

Now A Major Motion Picture

A NATIONAL BESTSELLER

A BEAUTIFUL MIND

SYLVIA NASAR

The Life of Mathematical Genius and Nobel Laureate John Nash

THE AWARD-WINNING BESTSELLER

How could you. A mathematician, believe that extraterrestrials were sending you messages""the visitor from Harvard asked the West Virginian with the movie-star looks and Ofulympian manner.

Because the ideas I had about supernatural beings came to me the same way my mathematical ideas did.- came the answer. "So I took them seriously".

Thus begins the true story of John Nash, the

-----7
mathematical genius who was a legend by age thirty when he slipped into madness, and who -- thanks to the selflessness of a beautiful woman and the loyalty of the mathematics community -- emerged after decades of ghost-like existence to win a Nobel Prize and world acclaim. The inspiration for a major motion picture, Sylvia Nasar's award-winning biography is a drama about the mystery of the human mind, triumph over incredible adversity, and the healing power of love.

"Reads like a fine novel."

comTHE NEW YORK TIMES

"Deeply interesting and extraordinarily moving." comOLIVER SACKS

"Superbly written and eminently fascinating." THE BOSTON GLOBE

A former economics correspondent for

The New York Times,

SYLVIA NASAR is

the Knight Professor of Journalism at Columbia University. She lives in Tarrytown, New York.

WINNER, NATIONAL BOOK CRITICS CIRCLE AWARD FOR BIOGRAPHY

FINALIST, PULITZER PRIZE IN

-----8

BIOGP-kPHY

Praise for A

Beautiful Mind

"Two paragraphs and I was hooked!" comOliver Sacks

"A brilliant book." comDavid Herbert Donald

"Reads like a fine novel." -- David Goodstein,

The New York Times

"Powerfully affecting ... a three-handkerchief read."

comCharles C. Mann,

The Wall StreetJournal

"A triumph of intellectual biography." comRobert Boynton,

Newsday

"Might be compared to a Rembrandt portrait, filled with somber

shadows and radiant light effects ... simply a beautiful A8
book." comMarcia Bartusiak,

The Boston Glohe

"A remarkable look into the arcane world of mathematics and the
tragedy of madness."

- Simon Singh,

-----9

The New York Times Book Review "A narrative of compelling power."

-- John Men Paulos,

Los Angeles Times

"A wonderfully absorbing puzzle." comClaire Douglas,

Washington Post Book World

"A poetical love and coming-of-age story." comTed Anton,

Chicago Tribune

"The stuff of classic tragedy." -- Robert A. Burton,

San Jose Mercury News

"A powerful story brilliantly told." -- Will St. John,

Detroit Free Press

"A worthy subject and a fascinating book." comCraig Ryan,

Purtland Oregonian

"A page-turner." comClaiborne Smith, Austin Chronicle

"An arresting portrait." comJune Kinoshita, St. Petershurg Times

"The parabolic arc of an American genius ... superbly and
thrillingly limned."

-----10

comW Blythe,

Mirahelia

"A staggering feat of writing and reporting." comMichael J.

Mandel, Business Week

"Profoundly sad yet redemptive."

- Worth Magazine

"Instead of facile theories, the reader enjoys wonder and
astonishment."

comRichard Dooling, Salon

"Extraordinarily moving." comJeremy Bernstein, Commentary

"Absolutely fascinating." -- Jim Holt, Slate

"An engrossing, ultimately uplifting book." comGregg Sapp,

Kirkus Reviews

"Will touch any reader who understands what it means to hope
comor to fear."

- Booklist

"Unique."

- The Economist

"A compelling book about a phenomenal figure." -- Roy Porter,
The Times

-----11

"Unblinking yet empathic." comDaniel Kevles,
Times Literary Supplement

"A romantic human story." -- Steven McCaffery,
Irish News

"Genuinely compulsive." -- Jon Oberlander, Sunday Herald

"An astonishing achievement." -- Brian Rotman,
London Review ofBooks

"A masterpiece of oral history." comKarl Sigmund,

Nature A11
"Be prepared for the birth of a new culture hero." -- Peter
Wilhelm,
Business Day
"I defy anyone to read Sylvia Nasar's prologue without being
moved."
comChristopher Beaman,
Broadway Dam andHigh
"A magnificent biography." - Roy Weintraub,
journal of the History ofEeconomic Thought
"High drama." comWade Roush,

-----12
MIT Technology Review
"Deeply moving." comPaul Trachtman, Smithsonian Magazine
"Presented with grace and skill: comBrian Hayes,
The Sciences
"A must-read with something for everyone." comKeith Devlin,
New Scientist
"Fascinating, complicated, and studious." comMark H. Fleisher,
JAMA
"A deeply moving love story, an account of the centrality of
human relationships."
- Richard Wyatt and Kay Jamison,
The New Englandjournal of Medicine
"A gripping narrative."
- Kenneth Arrow, Nobel Laureate,
The Times Higher Education Supplement

A
eau I
comU
B t f I
SYLVIA NASAR
A Touchstone Book Published by Simon and Schuster

-----13
NEW YORK LONDON TORONTO SYDNEY SINGAPORE
TOUCHSTONE Rockefeller Center
1230 Avenue of the Americas New York, NY10020
Copyright © 1998 by Sylvia
Nasea71`

All rights reserved,
including the right of reproduction in whole or in part in any
form.
Cover Art (© 2001 by Universal Studios Publishing Rights, a

Division of Universal Studios Licensing, Inc.

A Beautiful Mind is a trademark and copyright of Universal Studios. All rights reserved.

This Touchstone Edition 2001 Tbummm- and colophon are registered trademarks of Simon and Schuster, Inc.

For information about special discounts for bulk purchases, please contact Simon and Schuster Special Sales:

1-800-456-6798 or businessCandsimonandschustercom Designed by Edith Fowler

Manufactured in the United States of America

14

10 9 8

The Library of Congress has cataloged the hardcover edition as follows.- Nasar, Sylvia. A beautiful mind : a biography of John Forbes Nash, Jr., winner of the Nobel Prize in economics, 1994 Sylvia Nasar

people. cm.

Includes bibliographical references and index. 1. Nash, John F, 1928- . 2. Mathematicians--United States--Biography I Title. OA29DDATION25N37 1998

510'. 92

[B] -- DC21 98-2795

CIP

ISBN 0-68"] 9064

0-7432-2457-4 (Pbk)

The author and publisher gratefully acknowledge permission to reprint material from the following works: "The RAND Hymn" words and music by Malvina RCY1701DS, Copyright 1961 by Schroeder Music Co. (ASCAP). Used

-----15

by permission. All rights reserved. John F Nash Jr.

"(Autobiographical Essay) and "The Work of John Nash in Game Theory" (Nobel Seminar), in

Les Prix Nobel 1994

(Stockholm: Norstedts Tryckeri,

1995). Copyright © The Nobel foundation, 1994. Excerpts from

com Waking in the Blue" of Life Studies

by

Robert Lowell, Copyright © 1959 by Robert Lowell. Copyright renewed © 1987 by Harriet Lowell, Sheridan Lowell, and Caroline Lowell. Reprinted by permission of Farrar, Straus and Giroux, Inc.

Excerpts from the letters of Robert Lowell. Reprinted with the permission of the Estate of Robert Lowell.

Title page photo: Robert Mott together

Fortune

V-

IIUR ALICIA ESTHER LARDE NASH Another race hath been, and other palms are won. Thanks to the human heart by which we live, Thanks

-----16

to its tenderness, its joys, and fears,

To me the meanest flower that blows can give Thoughts that do often lie too deep for tears.

com11MLLIAM WORDSWORTH,
"Intimations of Immortality"

Prologue

Part One: A Beautiful Mind

I Bluefield (1928-4,)

2 Carnegie Institute of Technology
(June 1945-june 1948)

3 The Center of the Universe
(Princeton, Fea711 1948)

4 School of Genius
(Princeton, Fea7111948)

5	A16
Genius (Princeton, 1948-49)	
6	
Games (Princeton, Spring 1949)	
7 John von Neumann	
(Princeton, 1948-49)	
8 The Theory of Games	
9 The Bargaining Problem	
(Princeton, Spring 1949)	
10 Nash's Rival Idea	
(Princeton, 1949-50)	
-----	17
11	
Lloyd (Princeton, 1950)	
12 The War of Wits	
(RAND, Summer 1950)	
13 Game Theory at RAND	
14 The Draft	
(Princeton, 1950-51)	
15 A Beautiful Theorem	
(Princeton, 1950-51)	
16 MIT	
17 Bad Boys	
18 Experiments	
(RAND, Summer 1952)	
19	
Reds (Spring 1953)	
20 Geometry	
Part TW-O: Separate Lives	
21 Singularity	
22 A Special Friendship	
(Santa Monica, Summer 1952)	
23 Eleanor	
25 The Arrest	
(RAND, Summer 1954)	
184	
26 Alicia	190
-----	18
27 The Courtship	199
28	
Seattle (Summer 1956)	
203	
29 Death and Marriage	

(1956-57)

208

Part Three: A Slow Fire Burning

30 Olden Lane and Washington Square (1956-57)

215

31 The Bomb Factory 222

32 Secrets

(Summer 1958)

228

33 Schemes

(Fdd711 1958)

235	A18
34 The Emperor of Antarctica	239
35 In the Eye of the Storm (Spring 1959)	
248	
36 Day Breaks in Bowditch Hall (McLean Hospital, April-May 1959)	253
-----	19
37 Mad Hatter's Tea (May-June 1959)	
262	
Part Four: The Lost Years	
38 Citoyen du Monde (Paris and Geneva, 1959-60)	
269	
39 Absolute Zero (Princeton, 1960)	
283	
40 Tower of Silence (Trenton State Hospital, 1961)	
288	
41 An Interlude of Enforced Rationality (July 1961-April 1963)	
295	
42 The "Blowing Up" Problem (Princeton and Carrier Clinic, 1963-65)	305
43 Solitude (Boston, 1965-67)	
314	
44 A Man All Alone in a Strange World (Roanoke, 1967-70)	
323	
-----	20
45 Phantom of Fine Hall (Princeton, 1970's)	
332	
46 A Quiet Life (Princeton, 1970-90)	
340	
Part Five: The Most Worthy	
47 Remission	
48 The Prize	
49 The Greatest Auction Ever (Washington, D.C., December 1994)	
50 Reawakening	

(Princeton, 1995-97)

349

356

374

Epilogue Notes Select Bibliography Acknowledgments Index

Contents

9

389

391

437

441

"ere the statue stood

A20

-----21

Of Newton with his prism and silent face, The marble index of a
mind for ever

Voyaging through strange seas of Thought, alone.

- WILLIAM WORDSWORTH

JOHN FORBES NASH, JR. commathematical genius, inventor of a
theory of rational behavior, visionary of the thinking machine --
had been sitting with his visitor, also a mathematician, for
nearly half an hour. It was late on a weekday afternoon in the
spring of 1959, and, though it was only May,
uncomfortably warm. Nash was slumped in an armchair in one corner
of the hospital lounge, carelessly dressed in a nylon shirt that
hung limply over his unbelted trousers. His powerful frame was
slack as a rag doll's, his finely molded features expressionless.
He had been staring
dully at a spot immediately in front of the left
foot of Harvard professor George Mackey, hardly moving except to
brush his long dark hair away from his forehead in a fitful,
repetitive motion. His visitor sat upright, oppressed by the
silence, acutely conscious that the doors to the room were
locked. Mackey finally could contain himself no longer. His voice
was slightly querulous, but he strained to be gentle. "How could
you," bbgan

-----22

Mackey, "how could you, a mathematician, a man devoted to reason
and logical proof... how could you believe that extraterrestrials
are sending you messages? How could you believe that you are
being recruited by aliens from outer space to save the world? How
could you ... ?was

Nash looked up at last and fixed Mackey with an unblinking stare
as cool and dispassionate as that of any bird or snake.

"Becauseea"Nash said slowly in his soft, reasonable southern
drawl, as if talking to himself, "the ideas I had about
supernatural beings came to me the same way that my mathematical
ideas did. So I took them seriouslydd"I

The young genius from Bluefield, West Virginia -- handsome,
arrogant, and highly eccentric comburst onto the mathematical
scene in 1948. Over the next decade, a decade as notable for its
supreme faith in human rationality as for its dark anxieties
about mankind's survival,` Nash proved himself, in the words of
the eminent
geometer Mikhail Gromov, "the most remarkable mathematician of

the second half of the century." Games of strategy, economic rivalry, computer architecture, the shape of the universe, the geometry of imaginary spaces, the mystery of

-----23

prime numbers-all engaged his wide-ranging imagination. His ideas were of the deep and wholly unanticipated kind that pushes scientific thinking in new directions.

Geniuses, the mathematician Paul Halmos wrote, "are of two kinds: the ones who are just like all of us, but very much more so, and the ones who, apparently, have an extra human spark. We can

all run, and some of us can run the mile in less than 4 minutes; but there is nothing that most of us can do that compares with the creation of the Great G-minor Fuguedd0bled Nash's genius was of that mysterious variety more often associated with music and art than with the oldest of all sciences. It wasn't merely that his mind worked faster, that his memory was more retentive, or that his power of concentration was greater. The flashes of intuition were nonrational. Like other great mathematical intuitionists comGeorg Friedrich Bernhard Riemann, Jules Henri Poincar6, Srinivasa Ramanujan comNash saw the vision first, constructing the laborious proofs long afterward. But even after he'd try to explain some astonishing result, the actual route he had taken remained a mystery to others who tried to follow his reasoning. Donald Newman, a mathematician who knew

-----24

Nash at MIT in the 1950's, used to say about him that "everyone else would climb a peak by looking for a path somewhere on the mountain. Nash would climb another mountain altogether and from that distant peak would shine a searchlight back onto the first peakdd"I No one was more obsessed with originality, more disdainful of authority, or more jealous of his independence. As a young man he was surrounded by the high priests of twentieth-century science comAlbert Einstein, John von Neumann, and Norbert Wiener comb he joined no school, became no one's disciple, got along largely without guides or followers. In almost everything he did comf game theory to geometry -- he thumbed his nose at the received wisdom, current fashions, established methods. He almost always worked alone, in his head, usually walking, often whistling Bach. Nash acquired his knowledge of mathematics not mainly from studying what other mathematicians had discovered, but by rediscovering their truths for himself. Eager to astound, he was always on the lookout for the really big problems. When he focused on some new puzzle, he saw dimensions that people who really knew the subject (he never did) initially dismissed as naive or wrongheaded. Even as a student, his indifference to others' skepticism,

-----25

doubt, and ridicule was awesome. Nash's faith in rationality and the power of pure thought was extreme, even for a very young mathematician and even for the new age of computers, space travel, and nuclear weapons. Einstein once chided him for wishing to amend relativity theory without

studying physics

.6

His heroes were solitary thinkers and supermen like Newton and
Nietzsche⁷ Computers and science fiction were his passions. He
considered "thinking machines" ^z he called them, superior in
some ways to human beings. At one point, he became fascinated by
the possibility that drugs could heighten physical and
intellectual performance⁹ He was beguiled by
the idea of alien races of hyper-rational beings who had taught
themselves to disregard all emotion. ¹⁰ Compulsively rational, he
wished to turn life's decisions whether to take the first

elevator or wait for the next one, where to bank his money, A25 what job to accept, whether to marry cominffcalculations of advantage and disadvantage, algorithms or mathematical rules divorced from emotion, convention, and tradition. Even the small act of saying an

-----26

automatic hello to Nash in a hallway could elicit a furious "Why are you saying hello to me""I I His contemporaries, on the whole, found him immensely strange. They described him as "aloof haughty,0"without affect,0"detached,0"spooky,0"isolatedea"and "queer."" Nash mingled rather than mixed with his peers. Preoccupied with his own private reality, he seemed not to share their mundane concerns. His manner-slightly cold, a bit superior, somewhat secretive comsuggested something dismysterious and unnatural." His remoteness was punctuated by flights of garrulousness about outer space and geopolitical trends, childish pranks, and unpredictable eruptions of anger. But these outbursts were, more often than not, as enigmatic as his silences. "He is not one of u"was a constant refrain. A mathematician at the Institute for Advanced Study remembers meeting Nash for the first time at a crowded student party at Princeton: I noticed him very definitely among a lot of other people who were there. He was sitting on the floor in a half-circle discussing something. He made me feel uneasy. He gave me a peculiar

-----27

feeling. I had a feeling of a certain strangeness. He was different in some way. I was not aware of the extent of his talent. I had no idea he would contribute as much as he really did." But he did contribute, in a big way. The marvelous paradox was that the ideas themselves were not obscure. In 1958, Fortune singled Nash out for his achievements in game theory, algebraic geometry, and nonlinear theory, calling him the most brilliant of the younger generation of new ambidextrous mathematicians who worked in both pure and applied mathematicsdd14 Nash's insight into the dynamics of human rivalry -- his theory of rational conflict and cooperation -- was to become one of the most influential ideas of the twentieth century, transforming the young science of economics the way that Mendel's ideas of genetic transmission, Darwin's model of natural selection, and Newton's

celestial mechanics reshaped biology and physics in their day.
It was the great Hungarian-born polymath John von Neumann who
first recognized that social behavior could be analyzed as games.
Von Neumann's 1928 article on parlor games was

-----28
the first successful attempt to derive logical and mathematical
rules about rivalries." just as Blake saw the universe in a grain
of sand, great scientists have often looked for clues to vast and
complex problems in the small, familiar phenomena of daily life.
Isaac Newton reached insights about the heavens by juggling
wooden balls. Einstein contemplated a boat paddling upriver. Von

Neumann pondered the game of poker.

A28

A seemingly trivial and playful pursuit like poker, von Neumann argued, might hold the key to more serious human affairs for two reasons. Both poker and economic competition require a certain type of reasoning, namely the rational calculation of advantage and disadvantage based on some internally consistent system of values ("more is better than less"). And in both, the outcome for any individual actor depends not only on his own actions, but on the independent actions of others.

More than a century earlier, the French economist Antoine-Augustin Cournot had pointed out that problems of economic choice were greatly simplified when either none or a large number of

-----29

other agents were present." Alone on his island, Robinson Crusoe doesn't have to worry about others whose actions might affect him. Neither, though, do Adam Smith's butchers and bakers. They live in a world with so many actors that their actions, in effect, cancel each other out. But when there is more than one agent but not so many that their influence may be safely ignored, strategic behavior raises a seemingly insoluble problem:

"I think that he thinks that I think that he thinksea"and so forth. Von Neumann was able to give a convincing solution to this problem of circular reasoning for games that are two-person, zero-sum games, games in which one player's gain is another's loss. But zero-sum games are the ones least applicable to economics (as one writer put it, the zero-sum game is to game theory "what the twelve-bar blues is to jazz; a polar case, and a point of historical departure"). For situations with many actors and the possibility of mutual gain comthe standard economic scenario comvon Neumann's superlative instincts failed him. He was convinced that players would have to form coalitions, make explicit agreements, and

-----30

submit to some higher, centralized authority to enforce those agreementsdd"Q possibly his conviction reflected his generation's distrust, in the wake of the Depression and in the midst of a world war, of unfettered individualism. Though von Neumann hardly shared the liberal views of Einstein, Bertrand Russell, and the British economist John Maynard Keynes, he shared something of their belief that actions that might be reasonable from the point

of view of the individual could produce social chaos. Like them he embraced the then-popular solution to political conflict in the age of nuclear weapons: world government."

The young Nash had wholly different instincts. Where von Neumann's focus was the group, Nash zeroed in on the individual, and by doing so, made game theory relevant to modern economics. In his slender twenty-seven-page doctoral thesis, written when he was twenty-one, Nash created a theory for games in which there was a possibility of mutual gain, inventing a concept that let one cut through the endless chain of reasoning, "I think that you think that I think. . . .was 19 His insight was that the game

would be solved when every player independently chose his best response to the other players` best

A30

-----31
strategies.

Thus, a young man seemingly so out of touch with other people's emotions, not to mention his own, could see clearly that the most human of motives and behavior is as much of a mystery as mathematics itself, that world of ideal platonic forms invented by the human species seemingly by pure introspection (and yet somehow linked to the grossest and most mundane aspects of nature). But Nash

had grown up in a boom town in the Appalachian foothills where fortunes were made from the roaring, raw businesses of rails, coal, scrap metal, and electric power. Individual rationality and self-interest, not common agreement on some collective good, seemed sufficient to create a tolerable order. The leap was a short one, from his observations of his hometown to his focus on the logical strategy necessary for the individual to maximize his own advantage and minimize his disadvantages. The Nash equilibrium, once it is explained, sounds obvious, but by formulating the problem of economic competition in the way that he did, Nash showed that a decentralized decision-making process could, in fact, be coherent giving economics an updated, far more

-----32
sophisticated version of Adam Smith's great metaphor of the Invisible Hand.

By his late twenties, Nash's insights and discoveries had won him recognition, respect, and autonomy. He had carved out a brilliant career at the apex of the mathematics profession, traveled, lectured, taught, met the most famous mathematicians of his day, and become famous himself. His genius also won him love. He had married a beautiful young physics student who adored him, and fathered a child. It was a brilliant strategy, this genius, this life. A seemingly perfect adaptation.

Many great scientists and philosophers, among them René Descartes, Ludwig Wittgenstein, Immanuel Kant, Thorstein Veblen, Isaac Newton, and Albert Einstein, have had similarly strange and solitary personalities. 10 An emotionally detached, inward-looking temperament can be especially conducive to scientific creativity, psychiatrists and biographers have long observed, just as fiery fluctuations in mood may sometimes be linked to artistic expression. In
The Dynamics of Creation,

Anthony Storr, the British psychiatrist,

-----33

contends that an individual who "fears love almost as much as he fears hatred" may turn to creative activity not only out of an impulse to experience aesthetic pleasure, or the delight of exercising an active mind, but also to defend himself against anxiety stimulated by conflicting demands for detachment and human contact." In the same vein, Jean-Paul Sartre, the French philosopher and writer, called genius "the brilliant invention of someone who is looking for a way out." Posing the question of why people often are willing to endure frustration and misery in

order to create something, even in the absence of large rewards, Storr speculates:

A33

Some creative people ... of predominately schizoid or depressive temperaments ... use their creative capacities in a defensive way. If creative work protects a man from mental illness, it is small wonder that he pursues it with avidity. The schizoid state ... is characterized by a sense of meaninglessness and futility. For most people, interaction with others provides most of what they require to find meaning and significance in life. For the schizoid person, however, this is not the case, Creative activity is a particularly apt way to express himself ... the activity is solitary

-----34

... [but] the ability to create and the productions which result from such ability are generally regarded as possessing value by our society., Of course, very few people who exhibit "a lifelong pattern of social isolation"and "indifference to the attitudes and feelings of others"-the hallmarks of a so-called schizoid personality- possess great scientific or other creative talentdd" Andthe vast majority of people with such strange and solitary temperaments never succumb to severe mental illnessdd14 Instead, according to John G. Gunderson, a psychiatrist at Harvard, they tend "to engage in solitary activities which often involve mechanical, scientific, futuristic and other non-human subjects ... [and] are likely to appear increasingly comfortable over a period of time by forming a stable but distant network of relationships with people around work tasks."" Men of scientific genius, however eccentric, rarely become truly insane-the strongest evidence for the potentially protective nature of creativitydd16

Nash proved a tragic exception. Underneath the brilliant surface of his life, all was chaos and contradiction: his involvements with other men; a secret mistress and a neglected illegitimate

-----35

son; a deep ambivalence toward the wife who adored him, the university that nurtured him, even his country; and, increasingly, a haunting fear of failure. And the chaos eventually welled up, spilled over, and swept away the fragile edifice of his carefully constructed life.

The first visible signs of Nash's slide from eccentricity into madness appeared when he was thirty and was about to be made a full professor at MIT. The episodes were so cryptic and fleeting that some of Nash's younger colleagues at that institution

thought that he was indulging a private joke at their expense. He walked into the common room one winter morning in 1959 carrying The New York Times and remarked, to no one in particular, that the story in the upper left-hand corner of the front page contained an encrypted message from inhabitants of another galaxy that only he could decipher." Even months later, after he had stopped teaching, had angrily resigned his professorship, and was incarcerated at a private psychiatric hospital in suburban Boston, one of the nation's leading forensic psychiatrists, an expert who testified in the case of Sacco and Vanzetti, insisted that Nash was

perfectly sane. Only a few of those who witnessed the uncanny metamorphosis, Norbert Wiener among them, grasped its true significance." 36

At thirty years of age, Nash suffered the first shattering episode of paranoid schizophrenia, the most catastrophic, protean, and mysterious of mental illnesses. For the next three decades, Nash suffered from severe delusions, hallucinations, disordered thought and feeling, and a broken will. In the grip of this "cancer of the mind," as the universally dreaded condition is sometimes called, Nash abandoned mathematics, embraced numerology and religious prophecy, and believed himself to be a "messianic figure of great but secret importance." He fled to Europe several times, was hospitalized involuntarily half a dozen times for periods up to a year and a half, was subjected to all sorts of drug and shock treatments, experienced brief remissions and episodes of hope that lasted only a few months, and finally became a sad phantom who haunted the Princeton University campus where he had once been a brilliant graduate student, oddly dressed, muttering to himself, writing mysterious messages on

-----37
blackboards, year after year.

The origins of schizophrenia are mysterious. The condition was first described in 1806, but no one is certain whether the illness-or, more likely, group of illnesses comexisted long before then but had escaped definition or, on the other hand, appeared as an AIDS-like scourge at the start of the industrial agedd19 Roughly

1 percent of the population in all countries succumbs to xdd10 Why it strikes one individual and not another is not known, although the suspicion is that it results from a tangle of inherited vulnerability and life stresses." No element of environment -- war, imprisonment, drugs, or upbringing -- has ever been proved to cause, by itself, a single instance of the illness." There is now a consensus that schizophrenia has a tendency to run in families, but heredity alone apparently cannot explain why a specific individual develops the full-blown illness."

Eugen Bleuler, who coined the term schizophrenia in 1908, describes a "specific type of alteration of thinking, feeling and relation to the external world."

-----38

14

The term refers to a splitting of psychic functions, "a peculiar destruction of the inner cohesiveness of the psychic personality." "If the person experiencing early symptoms, there is a dislocation of every faculty, of time, space, and body." None of its symptoms -- hearing voices, bizarre delusions, extreme apathy or agitation, coldness toward others -- is, taken singly, unique to the illness. "And symptoms vary so much between individuals and over time for the same individual that the notion of a 'typical case' is virtually nonexistent. Even the degree of disability -- far more severe, on average, for men -- varies wildly.

The symptoms can be "slightly, moderately, severely, or absolutely disabling" according to Irving Gottesman, a leading contemporary researcher." Though Nash succumbed at age thirty, the illness can appear at any time from adolescence to advanced middle age. The first episode can last a few weeks or months or several years. The life history of someone with the disease can include only one or two episodes.

.41
Isaac Newton, always an eccentric and solitary

-----39
soul, apparently suffered a psychotic breakdown with paranoid delusions at age fifty-one.

.41
The episode, which may have been precipitated by an unhappy attachment to a younger man and the failure of his alchemy experiments, marked the end of Newton's academic career. But, after a year or so, Newton recovered and went on to hold a series of high public positions and to receive many honors. More often, as happened in Nash's case, people with the disease suffer many, progressively more severe episodes that occur at ever shorter intervals. Recovery, almost never complete, runs the gamut from a level tolerable to society to one that may not require permanent hospitalization but in fact does not allow even the semblance of a normal life.

More than any symptom, the defining characteristic of the illness is the profound feeling of incomprehensibility and inaccessibility that sufferers provoke in other people.

Psychiatrists describe the person's sense of being separated by a "gulf which defies description" of individuals who seem "totally strange, puzzling, inconceivable, uncanny and incapable of empathy,

-----40
even to the point of being sinister and frightening." 44
For Nash, the onset of the illness dramatically intensified a pre-existing feeling, on the part of many who knew him, that he was essentially disconnected from them and deeply unknowable. As Storr writes: However melancholy a depressive may be, the observer generally feels there is some possibility of emotional contact. The schizoid person, on the other hand, appears withdrawn and inaccessible. His remoteness from human contact makes his state of mind less humanly comprehensible, since his feelings are not communicated. If such a person becomes psychotic (schizophrenic) this lack of connection with people and the

external world becomes more obvious; with the result that the sufferer's behavior and utterances appear inconsequential and unpredictable⁴¹

Schizophrenia contradicts popular but incorrect views of madness as consisting solely of wild gyrations of mood, or fevered delirium. Someone with schizophrenia is not permanently disoriented or confused, for example, the way that an individual with a brain injury or Alzheimer's might be⁴⁶ He may have, indeed usually does have, a firm

grip on certain aspects of present reality. While he was 41
ill, Nash traveled all over Europe and America, got legal help,
and learned to write sophisticated computer programs.

Schizophrenia is also distinct from manic depressive illness
(currently known as bipolar disorder), the illness with which it
has most often been confounded in the past.

If anything, schizophrenia can be a ratiocinating illness,
particularly in its early phases

.41

From the turn of the century, the great students of schizophrenia
noted that its sufferers included people with fine minds and that
the delusions which often, though not always, come with the
disorder involve subtle, sophisticated, complex flights of
thought. Emil Kraepelin, who defined the disorder for the first
time in 1896, described "dementia praecox" as he called the
illness, not as the shattering of reason but as causing
"predominant damage to the emotional life and the

Wdd041

Louis A. Sass, a psychologist at Rutgers University, calls it
"not an escape from reason but an exacerbation of that
thoroughgoing illness Dostoevsky imagined ... at least in some of
its

-----42

forms ... a heightening rather than a dimming of conscious
awareness, and an alienation not from reason but from emotion,
instincts and the willdd049

Nash's mood in the early days of his illness can be described,
not as manic or melancholic, but rather as one of heightened
awareness, insomniac wakefulness and watchfulness. He began to
believe that a great many things that he saw coma telephone
number, a red necktie, a dog trotting along the sidewalk, a
Hebrew letter, a birthplace, a sentence in

The New York Times-had

a hidden significance, apparent only to him. He found such signs
increasingly compelling, so much so that they drove from his
consciousness his usual concerns and preoccupations. At the same
time, he believed he was on the brink of cosmic insights. He
claimed he had found a solution to the greatest unsolved problem
in pure mathe-

matics, the so-called Riemann Hypothesis. Later he said he was
engaged in an effort to "rewrite the foundations of quantum
physics." Still later, he claimed, in a torrent of letters to
former colleagues, to have discovered vast conspiracies and the

secret meaning of numbers and biblical texts. In a letter to the algebraist Emil Artin, whom he

-----43

addressed as "a great necromancer and numerologist" Nash wrote:
I have been considering Algerbiac [sic] questions and have noticed some interesting things that might also interest you ...
1, a while ago, was seized with the concept that numerical calculations dependent on the decimal system might not be sufficiently intrinsic also that language and alphabet structure might contain ancient cultural stereotypes interfering with clear understands [sic] or unbiased thinking.... I quickly wrote down a

new sequence of symbols.... These were associated with (in fact natural, but perhaps not computationally ideal but suited for mystical rituals, incantations and such) system for representing the integers via symbols, based on the products of successive primes."

A predisposition to schizophrenia was probably integral to Nash's exotic style of thought as a mathematician, but the full-blown disease devastated his ability to do creative work. His once-illuminating visions became increasingly obscure, self-contradictory, and full of purely private meanings, accessible only to himself His longstanding conviction that the universe was rational

-----44

evolved into a caricature of itself, turning into an unshakable belief that everything had meaning, everything had a reason, nothing was random or coincidental. For much of the time, his grandiose delusions insulated him from the painful reality of all that he had lost. But then would come terrible flashes of awareness. He complained bitterly from time to time of his inability to concentrate and to remember mathematics, which be attributed to shock treatmentsdd" He sometimes told others that his enforced idleness made him feel ashamed of himself, worthless." More often, he expressed his suffering wordlessly. On one occasion, sometime during the 1970's, he was sitting at a table in the dining hall at the Institute for Advanced Study-the scholarly haven where he had once discussed his ideas with the likes of Einstein, von Neumann, and Robert Oppenheimer- alone as usual. That morning, an institute staff member recalled, Nash got up, walked over to a wall, and stood there for many minutes, banging his head against the wall, slowly, over and over, eyes tightly shut, fists clenched, his face contorted with anguish." While Nash the man remained frozen in a dreamlike state, a phantom who haunted Princeton in the 1970's and 1980's scribbling

-----45

on blackboards and studying religious texts, his name began to surface everywhere-in economics textbooks, articles on evolutionary biology, political science treatises, mathematics journals. It appeared less often in explicit citations of the papers he had written in the 1950's than as an adjective for concepts too universally accepted, too familiar a part of the foundation of many subjects to require a particular reference: "Nash equilibrium,0"Nash bargaining solution Nash program,0"De Giorgi-Nash result,0"Nash embedding Nash-Moser theorem;" "Nash

blowing-up."

14

When a massive new encyclopedia of economics,
The New Palgrave,
appeared in 1987, its editors noted that the game theory
revolution that had swept through economics "was effected with
apparently no new fundamental mathematical theorems beyond those
of von Neumann and Nash.""
Even as Nash's ideas became more influential comin fields so
disparate that almost no one connected the

Nash of game theory with Nash the geometer or Nash the analyst comthe man himself remained shrouded in obscurity. Most of the young mathematicians and economists who made use of his ideas simply assumed, given the dates of his published articles, that he was dead. Members of the profession who knew otherwise, but were aware of his tragic illness, sometimes treated him as if he were. A 1989 proposal to place Nash on the ballot of the Econometric Society as a potential fellow of the society was treated by society officials as a highly romantic but essentially frivolous gesture comand rejecteddd16 No biographical sketch of Nash appeared in

The New Palgrave

alongside sketches of half a dozen other pioneers of game theorydd17

At around that time, as part of his daily rounds in Princeton, Nash used to turn up at the institute almost every day at breakfast. Sometimes he would cadge cigarettes or spare change, but mostly he kept very much to himself, a silent, furtive figure, gaunt and gray, who sat alone off in a corner, drinking coffee, smoking, spreading out a ragged pile of papers that he carried

-----47
with him alwaysdd18

Freeman Dyson, one of the giants of twentieth-century theoretical physics, one-time mathematical prodigy, and author of a dozen metaphorically rich popular books on science, then in his sixties, about five years older than Nash, was one of those who saw Nash every day at the institutedd19 Dyson is a small, lively sprite of a man, father of six children, not at all remote, with an acute interest in people unusual for someone of his profession, and one of those who would greet Nash without expecting any response, but merely as a token of respect.

On one of those gray mornings, sometime in the late 1980's, he said his usual good morning to Nash. "I see your daughter is in the news again today," Nash said to Dyson, whose daughter Esther is a frequently quoted authority on computers. Dyson, who had never heard Nash speak, said later: "I had no idea he was aware of her existence. It was beautiful. I remember the astonishment I felt. What I found most wonderful was this slow awakening. Slowly, he just somehow woke up. Nobody else has ever awakened the way he did."

-----48
More signs of recovery followed. Around 1990, Nash began to

correspond, via electronic mail, with Enrico Bombieri, for many years a star of the Institute's mathematics facultydd60 Bombieri, a dashing and erudite Italian, is a winner of the Fields Medal, mathematics` equivalent of the Nobel. He also paints oils, collects wild mushrooms, and polishes gemstones. Bombieri is a number theorist who has been working for a long time on the Riemann Hypothesis. The exchange focused on various conjectures and calculations Nash had begun related to the so-called ABC conjecture. The letters showed that Nash was once again doing real mathematical research, Bombieri said:
He was staying very much by himself But at some point he started

talking to people. Then we talked quite a lot about number theory. Sometimes we talked in my office. Sometimes over coffee in the dining hall. Then we began corresponding by e-mail. It's a sharp mind ... all the suggestions have that toughness ... there's nothing commonplace about those.... Usually when one starts in a field, people remark the obvious, only what is known. In this case, not. He looks

-----49

at things from a slightly different angle. A spontaneous recovery from schizophrenia comst widely regarded as a dementing and degenerative disease comis so rare, particularly after so long and severe a course as Nash experienced, that, when it occurs, psychiatrists routinely question the validity of the original diagnosisdd61 But people like Dyson and Bombieri, who had watched Nash around Princeton for years before witnessing the transformation, had no doubt that by the early 1990's he was "a walking miracle."

It is highly unlikely, however, that many people outside this intellectual Olympus would have become privy to these developments, dramatic as they appeared to Princeton insiders, if not for another scene, which also took place on these grounds at the end of the first week of October 1994.

A mathematics seminar was just breaking up. Nash, who now regularly attended such gatherings and sometimes even asked a question or offered some conjecture, was about to duck out. Harold Kuhn, a mathematics professor at the university and Nash's closest friend, caught up with him at the doordd61

Kuhn had telephoned Nash at home earlier that

-----50

day and suggested that the two of them might go for lunch after the talk. The day was so mild, the outdoors so inviting, the Institute woods so brilliant, that the two men wound up sitting on a

bench opposite the mathematics building, at the edge of a vast expanse of lawn, in front of a graceful little Japanese fountain. Kuhn and Nash had known each other for nearly fifty years. They had both been graduate students at Princeton in the late 1940's, shared the same professors, known the same people, traveled in the same elite mathematical circles. They had not been friends as students, but Kuhn, who spent most of his career in Princeton, had never entirely lost touch with Nash and had, as Nash became more accessible, managed to establish fairly regular contact with

him. Kuhn is a shrewd, vigorous, sophisticated man who is not burdened with "the mathematical personality" of a typical academic, passionate about the arts and liberal political causes, Kuhn is as interested in other people's lives as Nash is remote from them. They were an odd couple, connected not by temperament or experience but by a large fund of

-----51

common memories and associations.

Kuhn, who had carefully rehearsed what he was going to say, got to the point quickly. "I have something to tell you, John" he began. Nash, as usual, refused to look Kuhn in the face at first,

staring instead into the middle distance. Kuhn went A51

22

Prologue

on. Nash was to expect an important telephone call at home the following morning, probably around six o'clock. The call would come from Stockholm. It would be made by the Secretary General of the Swedish Academy of Sciences. Kuhn's voice suddenly became hoarse with emotion. Nash now turned his head, concentrating on every word. "He's going to tell you, John" Kuhn concluded, "that you have won a Nobel Prize."

