses, looking for openings. Writing about Simons and learning his secrets became my fixation. The obstacles he put up only added allure to the chase.

There were compelling reasons I was determined to tell Simons's story. A former math professor, Simons is arguably the most successful trader in the history of modern finance. Since 1988, Renaissance's flagship Medallion hedge fund has generated average annual returns of 66 percent, racking up trading profits of more than $100 billion (see Appendix 1 for how I arrive at these numbers). No one in the investment world comes close. Warren Buffett, George Soros, Peter Lynch, Steve Cohen, and Ray Dalio all fall short (see Appendix 2).

In recent years, Renaissance has been scoring over $7 billion annually in trading gains. That's more than the annual revenues of brand-name corporations including Under Armour, Levi Strauss, Hasbro, and Hyatt Hotels.

Here's the absurd thing—while those other companies have tens of thousands of employees, there are just three hundred or so at Renaissance.

I've determined that Simons is worth about $23 billion, making him wealthier than Elon Musk of Tesla Motors, Rupert Murdoch of News Corp, and Laurene Powell Jobs, Steve Jobs's widow. Others at the firm are also billionaires. The average Renaissance employee has nearly $50 million just in the firm's own hedge funds. Simons and his team truly create wealth in the manner of fairy tales full of kings, straw, and lots and lots of gold.

More than the trading successes intrigued me. Early on, Simons made a decision to dig through mountains of data, employ advanced mathematics, and develop cutting-edge computer models, while others were still relying on intuition, instinct, and old-fashioned research for their own predictions. Simons inspired a revolution that has since swept the investing world. By early 2019, hedge funds and other quantitative, or *quant*, investors had emerged as the market's largest players, controlling about 30 percent of stock trading, topping the activity of both individual investors and traditional investing firms.[2] MBAs once scoffed at the thought of relying on a scientific and systematic approach to investing, confident they could hire coders if they were ever needed. Today, coders say the same about MBAs, if they think about them at all.

Simons's pioneering methods have been embraced in almost every industry, and reach nearly every corner of everyday life. He and his team were crunching statistics, turning tasks over to machines, and relying on algorithms more than three decades ago—long before these tactics were embraced in Silicon Valley, the halls of government, sports stadiums, doctors' offices, military command centers, and pretty much everywhere else forecasting is required.

Simons developed strategies to corral and manage talent, turning raw brainpower and mathematical aptitude into astonishing wealth. He made

money from math, and a lot of money, at that. A few decades ago, it wasn't remotely possible.

Lately, Simons has emerged as a modern-day Medici, subsidizing the salaries of thousands of public-school math and science teachers, developing autism treatments, and expanding our understanding of the origins of life. His efforts, while valuable, raise the question of whether one individual should enjoy so much influence. So, too, does the clout of his senior executive,* Robert Mercer, who is perhaps the individual most responsible for Donald Trump's presidential victory in 2016. Mercer, Trump's biggest financial supporter, plucked Steve Bannon and Kellyanne Conway from obscurity and inserted them into the Trump campaign, stabilizing it during a difficult period. Companies formerly owned by Mercer and now in the hands of his daughter Rebekah played key roles in the successful campaign to encourage the United Kingdom to leave the European Union. Simons, Mercer, and others at Renaissance will continue to have broad impact for years to come.

The successes of Simons and his team prompt a number of challenging questions. What does it say about financial markets that mathematicians and scientists are better at predicting their direction than veteran investors at the largest traditional firms? Do Simons and his colleagues enjoy a fundamental understanding of investing that eludes the rest of us? Do Simons's achievements prove human judgment and intuition are inherently flawed, and that only models and automated systems can handle the deluge of data that seems to overwhelm us? Do the triumph and popularity of Simons's quantitative methods create new, overlooked risks?

I was most fascinated by a striking paradox: Simons and his team *shouldn't have been the ones* to master the market. Simons never took a single finance class, didn't care very much for business, and, until he turned forty, only dabbled in trading. A decade later, he still hadn't made much headway.

*Mercer is no longer Renaissance's co-CEO but he remains a senior employee of the firm.