This is the story of John Forbes Nash, Jr. It is a story about the mystery of the human mind, in three acts: genius, madness, reawakening.

PART ONE

A

Beautiful Mind

I

Bluefield

-----52

1928-45

I was taught to feel, perhaps too much The self-sufficing power of solitude.

- WILLIAM WORDSWORTH

AMONG

JOHN NASH'S EARLIEST MEMORIES

is one in which, as a child of about two or three, he is listening to his maternal grandmother play the piano in the front parlor of the old Tazewell Street house, high on a breezy hill overlooking the city of Bluefield, West Virginia.`

It was in this parlor that his parents were married on September 6, 1924, a Saturday, at eight in the morning to the chords of a Protestant hymn, amid basketfuls of blue hydrangeas, goldenrod, black-eyed susans, and white and gold marguerites.` The thirty-two-year-old groom was tall and gravely handsome. The bride, four years his junior, was a willowy, dark-eyed beauty. Her narrow, brown cut-velvet dress emphasized her slender waist and long, graceful back. She had perhaps chosen its deep shade out of deference to her father's recent death. She carried a bouquet of the same old-fashioned flowers that filled the room, and she wore more of these blooms woven through

-----53

her thick chestnut hair. The effect was brilliant rather than subdued. The vibrant browns and golds, which would have made a

woman with a lighter, more typically southern complexion look wan, embellished her rich coloring and lent her a striking and sophisticated air.

The ceremony, conducted by ministers from Christ Episcopal Church and Bland Street Methodist Church, was simple and brief, witnessed by fewer than a dozen family members and old friends.

By eleven o'clock, the newlyweds were standing at the ornate, wrought-iron gate in front of the rambling, white 1890's house waving their goodbyes. Then, according to an account that appeared some weeks later in the Appalachian Power Companys company newsletter, they embarked in the groom's shiny new Dodge

for an "extensive tour" through several northern states. A53
 The romantic style of the wedding, and the venturesome honeymoon, hinted

at certain qualities in the couple, no longer in the first bloom of youth, that set them somewhat apart from the rest of society in this small American town, John Forbes Nash, Sr., was "proper, painstaking, and very serious, a very conservative man in

-----54
 every respect", according to his daughter Martha Nash Leggddbled What saved him from dullness was a sharp, inquiring mind. A Texas native, he came from the rural gentry, teachers and farmers, pious, frugal Puritans and Scottish Baptists who migrated west from New England and the Deep South. He was born in 1892 on his maternal grandparents' plantation on the banks of the Red River in northern Texas, the oldest of three children of Martha Smith and Alexander Quincy Nash. The first few years of his life were spent in Sherman, Texas, where his paternal grandparents, both teachers, had founded the Sherman Institute (later the Mary Nash College for Women), a modest but progressive establishment, where the daughters of Texas's middle class learned deportment, the value of regular physical exercise, and a bit of poetry and botany. His mother had been a student and then a teacher at the college before she married the son of its founders. After his grandparents died, John Srdd's parents operated the college until a smallpox epidemic forced them to close its doors for good. His childhood, spent within the precincts of Baptist institutions of higher learning, was

-----55
 unhappy. The unhappiness stemmed largely from his parents' marriage. Martha Nash's obituary refers to "many heavy burdens, responsibilities and disappointments, that made a severe demand on her nervous system and physical forcedd06 Her chief burden was Alexander, a strange and unstable individual, a ne'er-do-well and a philanderer who either abandoned his wife and three children soon after the college's demise or, more likely, was thrown out. When precisely Alexander left the family for good or what happened to him after he departed is unclear, but he was in the picture long enough to earn his children's undying enmity and to instill in his youngest son a deep and ever-present hunger for respectability. "He was very concerned with appearances "his daughter Martha later said of her father; "he wanted everything to be very proper."`
 John Srdd's mother was a highly intelligent, resourceful woman.

After she and her husband separated, Martha Nash supported herself and her two young sons and daughter on her own, working for many years as an administrator at Baylor College, another Baptist institution for girls, in Belton, in central Texas. Obituaries refer to her "fine executive ability"and

-----56

"remarkable managerial skill." According to the Baptist Standard, "She was an unusually capable woman.... She had the capacity of managing large enterprises ... a true daughter of the true Southern gentrydd"Devout and diligent, Martha was also described as an "efficient and devoted"mother, but her constant struggle

against poverty, bad health, and low spirits, along with the shame of growing up in a fatherless household, left its scars on John Sr. and contributed to the emotional reserve he later displayed toward his own children.

Surrounded by unhappiness at home, John Sr. early on found solace and certainty in the realm of science and technology. He studied electrical engineering at Texas Agricultural and Mechanical, graduating around 1912. He enlisted in the army shortly after the United States entered World War I and spent most of his wartime duty as a lieutenant in the 144th Infantry Supply Division in France. When he returned to Texas, he did not go back to his previous job at General Electric, but instead tried his hand at teaching engineering students at Texas AandM.

-----57

Given his background and interests, he may well have hoped to pursue an academic career. If so, however, those hopes came to nothing. At the end of the academic year, he agreed to take a position in Bluefield with the Appalachian Power Company (now American Electric Power), the utility that would employ him for the next thirty-eight years. By June, he was living in rented rooms in Bluefield.

Photographs of Margaret Virginia Martin -- known as Virginia -- at the time of her engagement to John Sr. show a smiling, animated woman, stylish and whipper-snapper. One account called her "one of the most charming and cultured young ladies of the community." Outgoing and energetic, Virginia was a freer, less rigid spirit than her quiet, reserved husband and a far more active presence in her son's life. Her vitality and forcefulness were such that, years later, her son John, by then in his thirties and seriously ill, would dismiss a report from home that she had been hospitalized for a "nervous breakdown" as simply unbelievable. He would greet the news of her death in 1969 with similar incredulity.

Like her husband, Virginia grew up in a family

-----58

that valued church and higher education. But there the similarity ended. She was one of four surviving daughters of a popular physician, James Everett Martin, and his wife, Emma, who had moved to Bluefield from North Carolina during the early 1890's. The Martins were a well-to-do, prominent local family. Over time, they acquired a good deal of property in the town, and Dr. Martin eventually gave up his medical practice to manage his real-estate

investments and to devote himself to civic affairs. Some accounts refer to him as a one-time postmaster, others as the town's mayor. The Martins' affluence did not protect them from terrible blows comtheir first child, a boy, died in infancy; Virginia, the second, was left entirely deaf in one ear at age twelve after a bout of scarlet fever; a younger brother was killed in a train wreck; and one of her sisters died in a typhoid epidemic -- but on the whole Virginia grew up in a happier atmosphere than her husband. The Martins were also well-educated, and they saw to it that all of their daughters received university educations. Emma Martin was herself unusual in having graduated from a women's

college in Tennessee. Virginia studied English, French, A58
German, and

-----59

Latin first at Martha Washington College and later at West Virginia University. By the time she met her husband-to-be, she had been teaching for six years. She was a born teacher, a talent that she would later lavish on her gifted son. Like her husband, she had seen something beyond the small towns of her home state. Before her marriage, she and another Bluefield teacher, Elizabeth Shelton, spent several summers traveling and attending courses at various universities, including the University of California at Berkeley, Columbia University in New York, and the University of Virginia in Charlottesville.

When the newlyweds returned from their honeymoon, the couple lived at the Tazewell Street house with Virginia's mother and sisters. John Sr. went back to his job at the Appalachian, which in those years consisted largely of driving all over the state inspecting remote power lines.

Virginia did not return to teaching. Like most school districts around the country during the 1920's, the Mercer County school system had a marriage bar. Female teachers lost their jobs as soon as they married." But, quite apart from

-----60

her forced resignation, her new husband had a strong feeling that he ought to provide for and protect her from what he regarded as the shame of having to work, another legacy of his own upbringing. Bluefield, named for the fields of "azure chicory" in surrounding valleys that grows along every street and alleyway even today, owes its existence to the rolling hills full of coal. It is the wildest, most rugged and romantic country to be found in the mountains of Virginia or West Virginia - that surround the remote little city of Norfolk and Western, in a spirit of "mean force and ignorance" built a line in the 1890's that stretched from Roanoke to Bluefield, which lies in the Appalachians on the easternmost edge of the great Pocahontas coal seam. For a long time, Bluefield was a rough and ready outpost where Jewish merchants, African-American construction workers, and Tazewell County farmers struggled to make a living and where millionaire coal operators, most of whom lived ten miles away in Bramwell, battled Italian, Hungarian, and Polish immigrant laborers, and John L. Lewis and the UMW sat down with the coal operators to negotiate contracts,

-----61

negotiations that often led to the bloody strikes and lockouts documented in John Sayles's film

Ma te wa not.

By the 1920's, when the Nashes married, however, Bluefield's character was already changing. Directly on the line between Chicago and Norfolk, the town was becoming an important rail hub and had attracted a prosperous white-collar class of middle managers, lawyers, small businessmen, ministers, and teachers." A real downtown of granite office buildings and stores had sprung up. Handsome churches bad also gone up all over town. Snug frame houses with pretty little gardens edged by Rose of Sharon dotted

the hills. The town had acquired a daily newspaper, a hospital, and a home for the elderly. Educational institutions, from private kindergartens and dancing schools to two small colleges, one black, one white, were thriving. The radio, telegraph, and telephone, as well as the railroads and, increasingly, the automobile, eased the sense of isolation, Bluefield was not "a community of scholars"z John Nash later said with more than a hint of ironydd"Xs bustling commercialism, Protestant

-----62

respectability, and small-town snobbery couldn't have been further removed from the atmosphere of the intellectual hothouses of Budapest and Cambridge which produced John von Neumann and Norbert Wiener. Yet while John Nash was growing up, the town had a sizable group of men with scientific interests and engineering talent, men like John Sr. who were attracted by the railroad, the utility, and the mining companiesdd14 Some of those who came to work for the companies wound up as science teachers in the high school or one of the two local colleges. In his autobiographical essay, Nash described "having to learn from the world's knowledge rather than the knowledge of the immediate community"z "a challengedd"I I But, in fact, Bluefield offered a good deal of stimulation comadmittedly, of a downto-earth variety comfor an inquiring mind; John Nash's subsequent career as a multifaceted mathematician, not to mention a certain pragmatism of character, would seem to owe something to his Bluefield years.

More than anything, the newly married Nashes were strivers. Solid members of America's new, upwardly mobile professional middle class, they formed a tight alliance and devoted themselves

-----63

to achieving financial security and a respectable place for themselves in the town's social pyramidd16 They became Episcopalians, like many of Bluefield's more prosperous citizens, rather than continuing in the fundamentalist churches of their youth. Unlike most of Virginia's family, they also became staunch Republicans, though (so as to be able to vote for a Democratic cousin in the primaries) not registered party members. They socialized a good deal. They joined Bluefield's new country club, which was displacing the Protestant churches as the center of Bluefield's social life. Virginia belonged to various women's book, bridge, and gardening clubs. John Sr. was a member of the Rotary and a number of engineering societies. Later on, the only middle-class practice that they deliberately avoided was sending

their son to prep school. Virginia, as her daughter explained, was "a public-school thinker."

John Srdd`s job with the Appalachian remained secure right through the Depression of the 1930's. The young family fared considerably better in this period than many of their neighbors and fellow churchgoers, especially the small businessmen. John Sr4's

-----64

paycheck, while hardly munificent, was steady, and frugality did the rest. All decisions involving the expenditure of money, no matter how modest, were carefully considered; very often the

decision was to avoid, put off, or reduce. There were no A64 mortgages to be had in those days, no pensions either, even for a rising young middle manager in one of the nation's largest utilities. Virginia Nash used to accuse her husband, when they'd had an argument-which they rarely did within earshot of the children comof being quite likely, in the event that she died before him, to marry a younger woman and let her squander all the money she, Virginia, had scraped so hard to save. (Their savings, it turned out, were considerable, however. Even though John Sr. died some thirteen years before Virginia, and even with the high cost of hospitalizations for John Jr., Virginia barely dipped into her capital and was able to pass along a trust fund to her children.)

Though they began life as parents in a rental house owned by Emma Martin, the Nashes were soon able to move to their own modest but comfortable threebedroom home in one of the best parts of town, Country Club Hill. Built partly of cinder blocks that John Sr, was able to buy for a song from a nearby

-----65

Appalachian coal-processing plant, the house bore little resemblance to the imposing homes of the coal families scattered around the hill. But it was within a few hundred yards of the crest where the club was located, was built to order by a local architect, and contained all the comforts and conveniences that a small-town, middle-class family at that time could aspire to: a living room where Virginia's bridge club could be entertained in style, with a fireplace, built-in bookshelves, and graceful wooden trim at the tops of all the doorways, a neat little kitchen with a breakfast nook, a dining room where Sunday dinners of chicken and waffles were served, a real basement that might one day be fitted out with a maid's room, should live-in help be one day possible, and a separate bedroom for each of the two children.

However much they were forced to economize, the Nashes were able to keep up appearances. Virginia had nice clothes, most of which she sewed herself, and allowed herself the weekly luxury of going to a beauty parlor. By the time they moved to their own house, she had a cleaning woman who came once a week. Virginia always had a car to drive, typically a Dodge, which was hardly the norm even among

-----66

middle-class families at the time. John Sr., of course, had a company car, usually a Buick. The Nashes were a loyal couple,

like-minded.

John Forbes Nash, Jr., was born almost exactly four years after his parents` marriage, on June 13, 1928. He first saw the light of day not at home, but in the Bluefield Sanitarium, a small hospital on Ramsey Street that has long since been converted to other uses, Other than that single fact, again suggestive of the Nashes' comfortAle circumstances, nothing is now known of his coming into the world. Did Virginia catch influenza during her winter pregnancy? Were there any other complications? Were forceps needed during the delivery? While viral exposure in utero or a subtle birth injury might have played a role in his later

mental illness, there is no available record or memory to A66 suggest any such trauma. No anesthesia was required during the delivery, Virginia later told her daughter. The seven-pound baby boy was, as far as anyone still living remembers, apparently healthy, and was soon baptized in the Episcopal Church directly opposite the Martin house on Tazewell

-----67

Street and given his father's full name. Everyone, however, called him Johnny.

He was a singular little boy, solitary and introvertedddd17 The once-dominant view of the origins of the schizoid temperament was that abuse, neglect, or abandonment caused the child to give up the possibility of gratification from human relationships at a very early age." Johnny Nash certainly did not fit this nowdiscredited paradigm. His parents, especially his mother, were actively loving. In general, one can imagine, on evidence from biographies of many brilliant men who were peculiar and isolated as children, that an inward-looking child might react to intrusive adults by withdrawing further into his own private world or that efforts to make him conform might be met by firm resolve to do things his own way comor perhaps that unsympathetic taunting peers might have a similar effect. But the facts of Nash's childhood, in many ways so typical of the educated classes in small American towns of that era, suggest that his temperament may well have been one that he was born with. As the vivid memory of his grandmother's piano-playing suggests, Johnny Nash's infancy was spent a good deal in the company not only

-----68

of his adoring mother, but also of his grandmother, aunts, and young cousinsdd19 The Highland Bluefield

31

Street house to which the Nashes had moved shortly after his birth was within walking distance of Tazewell Street and Virginia continued to spend a great deal of time there, even after the birth of Johnny's younger sister Martha in 1930. But by the time Johnny was seven or eight, his aunts had come to consider him bookish and slightly odd. While Martha and her cousins rode stick horses, cut paper dolls out of old pattern books, and played house and hide-and-seek in the "almost scary but nice"attic, Johnny could always be found in the parlor with his nose buried in a book or magazine. At home, despite his mother's urgings, he ignored the neighborhood children, preferring to stay indoors

alone. His sister spent most of her free time at the pool or playing football and kick ball or taking part in crabapple battles with long, flimsy sticks. But Johnny played by himself with toy airplanes and cars.

Although he was no prodigy, Johnny was a bright and curious child. His mother, with whom he was always closest,

-----69

responded by making his education a principal focus of her considerable energy. "Mother was a natural teacher," Martha observes. "She liked to read, she liked to teach. She wasn't just a housewife" Virginia, who became actively involved in the PTA,

taught Johnny to read by age four, sent him to a private A69 kindergarten, saw to it that he skipped half a grade early in elementary school, tutored him at home and, later on, in high school, had him enroll at Bluefield College to take courses in English, science, and math. John Sr.'s hand in his son's education was less visible. More distant than Virginia, he nonetheless shared his interests with his children -- taking Johnny and Martha on Sunday drives to inspect power lines, for example -- and, more important, supplied answers to his son's incessant questions about electricity, geology, weather, astronomy, and other technological subjects and the natural world. A neighbor remembers that John Sr. always spoke to his children as if they were adults: "He never gave Johnny a coloring book. He gave him science books."

At school, Johnny's immaturity and social

-----70

awkwardness were initially more apparent than any special intellectual gifts. His teachers labeled him an underachiever. He daydreamed or talked incessantly and had trouble following directions, a source of some conflict between him and his mother. His fourth-grade report card, in which music and mathematics were his lowest marks, contained a note to the effect that Johnny needed "improvement in effort, study habits and respect for the rules." He gripped his pencil like a stick, his handwriting was atrocious, and he was somewhat inclined to use his left hand. John Sr. insisted he write only with his right hand. Virginia eventually made him enroll in a penmanship course at a local secretarial college, where he learned a certain style of printing and also how to type. A newspaper clipping from Virginia's scrapbook shows him sitting in a classroom with rows and rows of teenage girls, his eyes rolled up in his head, looking stupefyingly bored. Complaints about his writing, his talking out of turn or even "monopolizing the class discussion," and his sloppiness dogged him right through the end of high school." His best friends were books, and he was always happiest learning on his own. Nash alludes to his preference

-----71

obliquely in his autobiographical essay:

My parents provided an encyclopedia, Compton's Pictured Encyclopedia,

that I learned a lot from by reading it as a child. And also there were other books available from either our house or the house of the grandparents that were of educational valuedd22 And

the best time of day was after dinner every evening when John Sr. would sit at his desk in the small family room off the living room, the size of a sleeping porch, and John Jr. could sprawl in front of the radio, listening to classical music or news reports, or reading either the encyclopedia or the family's stacks of well-worn

Life and Time

magazines, and ask his father questions.

His great passion was experimenting. By the time he was twelve or so, he had turned his room into a laboratory. He tinkered with radios, fooled around with electrical gadgets, and did chemistry

experimentsdd"A neighbor recalls Johnny rigging the Nash A71
telephone to ring with the receiver
offdd14

Though he had no close companions, he enjoyed performing in front
of other children. At one point, he

-----72
would hold on to a big magnet that was wired with electricity to
show how much current he could endure without flinchingdd"Another
time, he'd read about an old Indian method for making oneself
immune to poison ivy. He wrapped poison ivy leaves in some other
leaves and swallowed them whole in front of a couple of other
boys."

One afternoon, he went to a carnival that had come to
Bluefieldddd17 The crowd of children he was with clustered around
a sideshow. There was a man sitting in an electric chair holding
swords in each of his hands. Sparks flashed and danced between
the two tips. He challenged anyone in the crowd to do the same.
Johnny Nash, then about twelve, stepped forward and grabbed the
swords and repeated the man's trick. "There's nothing to itea"he
said as he rejoined the others. How did you do that? asked one of
the children. "Static electricityea"answered Nash before
launching into a more detailed explanation.

Johnny's lack of interest in childish pursuits and lack of
friends were major sources of worry for his parents. An ongoing
effort to make him more "well rounded"bbcame a family
obsessiondd18 Whether his apparent resolve to march to his own
drummer was a question of his temperament or of his parents`
concerted

-----73
efforts to change his nature, the result was his withdrawal into
his own private world. Martha, with whom Johnny constantly
bickered, recalls: Johnny was always different. [My parents] knew
he was different. And they knew he was bright. He always wanted
to do things his way. Mother insisted I
do things for him, that I include him in my friendships. She
wanted me to get him dates. She was right. But I wasn't too keen
on showing off my somewhat odd brother.

The Nashes pushed Johnny as hard socially as they did
academically. At first, it was Boy Scout camp and Sunday Bible
classes; later on, lessons at the Floyd Ward dancing school and
membership in the John Aldens Society, a youth organization
devoted to improving the manners of its members. By high school,
the outgoing Martha was always being enlisted to include her

older brother when she socialized with friends. And in the summer holidays, the Nashes insisted that Johnny get jobs, including one at the Blueandld Daily Telegraph.

In order to get him to the paper, "they got up at the wee hours of the night" Martha said. "They thought it was very important in helping make him well rounded.

-----74

With a brain like John's, it seemed even more important. My mother and father didn't want him to be inside all the time with his hobbies and inventions .1129

Johnny did not openly rebel -- he dutifully trotted off to A74 camp, dancing school, Bible classes, and, later on, blind dates arranged by his sister at Virginia's urging but he did these things mainly to please his parents, especially his mother, and acquired neither friends nor social graces as a result. He continued to treat sports, going to church, the dances at the country club, visits with his cousins comall the things that so many of his peers found fascinating and enjoyable-z tedious distractions from his books and experiments. Always last to be chosen in softball, Johnny would stand in the right outfield, staring at the clouds above, eating bits of grass. Martha describes one occasion on which Virginia insisted he accompany the family to an Appalachian Power Company dinner. Johnny went, but spent the evening riding up and down in the elevator, which mesmerized him, until it broke commuch to his parents' embarrassment. And on his summer jobs he found ways to entertain himself. One of Nash's classmates recalled that Nash, after

-----75

disappearing for hours from his post at Bluefield Supply, was discovered rigging an elaborate system of mousetrapsdd10 At a dance, he pushed a stack of chairs onto the dance floor and danced with them rather than with a girl." Virginia kept scrapbooks chronicling her children's lives and accomplishments. In one of them is a faded and yellowed essay by one Angelo Patri, clipped from a newspaper, covered with her pen marks, underlinings, and circles compoignant hints of her hopes and fears:

Queer little twists and quirks go into the making of an individual. To suppress them all and follow clock and calendar and creed until the individual is lost in the neutral gray of the host is to be less than true to our inheritance.... Life, that gorgeous quality of life, is not accomplished by following another man's rules. It is true we have the same hungers and same thirsts, but they are for different things and in different ways and in different seasons.... Lay down your own day, follow it to its noon, your own noon, or you will sit in an outer hall listening to the chimes but never reaching high enough to strike your own.

-----76

32

The earliest hint of Johnny's mathematical talent, ironically, was a B-minus in fourth-grade arithmetic. The teacher told Virginia that Johnny couldn't do the work, but it was obvious to

his mother that he had merely found his own ways of solving problems. "He was always looking for different ways to do things," his sister commented. More experiences like this followed, especially in high school, when he often succeeded in showing, after a teacher had struggled to produce a laborious, lengthy proof, that the proof could be accomplished in two or three elegant steps.

There is no sign of a mathematical pedigree in Nash's ancestry or any indication that mathematics was much in the air at the Nash household. Virginia Nash was literary. And for all his interest in contemporary developments in science and technology, John Sr.

was not well-versed in abstract mathematics. Nash does not recall ever discussing his later research with his father. Martha's recollections of dinner-table discussions were that they revolved around the meaning of words, books the children were reading, and current events. The first bite of the mathematical apple probably

-----77

occurred when Nash at around age thirteen or fourteen read E. T. Bell's extraordinary book, *Men of Mathematics*—an experience he alludes to in his autobiographical essay. Bell's book, which was published in 1937, would have given Nash the first glimpse of real mathematics, a heady realm of symbols and mysteries entirely unconnected to the seemingly arbitrary and dull rules of arithmetic and geometry taught in school or even to the entertaining but ultimately trivial calculations that Nash carried out in the course of chemistry and electrical experiments.

Men of Mathematics

consists of lively command, as it turns out, not entirely accurate biographical sketches. Its flamboyant author, a professor of mathematics at the California Institute of Technology, declared himself disgusted with "the ludicrous untruth of the traditional portrait of the mathematician" and a "slovenly dreamer totally devoid of common sense." He assured his readers that the great mathematicians of history were an exceptionally virile and even adventuresome breed.

-----78

He sought to prove his point with vivid accounts of infant precocity, monstrously insensitive educational authorities, crushing poverty, jealous rivals, love affairs, royal patronage, and many varieties of early death, including some resulting from duels. He even went so far, in defending mathematicians, as to answer the question "How many of the great mathematicians have been perverts?" "None," was his answer. "Some lived celibate lives, usually on account of economic disabilities, but the majority were happily married.... The only mathematician discussed here whose life might offer something of interest to a Freudian is Pascal." The book became a bestseller as soon as it appeared. What makes Bell's account not merely charming, but intellectually seductive, are his lively descriptions of mathematical problems that inspired his subjects when they were young, and his breezy assurance that there were still deep and beautiful problems that

could be solved by amateurs, boys of fourteen, to be specific. It was

Bell's essay on Fermat, one of the greatest mathematicians of all time but a perfectly conventional seventeenth-century French magistrate

-----79

whose life was "quiet, laborious and uneventful" caught Nash's eye. The main interest of Fermat, who shares the credit for inventing calculus with Newton and analytic geometry with Descartes, was number theory, the higher arithmetic. Number theory "investigates the mutual relationships of those common

whole numbers, 1, 2, 3, 4, 5 ... which we utter almost as soon as we learn to talk." A79

For Nash, proving a theorem known as Fermat's Theorem about prime numbers, those mysterious integers that have no divisor besides themselves and one, produced an epiphany of sorts. Other mathematical geniuses, Einstein and Bertrand Russell among them, recount similarly revelatory experiences in early adolescence. Einstein recalled the "wonder" of his first encounter with Euclid at age twelve:

Here were assertions, as for example the intersection of three altitudes of a triangle at one point which -- though by no means evident -- could nevertheless be proved with such certainty that any doubt appeared to be out of the question. This lucidity and certainty made an indescribable impression on me. Nash does not describe his feelings when he

-----80

succeeded in devising a proof for Fermat's assertion that if n is any whole number and p any prime, then n multiplied by itself p times minus n is divisible by p . But he notes the fact in his autobiographical essay, and his emphasis on this concrete result of his initial encounter with Fermat suggests that the thrill of discovering and exercising his own intellectual powers -- as much as any sense of wonder inspired by hitherto unsuspected patterns and meanings -- was what made this moment such a memorable one. That thrill has been decisive for many a future mathematician. Bell describes how success in solving a problem posed by Fermat led Carl Friedrich Gauss, the renowned German mathematician, to choose between two careers for which he was similarly talented. "It was this discovery ... which induced the young man to choose mathematics instead of philology as his life work

dis041

However heady it may have been to prove a theorem of Fermat's, the experience was hardly enough to plant the notion in Nash's mind that he might himself become a

-----81

mathematician. Although as a high-school student Nash took mathematics at Bluefield College, as late as his senior year, when he already had gone much further into number theory, he still had firmly in mind following in his father's footsteps and becoming an electrical engineer. It was only after he had entered Carnegie Tech, with enough math to skip most entry-level courses,

that his professors would convince him mathematics, for a chosen few, was a realistic choice as a profession.

The Japanese attack on the Pearl Harbor naval base in Hawaii, on December 7, 1941, came halfway through Johnny's first year in high school. A few days later,

Johnny and Mop, as he called his younger sister, got a lesson from their father in how to shoot a .22 caliber rifle⁴² He drove them up to a ridge where the power lines cut a wide swath through the scrubby, snow-dusted pine wood. Pointing toward the town below, huddling under a sooty gray cloud, he told them, in the soft, formal way he had of addressing his children, that the

Japanese wouldn't rest until they had reached their West A81
Virginia hometown, remote and surrounded by mountains as it

-----82

was, because blowing up the coal trains was the only way they
could cripple the mighty American war machine.
A .22, he said, was only a squirrel gun. You couldn't even kill a
deer or a bear with one. But it was easier than a heavier gun for
women and children to handle. They had no choice, really. The
Japanese wouldn't be satisfied with destroying trains. They'd
raze the city, round up all the men, murder all the civilians,
even schoolchildren like them. If you could shoot this thing, you
might be able to stop someone who was coming after you long
enough to run away and hide someplace until the army rescued you.
Years later, when Johnny Nash saw secret signs of invaders
everywhere and believed that he, and only he, could keep the
universe safe, he would be sick with anxiety, shaking and
sweating and sleepless for hours and days at a time. But on that
bright December afternoon, he was excited and happy as he
fingered the rifle. The war came thundering through Bluefield,
West Virginia, in the roaring, raffling shapes of freight car
after car heaped high with coal from the great Pocahontas
coalfield in the mountains to the west -- 40 percent of all the
coal fueling the war machine comand troop trains crowded with
sailors and

-----83

soldiers, round-faced farm boys from Iowa and Indiana and edgy
factory hands from Pittsburgh and Chicagodd41 The war shook and
rattled the city out of its Depression slumber, filling its
warehouses and streets, making overnight fortunes for scrap
speculators and wheeler-dealers of all kinds. Workers were
suddenly in short supply and there were jobs for everybody who
wanted them. Bluefield teenagers hung around the train station
watching it all, attended war bond rallies (Greer Garson showed
up at one), and in school took part in tin can drives and bought
war bonds with books of ten-cent stamps they bought in school.
The war made a lot of Bluefield boys want to hurry and grow up
lest the war be over before they were eligible to join. But
Johnny didn't feel that way, his sister recalled. He did become
obsessed with inventing secret codes consisting, as one former
schoolmate recalled, of weird little animal and people
hieroglyphics, sometimes adorned with biblical phrases:
Though the Wealthyand GreatlRollin splendor and State lIenvy them
not, lIdeclare it.

Adolescence wasn't easy for an intellectually precocious boy with few social skills or

-----84

athletic interests to help him blend in with his small-town peers. The boys and girls on Country Club Hill let him tag along when they went hiking in the woods, explored caves, and hunted batsdd44 But they found him-his speech, his behavior, the knapsack he insisted on carrying -- weirddd41 "He was teased more than average comsimply because he was so far out `was Donald V. Reynolds, who lived across the street from the Nashes, said. "What he thought of as

experimenting, we thought of as crazy. We called him Big Brainsdd046 Once some boys in the neighborhood tricked him into a boxing match and he took a beatingdd47 But because he was tall, strong, and physically courageous, the teasing only rarely degenerated into outright bullying. He rarely passed up a chance to prove that he was smarter, stronger, braver.

Boredom and simmering adolescent aggression led him to play pranks, occasionally ones with a nasty edge. He caricatured classmates he disliked with weird little cartoons. He later told a fellow mathematician at MIT that, as a youngster, he had sometimes "enjoyed torturing

-----85
animalSdd048

He once constructed a Tinkertoy rocking chair, wired it electrically, and tried to get Martha to sit in xddbled` He played a similar prank on a neighboring child. Nelson Walker, head of Bluefield's Chamber of Commerce, told a newspaper reporter the following story:

I was a couple of years younger than Johnny. One day I was walking by his house on Country Club Hill and he was sitting on the front steps. He called for me to come over and touch his hands. I walked over to him, and when I touched his hands, I got the biggest shock I'd ever gotten in my life. He had somehow rigged up batteries and wires behind him, so that he wouldn't get shocked but when I touched his hands, I got the living fire shocked out of me. After that he just smiled and I went on my way." Occasionally the pranks got him into hot water. One incident involving a small explosion in the high school chemistry lab landed him in the principal's office." Another time, he and some other boys were picked up by the police for a curfew violation." When he was fifteen, Nash and a couple of boys from across the street, Donald Reynolds and Herman Kirchner, began fooling around with homemade

-----86
explosiveSdd51 They gathered in Kirchner's basement, which they called their "laboratory," where they made pipe bombs and manufactured their own gunpowder. They constructed cannons out of pipe and shot stuff through them. Once they managed to shoot a candle through a thick wooden board. One day Nash showed up at the lab holding a beaker. "I've just made some nitroglycerinea"he announced excitedly. Donald didn't believe him. He told him "to go down to Crystal Rock and throw it over the cliff to see what

would happend"Nash did just that. "Luckily," said Reynolds, "it didn't work. He would have blown off the whole side of the mountaindd"The bombmaking came to a horrifying end one afternoon in January 1944. Herman Kirchner, who was alone at the time, was building yet another pipe bomb when it exploded in his lap, severing an artery. He bled to death in the ambulance that came for him. Donald Reynolds's parents packed him off to boarding school the following fall. For Nash, whose parents may or may not have known the extent of his involvement in the bombmaking, it was a sobering experience that brought home the dangers of his experiments.

He had grown up, essentially, without ever making a A86

-----87

close friend. Just as he learned to deflect his parents' criticism of his behavior with his intellectual achievements, he learned to armor himself against rejection by adopting a hard shell of indifference and using his superior intelligence to strike back. Julia Robinson, the first woman to become president of the American Mathematical Society, said in her autobiography that she believed that many mathematicians felt themselves to be ugly ducklings as children, unlovable and out of kilter with their more conventional, conforming peers¹⁴ Johnny's apparent sense of superiority, his standoffishness, and his occasional cruelty were ways of coping with uncertainty and loneliness. What he lost by his lack of genuine interaction with children his own age was a "lively sense, in reality, of his actual position in the human hierarchy" that prevents other children with more social contact from feeling either unrealistically weak or unrealistically powerful¹⁵ If he could not believe he was lovable, then feeling powerful was a good substitute. As long as he could be successful, his self-esteem could remain intact. Johnny chose the time-honored escape route from the confines of small-town life: He performed well in

-----88

school. With Virginia's encouragement, he took courses at Bluefield College. He read voraciously, mostly futuristic fantasy books, popular science magazines, and real science texts¹⁶ "He was just an outstanding problem solver" his high school chemistry teacher later told the Bluefield Daily Telegraph.

"When I put a chemistry problem up on the blackboard, all the students would get out a pencil and a piece of paper. John wouldn't move. He would stare at the formula on the board, then stand up politely and tell us the answer. He could do it all in his head. He never even took out a pencil or a piece of paper." This youthful Gedanken experimentation actually helped shape the way he approached mathematical problems later on. His peers became more respectful. At a time when the war was making heroes out of scientists, Johnny's classmates assumed he was slated to become one¹⁸

In high school, Nash became friendly -- though not close friends -- with a couple of fellow students, John Williams and John Louthan, both sons of Bluefield College professors. The

-----89

three rode a public bus to school together and Johnny helped Williams with Latin translations. Williams recalled, "We were attracted to him. He was an interesting guy. That was sort of it. I don't think we ever went over to John's house. It was pretty much of a school thingdd059 The three also constantly maneuvered to get out of their classes as much as possible. Before the widespread use of the SAT's, college recruiters routinely came to the high school and would invite students to take their admissions tests. "We spent many mornings taking those testsea"Williams said.

At the beginning of the year, at Johnny's instigation, they

made a A89
 bet -- no one remembers for how much -- that they could make the
 honor roll without ever cracking a book. All three thought they
 were pretty smart but at the same time were contemptuous of
 grinds and teachers' pets. "We kind of got drug into it by
 Nashea" Williams said. Nash, who was already taking a full load of
 courses at
 Bluefield

39

-----90

Bluefield College, never made the honor society, missing it by a
 few tenths of a percent, The other two did, though by a hair.
 John Sr. suggested that Johnny apply to West Point, a suggestion
 that, once again, may have reflected the father's anxiety that
 his son was not growing up wellrounded as much as it did the
 prospect of free college tuition. But as Martha said, "Even I
 could see that wouldn't have workeddd060 Whatever fantasies he
 may have had about becoming a scientist, when asked to describe
 his career aspirations in an essay, Johnny wrote that he hoped to
 become an engineer like his fatherdd61 He and John Sr. wrote an
 article together describing an improved method for calculating
 the proper tensions for electric cables and wires coma project
 that entailed weeks of field measurements comand published the
 results jointly in an engineering journal

.61

Johnny entered the George Westinghouse competition and won a full
 scholarship, one of ten that were awarded nationallydd61 The fact
 that Lloyd Shapley, a son of the famous Harvard astronomer Harlow
 Shapley, also won a Westinghouse that year made the

-----91

achievement all the sweeter in the eyes of the Nash family.
 Johnny was accepted at the Carnegie Institute of Technology.
 Because of the war all colleges were on accelerated schedules and
 operated year-round so that students could graduate in three
 years. Johnny left Bluefield for Pittsburgh, taking a train from
 nearby Hinton, in mid-June, a few weeks before the VE Day parade
 celebrating Hitler's defeat.

2 Carnegie Institute of Technology

June 1945-June 1948

In

those days very few people became mathematicians. It was like
 becoming a conceitpiamust, -- R4ouL B67T, 1995

I 1ASH WENT TOP-ITTSBURGH

to become a chemical engineer, but his growing interest was in mathematics. It was not long before he abandoned the laboratory and slide rule for Mbbius knots and Diophantine equations.`

With its smelters, power plants, polluted rivers, and ubiquitous slag heaps, Pittsburgh was a city of violent strikes and frequent floods.` So

dense was the sulfurous haze that engulfed its downtown that 92
 travelers arriving by rail often mistook morning for midnight.
 The Carnegie Institute of Technology, perched halfway up Squirrel
 Hill, hardly escaped the inferno. The ivory-colored brick of its
 buildings --
 designed, or so students said, to serve as factories should
 Andrew Carnegie's school fail comwere glazed yellow black. Its
 walkways were gritty with soot particles the size of pebbles. Its
 students were forced, before a lecture was half over, to brush
 the cinders from their lecture notes. Even at high noon in
 midsummer, one could stare directly at the sun without blinking.
 In that era, Carnegie was shunned by the local ruling elite,
 which sent its children east to Harvard and Princeton. Richard
 Cyert, who joined the Carnegie faculty after the war and would
 later become its president, recalled, "When I
 came
 this place was really very backward."` The engineering school,
 with its two thousand or so students, still resembled the trade
 school for sons and daughters of electricians and bricklayers
 that it had been at the turn of the century.

-----93

But like so many other colleges right after the war, Carnegie was
 changing. Robert Doherty, its president, had seized the
 opportunities created by wartime research to turn the engineering
 school into a real university. He parlayed defense contracts and
 the prospect of ballooning enrollments into a big push to recruit
 brilliant young researchers in math, physics, and economics. "The
 theoretical Carnegie Institute of Technology

41

sciences were being pushed very hardea"recalled Richard Duffin, a
 mathematician. "Doherty was trying to take CT into the big
 tiMedd0bled

Corporate giants like Westinghouse, whose headquarters were in
 Pittsburgh, supplied generous scholarships to lure talented young
 people to Carnegie. Among the scholarship recipients who entered
 Carnegie in 1945 were talented youngsters like Andy Warhol, the
 artist, as well as a group of young men who would eventually,
 like Nash, shun engineering for science and mathematics.`

Nash arrived by train in June 1945; gasoline rationing made car
 travel impracticaldd6 Carnegie Tech was still operating in
 wartime mode: classes went year-round, most campus

-----94

activities remained canceled, and most of the fraternity houses

were still shut. Within a year the campus would be inundated with veterans and classes would be jammed with these older students. But that June, two months before the war finally ended, it was mostly freshmen and sophomores who were on campus. The scholarship students were housed together in Welch Hall and took most of their classes together -- small ones taught by hand-picked instructors, some of whom were first-rate. Nash took his first physics course from Immanuel Estermann, for example, a top-flight physicist who had done much of the experimental work that had netted Otto Stern, a German émigré, the 1943 Nobel Prize for physics⁷

Nash's engineering aspirations did not survive his first semester, killed off by an unhappy experience in mechanical drawing: "I reacted negatively to the regimentation" he later wrote. But chemistry, his newly chosen major, proved no better suited to his temperament or interests. He worked briefly as a lab assistant for one of his teachers but got into trouble for breaking equipment. He was so bored at his summer job at the Westinghouse Lab that he spent most of his two

-----95

months there making and polishing a brass egg in the lab's machine shop. The final blow was a C in physical chemistry, which he got after a running dispute with the professor over the lack of rigor of the mathematics in the course. David Lide recalled, "He refused to do the problems the way the professor expected." Of chemistry in general Nash would complain: "It was not a matter of how well one could think ... but of how well one could handle a pipette and perform titration in the laboratory." Even as he struggled in the laboratory, Nash was already discovering a brilliant group of newcomers to Carnegie. By his sophomore year, Doherty's program of upgrading the theoretical sciences had brought to Carnegie John Synge, nephew of the Irish playwright John Millington Synge, who became head of the mathematics department. Despite his startling appearance Synge wore a black patch over one eye and a filter that protruded from one of his nostrils. He was a man of great charm who attracted younger scholars like Richard Duffin, Raoul Bott, and Alexander Weinstein, a European whom Einstein had once invited to become a

-----96

collaborator." When Albert Tucker, a Princeton topologist who did pathbreaking work in operations research, came to Carnegie to lecture that year, he was so impressed with the depth of mathematical talent at Carnegie that he confessed that he felt as if he were "bringing coals to Newcastle."

14

From the start, Nash dazzled his mathematics professors; one of them called him "a young Gauss." He took courses in tensor calculus, the mathematical tool used by Einstein to formulate the general theory of relativity, and relativity from Synge.

16

Synge was impressed with Nash's originality and his appetite for difficult problems. He and others began urging Nash to major in mathematics and to consider an academic career. Nash's doubts

that one could make a living as a mathematician took some time to overcome. But by the middle of his second year he was concentrating almost exclusively on mathematics. The Westinghouse scholarship administrators were unhappy with Nash's switch to mathematics, but by the time they learned of it, it was a
-----97

fait accomplidd11

College is a time when many ugly ducklings discover that they are swans, not just intellectually but socially. Most of the boys in Welch Hall comprecocious but immature comfound common interests, kindred spirits, and a measure of acceptance painfully lacking in

high school. Hans Weinberger recalled, "We were all nerds A97
back in our high schools and here we were able to talk to one
anotherdd019 Nash was not so lucky. While his professors singled
him out as a potential star, his new peers found him weird and
socially inept. "He was a country boy, unsophisticated even by
our standards," recalled Robert Siegel, a physics major, who
remembered that Nash had never attended a symphony performance
beforedd"He behaved oddly, playing a single chord on the piano
over and over," leaving an ice cream cone melting on top of his
castoff clothing in the loungeea"walking on his roommate's
sleeping body to turn off a lightea"pouting when he lost a game
of bridge .14

Nash was rarely invited to go to concerts or restaurants with the
group. Paul Zweifel, an avid bridge player, taught Nash how to
play

-----98
bridge, but Nash's pouting and inattention to the details of the
game made him a poor partner. "He wanted to talk about the
theoretical aspects.0"Nash roomed with Weinberger for a term, but
the two clashed constantly -- Nash once pushed Weinberger around
to end an argument

16
comand Nash moved into a private room at the end of the hall. "He
was extremely lonelyea"recalled Siegel
.17

Later in life, as his accomplishments multiplied, his peers would
be more apt to be forgiving. But at Carnegie, where he was thrust
together with other adolescents around the clock, he became a
target. He was not so much bullied comthe other boys were afraid
of his strength and temper-z ostracized and relentlessly teased.
That he was envied for his size and his brains only fueled the
teasing. "He was the butt of people's jokes because he was
differentea"recalled George Hinman, a physics studentdd28 "Here
was a guy who was socially underdeveloped and acting much
younger. You do what you can to make his life miserable` "Zweifel
admitted. "We tormented poor John. We were very unkind. We were
obnoxious.

-----99
We sensed he had a mental problem."

29
Carnegie Institute of Technology
43

That first summer, Nash, Paul Zweifel, and a third boy spent an

afternoon exploring the subterranean maze of steam tunnels under Carnegie. In the dark, Nash suddenly turned to the others and blurted out, "Gee, if we got trapped down here we'd have to turn homodd"Zweifel, who was fifteen, found the remark pretty odd. But during Thanksgiving break, in the deserted dormitory, Nash climbed into Zweifel's bed when the latter was sleeping and made a pass at hmdd10

Away from home, living in close proximity with other adolescents, Nash discovered that he was attracted to other boys. He spoke and acted in ways that seemed natural to him only to find himself exposed to his peers' contempt. Zweifel and other boys in the

dormitory started calling Nash "Homo" and "Nash-Mo." "Once the statement was made" George Siegel said, "it stuck. John took a lot." No doubt, he found the label hurtful and humiliating, but his anger is all that anyone witnessed.

-----100

The boys made him the butt of various pranks. One time, Weinberger and a couple of others used a footlocker as a battering ram to break down Nash's door. Another time, Zweifel and a few others, knowing of Nash's extreme aversion to cigarette smoke, rigged up a contraption that smoked an entire pack of cigarettes and collected the smoke. "A bunch of us crowded around John's door and blew the smoke under it," Zweifel recalled. "Almost instantaneously, his room filled up with cigarette smoke." Nash exploded in rage. "He came roaring out of his room, picked up Jack [Wachtman], and threw him down on the bed," said Zweifel. "He ripped off Wachtman's shirt and bit him in the back. Then he ran out of the room."

At other times, Nash defended himself the only way he knew how. He wasn't practiced in invective, sarcasm, or ridicule, so he went for childish displays of contempt. "You stupid fool; he'd say," Siegel recalled. "He was openly contemptuous of people who he didn't think were up to his level intellectually. He showed that contempt for all of us: 'You're an ignoramus!' was After a year or so, after he had acquired a

-----101

reputation for being a genius, he began to hold court in Skibo Hall, the student center. Like the fairground magician with his swords, he would sit in a chair and challenge other students to throw problems at him to solve. A lot of students came to him with their homework. He was a star, but an outcast too. Nash stared glumly at the announcement tacked to the bulletin board outside the math department office in Administration Hall, which looked, even on the sunniest of days, like the inside of the Lincoln Tunnel. He stood in front of the board for a long time. He hadn't made it into the top five

.16

Nash's fantasy of instant glory crumbled. The William Lowell Putnam Mathematical Competition was a prestigious national tournament for undergraduates, sponsored by an old-money Boston family known mostly for its Harvard presidents and deans. Today the contest attracts upward of two thousand participants. In March 1947, it was a decade old and drew about 120. But even then, it was the first chance to establish one's rank in the

world of mathematics as well as to seize the limelight.

-----102

Then, as now, contestants were given a dozen problems and half an hour each to solve them. The problems were famously difficult. In any given year, the median score out of 120 possible points was zero. That meant that at least half the contestants weren't able to obtain so much as partial credit for even a single problem, and this in spite of the fact that most contestants had been chosen by their departments to compete. To have a prayer of winning-placing in the top five coma young mathematician had to be super-fast or especially ingenious. The prizes involved a

nominal amount of money, twenty to forty dollars for each A102 of the top ten contestants, and two hundred to four hundred dollars for each of the top five school teams, but winners became instant mini-celebrities in the mathematics world and were virtually assured a spot in a top graduate program. Different graduate programs pay more or less attention to the Putnam, but at Harvard it is, and always has been, a very, very big deal. That year Harvard pledged a fifteenhundred-dollar scholarship to one of the winners.

Nash had competed as a freshman and a sophomore. On his second try, he'd managed to get into the top ten, but not the top five. He'd been cocky

-----103

this time, too. In 1946 a mathematician named Moskovitz tutored the Carnegie Tech team using problems from past exams. Nash was able to solve problems that Moskovitz and the others could not solve. It was a tremendous blow to Nash that George Hinman ranked in the top ten in the 1946 competition and Nash didn't."

Another nineteen-year-old might have shrugged off the disappointment, especially a boy who had been plucked out of a chemical engineering program, welcomed with open arms by the school's mathematicians, and told that he had a brilliant future in mathematics. But for a teenager who had endured a lifetime of rejection by peers, the warm praise of such professors as Richard Duffin and J. L. Synge was too little, too late. Nash craved a more universal form of recognition, recognition based on what he regarded as an objective standard, uncolored by emotion or personal ties. "He always wanted to know where he stood," said Harold Kuhn recently. "It was always important to be in the club." 19 Decades later, after he had acquired a worldwide reputation in pure mathematics and had won a Nobel Prize in economics, Nash hinted in his Nobel

-----104

autobiography that the Putnam still rankled and implied that the failure played a pivotal role in his graduate career. 40 Today, Nash still tends to identify mathematicians by saying, "Oh, So and So, he won the Putnam three times."

In the fall of 1947, Richard Duffin stood at the board silent and frowning. 41 He was intimately familiar with Hilbert spaces, but he had prepared his lecture too hastily, had wandered down a cul de sac in the course of his proof, and was hopelessly stuck. It happened all the time.

The five students in the advanced graduate class were getting

restive. Wein-

Carnegie Institute of Technology

45

berger, who was Austrian by birth, was often able to explain the fine points of von Neumann's book

Mathematische Grundlagen der Quantenmechanik, which

Duffin was using as a text. But Weinberger was frowning too.

After a few moments, everybody turned toward the gawky undergraduate who was squirming in his seat. "Okay, John, you go to the

boarded" said Duffin. "See if you can get me out of 105
troubled" Nash leaped up and strode to the board 41
"He was infinitely more sophisticated than the rest of us" said
Bott. "He understood the difficult points naturally. When Duffin
got stuck, Nash could back him up. The rest of us didn't
understand the techniques you needed in this new medium 041 "He
always had good examples and counterexamples" another student
recalled.-

Afterward, Nash hung around. "I could talk to Nashea" Duffin
recalled shortly before his death in 1995. "After class one day
he started talking about Brouwer's fixed point theorem. He proved
it indirectly using the principle of contradiction. That's when
you show that if something's not there, something dreadful will
happen. Don't know if Nash had ever heard of Brouwer 041
Nash took Duffin's course in his third and final year at
Carnegie. At nineteen, Nash already had the style of a mature
mathematician. Duffin recalled, "He tried to reduce things to
something tangible. He tried to relate things to what he knew
about. He tried to get a feel for things before he actually tried
them. He tried to do little problems

-----106
with some numbers in them. That's how Ramanujan, who claimed he
got his results from spirits, figured things out, Poincaré said
he thought of a great theorem getting off a
bus 046
Nash liked very general problems. He wasn't all that good at
solving cute little puzzles. "He was a much more dreamy
person" said Bott. "He'd think a long time. Sometimes you could
see him thinking. Others would be sitting there with their nose
in a book 041 Weinberger recalled that "Nash knew a lot more
than anybody else there. He was working on things we couldn't
understand. He had a tremendous body of knowledge. He knew number
theory like
mad 041
"Diophantine equations were his love" recalled Siegel. "None of
us knew anything about them, but he was working on them then 049
It is obvious from these anecdotes that many of Nash's lifelong
interests as a mathematician-
number theory, Diophantine equations, quantum mechanics,
relativity- already fascinated him in his late teens. Memories
differ on whether Nash learned about the theory of games at
Carnegie. 10 Nash himself does not recall. He did, however,
-----107

take a course in international trade, his one and only formal course in economics, before graduatingdd"X was in this course that Nash first began to mull over one of the basic insights that eventually led to his Nobel Prize."

By the spring of 1948- in what would have been his junior year at Carnegie Nash had been accepted by Harvard, Princeton, Chicago, and Michiganea"the

four top graduate mathematics programs in the country. Getting into one of these was virtually a prerequisite for eventually landing a good academic appointment. Harvard was his first choicedd14 Nash told everyone that he believed that Har-

vard had the best mathematics faculty. Harvard's cachet A107 and social status appealed to him. As a university, Harvard had a national reputation, while Chicago and Princeton, with its largely European faculty, did not. Harvard was, to his mind, simply number one, and the prospect of becoming a Harvard man seemed terribly attractive.

The trouble was that Harvard was offering slightly less money than Princeton. Certain that Harvard's comparative stinginess was the consequence of his

-----108

less-than-stellar performance in the Putnam competition, Nash decided that Harvard didn't really want him. He responded to the rebuff by refusing to go there. Fifty years later, in his Nobel autobiography Harvard's lukewarm attitude toward him seems still to have stung: "I had been offered fellowships to enter as a graduate student at either Harvard or Princeton. But the Princeton fellowship was somewhat more generous since I had not actually won the Putnam competition." Princeton was eager. From the 1930's onward, Princeton had a far stronger department and was snaring the lion's share of the best graduate studentsdd16 Princeton was, as a matter of fact, more selective than Harvard at that point, admitting ten handpicked candidates each year, as opposed to Harvard's twenty-five or so. The Princeton faculty didn't care a hoot about the Putnam, or about tests of any kind, or grades. They paid attention exclusively to the opinions of mathematicians whose views they respected. And once Princeton decided it wanted someone, it pursued him with vigor.

Duffin and Synge were pushing Princeton hard. Princeton was full of purists comtopologists,

-----109

algebraists, number theorists-and Duffin especially regarded Nash as someone obviously suited, by interest and temperament, for a career in the most abstract mathematics. "I thought he would be a completely pure mathematician" Duffin recalled. "Princeton was first in topology. That's why I wanted to send him to Princeton."

17 The only thing Nash really knew about Princeton was that Albert Einstein and John von Neumann were there, along with a bunch of other European 6migr6's. But the polyglot Princeton mathematical milieu comforeign, Jewish, left-leaning comst seemed to him a distinctly inferior alternative.

Sensing Nash's hesitation, Solomon Lefschetz, the chairman of the Princeton department, had already written to him urging him to choose Princeton." He finally dangled a John S. Kennedy

Fellowshipdd19 The one-year fellowship was the most prestigious the department had to offer, requiring little or no teaching and guaranteeing a room in Princeton's residential college for graduate students. It was a sign of how much Princeton was panting for Nash. The \$1,150 fellowship covered the \$450 tuition and was more than

-----110

ample for the \$200 room rent for a year and \$14 a week in dining fees, as well as living expensesdd60

For Nash, that clinched the decisiondd61 The difference in the awards could not

have been huge in any practical sense. But, then, as so many times later in Nash's life, a relatively trivial amount of money loomed in his decision. It seems clear that Nash calculated Princeton's more generous fellowship as a measure of how Princeton valued him. A personal appeal from Lefschetz, with a flattering reference to his relative youth, also proved decisive. Lefschetz's phrase "We like to catch promising men when they are young and open-minded" struck a chord

Something else weighed on Nash's mind that last spring at Carnegie. As graduation drew closer, he became more and more worried about being drafted. He thought that the United States might go to war again and was afraid that he might wind up in the infantry. That the army was still shrinking three years after the end of World War I

-----111

and that the draft had, for all intents and purposes, ground to a standstill, did not make Nash feel safe. The newspapers -- of which he was a regular reader were full of signs, in particular the Russian blockade of Berlin and the subsequent American-British airlift that spring, that the Cold War was heating up. He hated any thought that his personal future might be hostage to forces outside his control and he was obsessed with ways to defend himself against any possible threats to his own autonomy or plans.

So Nash was palpably relieved when Lefschetz offered to help him obtain a summer job with a Navy research project. The project in White Oak, Maryland, was being run by Clifford Ambrose Truesdell, a former student of Lefschetz. Nash wrote to Lefschetz at the beginning of April:

Should there come a war involving the US I think I should be more useful, and better off, working on some research project than going, say into the infantry. Working on government sponsored research this summer would pave the way toward the more desirable eventuality

Though Nash did not display outward signs of

-----112

distress, the disappointments and anxieties of the spring cast a shadow over the summer between his graduation from Carnegie and his arrival at Princeton.

White Oak is a suburb of Washington, D.C. In the summer of 1948, it was a swampy, humid woodland full of raccoons, opossums, and

snakes. The mathematicians at White Oak were a hodgepodge of Americans, some of whom had been working for the Navy since the middle of the war, and others, German prisoners of war. Nash found himself a room in downtown Washington, which he rented from a Washington, D.C., police officer. He rode to White Oak in a car pool every day with two of the Germans

.66

Nash had been looking forward to the summer. Lefschetz had promised that the work would be pure mathematics." Truesdell, quite a good mathematician, was a tolerant supervisor who encouraged the mathematicians in his group to pursue their own

research. He essentially gave Nash carte blanche, issuing A112 no instructions and merely saying that he hoped Nash would write something before

48

-----113

A BEAUTIFUL MIND

he left at the end of the summer. But Nash seemed to have trouble working. He made no apparent progress on any of the problems he had mentioned vaguely to Truesdell at the start of the summer, and he never handed in a paper. At the end of the summer, he was forced to apologize to Truesdell for having wasted his time. Nash spent most of his days, evidently, simply walking around rather aimlessly, lost in thought. Charlotte Truesdell, Truesdell's wife and the project's girl Friday, recalls that Nash seemed terribly young, "like a sixteen-year-old" and almost never spoke to anyone. Once when she asked him what he was thinking, Nash asked whether she, Charlotte, didn't think it would be a good joke if he put live snakes in the chairs of some of the mathematicians. "He didn't do it," she said, "but he thought about it a lot."

Princeton, Fall 1948

...

a quaint ceremonious village.

comALBERT EINSTEIN

...

the mathematical center of the universe. comHARALD

-----114

BoHR

J. NASH ARRIVED

in Princeton, New Jersey, on Labor Day 1948, the opening day of Truman's re-election campaign. He was twenty years old. He came by train, directly from Bluefield, via Washington, D.C., and Philadelphia, wearing a new suit and carrying unwieldy suitcases stuffed with bedding and clothes, letters and notes, and a few books. Impatient and eager now, he got off at Princeton Junction, a nondescript little middle-class enclave a few miles from Princeton proper, and hurried onto the Dinky, the small single-track train that shuffles back and forth to the university.

What he saw was a genteel, prerevolutionary village surrounded by gently rolling woodlands, lazy streams, and a patchwork of cornfields. Settled by Quakers toward the end of the seventeenth century, Princeton was the site of a famous Washington victory

over the British and, for a brief six-month interlude in 1783, the de facto capital of the new republic. With its college-Gothic buildings nestled among lordly trees, stone churches, and dignified old houses,

-----115

the town looked every inch the wealthy, manicured exurb of New York and Philadelphia that, in fact, it was. Nassau Street, the town's sleepy main drag, featured a row of "better" men's clothing shops, a couple of taverns, a drugstore, and a bank. It had been paved before the war, but bicycles and pedestrians still accounted for most of the traffic. In

This Side of Paradise,

A115

F. Scott Fitzgerald had described Princeton circa World War I as "the pleasantest country club in America." Einstein called it "a quaint, ceremonious village" in the 1930s

Depression and wars had scarcely changed the place, May Veblen, the wife of a wealthy Princeton mathematician, Oswald Veblen, could still identify by name every single family, white and black, well-to-do and of modest means, in every single house in town. Newcomers invariably felt intimidated by its gentility. One mathematician from the West recalled, "I always felt like my fly was open"

Even the university's mathematics building conjured

-----116

up images of exclusivity and wealth. "Fine Hall is, I believe, the most luxurious building ever devoted to mathematics", one European émigré wrote

It was a gabled, NeoGothic red brick and slate fortress, built in a style reminiscent of the College de France in Paris and Oxford University. Its cornerstone contains a lead box with copies of works by Princeton mathematicians and the tools of the trade: two pencils, one piece of chalk, and, of course, an eraser. Designed by Oswald Veblen, a nephew of the great sociologist Thorstein Veblen, it was meant to be a sanctuary that mathematicians would be "loath to leave." The dim stone corridors that circled the structure were perfect for both solitary pacing and mathematical socializing. The nine "studies"-not offices!-for senior professors had carved paneling, hidden file cabinets, blackboards that opened like altars, oriental carpets, and massive, overstuffed furniture. In a gesture to the urgency of the rapidly advancing mathematical enterprise each office was equipped with a telephone and each lavatory with a reading light. Its well-stocked

-----117

third-floor library, the richest collection of mathematical journals and books in the world, was open twenty-four hours a day. Mathematicians with a fondness for tennis (the courts were nearby) didn't have to go home before returning to their offices: there was a locker room with showers. When its doors opened in 1921, an undergraduate poet called it "a country club for math, where you could take a bath."

Princeton in 1948 was to mathematicians what Paris once was to painters and novelists, Vienna to psychoanalysts and architects,

and ancient Athens to philosophers and playwrights. Harald Bohr, brother of Niels Bohr, the physicist, had declared it "the mathematical center of the universe" in 1936.⁹ When the deans of mathematics held their first worldwide meeting after World War 11, it was in Princeton.¹⁰ Fine Hall housed the world's most competitive, up-to-the-minute mathematics department. Next door -- connected, in fact -- was the nation's leading physics department, whose members, including Eugene Wigner, had driven off to Illinois, California, and New Mexico during the war, lugging bits of laboratory equipment, to help build the atomic bomb.¹¹ A

mile or so away, on what had been Olden Farm, was the 118
 Institute for Advanced Study, the modern equivalent of Plato's
 Academy, where Einstein, Gödel, Oppenheimer, and von Neumann
 scribbled on their blackboards and held their learned
 discourses." Visitors and students from the four corners of the
 world streamed to this polyglot mathematical oasis, fifty miles
 south of New York. What was proposed in a Princeton seminar one
 week was sure to be debated in Paris and Berkeley the week after,
 and in Moscow and Tokyo the week after that.

"It is difficult to learn anything about America in
 Princeton" wrote Einstein's assistant Leopold Infeld in his
 memoirs, "much more so than to learn about England in Cambridge.
 In Fine Hall English is spoken with so many different accents
 that the resultant mixture is termed Fine Hall English.... The
 air is full of mathematical ideas and formulae. You have only to
 stretch out your hand, close it quickly and you feel that you
 have caught mathematical air and that a few

51
 formulae are stuck to your palm. If one wants

-----119
 to see a famous mathematician one does not need to go to him; it
 is enough to sit quietly in Princeton, and sooner or later he
 must come to Fine Hall."

Princeton's unique position in the world of mathematics had been
 achieved practically overnight, barely a dozen years earlier. 14
 The university predated the Republic by a good twenty years. It
 started out as the College of New Jersey in 1746, founded by
 Presbyterians. It didn't become Princeton until 1896 and wasn't
 headed by a layman until 1903 when Woodrow Wilson became its
 president. Even then, however, Princeton was a university in name
 only -- "a poor place" an overgrown prep school;` particularly
 when it came to the sciences." In this regard, Princeton merely
 resembled the rest of the nation, which "admired Yankee ingenuity
 but saw little use for pure mathematics` "as one historian put
 it. Whereas Europe had three dozen chaired professors who did
 little except create new mathematics, America had none. Young
 Americans had to travel to Europe to get training beyond the B.A.
 The typical American mathematician taught fifteen to twenty hours
 a

-----120
 week of what amounted to high school mathematics to
 undergraduates, struggling along on a negligible salary and with
 very little incentive or opportunity to do research. Forced to

drill conic sections into the heads of bored undergraduates, the Princeton professor of mathematics was perhaps not as well off as his forebears of the seventeenth century who practiced law (Fermat), ministered to royalty (Descartes), or occupied professorships with negligible teaching duties (Newton). When Solomon Lefschetz arrived at Princeton in 1924, "There were only seven men there engaged in mathematical research" Lefschetz recalled. "In the beginning we had no quarters. Everyone worked at home" Princeton's physicists were in the same boat, still living in the age of Thomas Edison and Alexander Graham Bell, preoccupied with measuring electricity and supervising endless

freshman lab sections." Henry Norris Russell, a distinguished astronomer by the 1920's, fell afoul of the Princeton administration for spending too much time on his own research at the expense of undergraduate teaching. In its disdain for scientific research, Princeton was not very different from Yale or

-----121

Harvard. Yale refused for seven years to pay a salary to the physicist Willard Gibbs, already famous in Europe, on the grounds that his studies were "irrelevant"

While mathematics and physics at Princeton and other American universities were languishing, a revolution in mathematics and physics was taking place three thousand miles away in such intellectual centers as Göttingen, Berlin, Budapest, Vienna, Paris, and Rome.

John D. Davies, a historian of science, writes of a dramatic revolution in the understanding of the very nature of matter: The absolute world of classical Newtonian physics was breaking down and intellectual ferment was everywhere. Then in 1905 an unknown theoretician in the Berne patent office, Albert Einstein, published four epoch-making papers comparable to Newton's instant leap into fame. The most significant was the so-called Special Theory of Relativity, which proposed that mass was simply congealed energy, energy liberated matter: space and time, previously thought to be absolute, were dependent on relative motion. Ten years later he formulated the General Theory of

-----122

Relativity, proposing that gravity was a function of matter itself and affected light exactly as it affected material particles. Light, in other words, did not go "straight"; Newton's laws were not the real universe but one seen through the unreal `spectacles of gravity. Furthermore, he set forth a set of mathematical laws with which the universe could be described, structural laws and laws of motion

At around the same time, at the University of Göttingen, a German mathematical genius, David Hilbert, had unleashed a revolution in mathematics. Hilbert set out a famous program in 1900 of which the goal was nothing less than the axiomatization of all of mathematics so that it could be mechanized and solved in a routine manner. Göttingen became the center of a drive to put existing mathematics on a more secure foundation: "The Hilbert program emerged at the turn of the century as a response to a

perceived crisis in mathematics` "writes historian Robert Leonard. "The effect was to drive mathematicians to `clean up` Cantorian set theory, to establish it on a firm axiomatic basis, on the foundation of a limited number of

-----123

postulates.... This marked an important shift in emphasis towards abstraction in mathematicsdd010 Mathematics moved further and further away from "intuitive content -- in this case, our daily world of surfaces and straight lines-towards a situation in which mathematical terms were leached of their direct empirical content and simply defined axiomatically within the context of the

theory. The era of formalism had arrived." A123

The work of Hilbert and his disciples comamong them such future Princeton stars of the 1930's and 1940's as Hermann Weyl and John von Neumann-also triggered a powerful impulse to apply mathematics to problems hitherto considered unamenable to highly formal treatment. Hilbert and others were quite successful in extending the axiomatic approach to a range of topics, the most obvious being physics, in particular the "new physics" of "quantum mechanics" also to logic and the new theory of games. But for the first twenty-five years of the century, as Davies writes, Princeton, and indeed the whole American academic community, "stood outside this dramatically swift development." The catalyst for Princeton's transformation into a world capital of

-----124
 mathematics and theoretical physics was an accident coman accident of friendship. Woodrow Wilson, like most other educated Americans of his time, despised mathematics, complaining that "the natural man inevitably rebels against mathematics, a mild form of torture that could only be learned by painful processes of drill." And mathematics played no role whatever in his vision of Princeton as a real university with a graduate college and a system of instruction that emphasized seminars and discussions instead of drills and rote learning. But Wilson's best friend, Henry Burchard Fine, happened to be a mathematician. When Wilson set about hiring literature and history scholars as preceptors, Fine asked him, "Why not a few scientists?" Z a gesture of friendship more than anything else, Wilson said yes. After Wilson left the presidency of Princeton for the White House in 1912, Fine became dean of science and proceeded to recruit some top-notch scientists, among them mathematicians G. D. Birkhoff, Oswald Veblen, and Luthor Eisenhart, to teach graduate students. They were known around Princeton as

-----125
 "Fine's research mendd" The undergraduates, not a single one of whom majored in physics or math, complained bitterly of "brilliant but unintelligible lecturers with foreign accents" and "the European, or demi-God, theory of instruction." Fine's nucleus of researchers might well have scattered after the dean's premature death in 1928 in a cycling accident on Nassau Street had it not been for several dramatic instances of private philanthropy that turned Princeton into a magnet for the world's

biggest mathematical stars. Most people think that America's rise to scientific prominence was a by-product of World War II. But in fact the fortunes accumulated between the gilded eighties and the roaring twenties paved the way.

The Rockefellers made their millions in coal, oil, steel, railroads, and banking

- in other words, from the great sweep of industrialization that transformed towns like Bluefield and Pittsburgh in the late nineteenth and early twentieth centuries. When the family and its representatives started to give away some of the money, they were animated by dissatisfaction with the state of higher education in

America and a firm belief that

A125

-----126

"nations that do not cultivate the sciences cannot hold their own." Aware of the scientific revolution sweeping Europe, the Rockefeller Foundation and its offshoots started by sending American graduate students, including Robert Oppenheimer, abroad. By the mid-1920's, the Rockefeller Foundation decided that "instead of sending Mahomet to the Mountain, it would fetch the Mountain heredd" T is, it decided to import Europeans. To finance the effort, the foundation committed not just its income but \$19 million of its capital (close to \$150 million in today's dollars). While Wickliffe Rose, a philosopher on Rockefeller's board, scoured such European scientific capitals as Berlin and Budapest to hear about new ideas and meet their authors, the foundation selected three American universities, among them Princeton, to receive the bulk of its largesse. The grants enabled Princeton to establish five European-style research professorships with extravagant salaries, plus a research fund to support graduate and postgraduate students. Among the first European stars to arrive in Princeton in 1930 were two young geniuses of

-----127

Hungarian origin, John von Neumann, a brilliant student of Hilbert and Hermann Weyl, and Eugene Wigner, the physicist who went on to win a Nobel Prize in physics in 1963, not for his vital work on the atom bomb but for research on the structure of the atom and its nucleus. The two shared one of the professorships endowed by the Rockefeller Foundation, spending half a year in Princeton and the other half in their home universities of Berlin and Budapest. According to Wigner's autobiography, the men were unhappy at first, homesick for Europe's passionate theoretical discussion and its coffeehouses comthe congenial floating seminars of professors and students where the latest research was discussed. Wigncr wondered if they were part of the window dressing, like the faux-Gothic buildings. But von Neumann, an enthusiastic admirer of all things American, adapted more quicklydd14 With shrinking opportunities for research in Europe during the Depression, and mounting restrictions on Jews in German universities, they stayed. A second act of philanthropy, more serendipitous than the Rockefeller enterprise,

-----128

resulted in the creation of the independent Institute for Advanced Study in Princeton." The Bambergers were department store merchants who opened their first store in Newark and who had gone on to make a huge fortune in the dry-goods business. The owners, a brother and sister, sold out six weeks before the stock market crash of 1929. With a fortune of \$25 million between them, they decided to show their gratitude to the state of New Jersey. They had in mind perhaps founding a dental school. An expert on medical education, Abraham Flexner, soon convinced them to drop the idea of a medical school and instead to found a first-rate research institution with no teachers, no students, no classes,

but only researchers protected from the vicissitudes and pressures of the outside world. Flexner toyed with the idea of making a school of economics the core of the institute but was soon persuaded that mathematics was a sounder choice since it was more "fundamental." Furthermore, there was infinitely greater consensus among mathematicians on who the best people were. Its location was still up in the air. Newark, with its paint factories and slaughterhouses, offered no attractions for the international band of academic superstars Flexner

-----129

hoped to recruit. Princeton was more like it. Legend has it that it was Oswald Veblen who convinced the Bambergers that Princeton really could be thought of ("in a topological sense" he put it) as a suburb of Newark,

With zeal and deep pockets matching those of any impresario, Flexner began a worldwide search for stars, dangling unheard-of salaries, lavish perks, and the promise of complete independence. His undertaking coincided with Hitler's takeover of the German government, the mass expulsion of Jews from German universities, and growing fears of another world war. After three years of delicate negotiation, Einstein, the biggest star of them all, agreed to become the second member of the Institute's School of Mathematics, causing one of his friends in Germany to quip, "The pope of physics has moved and the United States will now become the center for the natural sciences." Kurt Gbdel, the Viennese wunderkind of logic, came in 1933 as well, and Hermann Weyl, the reigning star of German mathematics, followed Einstein a year later. Weyl insisted, as a condition of his acceptance, that the Institute appoint a bright light from the next generation. Von Neumann,

-----130

who had just turned thirty, was lured away from the university to become the Institute's youngest professor. Practically overnight, Princeton had become the new GiRtingen.

The Institute professors initially shared the deluxe quarters at Fine Hall with their university colleagues. They moved out in 1939 when the Institute's Fuld Hall, a Neo-Georgian brick building perched in the middle of sweeping English lawns surrounded by woods and a pond just a mile or two from Fine, was built. By the time Einstein and the others moved, the Institute and Princeton professors had become family and the clans continued to mingle like country cousins. They collaborated on research, edited journals jointly, and attended one another's

lectures, seminars, and teas. The Institute's proximity made it easier to attract the most brilliant students and faculty to the university, while the university's active mathematics department was a magnet for those visiting or working permanently at the Institute.

By contrast, Harvard, once the jewel of American mathematics, was in "a state of eclipse" the late 1940's. Its legendary chairman G. D.

-----131

Birkhoff was dead. Some of its brightest young stars, including Marshall Stone, Marston Morse, and Hassler Whitney, had recently

departed, two of them for the Institute for Advanced Study. Einstein had used to complain around the Institute that "Birkhoff is one of the world's great academic anti-Semites"dd"Whether or not this was true, Birkhoff's bias had prevented him from taking advantage of the emigration of the brilliant Jewish mathematicians from Nazi Germanydd"Indeed, Harvard also had ignored Norbert Wiener, the most brilliant American-born mathematician of his generation, the father of cybernetics and inventor of the rigorous mathematics of Brownian motion. Wiener happened to be a Jew and, like Paul Samuelson, the future Nobel Laureate in economics, he sought refuge at the far end of Cambridge at MIT, then little more than an engineering school on a par with the Carnegie Institute of Technology." William James, the preeminent American philosopher and older brother of the novelist Henry James, once wrote of a critical mass of geniuses causing a whole civilization to "vibrate and shakedd019 But the man in the street didn't feel the tremors emanating from

-----132

Princeton until World War II was practically over and these odd men with their funny accents, peculiar dress, and passion for obscure scientific theories became national heroes. From the start, the European brain drain had an immediate and electrifying effect on American mathematics and theoretical physics. The emigration gathered together a group of geniuses who brought not only broad and deep mathematical know-how, but a set of refreshing new attitudesdd10 In particular, the geographical origin of these mathematicians and physicists positioned them to appreciate the implications of the massive amount of new work that had been done in Europe since the turn of the century and gave them a great affinity for applications of mathematics to physics and engineering. Many of the newcomers were young and at the height of their research careers. Some historians have called World War II the scientists' war. But because the science required sophisticated mathematics, it was also very much a mathematicians' war, and the war effort tapped the eclectic talents of the Princeton mathematical communitydd"Princeton mathematicians became involved in ciphers and code breaking. A

-----133

cryptanalytic breakthrough enabled the United States to win a major battle at Midway Island, the turning point in the naval war

between the United States and Japan." In Britain, Alan Turing, a Princeton Ph.D., and his group at Bletchley Park broke the Nazi code without the Germans' knowledge, thus turning the tide in the submarine baffle for control of the Atlantic.

Oswald Veblen and several of his associates essentially rewrote the science of ballistics at the Aberdeen Proving Ground. Marston Morse, who had recently moved from Harvard to the Institute, headed a related effort in the Office of the Chief of Ordnance. Another mathematician, the Princeton statistician Sam Wilks, made best daily estimates of the position of the German submarine fleet on the basis of the prior day's sighting."

The most dramatic contributions were in the areas of A133
 weaponry: radar, infrared detection devices, bomber aircraft,
 long-range rockets, and torpedoes with depth chargesdd16 The new
 weapons were extremely costly, and the military needed
 mathematicians to devise new methods for

-----134
 assessing their effectiveness and the most efficient way to use
 them. Operations research was a systematic way of coming up with
 the numbers the military wanted. How many tons of explosive force
 must a bomb release to do a certain amount of damage? Should
 airplanes be heavily armored or stripped of defenses to fly
 faster? Should the Ruhr be bombed, and how many bombs should be
 used? All these questions required mathematical talent.

The ultimate contribution was, of course, the A-bombdd"Wigner at
 Princeton and Leo Szilard at Columbia composed a letter, which
 they brought to Einstein to sign, warning President Roosevelt
 that a German physicist, Otto Hahn, at the Kaiser Friedrich
 Institute in Berlin had succeeded in splitting the uranium atom.
 Lise Meitner, an Austrian Jew who was smuggled into Denmark,
 performed the mathematical calculations on how an atomic bomb
 could be constructed from these findings. Niels Bohr, the Danish
 physicist, visited Princeton in 1939 and transmitted the news.