Heck, Simons didn't even do applied mathematics, he did *theoretical* math, the most impractical kind. His firm, located in a sleepy town on the North Shore of Long Island, hires mathematicians and scientists who *don't know anything* about investing or the ways of Wall Street. Some are even outright suspicious of capitalism. Yet, Simons and his colleagues are the ones who changed the way investors approach financial markets, leaving an industry of traders, investors, and other pros in the dust. It's as if a group of tourists, on their first trip to South America, with a few odd-looking tools and meager provisions, discovered El Dorado and proceeded to plunder the golden city, as hardened explorers looked on in frustration.

Finally, I hit my own pay dirt. I learned about Simons's early life, his tenure as a groundbreaking mathematician and Cold War code-breaker, and the volatile early period of his firm. Contacts shared details about Renaissance's most important breakthroughs as well as recent events featuring more drama and intrigue than I had imagined. Eventually, I conducted more than four hundred interviews with more than thirty current and former Renaissance employees. I spoke with an even larger number of Simons's friends, family members, and others who participated in, or were familiar with, the events I describe. I owe deep gratitude to each individual who spent time sharing memories, observations, and insights. Some accepted substantial personal risk to help me tell this story. I hope I rewarded their faith.

Even Simons spoke with me, eventually. He asked me not to write this book and never truly warmed to the project. But Simons was gracious enough to spend more than ten hours discussing certain periods of his life, while refusing to discuss Renaissance's trading and most other activities. His thoughts were valuable and appreciated.

This book is a work of nonfiction. It is based on first-person accounts and recollections of those who witnessed or were aware of the events I depict. I understand that memories fade, so I've done my best to check and confirm every fact, incident, and quote.

I've tried to tell Simons's story in a way that will appeal to the general reader as well as to professionals in quantitative finance and mathematics. I will refer to hidden Markov models, kernel methods of machine learning, and stochastic differential equations, but there also will be broken marriages, corporate intrigue, and panicked traders.

For all his insights and prescience, Simons was blindsided by much that took place in his life. That may be the most enduring lesson of his remarkable story.

THE MAN WHO SOLVED THE MARKET

PROLOGUE

Jim Simons wouldn't stop calling.

It was the fall of 1990 and Simons was in his office on the thirty-third floor of a midtown Manhattan high-rise, his eyes glued to a computer screen flashing the latest moves in global financial markets. Friends didn't understand why Simons was still at it. Fifty-two years old, Simons had already lived a full life, enjoying enough adventure, accomplishment, and prosperity to satisfy the ambitions of his peers. Yet, there he was, overseeing an investment fund, sweating the market's daily eruptions.

Simons stood nearly five foot ten, though a slight stoop and a head of graying, thinning hair suggested someone a bit shorter and older. Creases enveloped his brown eyes, the likely result of a smoking habit he couldn't kick—or just didn't want to. Simons's rugged, craggy features, and the glint of mischief in his eyes, reminded friends of the late actor Humphrey Bogart.

On Simons's uncluttered desk sat an oversize ashtray awaiting the next flick of his burning cigarette. On his wall was a rather gruesome painting of a lynx feasting on a rabbit. Nearby, on a coffee table next to a couch and two comfortable leather chairs, sat a complicated mathematics research paper, a reminder of the thriving academic career Simons had discarded to the bewilderment of his fellow mathematicians.

By then, Simons had spent twelve full years searching for a successful investing formula. Early on, he traded like others, relying on intuition and instinct, but the ups and downs left Simons sick to his stomach. At one point, Simons became so discouraged an employee worried he was contemplating suicide. Simons recruited two renowned and headstrong mathematicians to trade with him, but those partnerships crumbled amid losses and acrimony. A year earlier, Simons's results had been so awful he had been forced to halt his investing. Some expected him to pull the plug on his entire operation.

Now on his second marriage and third business partner, Simons decided to embrace a radical investing style. Working with Elwyn Berlekamp, a game theorist, Simons built a computer model capable of digesting torrents of data and selecting ideal trades, a scientific and systematic approach partly aimed at removing emotion from the investment process.