"It was they rather than their American born colleagues who
 sensed the military implications of the new knowledge," wrote
 Davies. Roosevelt responded by appointing an

-----135
 advisory committee on uranium in October 1939, two months into
 the war, which eventually became the Manhattan Project.
 The war enriched and invigorated American mathematics, vindicated
 those who had championed the 6migr6's, and gave the mathematical
 community a claim on the fruits of the postwar prosperity that
 was to follow. The war demonstrated not only the power of the new
 theories but the superiority of sophisticated mathematical
 analysis over educated guesses. The bomb gave enormous prestige
 to Einstein's relativity theory, which before then had been seen
 as a small correction of the still-valuable Newtonian mechanics.
 Princeton rode high on the newfound status of mathematics in
 American society. It found itself on the leading edge not just of
 topology, algebra, and number theory, but also of computer
 theory, operations research, and the new theory of games." In
 1948, everyone was back and the anxieties and frustrations of the
 1930's had been swept away by a feeling of expansiveness and
 optimism. Science and mathematics were seen as the key to a

better postwar world. Suddenly the government, particularly the military, wanted to spend money on pure

-----136

research. journals

The Center of the Universe

57

started up. Plans were made for another world mathematical congress, the first since the dark days before the war.

A new generation was crowding in, eager to drink up the wisdom of the older generation, yet full of ideas and attitudes of its own.

There were no women yet, of course comwiththe exception of

Oxford's Mary Cartwright, who was in Princeton that year A136
comb Princeton was opening up. Suddenly, being a few or a
foreigner, having a working-class accent, or graduating from a
college that wasn't on the East Coast were no longer automatic
bars to a bright young mathematician. The biggest divide on
campus was suddenly between "the kids" and the war veterans, who,
in their mid-to-late twenties, were starting graduate school
alongside twenty-year-olds like Nash. Mathematics was no longer a
gentlemen's profession, but a wonderfully dynamic enterprise.
"The notion was that the human mind could accomplish anything
with mathematical ideas," a Princeton student of that era later
recalled. He added: "The postwar years had their threats comthe

-----137

Korean War, the Cold War, China going to the commies- but in
fact, in terms of science, there was this tremendous optimism.
The sense at Princeton wasn't just that you were close to a great
intellectual revolution, but that you were part of it."

Princeton, Fall 1948

Con versgtlon enriches the understanding, but solitude is the
school ofgenius.

comED-WARD QUITE;-OATION

0

NASH's SECOND AFTERNOON

in Princeton, Solomon Lefschetz rounded up the first-year
graduate students in the West Common Room. He was there to tell
them the facts of life, he said, in his French accent, fixing
them with his fierce gaze. And for an hour Lefschetz glared,
shouted, and pounded the table with his gloved, wooden hands,
delivering something between a biblical sermon and a drill
sergeant's diatribe.

They were the best, the very best. Each of them had been
carefully handpicked, like a diamond from a heap of coal. But
this was Princeton, where real mathematicians did real
mathematics. Compared to these men, the newcomers were babies,
ignorant, pathetic babies, and Princeton was going to make

-----138

them grow up, damn it!

Entrepreneurial and energetic, Lefschetz was the supercharged
human locomotive that had pulled the Princeton department out of
genteel mediocrity right to the top. He recruited mathematicians
with only one criterion in mind: research. His high-handed and
idiosyncratic editorial policies made the
Annals ofMathematics,

Princeton's once-tired quarterly, into the most revered mathematical journal in the world. He was sometimes accused of caving in to anti-Semitism for refusing to admit many Jewish students (his rationale being that nobody would hire them when they completed their degrees) but no one denies that he had brilliant snap judgment. He exhorted, bossed, and bullied, but with the aim of making the department great and turning his students into real mathematicians, tough like himself. When he came to Princeton in the 1920's, he often said, he was "an invisible man." He was one of the first Jews on the faculty, loud, rude, and badly dressed to boot. People pretended not to

see him in the hallways and gave him wide berth at faculty parties. But Lefschetz had overcome

-----139

far more formidable obstacles in his life than a bunch of prissy Wasp snobs. He had been born in Moscow and been educated in France. In love with mathematics, but effectively barred from an academic career in France because he was not a citizen, he studied engineering and emigrated to the United States. At age twenty-three, a terrible accident altered the course of his life. Lefschetz was working for Westinghouse in Pittsburgh when a transformer explosion burned off his hands. His recovery took years, during which he suffered from deep depression, but the accident ultimately became the impetus to pursue his true love, mathematics.

7

He enrolled in a Ph.D. program at Clark University, the university famous for Freud's 1912 lectures on psychoanalysis, soon fell in love with and married another mathematics student, and spent nearly a decade in obscure teaching posts in Nebraska and Kansas. After days of backbreaking teaching, he wrote a series of brilliant, original, and highly influential papers that eventually resulted in a "call" from Princeton. "My years in the west with total

-----140

hermetic isolation played in my development the role of 'a job in a lighthouse' which Einstein would have every young scientist assume so that he may develop his own ideas in his own way." Lefschetz valued independent thinking and originality above everything. He was, in fact, contemptuous of elegant or rigorous proofs of what he considered obvious points. He once dismissed a clever new proof of one of his theorems by saying, "Don't come to me with your pretty proofs. We don't bother with that baby stuff around here." Legend had it that he never wrote a correct proof or stated an incorrect theorem. His first comprehensive treatise on topology, a highly influential book in which he coined the term "algebraic topology," hardly contains one completely correct proof. It was rumored that it had been written during one of Lefschetz's sabbaticals ... when his students did not have the opportunity to revise it. I I He knew most areas of mathematics, but his lectures were usually incoherent. Gian-Carlo Rota, one of his students, describes the start of one lecture on geometry: "Well a Riemann surface is a certain kind of

Hausdorff space. You know what a Hausdorff space is, don't you? It's also compact, ok. I guess it is also a manifold. Surely you know what a manifold is. Now let me tell you one non-trivial theorem, the Riemann-Roch theorem."

On this particular afternoon in mid-September 1948, with the new graduate students, Lefschetz was just warming up. "It's important to dress well. Get rid of that thing;" he said, pointing to a pen holder. "You look like a workman, not a mathematician" he told one student. "Let a Princeton barber cut your hair" he said to another. 14 They could go to class or not go to class. He didn't

give a damn. Grades meant nothing. They were only recorded A141
to please the "goddamn deansdd"Only the "generals"counted. I I
There was only one requirement: come to tea.

16

They were absolutely required to come to tea every afternoon.
Where else would they meet the finest mathematics faculty in the
world? Oh, and if they felt like it, they were free to visit that
disembalming parlor," as he liked to call the Institute of
Advanced Study,

-----142

to see if they could catch a glimpse of Einstein, Gbdel, or von
Neumann.""Remember,"
he kept repeating, "we're not here to baby youdd"FfNash,
Lefschetz's opening spiel must have sounded as rousing as a Sousa
march.

Lefschetz's, hence Princeton's, philosophy of graduate
mathematics education had its roots in the great German and
French research universitiesdd18 The main idea was to plunge
students, as quickly as possible, into their own research, and to
produce an acceptable dissertation quickly. The fact that
Princeton's small faculty was, to a man, actively engaged in
research itself, was by and large on speaking terms, and was
available to supervise students` research, made this a practical
approachdd19 Lefschetz wasn't aiming for perfectly polished
diamonds and indeed regarded too much polish in a mathematician's
youth as antithetical to later creativity. The goal was not
erudition, much as erudition might be admired, but turning out
men who could make original and important discoveries.
Princeton subjected its students to a maximum of pressure but a
wonderful minimum of

-----143

bureaucracy. Lefichetz was not exaggerating when he said that the
department had no course requirements. The department offered
courses, true, but enrollment was a fiction, as were grades. Some
professors put down all

As,

others all Cs, on their grade reports, but both were completely
arbitrarydd10 You didn't have to show up a single time to earn
them and students' transcripts were, more often than not, works
of fiction "to satisfy the Philistines." There were no course
examinations. In the language examinations, given by members of
the mathematics department, a student was asked to translate a
passage of French or German mathematical text. But they were a

jokedd "If you could make neither heads nor tails of the passage
comunlikely, since the passages typically contained many
mathematical symbols and precious few words-you could get a
passing grade merely by promising to learn the passage later. The
only test that counted was the general examination, a qualifying
examination on five topics, three determined by the department,
two by the candidate, at the end of the first, or at latest,
second year. However, even the generals were sometimes tailored
to the

strengths and weaknesses of a student." If, for example, it 144
 was known that a student really knew one article well, but only
 one, the examiners, if they were so moved, might restrict
 themselves to that paper. The only other hurdle, before beginning
 the all-important thesis, was to find a senior member of the
 faculty to sponsor it.

If the faculty, which got to know every student well, decided
 that so-and-so wasn't going to make it, Lefschetz wasn't shy
 about not renewing the student's support or simply telling him to
 leave. You were either succeeding or on your way out. As a
 result, Princeton students who made it past the generals wound up
 with doctorates after just two or three years at a time when
 Harvard students were taking six, seven, or eight years."
 Harvard, where Nash had yearned to go for the prestige and magic
 of its name, was at that time a nightmare of bureaucratic red
 tape, fiefdoms, and faculty with relatively little time to devote
 to students. Nash could not possibly have realized it fully that
 first day, but he was lucky to have chosen Princeton over
 Harvard.

That genius will emerge regardless of circumstance is a widely
 held belief. The biographer of the great

-----145

Indian mathematician Ramanujan, for example, claims
 that the five years that the young Ramanujan spent in complete
 isolation from other mathematicians, having failed out of school
 and unable to get as much as a tutoring position, were the key to
 his stunning discoveriesdd14 But when writing Ramanujan's
 obituary, G. H. Hardy, the Cambridge mathematician who knew him
 best, called that view, held earlier by himself, "ridiculous
 sentimentalismdd" Af Ramanujan's death at thirty-three, Hardy
 wrote that the "the tragedy of Ramanujan was not that he died
 young, but that, during his five unfortunate years, his genius
 was misdirected, side-tracked, and to a certain extent
 distorted."

As was to become increasingly obvious over the months that
 followed, Princeton's approach to its graduate students, with its
 combination of complete freedom and relentless pressure to
 produce, could not have been better suited to someone of Nash's
 temperament and style as a mathematician, nor more happily
 designed to elicit the first real proofs of his genius. Nash's
 great luck, if you want to call it luck, was that he came onto
 the

-----146

mathematical scene at a time and to a place tailor-made for his particular needs. He came away with his independence, ambition, and originality intact, having been allowed to acquire a truly first-class training that was to serve him brilliantly.

Like nearly all the other graduate students at Princeton, Nash lived in the Graduate College. The College was a gorgeous, faux-English edifice of dark gray stone surrounding an interior courtyard that sat on a crest overlooking a golf course and lake. It was located about a mile from Fine Hall on the far side of Alexander Road, about halfivay between Fine and the Institute for Advanced Study. Especially in winter, when it was dark by the

time the afternoon seminar ended, it was a good long walk, A146
and once you were there, you didn't feel like going out again.
Its location was the outcome of a fight between Woodrow Wilson
and Dean Andrew West.

16

Wilson had wanted the graduate students to mix and mingle with
the undergraduates. West wanted to re-create the atmosphere of
one of the Oxbridge colleges, far removed from the rowdy,
snobbish

-----147

undergraduate eating clubs on Prospect Street.

In 1948, there were about six hundred graduate students, their
ranks swelled by the numbers of returning veterans whose
undergraduate or graduate careers had been interrupted by the
war." The College, a bit shabbier than before the war and in need
of sprucing up, was full, overflowing really, and a good many
less lucky first-year students had been turned away and were
being forced to lodge in rented rooms in the village. Almost
everyone else had to share rooms. Nash, who lived in Pyne Tower,
was lucky to get a private room, one of the perks of his
fellowship." About fifteen or twenty of the mathematics students,
second- and third-year as well as first-year students, and a
couple of instructors lived in the college at the time. Life was
masculine, monastic, and scholarly, exactly as Dean West had
envisionedd19 The graduate students ate breakfast, lunch, and
dinner together at the cost of fourteen dollars a week. Breakfast
and lunch were served in the "breakfast" room, hurried meals that
were taken on the run. But dinner, served in Procter
Hall, a refectory very much in the English style,

-----148

was a more leisurely affair. There were tall windows, long wooden
tables, and formal portraits of eminent PrincetonianS on the
walls; the evening prayer was led by Sir Hugh Taylor, the
college's dean, or his second in command, the college's master.
There were no candles and no wine, but the food was excellent.
Gowns were no longer required as before the war (they were
reinstated in the early 1950's, and did not disappear for good
until the 1970's), but jackets and ties were required.

The atmosphere at dinner was a combination of male debating
society, locker room, and seminary. Though historians, English
scholars, physicists, and economists all lived cheek by jowl with
the mathematicians, the mathematicians segregated themselves as
strictly as if they were living under some legal system of

apartheid, always occupying a table by themselvesdd10 The older, more sophisticated students, namely Harold Kuhn, Leon Henkin, and David Gale, met for sherry in Kuhn's rooms before dinner. Conversation at dinner, sometimes but not always mathematical, was more expansive than at teatime. The talkeaeaone. former student recalls, frequently revolved around "politics, music, and girls." Political debate resembled

-----149

discussions about sports, with more calculation of odds and betting than ideology. In that early fall, the Truman-Dewey race provided a great deal of entertainment. Being a more diverse

group, the graduate students were more evenly split A149
between the candidates than the Princeton undergraduates; 98
percent of the undergraduates at Princeton, it turned out, were
Dewey supporters. One graduate student even wore a Wallace button
for Henry Wallace, the candidate supported by the American Labor
party, a corn 'munist front organization."

Girls, or rather the absence of girls, the difficulty of meeting
girls, the real or imagined exploits of certain older and more
worldly students, were also hot subjectsdd"V few of the students
dated. Women were not allowed in the main dining hall, and, of
course, there were no female students. "We are allhomosexuals
here"was a famous remark made by a resident to fluster the dean's
wife." Isolation made the real prospects of meeting a girl
remote. A few venturesome souls, orgoodnized by a young
instructor named John Tukey, went to Thursday night folk dances
at the local high s'chooldd14 But most were too shy and
self-conscious

-----150
to do even that. Sir Hugh, a stuffed shirt roundly disliked by
the mathematicians, did his best to discourage what little
socializing there was. One student was called into the dean's
office because a pair of women's panties had been found in his
room; it turned out his sister had been visiting and he, to
preserve appearances, had moved out for the night. At one point,
a seemingly unnecessary rule was handed down that residents of
the Graduate College were not allowed to entertain a woman past
midnight. The very few students who actually had girlfriends
interpreted the rule literally to mean that a woman could be in
the room, but couldn't be entertained. Harold Kuhn spent his
honeymoon theredd"The only time and place that women were allowed
to join the larger group was Saturday lunch in the Breakfast
Room.

In short, social life was rather enveloping comx would be hard to
become really lonely-and at the same time limited to other men,
in Nash's case specifically to other mathematicians. The parties
held in student rooms were thus mostly all-male
affairs. Such evenings, as often as not, were devoted to
mathematical parties organized by one of the graduate students at
Lefschetz's request to entertain some visitor but actually to get
his

-----151
students much-needed job contacts. 16
The quality, diversity, and sheer volume of mathematics talked

about in Princeton every day, by professors, Institute professors, and a steady stream of visitors from all over the world, not to mention the students themselves, were unlike anything Nash had ever imagined, much less experienced. A revolution was taking place in mathematics and Princeton was the center of the action. Topology. Logic. Game theory. There were not only lectures, colloquia, seminars, classes, and weekly meetings at the institute that Einstein and von Neumann occasionally attended, but there were breakfasts, lunches, dinners, and after-dinner parties at the Graduate College, where most of the mathematicians lived, as well as the daily afternoon

teas in the common room. Martin Shubik, a young economist A151 studying at Princeton at that time, later wrote that the mathematics department was "electric with ideas and the sheer joy of the hunt. If a stray ten-year-old with bare feet, no tie, torn blue jeans, and an interesting theorem had walked into Fine Hall at tea times, someone would have listeneV

37

-----152

Tea was the high point of every daydd"X was held in Fine Hall between three and four between the last class and the four-thirty seminar that went until five-thirty or six. On Wednesdays it was held in the west common room, or the professor's room as it was also called, and was a far more formal affair, where the self-effacing Mrs. Lefschetz and the other wives of the senior faculty, wearing long gowns and white gloves, poured the tea and passed the cookies. Heavy silver teapots and dainty English bone china were brought out.

On other days, tea was held in the east common room, also known as the students` room, a much-lived-in, funky place full of overstuffed leather armchairs and low tables. The janitor would bring in the tea and cookies a few minutes before three o'clock and the mathematicians, tired from a day of working alone or lecturing or attending seminars, would start drifting in, one by one or in groups. The faculty almost always came, as did most of the graduate students and a sprinkling of more precocious undergraduates. It was very much a family gathering, small and intimate. It is hard to think where a student could get to know as many other mathematicians as well as at Princeton teatime.

-----153

The talk was by no means purely formal. Mathematical gossip aboundedwho was working on what, who had a nibble from what department, who had run into trouble on his generals. Melvin Hausner, a former Princeton graduate student, later recalled, "You went there to discuss math. To do your own version of gossiping. To meet faculty. To meet friends. We discussed math problems. We shared our readings of recent math papersdd019 The professors felt it their duty to come, not only to get to know the students but to chat with one another. The great logician Alonzo Church, who looked "like a cross between a panda and an owlea"never spoke unless spoken to, and rarely then, would head straight for the cookies, placing one between the fingers of his splayed hand, and munch awaydd40 The charismatic algebraist Emil Artin, son of a German opera singer,

would fling his gaunt, elegant body into one of the leather
armchairs, light a Camel, and opine on Wittgenstein and the like
to his disciples, huddled, more or less literally, at his
feetdd41 The topologist Ralph Fox, a go master, almost always
made a beeline for a game board, motioning some student to join
hmdd41 Another topologist, Norman Steenrod, a good-looking,

-----154

friendly midwesterner who had just created a sensation with his
now classic exposition of fiber bundles, usually stopped in for a
game of chessdd41 Albert Tucker, Lefschetz's righthand man, was
the straitlaced son of a Canadian Methodist minister and Nash's

eventual thesis adviser. Tucker always surveyed the room A154 before he came in and would make fussy little adjustments comsch as straightening the curtain weights if the drapes happened to be awry, or issuing a word-to-the-wise to a student who was taking too many cookiesdd44 More often than not, a few visitors, often from the Institute for Advanced Study, would turn up as well. The students who gathered at teatime were as remarkable, in a way, as the faculty. Poor Jews, new immigrants, wealthy foreigners, sons of the working classes, veterans in their twenties, and teenagers, the students were as diverse as well as brilliant group, among them John Tate, Serge Lang, Gerard Washnitzer, Harold Kuhn, David Gale, Leon Henkin, and Eugenio Calabidd41 The teas were heaven for the shy, friendless, and socially awkward, a category in which many of these young men belonged. John Milnor, the most

-----155

brilliant freshman in the history of the Princeton mathematics department, described it this way: "Everything was new to me. I was awkward socially, shy and isolated. Everything was wonderful. This was a whole new world. Here was a whole community in which I felt very much at home."

46

The atmosphere was, however, as competitive as it was friendlydd47 Insults and one-upmanship were always major ingredients in teatime banter. The common room was where the young bucks warily sized each other up, bluffed and postured, and locked horns. No culture was more hierarchical than mathematical culture in its precise ranking of individual merit and prestige, yet it was a ranking always in a state of suspense and flux, in which new challenges and scuffles erupted almost daily. Back in their undergraduate colleges, most of these young men had gotten used to being the brightest and best, but now they were bumping up against the brightest and best from other schools. One of the graduate students who entered with Nash admitted, "Competitiveness, it was sort of like breathing. We thrived on it. We were nasty. This guy, he's dumb, we'd say. Therefore he no longer existeddd041

-----156

There were cliques, mostly based on fields. The clique at the top of the hierarchy was the topology clique, which clustered around Lefschetz, Fox, and Steenrod. Then came analysis, grouped around Lefschetz's archrival in the department, a civilized and erudite lover of music and art named Bochner. Then came algebra, which

consisted of Emil Artin and a handful of anointed followers. Logic, for some reason, was not highly regarded, despite Church's towering reputation among early pioneers of computer theory. The game theory clique around Tucker School of Genius

65

was considered quite d6class6, an anomaly in this ivory tower of pure mathematics. Each clique had its own thoughts about the importance of its subject and its own way of putting the others down.

Nash had never in his life encountered anything like this exotic

little mathematical hothouse. It would soon provide him A156
with the emotional and intellectual context he so much needed to
express himself Princeton, 1948-49

It is good that I did not let myself be influenced. -

LuDwiG W equals GEN-STE-IATION

-----157

i

K

LA-I CHUNG,

a mathematics instructor who had survived the horrors of the
Japanese conquest of his native China, was surprised to see the
door of the Professors' Room standing ajar. It was usually
locked.

Kai Lai liked to stop

by on the rare occasions when it was open and nobody was about.

It had the feel of an empty church, no longer imposing and
intimidating as it was in the afternoons when it was crowded with
mathematical luminaries, but simply a beautiful sanctuary.

The light in the west common room filtered through thick
stained-glass windows inlaid with formulae: Newton's law of
gravity, Einstein's theory of relativity, Heisenberg's
uncertainty principle of quantum mechanics. At the far end, like
an altar, was a massive stone fireplace. On one side was a
carving of a fly confronting the paradox of the M6bius band.

Mbbius had given a strip of paper a half twist and connected the
ends, creating a seemingly impossible object: a surface with only
one

-----158

side. Kai Lai especially liked to read the whimsical inscription

over the fireplace, Einstein's expression of faith in science,

"Der Herr Gott ist raffiniert aber Boshaft ist Er nichtea"wh he

took to mean that "the Lord is subtle but not malicious."

On this particular fall morning, as he reached the threshold of
the half-open door, Kai Lai stopped abruptly. A few feet away, on
the massive table that dominated the room, floating among a sea
of papers, sprawled a beautiful dark-haired young man. He lay on
his back staring up at the ceiling as if he were outside on a
lawn under an elm looking up at the sky through the leaves,
perfectly relaxed, motionless, obviously lost in thought, arms
folded behind his head. He was whistling softly. Kai Lai
recognized the distinctive profile immediately. It was the new
graduate student from West Virginia. A trifle shocked and a
little embarrassed, Kai Lai backed away from the door and hurried

away before Nash could see or hear him. The first-year students were an extremely cocky bunch, but Nash immediately struck everyone as a good deal cockier-and odder. His appearance helped create the impression.` At twenty, Nash looked young,

-----159

perhaps younger than he was, but he was no longer a gawky youngster who looked as if he'd lust climbed off a tractor. Six foot one, he weighed nearly 170 pounds. He had broad shoulders, a heavily muscled chest, and a tapered waist. He had the build, if not the bearing, of an athlete, "a very strong, very masculine body," one fellow graduate student recalled. He was, moreover,

"handsome as a god," according to another student. His high forehead, somewhat protruding ears, distinctive nose, fleshy lips, and small chin gave him the look of an English aristocrat. His hair flopped over his forehead; he was constantly brushing it away. He wore his fingernails very long, which drew attention to his rather limp and beautiful hands and long, delicate fingers. His voice, on the high, reedy side, was cool and southern and had a slightly ironic edge. His speech had an Olympian and ornamental quality that struck others as a bit stilted. Moreover, his expression was somewhat haughty and he smiled to himself in a superior way.

From the start, he was quite visible at teatime. He seemed eager to be noticed and seemed to want to establish that he was smarter than anyone else in the

-----160
place. A fellow student, who had come to Princeton from the City College of New York, recalled, "He had a way of saying 'trivial' to anything you might have regarded as nontrivial. That could be taken as a put-down" Nash would accuse people of burbling. If somebody was talking on and on, he was just burbling. "ALGEBRA IS BURBLEEA" Nash once scrawled on a blackboard that another student, an algebraist, would pull down in the midst of a talk. "Hackers" was another favorite Nash term. A hacker was somebody who plodded along, somebody who was doing things not worth doing. As another student put it: "Nash was very interested that everyone would recognize how smart he was, not because he needed this admiration, but anybody who didn't recognize it wasn't on top of things. If anyone wasn't aware, he would take a little trouble to make sure he found out." Another student recalls, "He wanted to be noticed more than anything."

He seized opportunities to boast about his accomplishments. He would mention, out of the blue, that he'd discovered, as an undergraduate, an original proof of Gauss's proof of the fundamental theorem of algebra, one of the great achievements of

-----161
eighteenth-century mathematics, nowadays taught in advanced courses on the theory of complex variables. He was a self-declared free thinker. On his Princeton application, in answer to the question "What is your religion?" he wrote "Shinto." He implied that his lineage was superior to that of his fellow students, especially Jewish students. Martin Davis, a fellow student who grew up in a poor family in the Bronx, recalled catching up with Nash when he was ruminating about blood

lines and natural aristocracies one day as they were walking from the Graduate College to Fine Hall. "He definitely had a set of beliefs about the aristocracy," said Davis. "He was opposed to racial mixing. He said that miscegenation would result in the deterioration of the racial line. Nash implied that his own blood lines were pretty good." He once asked Davis whether Davis had grown up in a slum.

Nash appeared to be interested in almost everything mathematical: topology, algebraic geometry, logic, and game theory-and he seemed to absorb a tremendous amount about each of these during his first year. He himself recalled, without

elaborating, having "studied mathematics fairly broadly" at 162
 Princetondd10 Yet he avoided attending classes. No one recalls
 sitting in a regular class with him." He did, he later said,
 begin a course in algebraic topology offered by Steenrod, who
 essentially founded the field." Steenrod and Samuel Eilenberg had
 just invented the axioms that were the foundation of homology
 theory. The stuff was very trendy and the course attracted many
 students, but Nash decided it was too formal for him and not
 geometric enough for his taste, so he stopped going.
 Nobody remembers seeing Nash with a book during his graduate
 career eitherdd"In fact, he read astonishingly little. "Both Nash
 and I were dyslexic to some degree," said Eugenio Calabi, a young
 Italian immigrant who entered Princeton the year before Nash. "I
 had great difficulty keeping my attention on reading that
 required great concentration. Then, I just thought of it as
 laziness. Nash, on the other hand, defended not reading, taking
 the attitude that learning too much secondhand would stifle
 creativity and originality. It was a dislike of passivity and
 giving up controldd014
 Nash's main mode of picking up information he

-----163
 deemed necessary consisted of quizzing various faculty members
 and fellow students." He carried around a clipboard and
 constantly made notes to himself. They were little hints to
 himself, ideas, facts, things he wanted to do, Calabi recalled.
 His handwriting was almost unreadable. He once explained to
 Lefschetz that he had to use ruled notebook paper even when
 writing a letter because without the lines his script formed a
 "very irregular wavy line." As it was, his notes were full of
 crossouts and misspellings of even simple words like
 "InteresEted."

16
 He compensated by learning through conversation in the common
 room and by attending lectures given by visiting mathematicians.
 According to Calabi, Nash
 11 was quite systematic in asking shrewd questions and developing
 his own ideas from the answers. I've seen some of his results in
 the makingdd"Some of his best ideas came "from things learned
 only halfway, sometimes even wrongly, and trying to reconstruct
 them comeven if he could not do so completely.""
 He was always asking probing questions. The questions, not only
 about game theory, but also about topology and geometry, often
 contained a kernel of speculation.

John Milnor, who entered as a freshman that year, recalls one such question, posed in the common room: Let V , be a singular algebraic variety of dimension k , embedded in some smooth variety M_0 and let M_i equals $G_i(M_0)$ be the Grassmann variety of tangent k -planes to M_0 . Then V_0 lifts naturally to a k -dimensional variety $V_i \subset M_i$. Continuing inductively, we obtain a sequence of k -dimensional varieties. ... Do we eventually reach a variety V , which is nonsingular? (As it turns out, Milnor adds, the conjecture has since been proven

only in special cases.)"

A164

Nash spent most of his time, it appears, simply thinking. He rode bicycles borrowed from the racks in front of the Graduate College in tight little figure eights or ever-smaller concentric circles." He paced around the interior quadrangle of the college. He glided along the gloomy second-floor hallway of Fine, his shoulder pressed firmly against the wall, like a trolley never losing contact with the dark paneled walls." He would lie on a desk or table in

-----165

the empty common room, or more frequently, in the third-floor librarydd"Alm always, he whistled Bach, most often the Little Fugue." The whistling prompted the mathematics secretaries to complain about Nash to Lefschetz and Tucker."

Melvin Hausner recalled: "He was always buried in thought. He'd sit in the common room by himself He could easily walk by you and not see you. He was always muttering to himself. Always whistling. Nash was always thinking. . . . If he was lying on a table, it was because he was thinking. Just thinking. You could see he was thinkingdd014

He seemed to be enjoying himself immensely. A profound dislike for merely absorbing knowledge and a strong compulsion to learn by doing is one of the most reliable signs of genius. In Princeton, Nash's thinking began to take on an urgent, focused quality. He was obsessed with learning from scratch. Milnor recalled: "It was as if he wanted to rediscover, for himself, three hundred years of mathematics.0"Steenrod, who was to become Nash's sounding board as the year wore on, wrote several years later, "More than any other student I have known, Nash believes in learning a subject by doing

-----166

research in

itdd016

Like the nineteenth-century German mathematician Carl Friedrich Gauss, who complained that "such an overwhelming horde of ideas stormed my mind before I was twenty that I could hardly control them and had time but for a small fraction,"" Nash seemed to overflow with ideas. According to Steenrod, "During his first year of graduate work, he presented me with a characterization of a simple closed curve in the plane. This was essentially the same as one given by Wilder in 1932. Some time later he devised a system of axioms for topology based on the primitive concept of connectedness. I was able to refer him to papers by Wallace.

During his second year, he showed me a definition of a new kind of homology group which proved to be the same as the Reidemeister group based on homotopy chains. What is striking about the ideas that Steenrod attributes to Nash as a first-year student is that they are not merely clever exercises designed to show off the brilliance of a precocious student, but mathematically interesting and important ideas." Nash was always on the lookout for problems. "He was very much aware of unsolved problems," said Milnor.

"He really cross-examined people on what were the important 167 problems. It showed a tremendous amount of ambition.""", In this search, as in so much else, Nash displayed an uncommon measure of self-confidence and self-importance. On one occasion, not long after his arrival at Princeton, he went to see Einstein and sketched some ideas he had for amending quantum theory. That first fall in Princeton, Nash sometimes took a slight detour down busy Mercer Street in order to catch a glimpse of Princeton's most remarkable resident." Most mornings between nine and ten, Einstein walked the mile or so from his white clapboard house at 112 Mercer Street to his office at the Institute. On several occasions, Nash managed to brush past the saintly scientist-wearing a baggy sweater, drooping trousers, sandals without socks, and an impassive expression on the streetdd"He imagined how he might strike up a conversation, stopping Einstein in his tracks with some startling observation." But once when he passed him walking with Kurt G6del, Nash caught snatches of German and sadly wondered whether his own lack of that language might constitute an

-----168
insuperable barrier to communicating with the great mandd14
In 1948, Einstein had been a world cult figure for more than a quarter of a century." His special theory of relativity was published in 1905, as was his assertion that light was propagated in space not as waves but as discrete particles. The general theory of relativity appeared in 1916. Astronomers' confirmation in 1919 that light rays were bent by the sun's gravity -- as Einstein had predicted -- brought him fame unrivaled by any scientist before or since. Einstein's political activities comon behalf of the A-bomb and then for nuclear disarmament, world government, the state of Israel -- added a ch`aintly aura. For decades, Einstein's main scientific preoccupations had been two, one in which he achieved a measure of success, the other a complete failuredd16 He succeeded in casting doubt on some of the basic tenets of one of the most successful and widely accepted theories in physics -- quantum theory -- a theory first proposed by himself when he demonstrated the existence of light quanta in 1905, and subsequently developed by Niels Bohr and Werner Heisenberg, who insisted the act

of observation changes the object being measured. Einstein's 1935 attack on quantum theory produced a front-page headline in The New York Times and has never been satisfactorily refuted; indeed, as of the mid-1990's, the latest experimental evidence has breathed new life into his critique.

His greater preoccupation was the ultimate task of uniting the phenomena of light and gravity into a single theory. Einstein never was able, as one biographer put it, to "accept that the universe was fragmented into relativity on one side and quantum

mechanics on the other."

A169

17

On the eve of his seventieth birthday, he was still searching for a single, consistent set of principles that applied to all of the universe's diverse forces and particles and was, in fact, preparing what proved to be his final paper on so-called "unified field theory."

It was a measure of Nash's bravura and the power of his fantasy that he was not content merely to see Einstein but soon requested an audience with him. Just a few weeks into his first term at Princeton,

-----170

Nash made an appointment to see

Genius

71

Einstein in his office in Fuld Hall. He told Einstein's assistant that he had an idea that he wished to discuss with Professor Einstein. Einstein's office, a large airy room with a bay window that let in plenty of light, was messy. Einstein's twenty-two-year-old Hungarian assistant—an intense, chain-smoking logician named John Kemeny, who would later invent the computer language BASIC, become president of Dartmouth College, and head a commission to investigate Three Mile Island—ushered Nash in. Einstein's handshake, which ended with a twist, was remarkably firm, and he showed Nash to a large wooden meeting table on the far side of the office. The late-morning light streaming through the bay window produced a sort of aura around Einstein. Nash, however, quickly got into the substance of his idea while Einstein listened politely, twirled the curls on the back of his head with his finger, sucked on his tobaccoless pipe, and occasionally muttered a remark or asked a question. As he spoke, Nash became aware of a mild form of echolalia: deep, deep,

-----171

interesting, interesting

Nash had an idea about "gravity, friction, and radiation." As he later recalled. The friction he was thinking of was the friction that a particle, say a photon, might encounter as it moved through space due to its fluctuating gravitational field interacting with other gravitational fields

.41

Nash had given his hunch enough thought to spend much of the meeting at the blackboard scribbling equations. Soon, Einstein and Kemeny were standing at the blackboard as

welldd41

The discussion lasted the better part of an hour. But in the end all that Einstein said, with a kindly smile, was 'You had better study some more physics, young mandd"Nash did not immediately take Einstein's advice and he never wrote a paper on his idea. His youthful foray into physics would become a lifetime interest-though, like Einstein's search for the unified field, it would not be especially fruituldd41 Many decades later, however, a German physicist published a similar idea.

44

Nash conspicuously avoided attaching himself to any

particular faculty member, either in the department or at the institute. It was not a matter of shyness, his fellow students thought, but rather that he wished to preserve his independence. One mathematician who knew Nash at the time observed: "Nash was determined to keep his intellectual independence. He didn't want to be unduly influenced. He'd talk freely with other students, but he was always worried about getting too close to other professors for fear that he'd be overwhelmed. He didn't want to become dominated. He disliked the whole idea of being intellectually beholden." He did, however, use at least one faculty member, Steenrod, as a kind of sounding board. Temperamentally, Steenrod was an entirely different character from flamboyant, domineering types like Lefschetz and Bochner, whose lectures, it was said, were "exciting but 90 percent wrong." Steenrod was a careful, methodical man who chose his suits and sports coats according to a mathematical formula and had a mania for thinking up highly logical, if impractical, solutions to social problems like crime. Steenrod also happened to be friendly, helpful, and patient. He was immensely impressed by Nash, found him more

172

-----173
charming than not, and treated the young man's brashness and eccentricity with amused tolerance. Surrounded for the first time in his life by young men whom he regarded, if not exactly as his equals, at least as worth talking to, Nash preferred picking other students' brains. "Some mathematicians work very much by themselves," said one fellow student. "He liked to exchange ideas." One of the students he sought out was John Milnor, the first of a number of brilliant younger mathematicians to whom Nash was drawn. Tall, lithe, with a baby face and the body of a gymnast, Milnor was only a freshman but he was already the department's golden boy.

In his freshman year, in a differential geometry course taught by Albert Tucker, he learned about an unproved conjecture of a Polish topologist, Karol Borsuk, concerning the total curvature of a knotted curve in space. The story goes that Milnor mistook the conjecture for a homework assignment. "Whatever the case, he arrived at Tucker's door a few days after with a written proof and the request: "Would you be good enough to point out the flaw in this attempt. I'm sure there is one, but

-----174

can't find it." Tucker studied it, showed it to Fox and to

Shiing-shen Chern. No one could find anything wrong. Tucker encouraged Milnor to submit the proof as a Note to the Annals of Mathematics.

A few months later Milnor turned in an exquisitely crafted paper with a full theory of the curvature of knotted curves in which the proof of the Borsuk conjecture was a mere by-product. The paper, more substantial than most doctoral dissertations, was published in the

Annals

in 1950. Milnor also dazzled the department-and Nasb-by winning the Putnam competition in his second semester at Princeton (in

fact, he went on to win it two more times and was offered A174
a Harvard scholarship.⁵¹

Nash was choosy about whom he would talk mathematics with. Melvin Peisakoff, another student who would later overlap with Nash at the RAND Corporation, recalled: "Tou couldn't engage him in a long conversation. He'd just walk off in the middle. Or he wouldn't respond at all. I don't remember Nash having a conversation that came to a nice soft landing. I also don't remember him ever

-----175

having a conversation about mathematics. Even the full professors would discuss problems they were working on with other people." On one occasion in the common room, however, Nash was sketching an idea when another graduate student got very interested in what he was saying and started to elaborate on the idea. Nash said, "Well, maybe I ought to write a Note for the Proceedings of the National Academy on this." The other student said, "Well, Nash, be sure to give me a credit." Nash's reply was, "All right, I'll put in a footnote that So and So was in the room when I had the idea." Nash was respected but not well liked. He wasn't invited to Kuhn's room for sherry or out with the others when they went to Nassau Street to drink beer. "He wasn't somebody you'd want as a close friend," Calabi recalled. "I don't know many people who felt any warmth for him." Most of the graduate students were slightly odd ducks themselves, beset by shyness, awkwardness, strange mannerisms, and all kinds of physical and psychological tics, but they collectively felt that Nash was even odder. "Nash was out of the ordinary," said a former graduate

-----176

student from his time. "If he was in a room with twenty people, and they were talking, if you asked an observer who struck you as odd, it would have been Nash. It wasn't anything he consciously did. It was his bearing. His aloofness."

Another recalled, "Nash was totally spooky. He wouldn't look at you. He'd take a lot of time answering a question. If he thought the question was foolish, he wouldn't answer at all. He had no affect. It was a mixture of pride and something else. He was so isolated but there really was underneath it all a warmth and appreciation [for other people]."

When Nash did engage in one of his flights of garrulity, he often seemed to be simply thinking out loud. Hausner remembered, "A lot

of us would discount a lot of what Nash said. A lot of the things he said were so far out, you didn't want to engage him. 'What was happening on earth when the Martians took over and there was a period of violence and why such and such' You wouldn't know what he was talking about. Nash came out with things. They were unfinished and we weren't ready to hear them. I wouldn't want to listen. You didn't feel comfortable with the person. His sense of humor was not only childish but odd.

-----177

One former student recalled that Nash was personally responsible for getting the much-despised gown requirement at meals

temporarily restored. "Firstea" recounted Felix Browder, A177 who left Princeton in the fall of 1948, "he wrote a letter to Hugh Taylor, a pompous ass who was looking for an excuse, demanding that the custom be restored. After it was, nobody ate in the hall. It didn't make John popular."" He was also capable of frightening people when provoked. Occasionally, the teasing and needling would spill over into a sudden eruption of violence. On one occasion, Nash was baiting one of Artin's students by telling him that the best way into Artin's graces was to catch his beautiful daughter Karindd"The student, Serge Lang, who everyone knew was painfully obsessed by his shyness around girls, threw a cup of hot tea in Nash's face. Nash chased him around the table, threw him to the ground, and stuffed ice cubes down the back of his shirt. Another time, Nash picked up a metal ashtray stand comthe kind that supports a heavy glass ashtray and brought it down on Melvin Peisakoffs shins, hard enough to cause considerable pain for a number of weeksdd611 In the spring of 1949, Nash ran into some trouble

-----178

.61

He had acquired some strong supporters on the faculty, namely Steenrod, Lefschetz, and Tucker. Tucker was among those who believed that Nash was "very brilliant and original but rather eccentric"arguing that "his creative ability ... should make one tolerate his queernessdd061 But not everyone in the department felt that way. Some felt that Nash didn't belong at Princeton at all. Among them was Artin. Slender, handsome, with ice-blue eyes and a spellbinding voice, Artin looked like a 1920's German matinee idoldd61 He wore a black leather trench coat and sandals throughout the academic year, wore his hair long, and smoked incessantly. The representative of "modern"algebra, Artin, who had been recommended by Weyl for the appointment at the institute that von Neumann eventually got, was a wonderful lecturer who admired polish and scholarship, but was famously intolerant of those who did not meet his rather fastidious standards. He was well known for screaming and throwing chalk at students who asked obtuse questions in his classes. Artin and Nash bad clashed a number of times in the

-----179

common room. Artin was always interested in talking with talented students. Yet he apparently found Nash not only irritatingly brash but also shockingly ignorantdd64 At a faculty meeting in

the spring, Artin commented that he could see no way for Nash to pass his generals, which the better students were expected to take at the end of their first year. When Lefschetz proposed an Atomic Energy Commission fellowship for Nash for the following year, Artin opposed it and made it clear he thought it would be better if Nash left Princeton. Lefschetz and Tucker overruled Artin on the subject of the fellowship⁶¹ But they dissuaded Nash from sitting for the generals that spring and suggested that he take them in the fall instead. He was safe for the time being, but his unpopularity among some faculty members was to crop up again when he sought, two years later, to join the department as

an assistant professor.
Princeton, Spring 1949
JOHN

A179

VON NEUMANN,
aka the Great Man behind his back, was threading his way through
the crowd, nattily dressed as always and daintily holding a cup
in one hand, a saucer in the

-----180
other. I The students` common room was unusually crowded on this
late afternoon in spring. A large audience, from the Institute
and physics as well as math, had turned out for So and So's
lecture and was lingering over tea. Von Neumann hovered for a
moment by two rather sloppily dressed graduate students who
hunched over a peculiar-looking piece of cardboard. It was a
rhombus covered with hexagons. It looked like a bathroom floor.
The two young men were taking turns putting down black and white
go stones and had very nearly covered the entire board.

Von Neumann did not ask the students or anyone near him what game
they were playing and when Tucker caught his eye momentarily, he
averted his glance and quickly moved away. Later that evening, at
a faculty dinner, however, he buttonholed Tucker and asked, with
studied casualness, "Oh, by the way, what was it that they were
playing?" "Nashea" answered Tucker, allowing the corners of his
mouth to turn up ever so slightly, "Nash."

Games were one of the charming European customs that the 6migr6's
brought with them to Fine Hall in the 1930's. Since then one game
or another has

-----181
always dominated the students' common room. Today it's
backgammon, but in the late

1940's it was Kriegspiel, go, and, after it was invented by its
namesake, "Nash" or "John."

In Nash's first year, there was a small clique of go players led
by Ralph Fox, the genial topologist who had imported it after the
war. Fox, who was a passionate Ping-Pong player, had achieved
master status in go, not altogether surprising given his
mathematical specialty. He was sufficiently expert to have been
invited to Japan to play go and to have once invited a well-known
Japanese master named Fukuda to play with him at Fine Hall.
Fukuda, who also played against Einstein and won, obliterated Fox
comto the delight of Nash and some of the other denizens of
Fineddbled

Kriegspiel, however, was the favorite game. A cousin of chess,

Kriegspiel was
a century-long fad in Prussia. William Poundstone, the author of
Prisoner Dilemma,
reports that Kriegspiel was devised as an educational game for
German military schools in the eighteenth century, originally
played on a board

-----182

consisting of a map of the French-Belgian frontier divided into a
grid of thirty-six hundred squares. Von Neumann, growing up in
Budapest, played a version of Kriegspiel with his brothers. They
drew castles, highways, and coastlines on graph paper, then

advanced and retreated armies according to a set of rules. A182
 Kriegspiel turned up in the United States after the Civil War,
 but Poundstone quotes an army officer complaining that the game
 "cannot readily and intelligently be pursued by anyone who is not
 a mathematician." Poundstone compared it to learning a foreign
 language⁶ The version of Kriegspiel that surfaced in the common
 room in the 1930's was played with three chessboards, of which
 one-the only one that accurately showed the moves of both players
 was visible only to the umpire. The players sat back to back
 and were ignorant of each other's moves. The umpire told them
 only whether the moves they made were legal or illegal and also
 when a piece was taken.

A number of his fellow students remember thinking that Nash spent
 all of his time at Princeton in the common room playing board
 games. Nash, who had played chess in high school, played both
 go

-----183

and Kriegspiel, the latter frequently with Steenrod or Tukey⁹
 He was by no means a brilliant player, but he was unusually
 aggressive¹⁰ "Games brought out Nash's natural competitiveness and
 one-upmanship. He would stride into the common room, one former
 student recalls, where people were playing Kriegspiel, glance at
 the boards, and say offhandedly but loudly enough for the players
 to hear, "Oh, white really missed his opportunity when he didn't
 take castle three moves ago"¹¹ One time, a new graduate
 student was playing go. "He managed not just to overwhelm me but
 to destroy me by pretending to have made a mistake and letting me
 think I was catching him in an oversight"¹² Hartley Rogers
 recalled. "This is regarded by the Japanese as a very invidious
 way of cheating

- hamate -

poker-type bluffing. That was a lesson both in how much better he
 was and how much better an actor."¹³ That spring, Nash astounded
 everyone by inventing an extremely clever game that quickly took
 over the common room." Piet Hein, a Dane, had invented the game a
 few years before Nash, and it would be marketed by Parker
 Brothers in the mid-1950's as Hex. But Nash's invention of the
 game appears

-----184

to have been entirely independent¹⁴

One can imagine that von Neumann felt a twinge of envy on hearing
 Tucker tell him that the game he was watching had been dreamed up
 by a first-year graduate student from West Virginia. Many great

mathematicians have amused themselves by thinking up games and puzzles, of course, but it is hard to think of a single one who has invented a game that other mathematicians find intellectually intriguing and esthetically appealing yet that nonmathematical people could enjoy

77

playing. I I The inventors of games that people do play -- whether chess, Kriegspiel, or go comare, of course, lost in the mists of time. Nash's game was his first bona fide invention and the first hard evidence of genius.

The game would likely not have appeared in a physical

manifestation, in the Princeton common room or anywhere else, had it not been for another graduate student named David Gale. Gale, a New Yorker who had spent the war in the MIT Radiation Lab, was one of the first men Nash met at the Graduate College.

16

-----185

Gale, Kuhn, and Tucker ran the weekly game theory seminar. Now a professor at Berkeley and the editor of a column on games and puzzles in

The MddblegtheMdd76671;Intelligencer,

Gale is an aficionado of mathematical puzzles and games. Nash knew of Gale's interest in such games since Gale was in the habit, during mealtimes at the Graduate College, of silently laying down a handful of coins in a pattern or drawing a grid and then abruptly challenging whoever was dining across the table to solve some puzzle. (This is exactly what Gale did when he saw Nash for the first time after a fifty-year hiatus at a small dinner in San Francisco to celebrate Nash's Nobel award.)

One morning in late winter 1949, Nash literally ran into the much shorter, wiry Gale on the quadrangle inside the Graduate College. "Gale! I have an example of a game with perfect information," he blurted out. "There's no luck, just pure strategy. I can prove that the first player always wins, but I have no idea what his strategy will be. If the first player loses at this game, it's because he's made a mistake, but nobody knows what

-----186

the perfect strategy is."

Nash's description was somewhat elliptical, as most of his explanations were. He described the game not in terms of a rhombus with hexagonal tiles, but as a checkerboard. "Assume that two squares are adjacent if they are next to each other in a horizontal or vertical row, but also on the positive diagonals," he said. "Then he described what the two players were trying to do.

When Gale finally understood what Nash was trying to tell him, he was captivated. He immediately started to think about how to design an actual game board, something that had apparently never occurred to Nash, who had been toying with the idea of the game since his final year at Carnegie. "You could make it pretty, I thought." Gale, who came from a well-to-do business family, was artistic and a bit of a tinkerer. He also thought, and said as much to Nash, that the game might have some commercial potential.

"So I made a board game," said Gale. "People played it using go stones. I left it in Fine Hall. It was the mathematical idea that counted. What I did was just design. I acted as his agent."

"Nash" or "John" is a beautiful example of a zero-sum two-person game with perfect information in

-----187

which one player always has a winning strategy." Chess and tic-tac-toe are also zero-sum two-person games with perfect information but they can end in draws. "Nash" is really a topological game. As Milnor describes it, an

11

n by n"

A187

Nash board consists of a rhombus tiled with n hexagons on each side." The ideal size is fourteen by fourteen. Two opposite edges of the board are colored black, the other two white. The players use black and white go stones. They take turns placing stones on the hexagons, and once played the pieces are never moved. The black player tries to construct a connected chain of black stones from the black to black boundary. The white player tries to do the same with white stones from the white to white boundary. The game continues until one or the other player succeeds. The game is entertaining because it is challenging and appealing because it involves no complex set of rules as does chess.

Nash proved that, on a symmetrical board, the first player can always win, His proof is extremely

-----188

deft, "marvelously nonconstructive" in the words of Milnor, who plays it very well. If the board is covered by black and white pieces, there's always a chain that connects black to black or white to white, but never both. As Gale put it, "You can walk from Mexico to Canada or swim from California to New York, but you can't do both." That explains why there can never be a draw as in tic-tac-toe. But as opposed to tic-tac-toe, even if both players try to lose, one will win, like it or not.

The game quickly swept the common room.

It brought Nash many admirers, including the young John Milnor, who was beguiled by its ingenuity and beauty. Gale tried to sell the game. He said, "I even went to New York and showed it to several manufacturers. John and I had some agreement that I'd get a share if it sold. But they all said no, a thinking game would never sell. It was a marvelous game though. I then sent it off to Parker Brothers, but I never got a response." Gale is the one who suggested the name Hex in his letter to Parker Brothers, which Parker used for the Dane's game. (Kuhn remembers Nash describing the

-----189

game to him, very likely over a meal at the college, in terms of points with six arrows emanating from each point, proof, in Kuhn's mind, that his invention was independent of Hein's.

(16

Kuhn made a board for his children, who played it with great delight and saw to it that their children learned it too.

Milnor still has a board that he made for his childrendd"His poignant essay on Nash's mathematical contributions for the Mathematical Intelligencer, written after Nash's Nobel Prize, begins with a loving and detailed description of the game. Princeton, 1948-49

JOHN

VON NEUMANN Was

the very brightest star in Princeton's mathematical firmament and the apostle of the new mathematical era. At forty-five, he was universally considered the most cosmopolitan, multifaceted, and intelligent mathematician

the twentieth century had produced. No one was more responsible for the newly found importance of mathematics in America's intellectual elite.

A189

-----190

Less of a celebrity than Oppenheimer, not as remote as Einstein, as one biographer put it, von Neumann was the role model for Nash's generation. He held a dozen consultancies, but his presence in Princeton was much felt. "We were all drawn by von Neumann." Harold Kuhn recalled. Nash was to come under his spell. Possibly the last true polymath, von Neumann made a brilliant career of half a dozen brilliant careers-by plunging fearlessly and frequently into any area where highly abstract mathematical thought could provide fresh insights. His ideas ranged from the first rigorous proof of the ergodic theorem to ways of controlling the weather, from the implosion device for the A-bomb to the theory of games, from a new algebra [of rings of operators) for studying quantum physics to the notion of outfitting computers with stored programs. A giant among pure mathematicians by the time he was thirty years old, he had become in turn physicist, economist, weapons expert, and computer visionary. Of his 150 published papers, 60 are in pure mathematics, 20 in physics, and 60 in applied mathematics, including statistics and game theory. When he died in

-----191

1957 of cancer at fifty-three, he was developing a theory of the structure of the human brain.

Unlike the austere and otherworldly G. H. Hardy, the Cambridge number theorist idolized by the previous generation of American mathematicians, von Neumann was worldly and engaged. Hardy abhorred politics, considered applied mathematics repellent, and saw pure mathematics as an esthetic pursuit best practiced for its own sake, like poetry or music. Von Neumann saw no contradiction between the purest mathematics and the grittiest engineering problems or between the role of the detached thinker and the political activist.

He was one of the first of those academic consultants who were always on a train or plane bound for New York, Washington, or Los Angeles, and whose names frequently appeared in the news. He gave up teaching when he went to the Institute in 1933 and gave up full-time research in 1955 to become a powerful member of the Atomic Energy Commission. "He was one of the people who told Americans how to think about the bomb and the Russians, as well as how to think about the peaceful uses of

atomic energydd"An alleged model for Dr.

-----192

Strangelove in the 1963 Stanley Kubrick film," he was a passionate Cold Warrior, advocating a first strike against Russia"and defending nuclear testingdd14 Twice married and wealthy, he loved expensive clothes, hard liquor, fast cars, and dirty jokes." He was a workaholic, blunt and even cold at times. 16 Ultimately he was hard to know; the standing joke around Princeton was that von Neumann was really an extraterrestrial who had learned how to imitate a human perfectly." In public, though, von Neumann exuded Hungarian charm and wit. The parties he gave

in his brick mansion on Princeton's fashionable Library Place were "frequent and famous and long," according to Paul Halmos, a mathematician who knew von Neumann. His rapid-fire repartee in any of four languages was packed with references to history, politics, and the stock market. His memory was astounding and so was the speed with which his mind worked. He could instantly memorize a column of phone numbers and virtually anything else. Stories of von Neumann's beating computers in mammoth feats of calculation abound. Paul Halmos tells the story in an obituary of the first

-----193

test of von Neumann's electronic computer. Someone suggested a question like "What is the smallest power of 2 with the property that its decimal digit fourth from the right is 7?" Z Halmos recounts, "The machine and Johnny started at the same time, and Johnny finished first." Another time somebody asked him to solve the famous fly puzzle: "Two bicyclists start twenty miles apart and head toward each other, each going at a steady rate of 10 m.p.h. At the same time, a fly that travels at a steady 15 m.p.h. starts from the front wheel of the southbound bicycle and flies to the front wheel of the northbound one, then turns around and flies to the front wheel of the southbound one again, and continues in this manner till he is crushed between the two front wheels. Question: what total distance did the fly cover? There are two ways to answer the problem. One is to calculate the distance the fly covers on each leg of its trips between the two bicycles and finally sum the infinite series so obtained. The quick way is to observe that the bicycles meet exactly an hour after they start so that the fly had just an hour for his travels; the answer must therefore be 15 miles.

-----194

When the question was put to von Neumann, he solved it in an instant, and thereby disappointed the questioner: "Oh, you must have heard the trick before!" What trick? asked von Neumann, "all I did was sum the infinite series." This seems astounding until one learns that at six, von Neumann could divide two eight-digit numbers in his head. Born in Budapest to a family of Jewish bankers, von Neumann was undeniably John von Neumann precocious. At age eight, he had mastered calculus. At age twelve, he was reading works aimed at professional

mathematicians, such as Emile Borel's

Theorie des Fonctions,

But he also loved to invent mechanical toys and became a child expert on Byzantine history, the Civil War, and the trial of Joan of Arc. When it was time to go off to university, he agreed to study chemical engineering as a compromise with his father, who feared that his son couldn't make a living as a mathematician.

Von Neumann kept his bargain by enrolling at the University of Budapest and promptly leaving for Berlin, where he spent his time

doing mathematics, including visiting lectures by Einstein, 195 and returning to Budapest at the end of every semester to take examinations. He published his second mathematics paper, in which he gave the modern definition of ordinal numbers which superseded Cantor's, at age nineteen¹⁴By age twenty-five he had published ten major papers; by age thirty, nearly three dozen."

As a student in Berlin, von Neumann frequently took the three-hour train trip to Gatingen, where he got to know Hilbert. The relationship led to von Neumann's famous 1928 paper on the axiomatization of set theory. Later he found the first mathematically rigorous proof of the ergodic theorem, solved Hilbert's so-called Fifth Problem for compact groups, invented a new algebra and a new field called "continuous geometry," which is the geometry of dimensions that vary continuously (instead of a fourth dimension, one could now speak of three and three-quarters dimension). He was also a leader in the drive among mathematicians to colonize other disciplines by inventing new approaches¹⁶Von Neumann was still in his twenties when he wrote his famous paper on the theory of parlor games and his groundbreaking

-----196
book on the mathematics of the new quantum physics, Mathematische Grundlagen der Quantenmechanik- the one Nash studied in the original German at Carnegie.
17

Von Neumann was a privatdozent first at Berlin and then at Hamburg. He became a half-time professor at Princeton in 1931 and joined the Institute for Advanced Study in 1933 at age thirty. When the war came, his interests shifted once again. Halmos says that "till then he was a top-flight pure mathematician who understood physics; after that he was an applied mathematician who remembered his pure work."" During the war, he collaborated with Morgenstern on a twelvehundred-page manuscript that became The Theory of Games and Economic Behavior. He was also the top mathematician in Oppenheimer's Manhattan Project from 1943 onward. His contribution to the A-bomb was his proposal for an implosion method for triggering an

-----197
explosion with nuclear fuel, an idea credited with shortening the time needed to develop the bomb by as much as a year¹⁹
In 1948, he was back at the Institute and very much a presence in

Princeton. He did not teach any courses, but he edited and held court at the IASDD11 He dropped in at Fine Hall teas from time to time. He and Oppenheimer were already deep into their great debate over whether the H-bomb, or the Super, as it was known, could and should be built." He was fascinated by meteorological prediction and control, suggesting once that the north and south poles be dyed blue in order to raise the earth's temperature. He not only showed the physicists, economists, and electrical engineers that formal mathematics could yield fresh breakthroughs in their fields but made the enterprise of applying mathematics to real-world disciplines seem glamorous to

the purest of young mathematicians.

A197

By the end of the war, von Neumann's real passion had become computers, though he called his interest in them "obscene."

While he did not build the first computer, his ideas about computer architecture were accepted, and he invented mathematical techniques

-----198

needed for computers. He and his collaborators, who included the future scientific director of IBM, Hermann Goldstine, invented stored rather than hardwired programs, a prototype digital computer, and a system for weather prediction. The theoretically oriented Institute had no interest in building a computer, so von Neumann sold the idea to the Navy, arguing that the Normandy invasion had almost failed because of poor weather predictions. He promoted the MANIAC, as the machine was eventually named, as a device for improving meteorological prediction. More than anything, though, von Neumann was the one who saw the potential of these "thinking machines" most clearly, arguing in a speech in Montreal in 1945 that "many branches of both pure and applied mathematics are in great need of computing instruments to break the present stalemate created by the failure of the purely analytical approach to nonlinear problems."

Everything von Neumann touched was imbued with his glamour. By wading fearlessly into fields far beyond mathematics, he inspired other young geniuses, Nash among them, to do the same. His success in applying similar approaches to dissimilar problems

-----199

was a green light for younger men who were problem solvers rather than specialists.

The invention of deliberately oversimplified theories is one of the major techniques of science, particularly of the "exact" sciences, which make extensive use of mathematical analysis. If a biophysicist can usefully employ simplified models of the cell and the cosmologist simplified models of the universe then we can reasonably expect that simplified games may prove to be useful models for more complicated conflicts.

comJOHN WILLIAMS,

The Compleat Strategist

I

11 NASH BECAME AWARE-OF

a new branch of mathematics that was in the air of Fine Hall. It was an attempt, invented by von Neumann in the 1920's, to construct a systematic theory of rational human behavior by

focusing on games as simple settings for the exercise of human rationality.

The first edition of

The Theory of Games and Economic Behavior by von Neumann and Oskar Morgenstern came out in

-----200

1944.1 Tucker

was running a popular new seminar in Fine on game theory.` The Navy, which had made use of the theory during the war in antisubmarine warfare, was pouring money into game theory research at Princeton.` The pure mathematicians around the

department and at the Institute were inclined to view the A200 new branch of mathematics, with its social science and military orientation, as "trivial;" "just the latest fad" and "d6class6"

"4 but to many of the students at Princeton at the time it was glamorous, heady stuff, like everything associated with von Neumann."

Kuhn and Gale were always talking about von Neumann and Morgenstern's book

.6 Nash attended a lecture by von Neumann, one of the first speakers in Tucker's seminar. Nash was intrigued by the apparent wealth of interesting, unsolved problems. He soon became one of the regulars at the seminar that met Thursdays at five o'clock; before long he was identified as a member of "Tucker's clique."

-----201
Mathematicians have always found games intriguing. Just as games of chance led to probability theory, poker and chess began to interest mathematicians around G6menttingen, the Princeton of its time, in the 1920'sdd9 Von Neumann was the first to provide a complete mathematical description of a game and to prove a fundamental result, the min-max theorem."

Von Neumann's 1928 paper, Zur Theorie der Gcsellschaftsspiele, suggests that the theory of games might have applications to economics: "Any eventgiven the external conditions and the participants in the situation (provided that the latter are acting of their own free will) -- may be regarded as a game of strategy if one looks at the effect it has on the participantsea"adding, in a footnote, "[this] is the principal problem of classical economics: how is the absolutely selfish `homo economicus` going to act under given external circumstances.0"B the focal point of the theory-in von Neumann's lectures and in discussions in mathematical circles during the 1930's-basically remained the exploration of parlor games like chess and pokerdd12 It was not until von Neumann met Morgenstern, a

-----202
fellow 6migr6, in Princeton in 1938 that the link to economics was forged." Morgenstern, a tall, imposing expatriate from Vienna who was given to Napoleonic airs, claimed to be the grandson of the Kaiser's father, Friedrich In of Germanydd14 Tall, darkly handsome, "with cool gray eyes and a sensuous mouth," Morgic cut

an elegant figure on horseback, and caused a sensation among his students by abruptly marrying a beautiful redhead named Dorothy, a volunteer for the World Federalists many years his junior." Born in Silesia, Germany, in 1902, Morgenstern grew up and was educated in Vienna in a period of great intellectual and artistic ferment¹⁶ After a three-year fellowship abroad financed by the Rockefeller Foundation, he became a professor and, until the Anschluss, was head of an institute for business cycle research. When Hitler marched into Vienna, Morgenstern happened to be visiting Princeton, and he decided it made sense to stay. He joined the university's economics faculty, but disliked most of

his American colleagues. He gravitated to the Institute, A202
where Einstein, von Neumann, and G6deI were working at the time,
-----203

angling for, but never receiving, an appointment there. "There is
a spark missing," he wrote disdainfully to a friend, referring to
the University. "It is too provincial."

Morgenstern was, by temperament, a critic.

His first book,

Wirtschaftspearognose

(Economic Prediction),

was an attempt to prove that forecasting the ups and downs of the
economy was a futile endeavor." One reviewer called it as
disremarkable for its pessimism as it is for any ... theoretical
innovationdd"19 Unlike those in astronomy, economic predictions
have the peculiar ability to change outcomes." Predict a
shortage, and businesses and consumers will react; the result is
a glut.

His larger theme was the failure of economic theory to take
proper account of interdependence among economic actors. He saw
interdependence as the salient feature of all economic decisions,
and he was always criticizing other economists for ignoring
itdd"Robert Leonard, the historian, writes: "To some extent, his
increasingly harsh views of economic theory were the product of

-----204
mathematicians' critical stance on the subject.0"Von Neumann, he
found, "focused on the black hole in the middle of economic
theory.0"Ac to one of von Neumann's biographers, Morgenstern
"interested him in aspects of economic situations, specifically
in problems of exchange of goods between two or more persons, in
problems of

The Theojoy of Games

monopoly, oligopoly and free competition. It was in a discussion
of attempts to schernatize mathematically such processes that the
present shape of this theory began to take formdd014

Morgenstern yearned to do "something in the truly scientific
spiritdd015 He convinced von Neumann to write a treatise with him
arguing that the theory of games was the correct foundation for
all economic theory. Morgenstern, who had studied philosophy, not
mathematics, could not contribute to the elaboration of the
theory, but played muse and producerdd16 Von Neumann wrote almost
the whole twelve-hundred-page treatise, but it was Morgenstern
who crafted the book's provocative introduction and framed the
issues in such a way that the book captured the attention of the

mathematical and

-----205

economic community.

27

The Theory of Games and Economic Behavior

was in every way a revolutionary book. In line with Morgenstern's agenda, the book was "a blistering attack" on the prevailing paradigm in economics and the Olympian Keynesian perspective, in which individual incentives and individual behavior were often subsumed, as well as an attempt to ground the theory in individual psychology. It was also an effort to reform social

theory by applying mathematics as the language of scientific logic, in particular set theory and combinatorial methods. The authors wrapped the new theory in the mantle of past scientific revolutions, implicitly comparing their treatise to Newton's Principia

and the effort to put economics on a rigorous mathematical footing-to Newton's mathematization, using his invention of the calculus, of physicsdd"One reviewer, Leo Hurwicz, wrote, "Ten more such books and the future of economics is assureddd019 The essence of von Neumann and Morgenstern's

-----206
message was that economics was a hopelessly unscientific discipline whose leading members were busily peddling solutions to pressing problems of the day-such as stabilizing employment comwithout the benefit of any scientific basis for their proposals.`,, The fact that much of economic theory had been dressed up in the language of calculus struck them as "exaggerated" and a failuredd"Th was not, they said, because of the "human element"or because of poor measurement of economic variablesdd"R, they claimed, "Economic problems are not formulated clearly and are often stated in such vague terms as to make mathematical treatment q priori appear hopeless because it is quite uncertain what the problems really are.""

Instead of pretending that they had the expertise to solve urgent social problems, economists should devote themselves to "the gradual development of a theorydd014 The authors argued that a new theory of games was "the proper instrument with which to develop a theory of economic behavior.0"The authors claimed that "the typical problems of economic behavior become strictly identical with the mathematical notions of suitable games of -----207
strategy."

16
Under the heading "necessary limitations of the objectivesea"von Neumann and Morgenstern admitted that their efforts to apply the new theory to economic problems had led them to "results that are already fairly well known," but defended themselves by contending that exact proofs for many well-known economic propositions had been lacking."
Before they have been given the respective proofs, theory simply

does not exist as a scientific theory. The movements of the planets were known long before their courses had been calculated and explained by Newton's theory...

We believe that it is necessary to know as much as possible about the behavior of the individual and about the simplest forms of exchange. This standpoint was actually adopted with remarkable success by the founders of the marginal utility school, but nevertheless it is not generally accepted. Economists frequently point to much larger, more burning questions and brush everything aside which prevents them from making statements about them. The experience of more advanced sciences, for example, physics,

indicates this impatience merely A207

-----208

delays progress, including the treatment of the burning questions.

When the book appeared in 1944,

von Neumann's reputation was at its peak. It got the kind of public attention comincluding a breathless front-page story in The New York Times-that

no other densely mathematical work had ever received, with the exception of Einstein's papers on the special and general theories of relativity." Within two or three years, a dozen reviews appeared by top mathematicians and economistsdd39

The timing, as Morgenstern had sensed, was perfect. The war had unleashed a search for systematic attacks on all sorts of problems in a wide variety of fields, especially economics, previously thought to be institutional and historical in character. Quite apart from the new theory of games, a major transformation was under way comled by Samuelson's Foundations of Economic Theory-making economic theory more rigorous through the use of calculus and advanced statistical methodsdd40 Von Neumann was critical of these efforts, but

-----209

they surely prepared the ground for the reception of game theorydd41

Economists were actually somewhat standoffish, at least compared to mathematicians, but Morgenstern's antagonism to the economics profession no doubt contributed to that reaction. Samuelson later complained to Leonard, the historian, that although Morgenstern made "great claims, he himself lacked the mathematical wherewithal to substantiate them. Moreover [Morgenstern] had the irksome habit of always invoking the authority of some physical scientist or anotherdd041 In Princeton, Jacob Viner, the chairman of the economics department, heaped scorn on the unpopular Morgenstern by saying that if game theory couldn't even solve a game like chess, what good was it, since economics was far more complicated than cheSS"41

It must have become obvious to Nash fairly early on that "the biblea"z

The Theory of Games and Economic Behavior

was known to students, though mathematically innovative,

contained no fundamental new theorems beyond von Neumann's
stunning min-max theorem.- He reasoned that von Neumann had

-----210

The Theory of Games

87

succeeded neither in solving a major outstanding problem in
economics using the new theory nor in making any major advance in
the theory itself⁴ful Not a single one of its applications to
economics did more than restate problems that economists had
already grappled with^{dd46} More important, the best-developed part
of the theory com^{wh} took up one-third of the book com^{cc}cerned

zero-sum two-person games, which, because they are games of total conflict, appeared to have little applicability in social science

.47

Von Neumann's theory of games of more than two players, another large chunk of the book, was incomplete. He couldn't prove that a solution existed for all such games. The last eighty pages of

The Theory of Games and Economic Behavior dealt with non-zero-sum games, but von Neumann's theory reduced such games formally to zero-sum games by introducing a fictitious player who consumes the excess or makes up the deficit. As one commentator was later to write, "This artifice helped but did not suffice for a

-----211

completely adequate treatment of the non-zero-sum case. This is unfortunate because such games are the most likely to be found useful in practice."

To an ambitious young mathematician like Nash, the gaps and flaws in von Neumann's theory were as alluring as the puzzling absence of ether through which light waves were supposed to travel was to the young Einstein. Nash immediately began thinking about the problem that von Neumann and Morgenstern described as the

most important test of the new theory. Princeton, Spring 1949

We hope however to obtain a real understanding of the problem of exchange by studying it from an altogether different angle; that is, from the perspective of a `came of/ateea7. ?- Voation

NE-UMANN AND MoRGEN-STERN,

The Theory of Games and Economic Behavior, second edition, 1947

ASH WROTE HIS FIRST PAPER, one of the great classics of modern economics, during his second term at Princeton. "The Bargaining Problem" is a remarkably down-to-earth work for a mathematician, especially a young mathematician.

-----212

Yet no one but a brilliant mathematician could have conceived the idea. In the paper, Nash, whose economics training consisted of a single undergraduate course taken at Carnegie, adopted "an altogether different angle" on one of the oldest problems in economics and proposed a completely surprising solution. By so doing, he showed that behavior that economists had long considered part of human psychology, and therefore beyond the reach of economic reasoning, was, in fact, amenable to systematic analysis.

The idea of exchange, the basis of economics, is nearly as old as man, and deal-making has been the stuff of legend since the Levantine kings and the pharaohs traded gold and chariots for weapons and slaves. Despite the rise of the great impersonal capitalist marketplace, with its millions of buyers and sellers who never meet face-to-face, the one-on-one bargain cominvolving wealthy individuals, powerful governments, labor unions, or giant corporations comdominates the headlines, But two centuries after the publication of Adam Smith's The Wealth of Nations, there were still no principles of economics that could

tell one how the parties to a potential bargain would interact, or how they would split up the pie.

The economist who first posed the problem of the bargain was a reclusive Oxford don, Francis Ysidro Edgeworth, in 1881.¹

Edgeworth and several of his Victorian contemporaries were the first to abandon the historical and philosophical tradition of Smith, Ricardo, and Marx and to attempt to replace it with the mathematical tradition of physics, writes Robert Heilbroner in

The Worldly Philosophers.⁶

Edgeworth was not fascinated with economics because it justified or explained or condemned the world, or because it opened new vistas, bright or gloomy, into the future. This odd soul was fascinated by economics because economics dealt with quantities

and because anything that dealt with quantities could be translated into

mathematics.¹

Edgeworth thought of people as so many profit-and-loss calculators and recognized that the world of perfect competition had "certain properties peculiarly

-----214

favorable to mathematical calculation; namely a certain indefinite multiplicity and dividedness, analogous to that infinity and infinitesimality which facilitate so large a portion of Mathematical Physics ... (consider the theory of Atoms, and all applications of the Differential Calculus)."

The weak link in his creation, as Edgeworth was uncomfortably aware, was that people simply did not behave in a purely competitive fashion. Rather, they did not behave this way all the time. True, they acted on their own. But, equally often, they collaborated, cooperated, struck deals, evidently also out of self-interest. They joined trade unions, they formed governments, they established large enterprises and cartels. His mathematical models captured the results of competition, but the consequences of cooperation proved elusive.⁹

Is it peace or war? asks the lover of "Maud" of economic competition, It is both, pax or pact between contractors during contract, war, when some of the contractors without consent of others contract.

The first principle of Economics is that every agent is actuated only by self-interest. The workings of this

-----215

principle may be viewed under two aspects, according as the agent acts without, or with, the consent of others affected by his actions. In a wide sense, the first species of action may be called war; the second contract.

Obviously, parties to a bargain were acting on the expectation that cooperation would yield more than acting alone. Somehow, the parties reached an agreement to share the pie. How they would split it depended on bargaining power, but on that score economic theory had nothing to say and there was no way of finding one solution in the haystack of possible solutions that met this rather broad criterion. Edgeworth admitted defeat: "The general

answer is -- (a) Contract without competition is A215
indeterminatedd010

Over the next century, a half-dozen great economists, including the Englishmen John Hicks and Alfred Marshall and the Dane F. Zeuthen, took up Edgeworth's problem, but they, too, ended up throwing up their handsdd"Von Neumann and Morgenstern suggested that the answer lay in reformulating the problem as a game of strategy, but they themselves did not succeed in solving it." Nash took a completely novel approach to the

-----216
problem of predicting how two rational bargainers will interact. Instead of defining a solution directly, he started by writing down a set of reasonable conditions that any plausible solution would have to satisfy and then looked at where they took him. This is called the axiomatic approach -- a method that had swept mathematics in the 1920's, was used by von Neumann in his book on quantum theory and his papers on set theory, and was in its heyday at Princeton in the late 1940'sdd11 Nash's paper is one of the first to apply the axiomatic method to a problem in the social sciencesdd14

Recall that Edgeworth had called the problem of the bargain "indeterminatedd" In other words, if all one knew about the bargainers were their preferences, one couldn't predict how they would interact or how they would divide the pie. The reason for the indeterminacy would have been obvious to Nash. There wasn't enough information so one had to make additional assumptions. Nash's theory assumes that both sides' expectations about each other's behavior are based on the intrinsic features of the bargaining situation itself. The essence of a situation that results in a deal is "two individuals who have the opportunity

-----217
to collaborate for mutual benefit in more than one way.0" How they will split the gain, he reasoned, reflects how much the deal is worth to each individual.

He started by asking the question, Vs/bat reasonable conditions would any solution comany split comh to satisfy? He then posed four conditions and, using an ingenious mathematical argument, showed that, if his axioms held, a unique solution existed that maximized the product of the players' utilities. In a sense, his contribution was not so much to "solve" the problem as to state it in a simple and precise way so as to show that unique solutions were possible.

The striking feature of Nash's paper is not its difficulty, or

its depth, or even its elegance and generality, but rather that it provides an answer to an important problem. Reading Nash's paper today, one is struck most by its originality. The ideas seem to come out of the blue. There is some basis for this impression. Nash arrived at his essential idea-the notion that the bargain depended on a combination of the negotiators' back-up alternatives and the potential benefits of striking a deal comz an undergraduate at Carnegie Tech before he came

-----218

to Princeton, before he started attending Tucker's game theory seminar, and before. he had read von Neumann and Morgenstern's

book. It occurred to him while he was sitting in the only A218
economics course he would ever attend.

16

The course, on international trade, was taught by a clever and
young Viennese

6migr6

in his thirties named Bert Hoselitz. Hoselitz, who emphasized
theory in his course, had degrees in law and economics, the
latter from the University of Chicagodd"International agreements
between governments and between monopolies had dominated trade,
especially in commodities, between the wars, and Hoselitz
was an expert on the subject of international cartels and
tradedd"Nash took the course in his final semester, in the spring
of 1948, simply to fulfill degree requirements. 19 As always,
though, the big, unsolved problem was the bait.