"If we have enough data, I *know* we can make predictions," Simons told a colleague.

Those closest to Simons understood what really was driving him. Simons had earned a PhD at the age of twenty-three and then became an acclaimed government code-breaker, a renowned mathematician, and a groundbreaking university administrator. He needed a new challenge and a bigger canvas. Simons told a friend that solving the market's age-old riddle and conquering the world of investing "would be remarkable." He wanted to be the one to use math to beat the market. If he could pull it off, Simons knew he could make millions of dollars, maybe even more, perhaps enough to influence the world beyond Wall Street, which some suspected was his true goal.

In trading, as in mathematics, it's rare to achieve breakthroughs in midlife. Yet, Simons was convinced he was on the verge of something special, maybe even historic. A Merit cigarette lodged between two fingers, Simons reached for the phone to call Berlekamp one more time.

"Have you seen gold?" Simons asked, the accent of his gravelly voice hinting at his Boston upbringing.

Yes, I've seen gold prices, Berlekamp responded. And, no, we don't need to adjust our trading system. Simons didn't push, hanging up politely, as usual. Berlekamp was becoming exasperated by Simons's pestering, however. Serious and slim with blue eyes behind thick glasses, Berlekamp worked on the other side of the country in an office that was a short walk from the campus of University of California, Berkeley, where he continued to teach. When Berlekamp discussed his trading with graduates of the university's business school, they sometimes mocked the methods he and Simons had embraced, calling them "quackery."

"Oh, come on. Computers can't compete with human judgment," one had told Berlekamp.

"We're gonna do things *better* than humans can," Berlekamp responded.

Privately, Berlekamp understood why their approach screamed of modern-day alchemy. Even he couldn't fully explain why their model was recommending certain trades.

It wasn't just on campus where Simons's ideas seemed out of touch. A golden age for traditional investing had dawned as George Soros, Peter Lynch, Bill Gross, and others divined the direction of investments, financial markets, and global economies, producing enormous profits with intelligence, intuition, and old-fashioned economic and corporate research. Unlike his rivals, Simons didn't have a clue how to estimate cash flows, identify new products, or forecast interest rates. He was digging through reams of price information. There wasn't even a proper name for this kind of trading, which involved *data cleansing*, *signals,* and *backtesting*, terms most Wall Street pros were wholly unfamiliar with. Few used email in 1990, the internet browser hadn't been invented, and algorithms were best known, if at all, as the step-by-step procedures that had enabled Alan Turing's machine to break coded Nazi messages during World War II. The idea that these formulas

might guide, or even help govern, the day-to-day lives of hundreds of millions of individuals, or that a couple of former math professors might employ computers to trounce seasoned and celebrated investors, seemed far-fetched if not outright ludicrous.

Simons was upbeat and confident by nature, though. He detected early signs of success for his computer system, sparking hope. Besides, Simons didn't have a lot of options. His once-thriving venture investments weren't going anywhere, and he sure didn't want to return to teaching.

"Let's work on the system," Simons told Berlekamp in one more urgent phone call. "Next year, I know, we can be up 80 percent."

Eighty percent in a year? Now he's really gone too far, Berlekamp thought.

Such enormous returns weren't likely, he told Simons. And you really don't need to call so much, Jim. Simons couldn't stop, though. Eventually, it all became too much—Berlekamp quit, a fresh blow for Simons.

"The hell with it, I'm just going to run it myself," Simons told a friend.

=

Around the same time, in a different part of New York State fifty miles away, a tall, handsome, middle-aged scientist stared at a whiteboard, grappling with his own challenges. Robert Mercer was working in a sprawling IBM research center in a Westchester suburb searching for ways to get computers to do a better job transcribing speech into text and even translate languages, among other tasks. Rather than follow conventional methods, Mercer was tackling his problems with an early form of large-scale machine learning. He and his colleagues were feeding their computers with enough data to enable them to perform tasks on their own. Mercer was nearing his second decade at the computer giant, however, and it still wasn't clear how much he and the team could accomplish.