That problem concerned trade deals between countries with
separate currencies, as he told Roger Myerson, a game theorist at
Northwestern University, in

-----219

1996.11 One of Nash's axioms, if applied in an international
trade context, asserts that the outcome of the bargain shouldn't
change if one country revalued its currency. Once at Princeton,
Nash would have quickly learned about von Neumann and
Morgenstern's theory and recognized that the arguments that he'd
thought of in Hoselitz's class had a much wider applicability."
Very likely Nash sketched his ideas for a bargaining solution in
Tucker's seminar and was urged by Oskar Morgenstern -- whom Nash
invariably referred to as Oskar La Morgue -- to write a paper."
Legend, possibly encouraged by Nash himself, soon had it that
he'd written the whole paper in Hoselitz's class commuch as
Milnor solved the Borsuk problem in knot theory as a homework
assignment comand that he had arrived at Princeton with the
bargaining paper tucked into his briefcasedd"Nash has since
corrected the record

.14

But when the paper was published in 1950, in *Econometrica*,
the leading journal of mathematical economics, Nash was careful
to retain full credit for the ideas:

-----220

"The author wishes to acknowledge the assistance of Professors
von Neumann and Morgenstern who read the original form of the
paper and gave helpful advice as to the presentation."

15

And in his Nobel autobiography, Nash makes it clear that it was his interest in the bargaining problem that brought him into contact with the game theory group at Princeton, not the other way around: "as a result of that exposure to economic ideas and problems I arrived at the idea that led to the paper `The Bargaining Problem` which was later published in *Econometrica*. And it was this idea which in turn, when I was a graduate student at Princeton, led to my interest in the game theory studies there." 16

Nash's Rival Idea

Princeton, 1949-50

I was playing a non-cooperative game in rebellion to von A220
 Neumann rather than
 simply seeking to join his coalition. comJOHN F NA-SH, JR., 1993
 IN
 THE SUMMER OF

-----221
 1949, Albert Tucker caught the mumps from one of his children.
 He had planned to be in Palo Alto, California, where he was to
 spend his sabbatical year, by the end of August. Instead, he was
 in his office at Fine, gathering up some books and papers, when
 Nash walked in to ask whether Tucker would be willing to
 supervise his thesis.

Nash's request caught him by surprise. Tucker had little direct
 contact with Nash during the latter's first year and had been
 under the impression that he would probably write a thesis with
 Steenrod. But Nash, who offered no real explanation, told Tucker
 only that he thought he had found some "good results related to
 game theory." Tucker, who was still feeling out of sorts and
 eager to get home, agreed to become his adviser only because he
 was sure that Nash would still be in the early stages of his
 research by the time he returned to Princeton the following
 summer.

Six weeks later, Nash and another student were buying beers for a
 crowd of graduate students and professors in the bar in the
 basement of the Nassau Inn--a tradition demanded of men who had
 just passed their generals. The mathematicians were growing more
 boisterous and drunken by the minute. A limerick

-----222
 competition was in full swing. The object was to invent the
 cleverest, dirtiest rhyme
 a member of the Princeton mathematics department, preferably
 about one of the ones present, and shout it out at the top of
 one's lungs. At one point, a shaggy, tall
 aptly named Macbeath jumped to his feet, beer bottle in hand, and
 began to belt out stanza after stanza of a popular and salacious
 drinking song, with the others chiming in for the chorus: "I put
 my hand upon her breast. She said, 'Young man, I like that
 best.'"
 Chorus) Gosh, gore, blimey, how ashamed I was."
 That night, with its quaint, masculine rite of passage, marked
 the effective end of Nash's years as a student. He had been
 trapped in Princeton for an entire
 hot and sticky summer, forced to put aside the interesting
 problems he had been thinking about, to cram for the general

examination

.6

Luckily, Lefschetz had appointed a friendly trio of examiners:
Church, Steenrod, and a visiting professor from Stanford, Donald
Spencer⁷ The whole nerve-racking event had gone

-----223

rather well.

Many mathematicians, most famously the French genius Henri
Poincar⁶, have testified to the value of leaving a partially
solved problem alone for a while and letting the unconscious work
behind the scenes. In an oft-quoted passage from a

1908 essay about the genesis of mathematical discovery, A223

Poincaré writes: I

For fifteen days I struggled to prove that no functions analogous to those I have since called Fuchsian functions could exist. I was then very ignorant. Every day I sat down at my work table where I spent an hour or two; I tried a great number of combinations and arrived at no result.... I then left Caen where I was living at the time, to participate in a geological trip sponsored by the School of Mines. The exigencies of travel made me forget my mathematical labors; reaching Coutances we took a bus for some excursion or another. The instant I put my foot on the step the idea came to me, apparently with nothing whatever in my previous thoughts having prepared me for it. Nash's "wasted" summer, with its enforced break from his research, proved unexpectedly fruitful, allowing several vague hunches from the spring to crystallize

-----224

and mature. That October, he started to experience a virtual storm of ideas. Among them was his brilliant insight into human behavior: the Nash equilibrium.

Nash went to see von Neumann a few days after he passed his generalsdd9 He wanted, he had told the secretary cockily, to discuss an idea that might be of interest to Professor von Neumann. It was a rather audacious thing for a graduate student to do." Von Neumann was a public figure, had very little contact with Princeton graduate students outside of occasional lectures, and generally discouraged them from seeking him out with their research problems. But it was typical of Nash, who had gone to see Einstein the year before with the germ of an idea.

Von Neumann was sitting at an enormous desk, looking more like a prosperous bank president than an academic in his expensive three-piece suit, silk tie, and jaunty pocket handkerchiefdd" He had the preoccupied air of a busy executive. At the time, he was holding a dozen consultancies, "arguing the ear off Robert Oppenheimer" over the development of the H-bomb, and overseeing the construction and programming of two

-----225

prototype computers." He gestured Nash to sit down. He knew who Nash was, of course, but seemed a bit puzzled by his visit. He listened carefully, with his head cocked slightly to one side and his fingers

tapping. Nash started to describe the proof he had in mind for an equilibrium in games of more than two players. But before he had

gotten out more than a few disjointed sentences, von Neumann interrupted, jumped ahead to the yet unstated conclusion of Nash's argument, and said abruptly, "That's trivial, you know. That's just a fixed point theorem."

It is not altogether surprising that the two geniuses should clash. They came at game theory from two opposing views of the way people interact. Von Neumann, who had come of age in European caf6 discussions and collaborated on the bomb and computers, thought of people as social beings who were always communicating. It was quite natural for him to emphasize the central importance of coalitions and joint action in society. Nash tended to think

of people as out of touch with one another and acting on their own. For him, a perspective founded on the ways that people react to individual incentives seemed far more natural.

-----226

Von Neumann's rejection of Nash's bid for attention and approval must have hurt, however, and one guesses that it was even more painful than Einstein's earlier but kindlier dismissal. He never approached von Neumann again. Nash later rationalized von Neumann's reaction as the naturally defensive posture of an established thinker to a younger rival's idea, a view that may say more about what was in Nash's mind when he approached von Neumann than about the older man. Nash was certainly conscious that he was implicitly challenging von Neumann. Nash noted in his Nobel autobiography that his ideas

deviated somewhat from the conventional lines of von Neumann and Morgenstern book. "I

his

Valleius, the Roman philosopher, was the first to offer a theory for why geniuses often appeared, not as lonely giants, but in clusters in particular fields in particular cities. He was thinking of Plato and Aristotle, Pythagoras and Archimedes, and Aeschylus, Euripides, Sophocles, and Aristophanes, but there are many later examples as well, including Newton and

-----227

Locke, or Freud, Jung, and Adler. He speculated that creative geniuses inspired envy as well as emulation and attracted younger men who were motivated to complete and recast the original contribution."

In a letter to Robert Leonard, Nash wrote a further twist: "I was playing a non-cooperative game in relation to von Neumann rather than simply seeking to join his coalition. And of course, it was psychologically natural for him not to be entirely pleased by a rival theoretical approach."

16

In his opinion, von Neumann never behaved unfairly. Nash compares himself to a young physicist who challenged Einstein, noting that Einstein was initially critical of Kaluza's five-dimensional unified theory of gravitational and electric fields but later supported its publication. Nash, so often oblivious to the feelings and motivations of other people, was quick, in this case, to pick up on certain emotional undercurrents, especially envy and jealousy. In a way, he saw rejection as the price genius must pay.

A few days after the disastrous meeting with von Neumann, Nash accosted

-----228

David Gale. "I think I've found a way to generalize von Neumann's min-max theorem" he blurted out. "The fundamental idea is that in a two-person zero-sum solution, the best strategy for both is ... The whole theory is built on it. And it works with any number of people and doesn't have to be a zero-sum game." Gale recalls Nash's saying, "I'd call this an equilibrium point." The idea of equilibrium is that it is a natural resting point that tends to persist. Unlike von Neumann, Gale saw Nash's point. "Hm" he

said, "that's quite a thesis" Gale realized that Nash's idea applied to a far broader class of real-world situations than von Neumann's notion of zero-sum games. "He had a concept that generalized to disarmament" Gale said later. But Gale was less entranced by the possible applications of Nash's idea than its elegance and generality. "The mathematics was so beautiful. It was so right mathematically."

Once again, Gale acted as Nash's agent. "I said this is a great result" Gale recalled. "This should get priority." He told Nash that he was sure that Nash had a brilliant thesis in hand. But he also urged Nash to take credit for the result right

-----229
away before someone else came up with a similar idea. Gale suggested asking a member of the National Academy of Sciences to submit the proof to the academy's monthly proceedings. "He was spacey. He would never have thought of doing that" Gale said recently, "so he gave me his proof and I drafted the NAS note" Lefschetz submitted the note immediately and it appeared in the November proceedings 19 Gale added later, "I certainly knew right away that it was a thesis. I didn't know it was a Nobel" 10

Almost fifty years later, two months before his death, Tucker could not recall getting Nash's first draft of the thesis, which Nash mailed to him at Stanford, or his own reaction on reading it, other than being surprised that Nash had produced a result so quickly. He was certain, however, that he had not been bowled over. He said: "Whether or not this was of any interest to economists wasn't known." Nash used to say that Tucker was "a machine" implying that Tucker was methodical but unimaginative "B, in fact, Nash was quite astute to have chosen him as an adviser. Tucker, a Canadian, Methodist rigidity notwithstanding, possessed a rare willingness to defend

-----230
unconventional ideas and individuals. A truly fine teacher, he firmly believed that students should choose research topics they felt passionate about, not ones they merely believed would appeal to their professors. A few years later, it was Tucker who convinced another young, offbeat genius who would go on to become one of the fathers of artificial intelligence, Marvin L. Minsky, to drop the mainstream but boring mathematics problem he had chosen as a thesis topic and instead to write on his real passion, the structure of the brain "Tucker always claimed that he did little more than sign off on Nash's slender,

twenty-seven-page dissertation com "There was no essential role played by me," Tucker said -- but he encouraged Nash to get it out quickly and defended its merits within the departmentdd14 Kuhn, who was close to Tucker at the time, later recalled: "The thesis itself was completed and submitted after the persistent urging and counsel of Professor Tucker. John always wanted to add more material, and Tucker had the wisdom to say, `Get the results out early! "I I Tucker responded to Nash's first draft by demanding

that Nash include a concrete example of his equilibrium 231
 idea. He also suggested a number of changes in Nash's
 presentation. "I urged him to deal with a particular case rather
 than only a general case," Tucker said. The recommendation, to
 his mind, was largely esthetic. "When you deal with the general
 case you have to deal with sophisticated notation that is very
 hard to read," he said. Nash responded with a prolonged silence
 that was in fact a measure of his fury. "He reacted unfavorably,
 largely by expressing nothing. I didn't hear from him again for a
 long time," Tucker recalled.

Nash was actually considering dropping the thesis with Tucker and
 pursuing another topic, an ambitious problem in algebraic
 geometry, with Steenrod instead. He chose to interpret
 Tucker's demands for revisions—along with von Neumann's coldly
 dismissive reaction—as signs that the department would not accept
 his work on game theory for a dissertation. However, Tucker, who
 could be surprisingly forceful, eventually convinced Nash to
 stick with his original conception and to make the requested
 changes. "Nash had an answer for everything," he said. "You
 couldn't catch him out in a

-----232
 mathematical fault." A May 10 letter to Lefschetz reads: "It is
 not necessary that I see the revised draft, for he has kept me
 informed (almost daily) of the progress of the revision." Tucker
 adds, "I was delighted to notice a pleasant change of attitude in
 Nash during the course of our long correspondence on his work. He
 became much more cooperative and appreciative towards the end. I
 wrote to him like a Dutch uncle, but I suspect you or someone
 else at the Princeton end had some influence in effecting the
 change."

The entire edifice of game theory rests on two theorems: von
 Neumann's min-max theorem of 1928 and Nash's equilibrium theorem
 of 1950. One can think of Nash's theorem as a generalization of
 von Neumann's, as Nash did, but also as a radical departure. Von
 Neumann's theorem was the cornerstone of his theory of games of
 pure opposition, so-called two-person zero-sum games. But
 two-person zero-sum games have virtually no relevance to the real
 world. Even in war there is almost always something to be
 gained from cooperation. Nash introduced the distinction between
 cooperative and noncooperative games. "Cooperative games are
 games in which players can

-----233
 make enforceable agreements with other players. In other words,

as a group they can fully commit themselves to specific strategies. In contrast, in a noncooperative game, such collective commitment is impossible. There are no enforceable agreements. By broadening the theory to include games that involved a mix of cooperation and competition, Nash succeeded in opening the door to applications of game theory to economics, political science, sociology, and, ultimately, evolutionary biologydd16

Although Nash used the same strategic form as von Neumann had proposed, his approach is radically different. More than half of the von Neumann and

Morgenstern book deals with cooperative theory. In addition, von Neumann and Morgenstern's solution concept comsomething called a stable set comdoes not exist for every game. By contrast, Nash proved on page six of his thesis that every noncooperative game with any number of players has at least one Nash equilibrium point.

To understand the beauty of Nash's result, write Avinash Dixit and Barry Nalebuff in Thinking Strategic]

-----234

1v, one begins with the notion that interdependence is the distinguishing feature of games of strategydd17 The outcome of a game for one player depends on what all the other players choose to do and vice versa. Games like tic-tac-toe and chess involve one kind of interdependence. The players move in sequence, each aware of the other's moves. The principle for a player in a sequential-move game is to look ahead and reason back. Each player tries to figure out how the other players will respond to his current move, how he will respond in turn, and so forth. The player anticipates where his initial decision will ultimately lead and uses the information to make his current best choice. In principle, any game that ends after a finite sequence of moves can be solved completely. The player's best strategy can be determined by looking ahead to every possible outcome. For chess, in contrast to tic-tac-toe, the calculations are too complex for the human brain-or even for computer programs written by humans. Players look a few moves ahead and try to evaluate the resultant positions on the basis of experience.

-----235

Games like poker, on the other hand, involve simultaneous moves. "In contrast to the linear chain of reasoning for sequential games, a game with simultaneous moves involves a logical circlelea"write Dixit and Nalebuff. "Although players act at the same time, in ignorance of other players` current actions, each is forced to think about the fact that there are other players who in turn are similarly awaredd"Poker is an example of, `I think he thinks that I think that he thinks that I think. . .` Each must figuratively put himself in the shoes of all and try to calculate the outcome. His own best action is an integral part of the calculation."

Such circular reasoning would seem to have no conclusion. Nash squared the circle using a concept of equilibrium whereby each

player picks his best response to what the others do. Players look for a set of choices such that each person's strategy is best for him when all others are playing their best strategies. Sometimes one person's best choice is the same no matter what the others do. That is called a dominant strategy for that player. At other times, one player has a uniformly bad choice -- a

-----236

dominated strategy -- in the sense that some other choice is best for him irrespective of what the others do. The search for equilibrium should begin by looking for dominant strategies and eliminating dominated ones. But these are special and relatively

rare cases. In most games each player's best choice does depend on what the others do, and one must turn to Nash's construct. Nash defined equilibrium as a situation in which no player could improve his or her position by choosing an alternative available strategy, without implying that each person's privately held best choice will lead to a collectively optimal result. He proved that for a certain very broad class of games of any number of players, at least one equilibrium exists as long as one allows mixed strategies. But some

98 A BEAUTIFUL MIND

games have many equilibria and others, relatively rare ones that fall outside the

class

he defined, may have none.

Today, Nash's concept of equilibrium from strategic games is one of the basic paradigms in social sciences and biology. It is largely

-----237

the success of his vision that has been responsible for the acceptance of game theory as, in the words of

The New Yorker,

"a powerful and elegant method of tackling a subject that had become increasingly baroque, much as Newtonian methods of celestial mechanics had displaced the primitive and increasingly ad hoc

methods of the ancients." Like many great scientific ideas, from Newton's theory of gravitation to Darwin's theory of natural selection, Nash's idea seemed initially too simple to be truly interesting, too narrow to be widely applicable, and, later on, so obvious that its discovery by someone

was deemed all but inevitable. As Reinhard Selten, the German economist who shared

the 1994

Nobel with Nash and John C. Harsanyi, said: "Nobody would have foretold the great impact of the Nash equilibrium on economics and social science in general. It was even less expected that Nash's equilibrium point concept would ever have

-----238

any significance for biological theory. 1141

Its significance was not immediately recognized, not even by the brash twenty-one-year-old author himself, and certainly not by the genius who inspired Nash, von Neumann. 43

Lloyd

Princeton, 1950

All mathematicians live in two different worlds. They live in a crystalline world of perfect platonic forms. An ice palace. But they also live in the common world where things are transient, ambiguous, subject to vicissitudes. Mathematicians go backward and forward from one world to another. They dwell in the crystalline world, but find the real one. -- 5

CAPPELL,

Courant Institute of Mathematics, 1996

AT

TWENTY-ONE,

A238

Nash the mathematical genius had emerged and connected with the larger community of mathematicians around him, but Nash the man remained largely hidden behind a wall of detached eccentricity. He was quite popular with his professors, but utterly out of touch with his

-----239

peers. His interactions with most of the men his own age seemed motivated by an aggressive competitiveness and the most cold considerations of self-interest. His fellow students believed that Nash had felt nothing remotely resembling love, friendship, or real sympathy, but as far as they were able to judge, Nash was perfectly at home in this and state of emotional isolation. This was not the case, however. Nash, like all human beings, wanted to be close to someone, and at the beginning of his second year at Princeton he had finally found what he was looking for. The friendship with Lloyd Shapley, an older student, was the first of a series of emotional attachments Nash formed to other men, mostly brilliant mathematical rivals, usually younger. These relationships, which usually began with mutual admiration and intense intellectual exchange, soon became one-sided and typically ended in rejection. The relationship with Shapley foundered within a year, although Nash never completely lost touch with him over the decades to follow comall through his long illness and after he began to recover comwhen he and Shapley became direct competitors for the Nobel Prize. When he first moved into the Graduate College a

-----240

few doors down from Nash in the fall of 1949, Lloyd Shapley had just turned twenty-six, five years and eleven days older than Nash.` No one could have presented a stronger contrast with the childish, boorish, handsome, and uninhibited boy wonder from West Virginia. Born and bred in Cambridge, Massachusetts, Shapley was one of five children of one of the most famous and revered scientists in America, the Harvard astronomer Harlow Shapley. The senior Shapley was a public figure known to every educated household, and also one of the most politically active.` In 1950, he was accorded the dubious honor of being the first prominent scientist to appear on the earliest of Senator Joseph McCarthy's famous lists of crypto-communistsddl Lloyd Shapley was a war heroddbbled He was drafted in 1943. He refused an offer to become an officer. That same year, as a

sergeant in the Army Air Corps in Sheng-Du, China, Shapley got a Bronze Star for breaking the Japanese weather code. In 1945, he went back to Harvard, where he had begun to study mathematics before he was drafted, and finished his

-----241

B.A. in mathematics in 1948.

When Shapley showed up at Princeton, von Neumann already considered him the brightest young star in game theory research. Shapley had spent the year after graduating from Harvard at the RAND Corporation, a think tank in Santa Monica that was attempting to use game theory applications to solve military

problems, and came to Princeton while technically on leave A241
from RAND. He was immediately recognized as brilliant and quite
sophisticated in his thinking. One contemporary remembers that he
"talked good math, knew a lot

He did extraordinarily hard double crostics from The New York
Times

without using a pencil.` He was a fiercely competitive and highly
accomplished player of Kriegspiell and go. "Everybody knew that
his game was strictly his own" said another fellow student, "He
went out of his way to find nonstandard moves. No one was going
to anticipate them" He was also well read. He played the piano
beautifully, His manner suggested an acute awareness of
pedigree and prospects. When Lefschetz wrote him a letter telling
him of a very

-----242

generous grant if he came to Princeton, for example, Shapley
replied loftily and with a hint of disdain, "Dear Lefschetz, The
arrangements are satisfactory. Go ahead with the formalities.

Shapley

Shapley was by no means as self-confident as his imperious note
to Lefschetz implied. His appearance can only be described as
rather strange. Tall, dark, and so thin that his clothing hung
from him like a scarecrow's, Shapley reminded one young woman of
a giant insect; another contemporary says he looked like a
horse" His normally gentle demeanor and ironic banter hid a
violent temper and a harshly self-critical streak." When
challenged in some unexpected fashion, he could become
hysterical, literally vibrating and shaking with fury

His
perfectionism, which would later prevent him from publishing a
large portion of his research, was extreme." He was, moreover,
acutely self-conscious about being a few years older than some of
the brilliant young men around the Princeton mathematics
department

Nash was one of the first students Shapley met at the Graduate
College. For a time, they shared a bathroom. Both of them
attended Tucker's game

-----243

theory seminar every Thursday, now run by Kuhn and Gale while
Tucker was at Stanford. The best way to describe the impression
Nash made on Shapley when the two first

Lloyd

101

talked about mathematics is to say that Nash took Shapley's

breath away. Shapley could, of course, see what the others saw comthe childishness, brattiness, obnoxiousness comb he saw a great deal more. He was dazzled by what he would later describe as Nash's "keen, beautiful, logical mind." 11 Instead of being alienated like the others by the younger man's odd manner and weird behavior, he interpreted these simply as signs of immaturity. "Nash was spiteful, a child with a social IQ of 12, but Lloyd did appreciate talentea"recalled Martin Shubikdd11 As for Nash, starved for affection, how could he not be drawn to Shapley? In Nash's eyes, Shapley had it all. A brilliant mathematician. War hero. Harvard man. A son of Harlow. Favorite

of von Neumann and, soon, of Tucker as well. Shapley, who A243
was popular with faculty and students alike, was one of the very
few

-----244

around Princeton, other than Milnor, who could really hold Nash's
attention in a mathematical conversation, challenge him, and help
him to pursue the implications of his own reasoning. And, for
that reason -- along with his open admiration and obvious
sympathy comhe was one who could engage Nash's emotions.
Nash acted like a thirteen-year-old having his first crush. He
pestered Shapley mercilesslydd19 He made a point of disrupting
his beloved Kriegspiel games, sometimes by sweeping the pieces to
the ground. He rifled through his mail. He read the papers on his
desk. He left notes for Shapley: "Nash was hereff" He played all
kinds of pranks on him. Shapley's greatest eccentricity at the
time was his claim that he was on a twenty-five-hour sleep
cycledd10 He worked and slept at extremely odd hours, often
transposing night and day. "Every once in a while he'd disappear
from sight," another student recalled. "That's what he said. We
accepted anything.0"Waking Shapley when he was lost to the world
became an ongoing prank. "A group of us was attending a regular
seminar at the institute given by de Rham and Kodaira. We were
always very anxious to go but only three or four of us had cars.

-----245

Lloyd Shapley was one but there was one difficulty. Lloyd liked
to sleep late and was often asleep at two o'clock in the
afternoon. So we had to devise all sorts of ways to wake him. We
dropped hot candle wax on him. I devised another method. We
played 45-rpm records of Lloyd's favorite Chinese music without
the little insert so that it oscillated all over the place (and
made excruciating noise)dd021 Nash once tried to wake Shapley by
climbing on his bed, straddling him and dropping water in his ear
with an eyedropper."

Sometimes the jokes, also aimed at other friends of Shapley's,
got totally out of hand. Shapley shared his room at the college
with a graduate student in economics, Martin Shubik, who became
interested in game theory and also developed a lifelong
friendship with Shapley. Shubik recalled: "Nash's idea of a joke
was to unscrew the electric light bulb in the bathroom. There was
a glass shade under the bulb, which he filled full of water. We
could easily have gotten electrocuted. Did he intend to
electrocute me? I'm not sure he didn't intendto."

Shubik, whom Nash insisted on calling Shoobie-Woobie, was a frequent target of Nash's digs. A typical putdown, from a postscript to a note ostensibly commiserating with Shubik after the latter was injured in a car accident: "Oscar 1ence Morgue would like for someone ... to blast Baumol [William Baumol, then the rising young star of the Princeton economics department] for his impudence in publishing a paper attacking confusedly the only true utility. It's beneath his dignity, but he doesn't really think you're the best man for the job because . . . `Shubik does not write very

clearly.`""

A246

John McCarthy, one of the inventors of artificial intelligence, also befriended Shapley and apparently aroused Nash's jealousy. One day McCarthy got an inquiry from a Philadelphia haberdashery about a massive shirt order he had placed¹⁶ How good was his credit, the company wanted to know? McCarthy, who hadn't placed any such order, immediately suspected Nash and asked Shapley if Nash was the culprit. Shapley confirmed that this was highly likely. McCarthy asked the company for the original order. Sure enough, a postcard came back with Nash's unmistakable

-----247

scrawl in green ink, the color Nash always used. Shubik and McCarthy cornered Nash and confronted him. "There was no denying what he had done. We threatened him with postal inspectors. The post office refused to merely bawl him out. `If we do anything, we'll prosecute him,` they said¹⁷ Concluding that Nash had learned his lesson, Shubik and McCarthy dropped the matter. Another time, he rigged up McCarthy's bed so that it would collapse when McCarthy tried to crawl under the covers¹⁸ It was Shapley who reacted to Nash's absurd behavior with amused tolerance, who proposed that they might channel his mischievous impulses in a more intellectually constructive way. So Nash, Shapley, Shubik, and McCarthy, along with another student named Me] Hausner, invented a game involving coalitions and double-crosses. Nash called the game comwh was later published under the name "So Long, Sucker"-Fuck Your Buddy." The game is played with a pile of different-colored poker chips. Nash and the others crafted a complicated set of rules designed to force players to join forces with one another to advance, but ultimately to double-cross one another in order

-----248

to win. The point of the game was to produce psychological mayhem, and, apparently it often did. McCarthy remembers losing his temper after Nash cold-bloodedly dumped him on the second-to-last round, and Nash was absolutely astonished that McCarthy could get so emotional. "But I didn't need you anymore¹⁹ Nash kept saying, over and over²⁰ By and large, Shapley tried to play the role of mentor. He came to Nash's aid, for example, when Tucker demanded that Nash include a concrete example of an equilibrium point in his thesis and Nash couldn't think of a good one. Shapley spent weeks working out an elaborate but convincing example of Nash's equilibrium concept involving three-handed poker, another Shapley

specialty." The friendship between the men always had a competitive edgedd"Shapley, who started out as the slightly older and wiser half of the relationship, may have resented Nash's reputation as a genius. He kept remarking on "running starts," and he made Lloyd it clear that he felt he was being left behinddd"Nash's stubborn independence in the face of well-meant advice, instead of delighting, began to irk.

Nash's real sin, though, may have been to publish three 249
important papers in the space of one year, long before Shapley
had even come close to finding a thesis topic for himself." In
one of them, Nash beat Shapley to the punch on a problem they
were both working on and had spent many hours discussingdd14 But
Shapley actually had good reason to feel secure. Despite Nash's
brilliant dissertation, the consensus at Princeton at the time
was that it was Shapley who was the real star of the next
generation and inheritor of the von Neumann mantle. Tucker wrote
in 19 5 3: Shapley is "the best young American mathematician
working in the subject.0"Z a person, Tucker added, Shapley is 11
agreeable, cooperative and well-liked by faculty and students."
16

A letter from Frederic Bohnenblust, Shapley's mentor at RAND,
dated 1953, says Shapley "perhaps lacked the wherewithal to
develop a theory and depended on others for ideasea"b added that
he thought him "second only to the creator of the theory of
games, John von Neumann.0"A letter from von Neumann dated January
1954 said: "I know Shapley very well and I think he is VERY good.
I

-----250
would put him above Bohnenblust and I would bracket him with
Segal and Birkhoffdd011
But something other than graduate-student rivalry caused a sudden
break. By the middle of the next year, by which time Nash had
already completed his thesis and was on the job market, Shapley
told a fellow student that he would not return to RAND if Nash,
who had been offered a permanent post there, were to accept xdd39
Fifty years later, Shapley made a point of correcting anyone who
suggested that he and Nash had ever been close friends.
40

RAND, Summer 1950
Oh, the RAND Corpon7mention is the hoon of the world; They
thinkall diy for a fee.
They sitandplaygamesahoutgoing up in flames, For counters they
use you and me, Honey Bee, For counters they use you and me.
comMAL viNA REYN-OLD's,
"The RAND H 1961 yrn,
TE
DC-3 SHOOK as
it droned past the desert and mountains toward the opaque Pacific
and water-colored sky. Los

-----251

Angeles lay thousands of feet below, resembling some science-fiction vision of a space colony under its sulfurous blanket of haze. Nash had boarded the TWA flight in New York almost twenty-four hours earlier. He had not slept at all. He was rumped, sweaty, cramped, and exhausted, but as the plane descended, he hardly registered these discomforts. His attention was wholly absorbed by the exotic panorama and his own intense excitement.

Flying was still a highly novel experience in 1950, no more so than for a twenty-two-year-old West Virginian whose travels had mostly been limited to the Norfolk and Western runs between

Roanoke and Princeton. Nash's first flight marked the A251
beginning of his career as a consultant for the secretive RAND
Corporation. RAND is a civilian think tank in Santa Monica,
described by
Fortune

in 1951 as "the Air Force's big-brain-buying venture," where
brilliant academics pondered nuclear war and the new theory of
games. Nash's on-and-off encounter with RAND over the next four
years was a transforming experience in his life. His association
with RAND, at the height of the Cold

-----252

War, started promisingly in the summer of 1950, just as the
Korean War began, and ended traumatically in the summer of
1954, when McCarthyism reached its peak.

On a purely personal level, Nash's view of the world and himself
was permanently and subtly colored by the RAND Zeitgeist comxs
worship of the rational life and quantification, its geopolitical
obsessions, and its weirdly compelling mix of Olympian
detachment, paranoia, and megalomania. Intellectually, it was
another story. From the moment of his arrival, Nash began
actively disengaging himself from the interests and individuals
that brought him to RAND in the first place, retreating from game
theory and moving rapidly into pure mathematics, a process of
disengagement that would repeat itself several times over the
rest of the decade.

Nothing like the RAND of the early 1950's has existed before or
since. It was the original think tank, a strange hybrid of which
the unique mission was to apply rational analysis and the latest
quantitative methods to the problem of how to use the terrifying
new nuclear weaponry to forestall war with Russia comor to win a
war if deterrence failed.

-----253

The people of RAND were there to think the unthinkable, in Herman
Kahn's famous phrase

.3

It attracted some of the best minds in mathematics, physics,
political science, and economics. RAND may well have been the
model for Isaac Asimov's

Foundation

series, about a RAND-LIKE organization full of hyper-rational
social scientists --

psychohistorians -- who are supposed to save the galaxy from
chaosddbled And Kahn and von Neumann, RAND's most celebrated

thinkers, were among the alleged models for Dr. Strangelove¹. Although its heyday lasted a decade or less, RAND's way of looking at human conflict not only shaped America's defense in the second half of the century but also made a deep and lasting impression on American social science. RAND had its roots in World War

11, when the American military, for the first time in its history, had recruited legions of scientists, mathematicians, and economists and used them to help

win the war. As Fred Kaplan writes of RAND's role in nuclear strategyea6 254

[World War 11 was] a war in which the talents of scientists were exploited to an unprecedented, almost extravagant degree. First, there were all the new inventions comof warfare comradar, infrared detection devices, bomber aircraft, long-range rockets, torpedoes with depth charges, as well as the atomic bomb. Second, the military had only the vaguest of ideas about how to use these inventions.... Someone had to devise new techniques for these new weapons, new methods of assessing their effectiveness and the most efficient way to use them. It was a task that fell to the scientists. Initially, the scientists worked on narrow technical problems-for example, how to build the bomb, how deep to set the charges, the choice of targets. But when it became clear that people didn't know the best way to use this incredibly expensive and destructive weaponry, they were increasingly drawn into discussions of strategy.

The advent of the bomb turned the temporary wartime partnership between the military and the scientific establishment into a continuing relationship. The Air Force, which controlled the new weaponry, emerged after

-----255

the war as the linchpin of the national defense. "Whole conceptions of modern warfare, the nature of international relations, the question of world order, the function of weaponry, had to be thought through again. Nobody knew the answersea"Kaplan writes.` Again the military turned to the academic community. As Oskar Morgenstern, also a RAND consultant during the 1950's, put it in his book on defense issues: "Military matters have become so complex and so involved that the ordinary experience and training of the generals and admirals were no longer sufficient to master the problems.... More often than not their attitude is, 'here is a big problem. Can you help us?` And this is not restricted to the making of new bombs, better fuel, a new guidance system or what have you. It often comprises tactical and strategic use of the things on hand and the things only planned."`

Fortune

magazine put it more succinctly: "If World War 11 was a war of weapons, another conflict would include on both sides a war of wits at the highest level of knowledgedd09

In the final days of the war, the Air Force generals began to worry about the brain drain of top

scientistsdd" How to keep the best and brightest thinking about military problems was far from obvious. Men of the caliber of John von Neumann would hardly sign up for the civil service. But scientists would have to have access to secrets so one couldn't just rely on contracts with universities. The solution was a private nonprofit organization outside the military but with close ties to the Air Force. In the fall of 1945, General Henry "Hap" Arnold promised to give Douglas Aircraft \$10 million of leftover wartime procurement funds for a research venture to be called Project RAND (for "research and developmentea" though wits

later insisted the acronym stood for "research and nondevelopment"). The project was housed on the third floor of Douglas's Santa Monica plant. Friction between Douglas and the new entity led to a spinoff as a private nonprofit corporation in 1946, which was when RAND moved to its downtown offices. RAND's Air Force contract gave it an amazingly free hand, according to William Poundstone's history of RAND. The contract called for research on intercontinental warfare, which, given the dominant

A256

-----257
 role of nuclear weaponry, effectively gave RAND an unrestricted license to roam over the front lines of the U.S. defense strategy. Within these guidelines, RAND scientists could study anything that interested them. RAND could also refuse specific studies requested by the Air Force. From the beginning, RAND's work was a curious mix of narrowly focused engineering, cost-benefit studies, and blue-sky conjecture. A now-famous 1946 study, completed more than a decade before the launch of Sputnik in 19

57, proved remarkably prescient. In "Preliminary Design of an Experimental World-Circling Spaceship" RAND scientists argued that "the nation which first makes significant achievements in space travel will be acknowledged as the world leader in both military and scientific techniques. To visualize the impact on the world, one can imagine the consternation and admiration that would be felt here if the US were to discover suddenly that some other nation had already put up a successful satellite." RAND's civilian scientists soon made a mark on American defense policy. Poundstone

-----258
 reports that RAND played a leading role in the development of the ICBM; RAND convinced the Air Force to adopt in-flight refueling of jet bombers; it was responsible for the fail-safe protocol whereby bombers are kept in the air at all times and during a crisis head for targets in an enemy nation. Its worry that a psychotic individual in a position of power could trigger a nuclear war convinced the Air Force to adopt a safer button that required cooperation of several individuals to arm and detonate a nuclear warhead.

To be plucked from academe and initiated into the secret world of the military had become something of a rite of passage for the mathematical elite. In World War 11, the very best had traveled

into the New Mexico desert to Los Alamos to work on the A-bomb alongside von Neumann, and to Bletchley Park north of London to help Turing and his team break the Nazi code. Many others, less well known or simply younger, wound up at dozens of less famous sites working on weapon design, encryption, bomb targeting, and submarine chases.

The recruitment of scientists by the military hadn't

-----259

stopped when the war ended, much to everyone's surprise. Many of the mathematicians and scientists did not return to their quiet prewar routines but instead took on military research contracts,

made frequent visits to the Pentagon and the Atomic Energy Commission, and, in a few cases, stayed on at Los Alamos and the other government weapons labs. For an elite cadre of applied mathematicians, computer engineers, political scientists, and economists RAND was the equivalent of Los Alamos.¹⁴ The problems the military asked the scientists to solve called for new theories and new techniques, which in turn attracted the top scientific talent on which RAND's credibility depended. "We had so many practical problems that involved mathematicians and we didn't have the right tools," said Bruno Augenstein, a former RAND vice-president, years later. "So we had to invent or perfect the tools." Mostly, according to Duncan Luce, a psychologist who was a consultant at RAND, "RAND capitalized on ideas that surfaced during the war."

16
These were scientific, or at least systematic,

-----260
approaches to problems that had been previously considered the exclusive province of men of "experience." They included such topics as logistics, submarine research, and air defense. Operations research, linear programming, dynamic programming, and systems analysis were all techniques that RAND brought to bear on the problem of "thinking the unthinkable." Of all the new tools, game theory was far and away the most sophisticated. The spirit of quantification, however, was contagious, and it was at RAND, more than anywhere else, that game theory in particular and mathematical modeling in general entered the mainstream of postwar thinking in economics. At that point, the military was the only government sponsor of pure research in the social sciences—a role later taken over by the National Science Foundation—and it bankrolled a great many ideas that turned out to have little true relevance for the military but a great deal for other endeavors. RAND attracted a younger generation of mathematically sophisticated economists who embraced the new methods and tools, including the computer, and attempted to turn economics from a branch of political philosophy into a precise, predictive science.

-----261
Take Kenneth Arrow, one of the early Nobel Laureates in economics. When Arrow came to RAND in 1948, he was an unknown youngster.¹⁵ His famous thesis, written in the as-yet-unfamiliar language of symbolic logic, was a product of a RAND assignment. The assignment was to demonstrate

that it was okay to apply game theory, which is formulated in terms of individuals, to aggregations of many individuals, namely nations. Arrow was asked to write a memorandum showing how it could be done. As it turned out, the memorandum became Arrow's dissertation, an attempt to restate the theories of British economist John Hicks in modern mathematical language. "That was it! It took about five days to write in September 1948" he recalled. "When every attempt failed I thought of the impossibility theorem." Arrow showed that it is logically impossible to add up the choices of individuals into an unambiguous social choice not just under a constitution based on

the principle of majority rule, but under every A261
conceivable constitution except dictatorship. Arrow's theorem,
along with his proof of the existence of a competitive
equilibrium, which also owes something

-----262

to Nash, earned him the Nobel Prize in 1972 and ushered in the
use of sophisticated mathematics in economic theory.
Other giants of modern economics who did seminal work at RAND in
the early 1950's included Paul A. Samuelson, probably the most
influential economist of the twentieth century, and Herbert
Simon, who pioneered the study of decisionmaking inside
organizations. RAND's location was part of its allure. The
corporation's headquarters, in a oncesleepy beach colony, lies
five miles to the south of the Santa Monica Mountains at the far
end of the Malibu Crescent, just west of Los Angeles. In the
early 1950's, Santa Monica looked the way Nash imagined that
certain towns in Italy or France might look. Wide avenues were
lined with pencil-thin palm trees. Cream-colored houses were
topped with tiled roofs and encircled by shoulder-high walls.
Seaside hotels and rest homes were across from a seaside
promenade. The magentas and reds of the bougainvillea and
hibiscus were improbably intense. The breeze, surprisingly cool,
smelled of oleander and seawater. Some of the best work was done
in beach chairs.

-----263

RAND itself was tucked out of sight of the ocean on Fourth and
Broadway at the edge of Santa Monica's slightly rundown business
district. The 1920's bank building was a white stucco affair
ornamented with Victorian flourishes. The building had recently
housed the presses of the Santa Monica Evening
Outlook; the
newspaper had moved catty-corner to a former Chevy dealership
when RAND moved in. By 1950, RAND was already spilling over into
several annexes located over storefronts, including ones occupied
by the
Outlook and
a bicycle shop. A year later, when
Fortune
magazine discreetly introduced RAND to the wider public, it
described "bright walls shining through fog-sunny days and its
wide, white-lighted windows shining on uninterruptedly through
the night. The building is never closed, nor is it ever really
openedd019

It was one of the most difficult buildings in the United States
to get into,
Fortune

-----264

said. On Nash's first day, members of RAND's uniformed, armed
police force stood guard in front of the building and in its
lobby, scrutinizing him closely
and memorizing his facedd10 After that, for the rest of the
summer and in subsequent years, the guards always greeted him
with a cool, respectful "Hello, Dr. Nashdd" There were no ID cards
in those days. Inside were a series of locked doors, with offices

clustered by types of security clearance needed to gain access to them. The math division occupied a group of small private offices in the middle of the first floor, upstairs from the electronics shop where von Neumann's new computer, the johnniac, stood. Nash got an office to himself, a small windowless cubicle whose walls didn't quite extend to the ceiling, with a desk, blackboard, fan, and, of course, a safe. RAND bristled with self-confidence, a sense of mission, an esprit de corps." Military uniforms signaled visitors from Washington. Executives from defense firms came for meetings. The consultants, mostly under thirty, carried briefcases, smoked pipes, and walked around looking self-important. Big shots like

-----265

von Neumann and Herman Kahn had shouting matches in the hallways. There was a feeling around the place of "wanting to outrun the enemy." A former RAND vice-president later put it this way:

Arrow, who was an army veteran from the Bronx, said, "We were all convinced that the mission was important though there was lots of room for intellectual vision."

RAND's sense of mission was propelled largely by a single fact: Russia had the A-bomb. That shocking news had been delivered by President Truman the previous fall, a mere four years after Nagasaki and Hiroshima, and many years before Washington had expected it. The military had hard evidence, the president said in a speech on September 13, 1949, of a nuclear explosion deep inside the Soviet Union. Nobody in the scientific community, especially around Princeton, where von Neumann and Oppenheimer were engaged in an almost daily debate over the wisdom of pushing ahead with the Super, doubted that the Soviets were capable of developing nuclear weapons. The shock was that they had succeeded so quickly. Physicists and mathematicians, who were less

-----266

convinced of Russia's scientific and technological backwardness, had been warning the administration all along that predictions by senior government officials that America's nuclear monopoly would persist another ten, fifteen, or twenty years were hopelessly naive, but the sense of being caught off guard was still very great. The news effectively ended the debate over the hydrogen bomb more or less immediately. By the time the president delivered the news of the Soviet explosion to the public, he had authorized a crash program at Los Alamos to design and

manufacture an H-bomb-19

It was unthinkable that such destructive power would be unleashed. Therefore RAND insisted that it was necessary to ponder the possibility."` The rational life was worshiped to an almost absurd degree. RAND was full of men and women committed to the idea that systematic thought and quantification were the key to the most complex problems. Facts, preferably detached from emotion, convention, and preconception, reigned supreme. If reducing complex political and military choices, including the problem of nuclear war, to mathematical formulae could produce light, why then the same

approach must be good for more mundane matters. RAND 267
 scientists tried to tell their wives that the decision whether to
 buy or not to buy a washing machine was an "optimization
 problem."

RAND was privy to the military's most highly guarded secrets at a
 time when the nation was growing increasingly nervous about the
 safeguarding of those secrets to the point of paranoia. From the
 summer of 1950 on, RAND would be increasingly affected by the
 growing alarm over Russian access to American military secrets."
 It began with the Fuchs trial in the winter of 1950.¹¹ Fuchs was
 a German emigre scientist who had fled to Britain during the war
 and eventually wound up working with von Neumann and Edward
 Teller at Los Alamos. A clandestine member of the British
 Communist Party, Fuchs subsequently confessed in January 1950 to
 passing atomic secrets to the Russians and was tried and
 convicted in London that February. Senator Joseph McCarthy had
 embarked that same month on his anticommunist campaign, accusing
 the federal government of security breaches.¹⁴ Four years later,
 in April of 1954, Robert Oppenheimer, the former head of the
 Manhattan Project, the director of the

-----268
 Institute for Advanced Study, and the most famous scientist in
 America, was declared a security risk by Eisenhower and stripped
 of his security clearances in the full glare of national
 publicity.^{dd} The ostensible reason was Oppenheimer's youthful
 left-wing associations, but the real reason, as von Neumann and
 most scientists testified at the time, was Oppenheimer's refusal
 to support the development of the H-bomb.

The fact that McCarthy himself ultimately became a target of
 censure would do little to dispel the atmosphere of paranoia and
 intimidation at RAND, which lived on Air Force and AEC money and
 had projects on the H-bomb and ICBM.^{SDD16} Most of what the
 mathematicians worked on was not in fact classified, but that
 didn't matter. RAND, which harbored a collection of oddballs like
 Richard Bellman (a former Princeton mathematician who had all
 kinds of communist associations, mostly accidental, including a
 chance encounter with a cousin of Julius and Ethel Rosenberg),
 would become particularly careful about minding its Ps and
 Qs.^{dd37}

Everybody needed a top-secret clearance. People who arrived
 without a temporary security clearance were

-----269
 banished to "quarantine" or "preclearance" and weren't permitted to

sit with everybody else. Nash's secret clearance was granted on October 25, 1950.¹¹¹ His recollection that he had a top-secret clearance comwh a large contingent in the math division did have-is probably faulty. Nash also recalls that he applied for a Q clearance in 1952.¹⁹ Any consultant to the math division who worked on Atomic Energy Commission contracts was required to have a Q clearance because of access to documents related to the construction and use of nuclear weapons. But despite a November 10, 1952, postcard to his parents telling them that he had applied for a higher clearance at RAND, Nash now says
In

it was never approved commeaning that his role at RAND was A269
largely confined to highly theoretical excercises as opposed to
applications of game theory concepts to actual questions of
nuclear strategy comthe province of men like von Neumann, Herman
Kahn, and Thomas Schellingdd411

Everyone had a safe in his office for storing classified
documents, and everyone was warned about taking documents out of
the building or talking out of

-----270

schooldd41 Papers had to be put in the safes at the end of every
day. There were spot checks. There was a public address system
and there were parts of the building that were off-limits to
people who didn't have a Q clearance.

By 1953, soon after Eisenhower issued a new set of security
guidelines, security consciousness, in the sense of not
overlooking anyone who might be thought remotely unreliable,
greWdd42

The Eisenhower guidelines broadened the grounds for denying a
clearance or stripping someone of an existing clearance. Without
a doubt, fear about potential leaks brought to a boil many
simmering antagonisms against individuals and groups who posed
little or no actual threat to security. Almost any sign of
nonconformity, political or personal, came to be considered a
potential security breach. The notion, for example, that
homosexuals were unreliable, because of either poor judgment or
vulnerability to blackmail, was first codified in the Eisenhower
guidelines.

Like the decade itself, RAND had a split personality. Its style
was informal. It tolerated quirky people. It was in some ways
more democratic

-----271

than a university. Almost everyone, including von Neumann, was
called by his or her first name, except by the guards, never
Doctor or Professor or Sir. Graduate students rubbed shoulders
with full professors in a way unimaginable in most academic
departments. RAND's president, a former Douglas Aircraft
executive, was a spit-andpolish man who was almost never seen in
a suit and tie. All but one or two of the mathematicians,
including Nash, came to work in short-sleeved shirts. Appearances
were so casual that one mathematician, who found it all very
d6class6, felt obliged to rebel by wearing a three-piece suit and
a tie to the office every daydd41 Practical jokes were as much a
part of the RAND culture as pipes and crewcuts. Mathematicians

and physicists mixed rubber bands into the pipe tobacco,
substituted dog biscuits for cookies, and tilted desks so pencils
rolled onto the
floordd44

Wit was greatly appreciated. When John Williams, the head of
RAND's mathematics department, wrote a primer on game theory,
published as a RAND study, it was illustrated with

-----272

funny little cartoon figures and full of jokey examples starring
John Nash, Alex Mood, Lloyd Shapley, John Milnor, and other
members of the math department

.41

A272

The mathematicians were, as usual, the freest spirits^{dd46} They had no set hours. If they wanted to come into their offices at 3:00 A.M.,

fine. Shapley, who had come back from Princeton for the summer and continued to insist on the sanctity of his sleep cycle, was rarely seen before mid^{afn}. Another man, an electrical engineer named Hastings, typically slept in the "shop" next to his beloved computer.

Lunches were long, much to the annoyance of RAND's engineers, who prided themselves on sticking to a more respectable routine. The mathematicians mostly took their bag lunches to a conference room and pulled out chessboards. They invariably played Kriegspiel, usually in total silence, occasionally punctuated by a wrathful outburst from Shapley, who frequently lost his temper over an umpire's or opponent's error. Even though the games typically lasted well into the afternoon, they were

-----273

rarely finished and finally reluctantly abandoned midgame. Poker and bridge groups met after hours.

There were no afternoon teas, formal seminars, or faculty meetings at RAND. Unlike the physicists and engineers, the mathematicians usually worked alone. The idea was that they would work on their own ideas but would help solve the myriad problems encountered by researchers, picking up problems to solve as the spirit moved them^{dd47} People would drift into each other's offices or, more frequently, simply stop to chat in the corridors near the coffee stations. The grids and courtyards of RAND's permanent headquarters com^{to} which the mathematics group moved in 1953, the year before Nash's final summer at RAND-were designed, by John Williams, as it happens, "to maximize chance meetings^{dd0411} Through such encounters new research was "announced" and mathematicians got hooked on problems that colleagues in other departments wanted solved. Most of the work wasn't reported formally, and even when it was published as RAND memoranda, there was no formal approval process. A consultant would simply go to the math department secretaries, hand over a handwritten paper, and a day or two later a RAND

-----274

memorandum would appear^{dd49} Published reports for outside circulation didn't go through a much more rigorous vetting process.

This copacetic atmosphere was mostly Williams's doing." Witty and

charming, weighing close to three hundred pounds, expensively suited, Williams looked like a businessman always about to reach into his pocket to pull out a wad of twenties. An astronomer from Arizona who had spent a couple of years in Princeton attending lectures in Fine Hall, playing poker, and developing an enthusiasm for the theory of games, Williams had been a dollar-a-year man in Washington during the war and became RAND's fifth employee afterward. Williams hated flying. He loved fast cars. At one point, he spent an entire year outfitting his chocolate-brown Jaguar with a powerful Cadillac engine. It had taken substantial RAND resources (RAND had a repair shop) and

considerable bravado to install the thing. Cadillac and A274
Jaguar mechanics had both dismissed the idea as impractical, but
Williams had prevailed. He disproved the mechanics` conventional
wisdom in late-night, 125-mile-an-hour drives along the Pacific
-----275

Coast Highway.

Williams's approach to management would have made him very much
at home in Silicon Valley today: "Williams had a
theoryea"recalled his deputy, Alexander Mood, also a former
Princetonian. "He believed people should be left alone. He was a
great believer in basic research. He was a very relaxed
administrator. That's why people thought the math division was
pretty weirddd011 Williams's letter to von Neumann offering the
mathematician a two-hundred-dollar-a-month retainer conveys the
man's style. The letter said, "The only part of your thinking
we'd like

to bid for systematically is that which you spend shaving: we'd
like you to pass on to us any ideas that come to you while so
engagedddd011 When Williams first arrived, RAND was a tiny annex
inside a mammoth Douglas Aircraft factory where thirty thousand
workers punched time cards every day. Williams was the one who
freed the mathematicians from the clock and then proceeded to
demand coffee and blackboards for his mathematicians, explaining
that not providing these would guarantee that none of them would
produce anything worthwhile. After RAND and Douglas Aircraft
parted company, Williams went further. He

-----276
insisted that the building be open twenty-four hours a day
instead of just between eight and five. He got private offices.
He set up coffee stations that had their own special full-time
maintenance crew. He mollified the engineers and the Air Force
generals, who wondered why the hell the mathematicians had to be
allowed to be themselves. Everyone soon knew Nash by sight. He
roamed the halls incessantly." He was usually chewing an empty
paper coffee cup that was clamped firmly between his teeth. He
would glide through the corridors for hours at a time, frowning,
lost in thought, shirt untucked, his powerfully built shoulders
hunched forward, his sharp Nixonian nose leading the way.
Sometimes he wore a small, ironic smile that suggested some
secret amusement not likely to be shared with anyone he might
encounter. When he did meet someone he knew, he rarely greeted
him by name or even acknowledged his presence unless spoken to
first, and then not always. When he wasn't chewing a coffee cup,

he whistled, often the same tune, from Bach's

The Art of the Fugue,

over and over agdd14

His legend had preceded him. In the eyes of his new

-----277

colleagues, Arrow recalled, Nash was "a young genius who could do anything, a guy who liked solving problems." "Mathematicians who were struggling with tricky problems quickly learned to collar him by planting themselves squarely in his path. Nash's curiosity was easily piqued, they discovered, provided that the problem struck him as interesting and the speaker mathematically

competent. He was usually more than willing to step around A277
to their offices to look at masses of messy equations on their
blackboards. Williams's deputy, Alex Mood, was one of the first
to try." A gentle giant of a man with a dry wit and easy manner,
Mood happened to be oppressed by a problem left over from a
first, ill-fated thesis attempt at Princeton before the war. He
had found a better derivation of a famous solution, he felt, but
his proof was overly long, too complicated, and distressingly
inelegant. Could Nash come up with something "shorter, simpler"?
Nash listened and stared, frowned and walked away. But the very
next day, he was back at Mood's door with a clever and entirely
unanticipated solution. Nash had "sidestepped the whole induction
by regarding integers as variables and sending them to revealing
limitsdd"Z much as anything else, Mood was charmed

-----278

by Nash's style. "When he found a problemea"Mood recalled, "he
sat down and started attacking it immediately. He didn't, like
some of
his colleagues, browse through the library to see what related
stuff had already been done."
Williams too was immediately taken with Nash and took him under
his wing. He frequently told others that Nash had greater insight
into mathematical structure than any mathematician he had ever
known, an extraordinary remark ffrom a man who spent the late
1930's in Fine Hall and was an intimate of von Neumann's. "He
knew which factors of a hundred thousand were the most
important," Williams used to saydd17 He liked to describe how
Nash would come into an office, stare at a blackboard dense with
equations, and stand there silently, meditating. "Thenea"Williams
would say, "he'd solve the whole thing. He could
see
the structure."

However, Nash mostly kept to himself He talked about his own
research rarely and then only with a select few. When he did, it
was not usually because he was looking for help. "It wasn't so
much that he sought advice," another consultant recalled. "You
were a

-----279

reflecting mirror. He was his own creative object.0"The only
person he regularly sought out at RAND was Shapley, and fairly
soon people around the mathematics division started to think of
the two as a pair, RAND's Wunderkinder.
Still, Nash's eccentricity soon became fodder for RAND's gossip

mill. "He reinforced RAND's idea that mathematicians were a bit crazyea"Mood said.", His office, in which he could rarely be found, was a godawful mess. When he left at the end of that summer he did so without bothering to clean out his desk. The staffer who was saddled with the chore found, among other things, "banana peels. Bank statements for Swiss bank accounts with thousands of dollars in them. One or two hundred dollars in cash. Classified documents. The C-I isometric embedding paperdd060 Some people found Nash absurdly childish. He was fond of playing adolescent jokes on his colleagues. Knowing that his whistling irritated one particular musicloving mathematician, who

frequently asked him to stop, he once left behind a A279
recording of his whistling on the man's Dictaphonedd61 RAND's
blue-collar police

-----280

force and maintenance crew found Nash an entertaining subject.
They would watch him as he left the building walking north on
Fourth Avenue. On several occasions some of them complained to a
RAND manager that they had seen Nash tiptoeing exaggeratedly along
the avenue, stalking flocks of pigeons, and then suddenly rushing
forward, "trying to kick `em."``

We hope [the theory of gamesst will work, just as we hoped in 1942
that the atomic homb would work. comAN-ONymous PENTAGON SCIENTIST
to Fortune,
1949

1ASH's NOVEL IDEA about games with many players had preceded him
at RAND by several months. The first version of his elegant proof
of the existence of equilibrium for games with many players
comtwo skimpy pages in the November
1949 issue of the National Academy of Sciences proceedings
comswept through the white stucco building at Fourth and Broadway
like a California brushfiredd1

The biggest appeal of the Nash equilibrium concept was its
promise of liberation from the two-person zero-sum game. The
mathematicians, military

-----281

strategists, and economists at RAND had focused almost
exclusively on games of total conflict commy win is your loss or
vice versa combbt two players. Shapley and Dresher's
1949 review of game theory research at RAND refers to the
organization's "preoccupation with the zero-sum two person
game."`` That preoccupation was natural, given that these were
games for which the von Neumann theory was both sound and
reasonably complete. Zero-sum games also seemed to fit the
problem -- nuclear conflict between two superpowers comwh
absorbed most of RAND's attention.

Only it really didn't. At least some of the researchers at RAND
were already chafing at the central assumption of a fixed payoff
in such games, Arrow recalled.`` As weapons got ever more
destructive, even all-out war had ceased to be a situation of
pure conflict in which opponents had no common interest whatever.
Inflicting the greatest amount of damage on an enemy-bombing him
back to the Stone Age comno longer made any sense, as American
strategists realized during the final phase of the campaign

against Germany when they decided not to destroy the coal mines and industrial complexes of the Ruhrddbled As Thomas C. Schelling, one of

-----282

RAND's nuclear strategists, would put it a decade later,`
In international affairs, there is mutual dependence as well as opposition. Pure conflict, in which the interests of two antagonists are completely opposed, is a special case; it would arise in a war of complete extermination, otherwise not even in war. The possibility of mutual accommodation is as important and dramatic as the element of conflict. Concepts like

deterrence, limited war, and disarmament, as well as A282
 negotiation, are concerned with the common interest and mutual
 dependence that can exist between participants in a conflict.
 Schelling goes on to say why this is so: "These are games in
 which, though the element of conflict provides the dramatic
 interest, mutual dependence is part of the logical structure and
 demands some kind of collaboration or mutual accommodation-tacit,
 if not explicit-even if only in the avoidance of mutual
 disasterdd116

In 1950, at least the economists at RAND were aware that if game
 theory were to evolve into a descriptive theory that could be
 usefully applied to real-life military and economic conflicts,
 one

-----283

had to focus on games that allowed for cooperation as well as
 conflict. "Everybody was already bothered by the zero-sum
 gameea" Arrow recalled. "You're trying to decide whether to go to
 war or not. You couldn't say that the losses to the losers were
 gains to the winner. It was a troublesome thing."

Military strategists were the first to seize on the ideas of game
 theory. Most economists ignored The Theory of Games and Economic
 Behavior and the few that didn't, like John Kenneth Galbraith
 writing in

Fortune

and Carl Kaysen, later director of the Institute for Advanced
 Study, turn out to have had significant contact with military
 strategists during the wardd"An article in

Fortune

in

1949 by John

McDonald made it clear that the military hoped to use von
 Neumann's theory of games to work out intelligence missions,
 bombing patterns, and nuclear defense strategydd9 On the lookout
 for new ideas and with plenty of money to spend, the Air Force
 embraced game theory with the same enthusiasm

-----284

with which the Prussian military had embraced probability theory
 a couple hundred years earlierdd10

Game theory had already made its debut in military planning
 rooms. It had been used during the war to develop antisubmarine
 tactics when German submarines were destroying American military
 transports. As McDonald reported in
 Fortune.-I I

The military application of "Games" was begun early in the last war, some time in fact before the publication of the complete theory, by ASWOEG (Anti-Submarine Warfare Operations Evaluation Group). Mathematicians in the group had got hold of von Neumann's first paper on poker, published in 1928.

But von Neumann actually spent his frenetic visits to Santa Monica almost exclusively with the computer engineers and the nuclear scientists. His enormous prestige and Williams's deft salesmanship led to a major concentration on game theory at RAND from 1947 into the 1950's. The hope was that game theory would

provide the

A284

-----285

mathematical underpinning for a theory of human conflict and spread to disciplines other than mathematics. Williams convinced the Air Force to let RAND create two new divisions, economics and social science. By the time Nash arrived, a "trust" of game theory research had grown up at RAND including such game theorists as Lloyd S. Shapley, J. C. McKinsey, N. Dalkey, F. B. Thompson, and H. F. Bohnenblust, such pure mathematicians as John Milnor, statisticians David Blackwell, Sam Karlin, and Abraham Girschick, and economists Paul Samuelson, Kenneth Arrow, and Herbert Simon." Most of the RAND military applications of game theory concerned tactics. Air battles between fighters and bombers were modeled as duels.¹⁴ The strategic problem in a duel is one of timing. For each opponent, having the first shot maximizes the chance of a miss. But having the better shot also maximizes the chance for being hit. The question is when to fire. There's a tradeoff. By waiting a little longer each opponent improves his own chance of scoring a hit, but also increases the risk of being

-----286

shot down. Such duels can be both noisy and silent. With "silent gun" the duelist doesn't know the other has fired unless he is hit. Therefore, neither participant knows whether the other still has a bullet or has fired and missed and is now defenseless. A report by Dresher and Shapley summarizing RAND's game theory research between the fall of 1947 and the spring of 1949 gives the flavor.¹⁵ The mathematicians describe a problem of staggered attacks in a bombing mission:

Problem A single interceptor base, having I fighters, is located on a base line. Each fighter has a given endurance. If a fighter, vectored out against a bomber attack, has not yet engaged his original target, then at the option of the ground controller he may be vectored back to engage a second attack.

The attacker has a stock of N bombers and A bombs. The attacker chooses two points to attack and sends N_1 bombers including A_1 bomb carriers on the first attack and t minutes later he sends N_2 equals

$N - N_1$, bombers including A_2 equals $A - A_1$

-----287

com A_2 , carriers on the second attack. The payoff to the attacker is the number of bomb carriers that are not destroyed by the fighters.

Solution Both players have pure optimal strategies. An optimal strategy of the attacker is to attack both targets simultaneously and distribute the A bomb carriers in proportion to the number of bombers in each attack. An optimum strategy of the defender is to dispatch interceptors in proportion to the number of attacking bombers and not to revector fighters. The value of the game to the attacker will be V equals $\max (0, \frac{A}{Nk})$

where k is the kill probability of the fighter

The game Nash had in mind could be solved without communication or collaboration. Von Neumann had long believed that the RAND researchers ought to focus on cooperative games, conflicts in

which players have the opportunity to communi- A287
cate and collaborate and are able to discuss the situation and
agree on a rational joint plan of action, an agreement that is
assumed to be enforceable."

16
In cooperative games, players form coalitions

-----288
and reach agreements. The key assumption is that there's an
umpire around to enforce the agreement. The mathematics of
cooperative games, like the mathematics of zero-sum games, is
rich and elegant. But most economists, like Arrow, were cool to
the idea." It was like saying, they thought, that the only hope
for preventing a dangerous and wasteful nuclear arms race lay in
appointing a world government with the power to enforce
simultaneous disarmament. World government, as it happens, was a
popular idea among mathematicians and scientists at the time.
Albert Einstein, Bertrand Russell, and indeed much of the world's
intellectual elite subscribed to some version of "one worldism."

11 Even von Neumann tipped his hat to the notion, conservative
hawk that he was. But most social scientists were dubious that
any nation, much less the Soviets, would cede sovereignty to such
an extent. Cooperative game theory also seemed to have little
relevance to most economic, political, and military problems. As
Arrow jokingly put it, "You did have cooperative game theory. But
I couldn't force the other side to cooperatedd019

By demonstrating that noncooperative games, games that did not
involve joint actions, had stable

-----289
solutions, said Arrow, "Nash suddenly provided a framework to ask
the right questionsdd" At RAND, he added, it immediately led
"a
lot of people to calculate equilibrium points." News of Nash's
equilibrium result also inspired the most famous game of strategy
in all of social science: the Prisoner's Dilemma. The Prisoner's
Dilemma was partly invented at RAND, some months before Nash
arrived, by two RAND mathematicians who responded to Nash's idea
with more skepticism than appreciation of the revolution that
Nash's concept of a game would inspire." The actual tale of
prisoners used to illustrate the game's significance was invented
by Nash's Princeton mentor, A] Tucker, who used it to explain
what game theory was all about to an audience of psychologists at
Stanford."

As Tucker told the story, the police arrest two suspects and

question them in separate roomsdd"Each one is given the choice of confessing, implicating the other, or keeping silent. The central feature of the game is that no matter what the other suspect does, each (considered alone) would be better off if he confessed. If the other confesses, the suspect

-----290

in question ought to do the same and thereby avoid an especially harsh penalty for holding out. If the other remains silent, he can get especially lenient treatment for turning state's witness. Confession is the dominant strategy. The irony is that both prisoners (considered together) would be better off if neither

confessed -- that is, if they cooperated -- but since each A290 is aware of the other's incentive to confess, it is "rational" for both to confess.

Since 1950, the Prisoner's Dilemma has spawned an enormous psychology literature on determinants of cooperation and defectiondd"On a conceptual level, the game highlights the fact that Nash equilibria comdefined as each player's following his best strategy assuming that the other players will follow their best strategy-aren't necessarily the best solution from the vantage point of the group of playersdd14 Thus, the Prisoner's Dilemma contradicts Adam Smith's metaphor of the Invisible Hand in economics. When each person in the game pursues his private interest, he does not necessarily promote the best interest of the collective.

The arms race between the Soviet Union and the United States could be thought of as a Prisoner's

-----291

Dilemma. Both nations might be better off if they cooperated and avoided the race. Yet the dominant strategy is for each to arm itself to the teeth. However, it doesn't appear that Dresher and Flood, Tucker, or, for that matter, von Neumann, thought of the Prisoner's Dilemma in the context of superpower rivalry." For them, the game was simply an interesting challenge to Nash's idea. The very afternoon that Dresher and Flood learned of Nash's equilibrium idea, they ran an experiment using Williams and a UCLA economist, Armen Alchian, as guinea pigSdd16 Poundstone says that Flood and Dresher "wondered if real people playing the game comespecially people who had never heard of Nash or equilibrium points-would be drawn mysteriously to the equilibrium strategy. Flood and Dresher doubted it. The mathematicians ran their experiment one hundred times."

Nash's theory predicted that both players would play their dominant strategies, even though playing their dominated strategies would have left both better off. Though Williams and Alchian didn't always cooperate, the results hardly resembled a Nash equilibrium. Dresher and Flood argued, and von

-----292

Neumann apparently agreed, that their experiment showed that players tended not to choose Nash equilibrium strategies and instead were likely to "split the difference."

As it turns out, Williams and Alchian chose to cooperate more often than they chose to cheat. Comments recorded after each player decided on strategy but before he learned the other

player's strategy show that Williams realized that players ought to cooperate to maximize their winnings. When Alchian didn't cooperate, Williams punished him, then went back to cooperating next round.

Nash, who learned of the experiment from Tucker, sent Dresher and Flood a note -- later published as a footnote in their report -- disagreeing with their interpretation: 11

The flaw in the experiment as a test of equilibrium point theory is that the experiment really amounts to having the players play one large multi-move game. One cannot just as well think of the thing as a sequence of independent games as one can in zero-sum

cases. There is too much interaction.... It is really A292
striking however how inefficient [Player One] and [Player Two]
were in obtaining the rewards.

-----293

One would have thought them more rational.
Nash managed to solve a problem at RAND that he and Shapley had
both been working on the previous year. The problem was to devise
a model of negotiation
between two parties-whose interests neither coincided nor were
diametrically opposed comt the players could use to determine
what threats they should use in the process of negotiating. Nash
beat Shapley to the punch. "We all worked on this
problemea"Martin Shubik later wrote in a memoir of his Princeton
experiences, "but Nash managed to formulate a good model of the
two-person bargain utilizing threat moves to start with."
Instead of deriving the solution axiomatically comt is, listing
desirable properties of a "reasonable" solution and then proving
that these properties actually point to a unique outcome comz he
had in formulating his original model of bargaining, Nash laid
out a four-step negotiNea19 Stage One: Each player chooses a
threat. This is what I'll be forced to do if we can't make a
deal, that is, if our demands are incompatible. Stage Two: The
players inform each other of the threats. Stage Three: Each
player chooses a demand, that is,

-----294

an outcome worth a certain amount to him. If the bargain doesn't
guarantee him that amount, he won't agree to a deal. Stage Four:
If it turns out that a deal exists that satisfies both players`
demands, the players get what they ask for. Otherwise, the
threats have to be executed. It turns out that the game has an
infinite number of Nash equilibria, but Nash gave an ingenious
argument for selecting a unique stable equilibrium that coincides
with the bargaining solution he previously derived axiomatically.
He showed that each player had an "optimal"threat, that is, a
threat that ensures that a deal is struck no matter what strategy
the other player chooses.
Nash initially wrote up his results in a RAND memorandum dated
August 3 1,
1950, suggesting that he managed to finish the paper just before
leaving RAND for Bluefieldddd10 A longer and more descriptive
version of the paper was eventually accepted by
Econometrica,
which had published "The Bargaining Problem" that April. Accepted

for publication sometime during the following academic year, "Two Person Cooperative Games" did not in fact appear

-----295

until January 1953.¹¹ It was Nash's last significant contribution to the theory of games.

Nobody at RAND solved any big new problems in the theory of noncooperative games. For all intents and purposes, Nash stopped working in the field in 1950. The dominant thrust of game theory at RAND came from the mathematicians, particularly Shapley, and they were guided less by applications than by the mathematics themselves. During the 1950's Shapley focused on cooperative

games, which were necessarily of limited interest not only A295
to economists but also to military strategists. The justification
of all mathematical models is that, oversimplified, unrealistic,
and even false as they may be in some respect, they force
analysts to confront possibilities that would not have occurred
to them otherwise. The history of physics and medicine abounds
with wrong or incomplete theories that throw just enough light to
allow some other big breakthroughs. The atom bomb, for example,
was built before physicists understood the structure of
particles. The most significant application of game theory to a
military problem grew
straight out of the theory of duels and helped shape

-----296

what was probably RAND's single most influential strategic study.
The study was the brainchild of Alvin Wohlstetter, a mathematician
who joined RAND's economics group in early 1951, about six months
after Nash joined the mathematics group.

According to Kaplan, the SAC operational plan in the early 1950's
was to fly bombers from the United States to overseas bases and
then to mobilize and launch an attack against the Soviet Union
from there. "The Air Force's whole deterrence strategy was based
on the idea of the power of the H-bomb and America's ability to
respond in kind to any attack. Apparently, no one before
Wohlstetter had focused on vulnerability to a first strike aimed,
not at American cities, but at wiping out the SAC force, then
concentrated in a small number of foreign bases within striking
distance of the Soviet Union. Kaplan writes:

Up to that point, most military applications of game theory had
focused on tactics-the best way to plan a fighter-bomber duel,
how to design bomber formations or execute anti-submarine warfare
campaigns. But Wohlstetter would carry it further. It was this
insistence on figuring out one's own

-----297

best moves in light of the enemy's best moves that provoked
Wohlstetter to look at a map and to conclude that the closer we
are to them, the closer they are to us-the easier it is for us to
hit them, the easier it is for them to hit us. Wohlstetter and
his team estimated that a mere 120 bombs ... could destroy
75 to 85 percent of the B-47 bombers while they casually sat on
overseas bases. The SAC, seemingly the most powerful strike force
in the world, was appearing to be so vulnerable in so many ways
that merely putting the plan into action ... created a target so
concentrated that it invited a pre-emptive attack from the Soviet

Union.

33

Wohlstetter's study had an electrifying effect on the Air Force establishment. With its focus on American vulnerability and the temptation of a Soviet surprise attack, the study also rationalized a paranoia in the military establishment that seeped into the body politic and wound up as national hysteria over the supposed missile gap" in the second half of the 1950's. The RAND report, Fred Kaplan writes, "legitimized a basic fear of the enemy and the unknown through

mathematical calculation and rational analysis, providing 298
 the techniques and the general perspective through which the new
 and rather scary situation comthe Soviet Union's acquisition of
 long range nuclear weapons -- could be discussed and acted upon."
 14

The golden age at RAND, from the point of view of the
 mathematicians, strategic thinkers, and economists, was already
 coming to a closeddd35 After a time, RAND's sponsors grew less
 enthusiastic about pure research, less tolerant of
 idiosyncrasies, and more demanding. Mathematicians got bored and
 frustrated with game theory. Consultants stopped coming and
 permanent staffers drifted to universities. Nash never returned
 after the summer of 1954. Flood left for Columbia University in
 122

A BEAUTIFUL MIND

1953. Von Neumann, who in any case had played a very small role
 in the group after inspiring it, dropped his RAND consultancy in
 1954 when he accepted an appointment as a member of the Atomic
 Energy Commission.

Game theory, in any case, was going out of vogue

-----299

at RAND. R. Duncan Luce and Howard Raiffa concluded in their 1957
 book, Gamesand Decisions:

"We have the historical fact that many social scientists have
 become disillusioned with game theory. Initially there was a
 naive band-wagon feeling that game theory solved innumerable
 problems of sociology and economics, or that, at least it made
 their solution a practical matter of a few years' work. This has
 not turned out to be the case."" The military strategists were of
 the same mind. "Whenever we speak of deterrence, atomic
 blackmail, the balance of terror ... we are evidently deep in
 game theoryea"Thomas Schelling wrote in 1960, "yet formal game
 theory has contributed little to the clarification of these
 ideas.""

Princeton, 1950-51

J_ 1EITHER THE PROSPECT

of playing military strategist, nor living in Santa Monica, nor
 earning a handsome salary tempted Nash to accept Williams's offer
 of a permanent post at the think tank. Nash shared little of
 RAND's camaraderie or sense of mission. He wanted to work on his
 own and to have the freedom to roam

-----300

all over mathematics. To do that, he would have to obtain a

faculty position at a leading university.

For the moment, he planned to spend the upcoming academic year in Princeton. Tucker had arranged for his support by assigning him to teach a section of undergraduate calculus I and making him a research assistant on his Office of Naval Research grant. In fact, Nash intended to devote most of his energy to his own research and to looking for an academic opening for the following fall. But before he could turn to these matters, he was forced to confront an immediate threat to his career plans, namely, the Korean War.

North Korea had invaded the South on June 25, 1950, about the

time that Nash was flying to Santa Monica. A week later A300
 Truman promised to send American troops to repel the invasion.
 The first reinforcements landed July 19. By July
 31, Truman had issued an order to the Selective Service to call
 up one hundred thousand young men right away, twenty thousand
 immediately. A week or two later, John Sr. and Virginia wrote
 that Nash might be in imminent danger of being

-----301

drafted. Like most Republicans, they disliked Truman and had
 their doubts about the war. They urged Nash to come to Bluefield
 as soon as practical to talk with members of the local draft
 board personally to sound them out about a II-A. Surely, they
 said, Nash was more valuable at RAND or at Princeton than in
 uniform.

When Nash left RAND at the very end of August, he flew from Los
 Angeles to Boston and spent a day at the world mathematical
 congress, which was meeting in Cambridge. He presented his
 algebraic manifolds result to a small audience there, a nice
 distinction for a young mathematician. But he was anxious to get
 back to Bluefield and didn't stay for most of the meetings.
 He was determined to do all he could to avoid the draft. With a
 war on, even an unpopular and undeclared war, who knew how long
 he would have to serve? Any interruption of his research could
 jeopardize his dream of joining a top-ranked
 mathematics department. Returning World War 11 veterans had
 flooded the job market and enrollments were falling because of
 the draft. In two years there would be another crop of brilliant
 youngsters clamoring for the handful of instructors hips. His
 game theory thesis

-----302

had been greeted with a mix of indifference and derision by the
 pure mathematicians, so his only hope of a good offer, he felt,
 was to finish his paper on algebraic manifolds.
 Besides, he had no wish to become part of someone else's larger
 design and dreaded the thought of military life-his hawkish
 instincts and southern background notwithstanding. He had been
 one of the few boys at Beaver High who hadn't prayed for World
 War 11 to last long enough so that he would have a chance to
 serve. Life in the army, with its mindless regimentation,
 stultifying routines, and lack of privacy, revolted him, and he
 had heard enough stories from other mathematicians to dread being
 herded together with the kind of rude, uneducated young men whose
 company he had been only too happy to escape when he left

Bluefield for Carnegie Tech. Nash proceeded methodically. Once back in Bluefield, he called on two members of the board, including its chairman, a retired attorney named T. H. Scott, whom he later described as "a rock-ribbed Republican (Truman equals moron equals Roosevelt)," and a Dr. H. L. Dickason, the president of Bluefield State, a black

-----303

junior college on the far side of the town.` He made it his business to find out as much as he could about the men who would be deciding his fate. As it turned out, the board had only a fuzzy sense of what Nash was doing. Until he showed up at the

Peery building, they had no idea that he had already A303
received his doctorate and had assumed he was returning to
Princeton that fall as a student. His student deferment had not
yet been canceled.