Colleagues couldn't figure Mercer out, not even those who had spent years working closely with him. Mercer was unusually gifted. He was also

odd and socially awkward. Every day for lunch, Mercer ate either a tuna or peanut-butter-and-jelly sandwich packed in a used brown paper bag. Around the office, Mercer constantly hummed or whistled, usually classical tunes, wearing a look of detached amusement.

Much of what came out of Mercer's mouth was brilliant, even profound, though it could also be utterly jarring. Once, Mercer told colleagues he believed he would live forever. The staffers *thought* he was serious, though historic precedent didn't seem on his side. Later, colleagues would learn of Mercer's deep-seated hostility toward government and of radical political views that would come to dominate his life and affect the lives of many others.

At IBM, Mercer spent long hours huddled with a younger colleague named Peter Brown, a charming, creative, and outgoing mathematician whose dark glasses, thick mane of unruly brown hair, and kinetic energy brought to mind a mad professor. The two men didn't spend much time discussing money or markets. Personal turmoil would lead Mercer and Brown to join forces with Simons, however. His unlikely quest to crack the market's code and lead an investing revolution would become theirs.

=

Simons wasn't aware of the imposing obstacles in his way. Nor did he know that tragedy stalked him, or that political upheaval would upend his firm.

Looking out from his office onto the East River that day in the fall of 1990, Simons just knew he had a difficult problem to solve.

"There are patterns in the market," Simons told a colleague. "I know we can find them."

PART ONE

Money Isn't Everything

CHAPTER ONE

Jimmy Simons grabbed a broom and headed upstairs.

It was the winter of 1952 and the fourteen-year-old was trying to earn some spending money at Breck's garden supply near his home in Newton, Massachusetts, the leafy Boston suburb. It wasn't going well. Working in a stockroom downstairs, the young man found himself so lost in thought that he had misplaced the sheep manure, planting seeds, and most everything else.

Frustrated, the owners asked Jimmy to walk the store's narrow aisles and sweep its hardwood floors, a mindless and repetitive task. To Jimmy, the demotion felt like a stroke of luck. Finally, he was left alone to ponder what mattered most in his life. Math. Girls. The future.

They're paying me to think!

Weeks later, his Christmas-time job complete, the couple who owned the store asked Jimmy about his long-term plans.

"I want to study mathematics at MIT."

They burst out laughing. A young man so absentminded that he couldn't keep track of basic gardening supplies hoped to be a math major—at the Massachusetts Institute of Technology, no less?

"They thought it was the funniest thing they had ever heard," Simons recalls.

The skepticism didn't bother Jimmy, not even the giggles. The teenager was filled with preternatural confidence and an unusual determination to accomplish something special, the result of supportive parents who had experienced both high hopes and deep regrets in their own lives.

Marcia and Matthew Simons welcomed James Harris to the family in the spring of 1938. She and Matty poured time and energy into their son, who remained their only child after Marcia suffered a series of subsequent miscarriages. A sharp intellect with an outgoing personality and subtle wit, Marcia volunteered in Jimmy's school but never had the opportunity to work outside the home. She funneled her dreams and passions into Jimmy, pushing him academically and assuring him that success was ahead.

"She was ambitious for me," Simons recalls. "She saw me as her project."

Matty Simons had a different perspective on both life and parenting. From the age of six, Matty, one of ten children, hustled to make money for the family, selling newspapers in the streets and hauling bags for travelers at a nearby train station. When he reached high school age, Matty began working full time. He tried going to night school but quit, too tired to concentrate.

As a father, Matty was kind, soft-spoken, and easygoing. He enjoyed coming home and spinning tall tales for Marcia, telling her about Cuba's imminent plans to build a bridge to Florida, for example, as Jimmy did his best to mask a grin. Marcia might have been the family's intellect, but she also was remarkably gullible. Matty would concoct increasingly outrageous stories until Marcia finally picked up on the fibs, a family game guaranteed to crack Jimmy up.

"She didn't usually get it," Simons says, "but I did."

Matty worked as a sales manager for 20th Century Fox, driving to theaters around New England to pitch the studio's latest films. Shirley

Temple, the era's biggest star, was under contract to Fox, so Matty cobbled her films with four or five others and convinced theaters to pay for the package. Matty enjoyed his job and was promoted to sales manager, sparking hopes that he might rise in the corporate ranks. Matty's plans changed when his father-in-law, Peter Kantor, asked him to work at his shoe factory. Peter promised an ownership stake, and Matty felt obligated to join the family business.

Peter's factory, which produced upscale women's shoes, was a success, but money flew out almost as fast as it came in. A heavyset, flamboyant man who favored expensive clothing, drove a succession of late-model Cadillacs, and wore elevator shoes to compensate for his five-foot-four stature, Peter blew much of his wealth on horse races and a series of paramours. On paydays, Peter let Jimmy and his cousin Richard Lourie hold piles of cash "as high as our heads," Richard recalls. "We both loved it."[1]

Peter projected a certain insouciance and a love of life, attitudes Jimmy later would adopt. A native of Russia, Peter shared naughty stories about the old country—most of which featured wolves, women, caviar, and a lot of vodka—and he taught his grandsons a few key Russian phrases—"Give me a cigarette" and "Kiss my ass"—sending the boys into fits of laughter. Peter placed the bulk of his cash in a safe-deposit box, likely to shield it from taxes, but he made sure to have $1,500 in his breast pocket at all times. He was found with that exact amount the day he died, surrounded by Christmas cards from dozens of appreciative female friends.

Matty Simons spent years as the general manager of the shoe factory, but he never received the ownership share Peter had promised. Later in life, Matty told his son he wished he hadn't forgone a promising and exciting career to do what was expected of him.

"The lesson was: Do what you like in life, not what you feel you 'should' do," Simons says. "It's something I never forgot."

What Jimmy liked to do more than anything else was think, often about mathematics. He was preoccupied with numbers, shapes, and slopes. At the age of three, Jimmy doubled numbers and divided them in half, figuring out all the powers of 2 up to 1,024 before becoming bored. One day, while taking the family to the beach, Matty stopped for gasoline, perplexing the young boy. The way Jimmy reasoned, the family's automobile could never have run out of gas. After it used half its tank, there would be another half remaining, then they could use half of that, and so on, without ever reaching empty.

The four-year-old had stumbled onto a classic mathematical problem involving a high degree of logic. If one must always travel half the remaining distance before reaching one's destination, and any distance, no matter how small, can be halved, how can one ever reach one's destination? The Greek philosopher Zeno of Elea was the first to address the dilemma, the most famous of a group of paradoxes that challenged mathematicians for centuries.

Like many children without siblings, Jimmy sat with his thoughts for long stretches of time and even talked to himself. In nursery school, he would climb a nearby tree, sit on a branch, and ponder. Sometimes Marcia had to come and force him to climb down and play with the other children.

Unlike his parents, Jimmy was determined to focus on his own passions. When he was eight, Dr. Kaplan, the Simons family's doctor, suggested a career in medicine, saying it was the ideal profession "for a bright Jewish boy."

Jimmy bristled.

"I want to be a mathematician or a scientist," he replied.

The doctor tried to reason with the boy. "Listen, you can't make any money in mathematics."

Jimmy said he wanted to try. He didn't quite understand what mathematicians did, but it likely involved numbers, which seemed good enough. Anyway, he knew perfectly well he didn't want to be a doctor.

In school, Jimmy was smart and mischievous, displaying his mother's

self-assurance and his father's impish humor. He loved books, frequently visiting a local library to take out four a week, many well above his grade level. Mathematical concepts captivated him most, however. At the Lawrence School in Brookline, which counts television newscasters Mike Wallace and Barbara Walters as alumni, Jimmy was elected class president and finished close to the top of his grade, losing out in the latter case to a young woman who didn't find herself lost in thought nearly as often as he did.

During that time, Jimmy had a friend who was quite wealthy, and he was struck by the comfortable lifestyle his family enjoyed.

"It's nice to be very rich. I observed that," Simons later said. "I had no interest in business, which is not to say I had no interest in money."[2]

Adventures occupied much of Jimmy's time. Sometimes he and a friend, Jim Harpel, rode trolleys to Bailey's Ice Cream in Boston to enjoy a pint. When they were older, the pair sneaked into burlesque shows at the Old Howard Theatre. One Saturday morning, as the boys headed out the door, Harpel's father noticed binoculars around their necks.

"You boys going to the Old Howard?" he asked.

Busted.

"How'd you know, Mr. Harpel?" Jimmy asked.

"Not much bird watching around here," Mr. Harpel replied.

After ninth grade, the Simons family moved from Brookline to Newton, where Jimmy attended Newton High School, an elite public school well equipped to nurture his emerging passions. As a sophomore, Jimmy enjoyed debating theoretical concepts, including the notion that two-dimensional surfaces could extend forever.

After graduating high school in three years, Simons, thin and solidly built, set off on a cross-country drive with Harpel. Everywhere they went, the seventeen-year-olds—middle-class and, until then, largely sheltered from hardship—conversed with locals. Crossing into Mississippi, they saw African Americans working as sharecroppers and living in chicken coops.

"Reconstruction had left them as tenant farmers, but it was the same as slavery," Harpel recalls. "It was a bit of a shock to us."

Camping in a state park, the boys visited a swimming pool but saw no African Americans, which surprised them. Simons asked a heavyset, middle-aged park employee why no one of color was around.

"We don't allow no n——s," he said.

Visiting other cities, Simons and Harpel saw families living in abject poverty, experiences that left a mark on the boys, making them more sensitive to the plight of society's disadvantaged.

Simons enrolled at MIT, as he had hoped, and even skipped the first year of mathematics thanks to advanced-placement courses he took in high school. College brought immediate challenges, however. Early on, Simons dealt with stress and intense stomach pain, losing twenty pounds and spending two weeks in the hospital. Doctors eventually diagnosed colitis and prescribed steroids to stabilize his health.

Overconfident during the second semester of his freshman year, Simons registered for a graduate course in abstract algebra. It was an outright disaster. Simons was unable to keep up with his classmates and couldn't understand the point of the assignments and course topics.

Simons bought a book on the subject and took it home for the summer, reading and thinking for hours at a time. Finally, it clicked. Simons aced subsequent algebra classes. Though he received a D in an upper-level calculus course in his sophomore year, the professor allowed him to enroll in the next level's class, which discussed Stokes' theorem, a generalization of Isaac Newton's fundamental theorem of calculus that relates line integrals to surface integrals in three dimensions. The young man was fascinated—a theorem involving calculus, algebra, and geometry seemed to produce simple, unexpected harmony. Simons did so well in the class that students came to him seeking help.

"I just blossomed," Simons says. "It was a glorious feeling."

The way that powerful theorems and formulas could unlock truths and unify distinct areas in math and geometry captured Simons.

"It was the elegance of it all, the concepts were beautiful," he says.

When Simons studied with students like Barry Mazur—who graduated in two years and later would win top mathematics awards and teach at Harvard University—Simons concluded he wasn't quite at their level. He was close, though. And Simons realized he had a unique approach, mulling problems until he arrived at original solutions. Friends sometimes noticed him lying down, eyes closed, for hours at a time. He was a ponderer with imagination and "good taste," or the instinct to attack the kinds of problems that might lead to true breakthroughs.

"I realized I might not be spectacular or the best, but I could do something good. I just had that confidence," he says.

One day, Simons saw two of his professors, renowned mathematicians Warren Ambrose and Isadore Singer, in deep discussion after midnight at a local café. Simons decided he wanted that kind of life—cigarettes, coffee, and math at all hours.

"It was like an epiphany . . . a flash of light," he says.

Away from mathematics, Simons did everything he could to avoid courses demanding too much of him. MIT students were required to enroll in a physical-fitness course, but Simons didn't want to waste time showering and changing, so he signed up for archery. He and another student, Jimmy Mayer, who had come to MIT from Colombia, decided to make the class a bit more interesting, betting a nickel on every shot. They became fast friends, wooing girls and playing poker with classmates into the night.

"If you lost five dollars, you practically shot yourself," Mayer recalls.

Simons was funny, friendly, spoke his mind, and often got into trouble. As a freshman, he enjoyed filling water pistols with lighter fluid and then using a cigarette lighter to create a homemade flame thrower. Once, after Simons created a bathroom bonfire in Baker House, a dormitory on Charles

River, he flushed a pint of lighter fluid down a toilet and closed the door behind him. Glancing back, Simons saw an orange glow around the door frame—the inside of the bathroom was aflame.

"Don't go in there!" he screamed to approaching classmates.

Inside the toilet, the fluid had heated up and ignited into a fireball. Luckily, the dorm was built with dark red rustic bricks and the fire failed to spread. Simons confessed to his crime and paid the school fifty dollars total in ten-week installments for the necessary repairs.

By 1958, after three years at MIT, Simons had enough credits to graduate at the age of twenty, earning a bachelor of science in mathematics. Before entering graduate school, though, he yearned for a new adventure. Simons told a friend, Joe Rosenshein, that he wanted to do something that would "go down in the records" and would be "historic."

Simons thought a long-distance roller-skating trip might attract attention but it seemed too tiring. Inviting a news crew to follow him and his friends on a water-skiing trip to South America was another possibility, but the logistics proved daunting. Hanging out in Harvard Square with Rosenshein one afternoon, Simons saw a Vespa motor scooter race by.

"I wonder if we could use one of those?" Simons asked.

He developed a plan to undertake a "newsworthy" trip, convincing two local dealerships to give him and his friends discounts on Lambretta scooters, the top brand at the time, in exchange for the right to film their trip. Simons, Rosenshein, and Mayer set out for South America, a trip they nicknamed "Buenos Aires or Bust." The young men drove west through Illinois before heading south to Mexico. They traveled on country roads and slept on porches, in abandoned police stations, and in forests, where they set up jungle hammocks with mosquito netting. A family in Mexico City warned the boys about bandits and insisted they buy a gun for protection, teaching the young men to say a crucial phrase in Spanish: "If you move, we'll kill you."

Driving with a noisy, broken muffler through a small southern Mexican

town around dinnertime, wearing leather jackets and looking like the motorcycle gang in Marlon Brando's classic film *The Wild One,* the boys stopped to find a place to eat. When the locals saw visitors disturbing their traditional evening stroll, they turned furious.

"Gringo, what are you doing here?" someone called out.

Within minutes, fifty hostile young men, some holding machetes, surrounded Simons and his friends, pushing their backs up against a wall. Rosenshein reached for the gun but remembered it only had six bullets, not nearly enough to handle the swelling crowd. Suddenly, police officers emerged, pushing through the throng to arrest the MIT students for disturbing the peace.

The boys were thrown in jail. Soon, it was surrounded by a mob, which screamed and whistled at them, causing such commotion that the mayor sent someone to investigate. When the mayor heard that three college kids from Boston were causing trouble, he had them brought directly to his office. It turned out that the mayor had graduated from Harvard University and was eager to hear the latest news from Cambridge. Moments after fending off an angry mob, the boys sat down with local officials for a sumptuous, late-night dinner. Simons and his friends made sure to get out of town before dawn, though, to avoid additional trouble.

Rosenshein had enough of the drama and headed home, but Simons and Mayer pushed on, making it to Bogotá in seven weeks, through Mexico, Guatemala, and Costa Rica, overcoming mudslides and raging rivers along the way. They arrived with almost no food or money, thrilled to stay in the luxurious home of another classmate, Edmundo Esquenazi, a native of the city. Friends and family lined up to meet the visitors, and they spent the rest of the summer playing croquet and relaxing with their hosts.

When Simons returned to MIT to begin his graduate studies, his advisor suggested he finish his PhD at the University of California, Berkeley, so he could work with a professor named Shiing-Shen Chern, a former math