His meeting with Scott did nothing to ease his anxiety. The board
was already working through its list of twenty-two-year-olds. Now
that the board knew that he was no longer a graduate student, he
might very well be in the next call, which was scheduled for the
twentieth of the month, less than two weeks away. Nash mentioned
that he was doing classified research for the military, and
described both his affiliation with RAND and the ONR project at
Princeton. Scott did not rule out the possibility of granting an
occupational deferment, but he expressed some skepticism that a
young mathematician could be indispensable, except in uniform, in
a national emergency. Nash felt slightly better about his meeting
with Dickason, who had taught math and physics before the war and
appeared

-----304

to be impressed by Nash's Princeton degree and associates. It was
probably Dickason who tipped Nash off to the fact that merely
filing an application for a II-A, an occupational deferment,
would temporarily halt the wheels of the draft machinery and take
him out of the pool of potential draftees at least until the
board had time to consider his II-A application. Nash wasted no
time. In Bluefield, he went to the library and read the Selective
Service law. He thought about the board's psychology. He wrote to
Tucker, to the Office of Naval Research in Washington, and no
doubt also to Williams at RAND, though there is no record of such
a letterdd6 (A letter from the
Office of Naval Research in Washington, received by A] Tucker on
September 15, begins, "John Nash has written me asking if ONR can
help get him a draft deferment.") Nash asked them to request a
II-A deferment, but urged them to state only the bare facts,
promising more information later-so that "heavier guns may be
later rolled out without the appearance" of merely repeating the
initial statementsdd7 He was intent on buying as much time as
possible. Later on, in other

-----305

circumstances, Nash would repeatedly express his dislike and
resentment of "politics"and "politicking." But, impractical,
childish, and detached from everyday concerns as he was in some
ways, he was quite capable of plotting strategy, ferreting out
necessary facts, making use of his father's connections, and most

of all, marshaling allies and supporters. Tucker, the university, the Navy, and RAND responded sympathetically and promptly, claiming in unison that he was irreplaceable, it would take years to train a substitute, and his work was "essential to the welfare and security of this nation." I Fred D. Rigby at the Office of Naval Research in Washington advised Tucker that the best route to take was for a university officer to ask the New York branch of the ONR to write to the Bluefield draft board. "This process is said to work well. Normally, it takes place after the man is put in I-A, but there is no rule against its use in advance of that eventdd"Rigby also noted that "this kind of question is

coming up frequently these days," suggesting that Nash was hardly alone among young academics with Defense Department affiliations seeking to avoid the draft. Rigby also promised that, should the branch office action fail, "we will then

-----306

make a second try directly with the national selective service organization" adding, however, that in all likelihood "this will not be necessary." I

The concerted effort to save Nash from the draft was not much different from similar efforts made for a great many other young scientists at the time. The Korean War did not inspire the same patriotic fervor as World War II. Many academics regarded defense research as a kind of alternative service and the notion of exempting especially accomplished and valuable individuals had antecedents even in World War II. Kuhn remembers trying but failing to join the Navy's V-12 program, which would have allowed him to spend the war attending the same classes at Caltech that he would have attended as a civilian, only in uniform. He wound up in the infantry only because he failed the Navy's tougher physical." Korea did not prompt the massive draft evasion of the Vietnam era, de facto a working-class war, but among a certain elite in Nash's generation there was a sense of entitlement and a lack of embarrassment about obtaining special treatment.

The urgency of Nash's efforts to avoid the draft

-----307

suggests deeper fears than those related to career ambitions or personal convenience. He was a personality for which regimentation, loss of autonomy, and close contact with strangers were not merely unpleasant, but highly threatening. With some justification, Nash would later blame the onset of his illness partly on the stress of teaching, a far milder form of regimentation than military life. His fear of being drafted remained acute long after the Korean War ended and after he turned twenty-six (the age cut-off for draft eligibility). It eventually reached delusional proportions and helped drive him to attempt to abandon his American citizenship and seek political asylum abroad. Interestingly, Nash's gut instinct has since been validated by schizophrenia researchers. None of the life events known to produce mental disorders such as depression or anxiety neurosis combat, death of a loved one, divorce, loss of a job have ever been convincingly implicated in the onset of schizophrenia. But several studies have since shown that basic military training

during peacetime can precipitate schizophrenia in men with a hitherto unsuspected vulnerability to the

-----308

illnessdd"Alth the study subjects were all carefully screened for mental illnesses, hospitalization rates for schizophrenia turned out to be abnormally high, especially for draftees. Rigby's prediction was soon borne out. A handwritten note dated September 15 from the files of Princeton's dean of faculty, Douglas Brown, records a telephone call from Agnes Henry, the mathematics department secretary, who informed the dean's secretary that John Nash had telephoned her asking the dean to write to the Office of

Naval Researchdd"A few days later Nash filled out a A308 university form, "Information Needed in a National Emergency," in which he stated that he was registered at Local Board 12 in Bluefield, that his current classification was I-A, and that he had a "chance or 2-A, application pendingdd011 The form noted that Nash was engaged in project 727, Tucker's ONR logistics grant. In response to the question "Are you engaged in any other research work or consultation of possible national interest""Nash responded yes and listed "consultant. for RAND corporation." A note, added perhaps by the head of Princeton's grants office, mentioned that Nash had spent "3

-----309
years or more on the theory of games and related fields. Wrote paper in this field when at Carnegie Tech as undergraduate, Two years to get Ph.D. at Princeton. Dr. Rigby has already told NY to support."

The university immediately wrote to ONR stating that "this project is considered by the Logistics Branch of ONR, Washington as a very important contribution in the present national emergency. Dr. Nash is a key member of our staff in this project and is one of the very few individuals in the country who have been trained in this field,"" The ONR followed, on September 28, with a letter to the draft board saying that Nash was "a key research assistant"and "this contract is an essential part of the Navy Departments research and development program and is in the interest of national safetydd019

RAND protected Nash as well. RAND's former manager of security, Richard Best, recalls writing letters for Nash and another mathematician from Princeton, Mel Peisakoff, to "save"them from the draftdd10 (Peisakoff's recollection differs from Best's, however; he says he wanted to enlist but that his superiors at RAND wouldn't let him.)0"We had a lot of reservists and a great many

-----310
young peopleea"said Best. "In 1948, the average age was 28.35 years. The personnel office wasn't well
The Draft
127

[equipped to handle the situation]. I wrote some form letters to the draft board for Nashea"he recalled .12
Nash's lobbying campaign worked, though he was not immediately granted the desired 11-A. By October 6, the university informed Nash that "you seem to be safe until June 30dd0`1 Apparently, the

board had simply postponed the designation for active service until June 30, 1951. The university advised Nash, I would suggest that we defer any further action until next spring, at which time, we can again apply for a 11-A classification and can consider an appeal if this should be rejected." 14 But, at least for now, he had prevented the military from wrecking his plans. More important, by protecting his personal freedom, Nash may have protected the integrity of his personality and won the ability to function well for longer than he might otherwise have.

Princeton, 1950-51

STRANGE

311

AS IT MAY NOW SEEM,

the dissertation that would one day win Nash a Nobel wasn't highly regarded enough to assure him an offer from a top academic department. Game theory did not inspire much interest or respect among the mathematical elite, von Neumann's prestige notwithstanding. Indeed, Nash's mentors at Carnegie and Princeton were vaguely disappointed in him; they had expected the youngster who had re-proved theorems of Brouwer and Gauss to tackle a really deep problem in an abstract field like topology. Even his biggest fan, Tucker, had concluded that while Nash could "hold his own in pure mathematics" was not "his real strength."

Having successfully sidestepped the threat of the draft, Nash now began working on a paper that he hoped would win him recognition as a pure mathematician. The problem concerned geometric objects called manifolds, which were of great interest to mathematicians at that time. Manifolds were a new way of looking at the world, so much so that even defining them sometimes tripped up eminent mathematicians. At Princeton, Salomon

-----312

Bochner, one of the leading analysts of his day and a fine lecturer, used to walk into his graduate classes, start to give a definition of a manifold, get hopelessly bogged down, and finally give up, saying with an exasperated air, before moving on, "Well, you all know what a manifold is."

In one dimension, a manifold may be a straight line, in two dimensions a plane, or the surface of a cube, a balloon, or a doughnut. The defining feature of a manifold is that, from the vantage point of any spot on such an object, the immediate vicinity looks like perfectly regular and normal Euclidean space. Think of yourself shrunk to the size of a pinpoint, sitting on the surface of a doughnut. Look around you, and it seems that you're sitting on a flat disk. Go down one dimension and sit on a curve, and the stretch nearby looks like a straight line. Should you be perched on a three-dimensional manifold, however esoteric, your immediate neighborhood would look like the interior of a ball. In other words, how the object appears from afar may be quite different from the way it appears to your nearsighted eye.

By 1950, topologists were having a field day

-----313

with manifolds, redefining every object in sight topologically. The diversity and sheer number of manifolds is such that today, although all two-dimensional objects have been defined topologically, not all three- and four-dimensional objects comof which there is literally an infinite assortment -- have been so precisely described. Manifolds turn up in a wide variety of physical problems, including some in cosmology, where they are often very hard to cope with. The notoriously difficult three-body problem proposed by King Oskar 11 of Sweden and Norway in 1885 for a mathematical competition in which Poincar6 took part, which entails predicting

the orbits of any three heavenly bodies coms as the sun, A313
moon, and earth -- is one in which manifolds figure largely.`

Nash became fascinated with the subject of manifolds at
Carnegiedd6But it is likely that his ideas did not crystallize
until after he came to Princeton and began having regular
conversations with Steenrod. In his Nobel autobiography, Nash
says that, right around the time that he got his equilibrium
result for n-person games, that is, in the fall of 1949, he also

-----314

made "a nice discovery relating to manifolds and real algebraic
varieties."` This is the result that he had considered writing up
as a dissertation after von Neumann's cool reaction to his ideas
about equilibrium for games with many players.

The discovery came long before Nash had worked out the laborious
steps of the actual proof. Nash always worked backward in his
head. He would mull over a problem and, at some point, have a
flash of insight, an intuition, a vision of the solution he was
seeking. These insights typically came early on, as was the case,
for example, with the bargaining problem, sometimes years before
he was able, through prolonged effort, to work out a series of
logical steps that would lead one to his conclusion. Other great
mathematicians --

Riemann, Poincar6, Wienerhave also worked in this way.` One
mathematician, describing the way he thought Nash's mind worked,
said: "He was the kind of mathematician for whom the geometric,
visual insight was the strongest part of his talent. He would see
a mathematical situation as a picture in his mind. Whatever a
mathematician does has to be justified by a rigorous proof. But
that's not how the solution presents itself to him. Instead, it's
a bunch

-----315

of intuitive threads that have to be woven together. And some of
the early ones present themselves visuallydd09

With Steenrod's encouragement, 10 Nash gave a short talk on his
theorem at the International Congress of Mathematicians in
Cambridge in September 1950.11 Judging from the published
abstract, however, Nash was still missing essential elements of
his proof. Nash planned to complete it at Princeton.

Unfortunately for Nash, Steenrod was on leave in France."

Lefichetz, who undoubtedly was pressing Nash to have the paper
ready before the annual job market got under way in February,
urged Nash to go to Donald Spencer, the visiting professor who
had been on Nash's generals committee and had just been hired

away from Stanford, and to use Spencer as a sounding board for completing the paper."

As a visiting professor, Spencer occupied a tiny office squeezed between Artin's huge corner office and an equally grand study belonging to William Feller. Spencer, as Lefschetz wrote to the dean of faculty, was "probably the most attractive mathematician in America at that moment" as well as "one of the most

-----316

versatile American born mathematicians."

14

A doctor's son, Spencer grew up in Colorado and was admitted to Harvard, where he intended to study medicine. Instead, he wound up at MIT studying theoretical aerodynamics and then at Cambridge, England, where he became a student of J. E. Lifflewood, Hardy's great coauthor. Spencer did brilliant work in complex analysis, a branch of pure mathematics that has widespread engineering applications. He was a much sought-after collaborator, his most celebrated collaboration being with the Japanese mathematician Kunihiko Kodaira, a Fields medalist. Spencer himself won the B6cher Prize." Although he primarily worked in highly theoretical fields, he nonetheless had some applied interests, namely hydrodynamics. 19

A lively, voluble man, Spencer was "sometimes daunting in his reckless energy." His appetite for difficult problems was boundless, his powers of concentration impressive. He could drink enormous quantities of alcohol, comfive martinis out of "bird bath" glasses, and still talk circles around

-----317

other mathematicians. A man whose natural exuberance hid a darker tendency toward depression and introspection, Spencer's appetite for abstraction was accompanied by an extraordinary empathy for colleagues who were in trouble."

He did not, however, suffer fools gladly. The first draft of Nash's paper gave Spencer little confidence that the younger mathematician was up to the task he'd set for himself. "I didn't know what he was going to do, really. But I didn't think he was going to get anywhere." For months, Nash showed up at Spencer's door once or twice a week. Each time he would lecture Spencer on his problem for an hour or two. Nash would stand at the blackboard, writing down equations and expounding his points. Spencer would sit and listen and then shoot holes in Nash's arguments.

Spencer's initial skepticism slowly gave way to respect. He was impressed by the calm, professional way that Nash responded to his most outrageous challenges and his fussiest objections. "He wasn't defensive. He was absorbed in his work. He responded thoughtfully." He also liked Nash for not being a whiner. Nash never talked about himself, Spencer recalled. "Unlike other students

-----318

who felt underappreciated," he said, "Nash never complained." The more he listened to Nash, moreover, the more Spencer appreciated the sheer originality of the problem. "It

was not

a problem that somebody gave Nash. People didn't give Nash problems. He was highly original. Nobody else could have thought of this problem."

Many breakthroughs in mathematics come from seeing unsuspected relationships between objects that seem intractable and ones that mathematicians have already got their arms around.

Nash had in mind a very broad category of manifolds, all manifolds that are compact (meaning that they are bounded and do not run off into infinity the way a plane does, but are self-enclosed like a sphere) and smooth (meaning that they

have no sharp bends or corners, as there are, for example, A^3 on the surface of a cube). His "nice discovery," essentially, was that these objects were more manageable than they appeared at first glance because they were in fact closely related to a simpler class of objects called real algebraic varieties, something previously unsuspected.

-----319

Algebraic varieties are, like manifolds, also geometric objects, but they are objects defined by a locus of points described by one or more algebraic equations. Thus $x^2 + y^2 = 1$

plus

$xy = 1$ represents a circle in the plane, while $xy = 1$

equals

$xy = 1$ represents a hyperbola. Nash's theorem states the following:

Given any smooth compact k -dimensional manifold M , there exists a real algebraic variety V in \mathbb{R}^{k+1} and a connected component W of V so that W is a smooth manifold diffeomorphic to M .

M .

M .

In plain English, Nash is asserting that for any manifold it is possible to find an algebraic variety one of whose parts corresponds in some essential way to the original object. To do this, he goes on to say, one has to go to higher dimensions.

Nash's result was a big surprise, as the mathematicians who nominated Nash for membership in the National Academy of Sciences in 1996 were to write: "It had been assumed that smooth

-----320

manifolds were much more general objects than varieties.

Nash's result still impresses mathematicians as "beautiful" and

striking - quite apart from any applicability. "Just to

conceive of the theorem was remarkable," said Michael Artin,

professor of mathematics at MIT.

Artin and Barry Mazur, a mathematician at Harvard, used Nash's result in a 1965 paper to

estimate periodic points of a dynamical system.

just as biologists want to find many species distinguished by

only minor differences to trace evolutionary patterns,

mathematicians seek to fill in the gaps in the continuum between

bare topological spaces at one end and very elaborate structures

like algebraic varieties at the other. Finding a missing link in

this great chain command Nash did with this result com opened up new

avenues for solving problems. "If you wanted to solve a problem

in topology, as Mike and I did," said Mazur recently, "you could

climb one rung of the ladder and use techniques from algebraic

geometry.

What impressed Steenrod and Spencer, and later on, mathematicians of Artin and Mazur's

-----321

generation, was Nash's audacity. First, the notion that every manifold could be described by a polynomial equation is a larger-than-life thought, if only because the immense number and sheer variety of manifolds would seem to make it inherently unlikely that all could be described in so relatively simple a fashion. Second, believing that one could prove such a thing also involves daring, even hubris. The result Nash was aiming for would have seemed "too strong" and therefore improbable and

unprovable. Other mathematicians before Nash had spotted A321 relationships between some manifolds and some algebraic varieties, but had treated these correspondences very narrowly, as highly special and unusual cases.

29

By early winter, Spencer and Nash were satisfied that the result was solid and that the various parts of the lengthy proof were correct. Although Nash did not get around to submitting a final draft of his paper to the

Annals of Mathematics until

October 1951, ¹¹ Steenrod, in any case, vouched for the results that February,

referring to "a piece of research which he has

-----322

nearly completed, and with which I am well acquainted since he used me

as

a sounding board.⁰ "Spencer thought game theory was so boring that he never bothered to ask Nash in the course of that whole year what it was that he had proved in his thesis."

Nash's paper on algebraic manifolds -- the only one he was ever truly satisfied with, though it was not his deepest work?--established Nash

as

a pure mathematician of the first rank. It did not, however, save him from a blow that fell that winter. Nash hoped for an offer from the Princeton mathematics department. Although the department's stated policy was not to hire its own students, it did not, as a matter of practice, pass up ones of exceptional promise. Lefschetz and Tucker very likely dropped hints that an offer was a real possibility. Although most of the faculty other than Tucker neither understood nor displayed any interest in his thesis topic, they were aware that it had been greeted with respect by economists^{dd14}

In January, Tucker and Lefschetz made a formal proposal that Nash be offered an assistant

-----323

professorship^{dd} "Bochner and Steenrod were strongly in favor, although Steenrod, of course, was not present at the discussion. The proposal, however, was doomed to failure. No appointment could be made without unanimous support in a department as small as

Princeton's, and at least three members of the faculty, including

Emil Artin, voiced strong opposition. Artin simply did not feel that he could live with Nash, whom he regarded as aggressive, abrasive, and arrogant, in such a small department¹⁶ Artin, who supervised the honors calculus program in which Nash taught for a term, also complained that Nash couldn't teach or get along with students."

So the appointment wasn't offered. It was a bitter moment. The thought must have occurred to Nash that he was being rejected less on the basis of his work than on the basis of his personality. It was an even greater blow because the same faculty made it clear that it hoped that John Milnor, only a junior by

this time, would one day become part of the Princeton A323
faculty."

The job market, while not as bad as in the Depression, was
nonetheless rather bleak, the Korean War

-----324

having cut into university enrollments. Having been turned down
by Princeton, Nash knew he would be lucky to get a temporary
instructorship in a respectable department.

Both MIT and Chicago, it turns out, were interested in hiring
Nash as an instructordd"Bochner had the ear of William Ted
Martin, the new chairman of the MIT mathematics department, and
strongly urged Martin to offer Nash an instructorship.

40

Bochner urged Martin to ignore the gossip about Nash's supposedly
difficult personality. Tucker, meanwhile, was pushing Chicago to
do the samedd41 When MIT offered Nash a C. L. E. Moore
instructorship, Nash, who liked the idea of living in Cambridge,
acceptedddd41 BYTHE

END OF JUNE,

Nash was in Boston living in a cheap room on the Boston side of
the Charles.` Every morning he walked across the Harvard Bridge,
over the yellow-gray river to east Cambridge where MIT's modern,
aggressively utilitarian campus lay sprawled between the river
and a swath of

-----325

factories and warehouses. Even before he reached the far side, he
could smell the factory smells, including the distinct odors of
chocolate and soap mingling together from a Necco candy factory
and a PandG detergent plant.` As he turned right onto Memorial
Drive, he could see Building Two looming ahead, a featureless
block of cement painted an "alarming brownea"j to the right of
the new library, then under construction.` His office was on the
third floor next to the stairwell in a corner suite assigned to
several instructors, a spare, narrow room with a high ceiling,
overlooking the river and the low Boston skyline beyddbled

In 1951,

before

Sputnik

and

Vietnam, MIT was not exactly an intellectual backwater, but it
was nothing like what it is today. The Lincoln Laboratory was
famous for its wartime research, but its future academic
superstars were still relatively unknown youngsters, and

powerhouse departments for which it has since become known
comeconomics, linguistics, computer science, mathematics comwere
either infants or gleams in some

-----326

academic's eye. It was, in spirit and in fact, still very much
the nation's leading engineering school, not a great research
universitydd5

An environment more antithetical to the hothouse atmosphere of
Princeton is hard to imagine. MIT's large scale and modern
contours made it feel like the behemoth state universities of the
Midwest. The military, as well as industry, loomed awfully large,

so large that MIT's armed, plainclothes campus security A326
force existed solely for the purpose of guarding the half-dozen
"classified" sites scattered around the campus and preventing
those without proper security clearances and identification from
wandering in. ROTC and courses in military science were required
of all MIT's two-thousand-plus undergraduate men. The academic
departments like mathematics and economics existed pretty much to
cater to the engineering student-in Paul Samuelson's words, "a
pretty crude animaldd117 All counted as "service departments,"
gas stations where engineers pulled up to get their tanks filled
with obligatory doses of fairly elementary mathematics, physics,
and chemistry. Economics, for example, had no graduate program
at all until the wardd9

-----327

Physics had no Nobel Laureates on its faculty at the timedd10
Teaching loads were heavy-sixteen hours a week was not uncommon
for senior faculty-and
were weighted toward large introductory courses like calculus,
statistics, and linear algebradd"Xs faculty were younger, less
well known, and less credentialed than Harvard's, Yales, or
Princeton's.

"There were advantagesea"said Samuelson. "A lot of the MIT
faculty didn't have Ph.D4's. I came without a formal degree.
Solow came before he had a formal degree. We were treated
magnificently. It was more of a meritocracy." He added, "People
would say, doesn't everybody do that? Not up the river, we'd
answer. How do you explain that? We're Avis, we try harderdd"I I
Socially, MIT was dominated by an old guard not of high-society
intellectuals, but of middle-class Republicans and engineers. "It
certainly was not a faculty club populated by cultivated
Brahmins," said Samuelson, who was then twenty-five years old:
"When I came [in 1940] it was 85 percent engineering, 15 percent
science.""

-----328

MIT also had a less exclusionary tradition than Harvard or even
Princeton. By the 1950's, perhaps 40 percent of the mathematics
faculty and students at MIT were Jewishdd14 Bright youngsters
from New York City public schools, effectively barred even then
from attending Princeton as undergraduates, went there. Princeton
was "out of the question for a Jewea"recalls Joseph Kohn, who
enrolled as a freshman at MIT in 1950. "At Brooklyn Tech the
greatest thing in the world was sending a student to MITDD011
Still smarting from his rejection by Princeton, Nash arrived at

Building Two with something of a chip on his shoulder, a feeling that he was a swan among ducks. MIT was already changing, however. Indeed, bringing a brilliant young researcher like Nash on board in the mathematics department was itself a sign of that shift. There was money all of a sudden, not just for teaching the exploding numbers of students, but for researchdd"The amounts were small by post-Sputnik standards or even those of today, but huge by prewar standards. Support for science, initially fueled by the successes during World War 11, was now growing because

of the Cold War. It came not just from the Army, Navy, and 329
 Air Force but from the Atomic Energy Commission and the Central
 Intelligence Agency. MIT wasn't unique. Other institutions, from
 the big state universities in the upper Midwest to Stanford, grew
 up the same way. There was also the talent. Physics got many of
 the Los Alamos people. Electrical engineering was becoming a
 magnet for the first generation of computer scientists, an
 eclectic group of neurobiologists, applied mathematicians, and
 assorted visionaries like Jerome Lettvin and Walter Pitts, who
 saw the computer as a model for studying the architecture and
 functioning of the human brain.0"X was very much a growing
 environment and science was a growing sphere2'said Samuelson,
 adding that after the war, the 85 percent-15 percentsplit between
 engineering and science had shifted to 50 percent-50 percent. He
 added: "It was the upswing in money ... that made this possible.
 That was part of the whole postwar pattern.0"I
 Mathematics was on the verge of becoming an important department,
 although that was not obvious to everyone at the time. The
 department had one famous name, Norbert Wiener (who wound up at
 MIT

-----330
 largely thanks to Harvard's anti-Semitism), and two or three
 first-rate younger men, including the topologist George Whitehead
 and the analyst Norman Levinson. But otherwise, mathematics
 consisted largely of competent teachers rather than great
 researchers com"a few giants but a lot of mediocritiesdd019
 The man who changed all that was appointed chairman of the
 department in
 1947. William Ted Martin, called Ted by everyone who knew him,
 was the tall, skinny, loquacious son of an Arkansas country
 doctor. Blond and blue-eyed with a sunny disposition and a ready
 grin, Martin was married to the granddaughter of a president of
 Smith College and revved up with ambition. A man whose innate
 decency would turn him into one of Nash's protectors after Nash
 became ill, Martin would soon endure his own trial by fire. At
 the height of the McCarthy witch hunt, Martin's secret past as an
 underground member of the Communist Party in the late 1930's and
 early 1940's would be exposed, threatening both his career and
 his vision for the departmentdd10 But in 1951 the past was still
 safely buried. A "sparkplug of a chairmanea"his real

-----331
 talent was for making things happen, wheedling money out of the
 MIT administration, the Navy, and the Air Force, and using it to

great, indeed astounding, effect."

One of Martin's strokes of genius was figuring out that the cheapest and quickest way to upgrade the department was not to reel in a few more big'names, but to lure young hotshots there for a year or two and handle them, as much as possible, with kid gloves. Copying Harvard's Benjamin Pierce Fellows, Martin created C. L. E. Moore Instructorships, so called in honor of MIT's most distinguished mathematician in the 1920Sdd22Moore Instructors weren't expected to join the permanent faculty. The idea was to get a stream of talent that would act as a catalyst, firing up MIT's humdrum atmosphere and attracting better students, the best

of whom now automatically went to the Ivies and Chicago. A331
 Since he wouldn't have to live with them for long, or so he
 thought, Martin wasn't scared of difficult personalities.
 "Bochner said Nash was worth appointing. 'Don't worry about
 anything!'" Martin recalled²¹ And Martin didn't. He came to
 value Nash, not just as "a brilliant and

-----332
 creative young man^a as an ally in his quest to make the
 department great. He would come to particularly rely on Nash's
 absolute intellectual honesty: "V^{len} Nash mentioned somebody [as
 a potential hire], you didn't wonder if he was a crony or a
 relative. If Nash said he was top flight, you didn't need much in
 the way of outside references."

The most attractive figure at MIT from Nash's point of view was
 Norbert Wiener. Wiener was, in some ways, an American John von
 Neumann, a polymath of great originality who made stunning
 contributions in pure mathematics up until the beginning of World
 War 11 and then embarked on a second and equally astounding
 career in applied mathematics²⁴ Like von Neumann, Wiener is
 known to the public for his later work. He was, among other
 things, the father of cybernetics, the application of mathematics
 and engineering to communications and control problems.
 Wiener was also famously eccentric. His appearance alone was
 remarkable. His beard, Samuelson recalled after Wiener's death in
 1964, was like "the Ancient Mariner's." ¹¹ He puffed on fat
 cigars. He waddled like a duck, a myopic

-----333
 parody of an absentminded professor. His extraordinary upbringing
 at the hands of his father, Leo, was the subject of two popular
 books, *IA-MORE a Genius* and *IA-MORE a Mathematician*, the first of
 which became a bestseller in the early 1950's. Prolific as he
 was, Wiener generated as many anecdotes about himself as
 theorems. He hardly seemed to know where he was. He would ask,
 for example, "When we met, was I walking to the faculty club or
 away from it? For in the latter case I've already had my
 lunch¹⁶ He was notoriously insecure. If he encountered someone
 he knew carrying a book under his arm, he would, as likely as
 not, ask anxiously whether his name was in the book¹⁷ Friends
 and admirers traced this feature of his personality to his
 obsessive and overbearing father, who once bragged that he could
 turn a broomstick into a mathematician, and to Harvard's
 anti-Semitism, which cost Wiener an appointment in Birkhoff's
 department. As Samuelson said in a eulogy after Wiener's death:

"The exodus from Harvard dealt a lasting psychic trauma to Norbert Wiener. It did not help that his father was a Harvard professor ... or that Norbert's mother regarded his move as a cruel comedown in life."

-----334

Wiener's colleagues at MIT knew that he suffered from periods of manic excitability followed by severe depressions, constantly threatened to resign, and sometimes spoke of suicide. "When he was high he'd run all over MIT telling people his latest theoremea"Zipporah "Fagi"Levinson, the wife of Norman Levinson, recalled. "You couldn't stop himdd019At times, he would come to

the Levinsons' house, weeping, and say that he wished to A334
kill himself 10 One of Wiener's everpresent fears was that he
would go mad; his brother Theo, as well as two nephews, suffered
from schizophrenia."

Perhaps because of his own psychological struggles, Wiener had an
acute empathy for other people's trials. "He was egotistical and
childish, but also very sensitive to the real needs of
othersea"Mrs. Levinson recalled." When a younger colleague was
writing a book but couldn't afford a typewriter, Wiener showed up
at his door unannounced with a Royal portable under his arm.
When Nash arrived at MIT in 1951, Wiener embraced him
enthusiastically and encouraged Nash's growing interest in the
subject of fluid dynamics-an interest that eventually led Nash to
his

-----335

most important work. For example, Nash sent Wiener a note in
November 1952, inviting him to a seminar Nash was to give on
"turbulence via statistical mechanics, collision functions,
etc."His postscript, saying, "I've found the smoothing effect in
definite form now," suggests that Nash talked about his research
with Wiener, something he did with almost no one else in the
department. Nash saw Wiener, a genius who was at once adulated
and isolated, as a kindred spirit and fellow exiledd14 He copied
some of Wiener's more extreme mannerisms, his own form of homage
to the older man."

But Nash was to become far closer to Norman Levinson, a
first-rate mathematician and a man of extraordinary character,
who would play a role in Nash's career similar to those of
Steenrod and Tucker at Princeton coma combination of sounding
board and father substitute. Levinson, then in his early forties,
was more enigmatic than Martin but far more accessible than
Wienerdd16 Wiry, of medium height, with craggy features, Levinson
was a fine teacher who rarely displayed the slightest facial
expression and never referred to his own accomplishments. He
suffered from hypochondria and from

-----336

wide mood swings, long manic periods of intense creative activity
followed by months, sometimes years, of depression in which
nothing interested him. A former Communist like Martin, Levinson
would suffer doubly during the McCarthy years when he endured not
only notoriety and threats to his career as a mathematician, but
his teenage daughter's slide into mental illness.

Despite these burdens, Levinson was, and would long remain, by far the most respected member of the department. Thoughtful, decisive, and attuned to the personal as well as intellectual needs of those around him, Levinson was father confessor and wise elder, the one whose judgments were constantly sought and carried most weight, on everything from research to appointments. His personal history was one of individual triumph over bleak beginnings. Born in Lynn, Massachusetts, just before World War 1, Levinson was the son of a shoe factory worker who earned eight dollars a week and whose education consisted of attending a yeshiva for a few years. His mother was illiterate. Despite a

childhood of desperate poverty and an education that A336
 consisted of attending rundown vocational

-----337

in schools, Levinson's brilliance was undeniable. He managed, with the help of Wiener, who spotted his talent, to attend MIT and, later, Cambridge. At Cambridge, he became a protégé of G. H. Hardy and embarked on a series of brilliant papers on ordinary differential equations. "He was very uncouth, very provincial," his wife, Zipporah, who met Levinson soon after he returned from England, recalled in 1995. "He was highly opinionated and too ignorant to know that he didn't know everything. But he'd plunge in and make a good paper, despite the fact that he didn't know the literature. Wiener ignored his rough edges."

Like many promising young Jewish mathematicians of his generation, Levinson had difficulty getting an academic post when he returned to the States, and it was Hardy who, while visiting Harvard in 1937, was ultimately responsible for Levinson's appointment that year at MIT. The university's provost, Vannevar Bush, had turned down Wiener's recommendation that Levinson be offered an assistant professorship when Hardy, who at that time was both an outspoken opponent of Nazi anti-Semitism and the most

-----338

prominent member of the German mathematical society, went with Wiener to the provost's office to protest. "Tell me, Mr. Bush, do you think you're running an engineering school or a theological seminary?" he is supposed to have said. When the provost gave a puzzled frown, Hardy went on: "If it isn't, why not hire Levinson?"

Nash was attracted by Levinson's strong personality and by a quality that he both shared and admired, namely Levinson's uncommon willingness to tackle new and difficult problems.

Levinson was an early pioneer in the theory of partial

138 A BEAUTIFUL MIND

differential equations, recognized by a 136cher Prize, and the author of an important theorem in the quantum theory of scattering of particles. Most remarkably, when he was in his early sixties and already suffering from the brain tumor that would eventually kill him, Levinson achieved the most important result of his career, the solution to a part of the famous Riemann Hypothesis.`, In many ways, Levinson was a role model for Nash.

People considered him a had hoy- hut a great one. -

DONALD J NE-WMAN.

1995

The Great Man

...

is colder, harder, less hesitant, and without fear of opinion "he
#7cks the virtues that accompany respect and 'espectability, and
aitoe'ther everything that is the "virtue of the herd "If he
cannot lead, he goes alone... He knows he is incommunicable:
he finds it tiresome to be familiar. .

.

. "Even not speaking to himself, he wears a mask. There is a

solitude within him that is inaccessible to praise or blame. - A339

FmEDR-ICH NmyzscHE,
The Will to Power
I IASH WAS

just twenty-three years old when he became an MIT instructor. He was not only the youngest member of the faculty, but younger than many of the graduate students. His boyish looks and adolescent behavior won him nicknames like Li'l Abner and the Kid Professor.`

By MIT standards of that time, the teaching duties of C. L. E. Moore instructors were light. But

-----340
Nash found them irksome nonetheless comz he did everything that interfered with his research or smacked of routine. Later, he would be one of the few active researchers on the faculty who avoided giving courses in his own research area. Partly, it was a matter of temperament, partly a matter of calculation. He shrewdly realized that his advancement did not depend on how well or poorly he performed in front of students. He'd advise other instructors, "If you're at MIT, forget about teaching. Just do research."`

Perhaps for this reason, Nash was mostly assigned required courses for undergraduates. In the seven years of his teaching career at MIT, he seems to have taught only three graduate courses, all introductory, one in logic in his second year, one in probability, and a third, in the fall of 1958, in game theory.` Mostly, it seems, he taught different sections of undergraduate calculus.

His lectures were closer to free association than exposition. Once, he described how he planned to teach complex numbers to freshmen: "Let's see ... I'd tell them i equals square root of minus one. But I'd also tell them

-----341
that it could be minus the square root of minus one. Then so how would you decide which one. . . dis" He started to wander. Just what freshmen needed, the listener said, in disgusted tones, in 1995. "He didn't care whether the students learned or not, made outrageous demands, and talked about subjects that were either irrelevant or far too advancedddd0bled He was a tough grader too. At times his ideas about the classroom had more to do with playing mind games than pedagogy. Robert Aumann, who later became a distinguished game theoretician and was then a freshman at MIT,

described Nash's escapades in the classroom as "flamboyant" and "mischievous." I Joseph Kohn, later the chairman of the Princeton mathematics department, called him "a bit of a gamester." During the 1952 Stevenson-Eisenhower race, Nash was convinced, quite rightly as it turned out, that Eisenhower would win. Most of the students supported Stevenson. He made elaborate bets with the students that were constructed so that he would win regardless of who won the election. The very brightest students were amused, but most were frightened away and soon the better-informed students started to avoid his courses altogether.

In his first year at MIT, Nash taught an analysis course 342 for advanced undergraduates. The course was supposed to be an introductory look at calculus in which students weren't just learning manipulations but rather absolutely solid proofs of statements and how to construct such proofs. Between the first and second semesters of the yearlong course, the number of students dwindled from about thirty to five.

Kohn recalled: "He gave a one-hour test. He banded out blue books where you filled in your name and the course number on the cover. When the bell rang, you were supposed to turn over the exam sheet and start working on the test. There were four problems. Problem number one was 'What is your name?' The other three problems were fairly hard. Since I knew by then how his mind worked, I made sure to write next to number one, 'My name is Joseph Kohn.' People who assumed that writing their name on the cover was enough got twenty-five points taken offdd"I

Putting classic unsolved problems on exams was another of Nash's favorite tricks, Aumann recalled: "The students were supposed to show that pi is an irrational number. Later, when Nash was

-----343
upbraided by the chairman of the department for putting the equivalent of Fermat's Last Theorem on a final, he responded by saying that people have a mental picture that this is a difficult problem. Maybe that's the stumbling block. Maybe, if people didn't realize that the problem was 'hardl'they could solve it.'" On another occasion, one of Nash's graders actually confronted him after he put the following question on a test:

If you make up a bunch of fractions of pi 3.141592.... If you start from the decimal point, take the first digit, and place decimal point to the left, you get .1
Then take the next 2 digits .41 Then take the next 3 digits .592
And so on and so on. You get a sequence of fractions between 0 and 1. What are the limit points of this set of numbers? (A limit point is a point such that in any open interval containing it, however small, there are an infinite number of numbers from the sequence.)`

The grader immediately realized that it was a question that nobody had ever answered. The decimal expansion of pi isn't a famous outstanding problem, but it's the kind of thing mathematicians ask each other, not

-----344
undergraduates. Only one fact has been proved, namely, that it has to have at least one limit point. It was clear that the

students should know that there was at least one limit. But Nash thought that he knew, intuitively, that every number between 0 and 1 should be a limit point. He felt strongly that he knew the answer intuitively, which is of course quite different from having a solid proof. "It was a sort of strange thing to do," said the grader, in 1996. Nash's propensity for tricks of this kind was so well known that it became the occasion of a small joke on him, George Whitehead, a topologist in the department at the time, recalled in a conversation in 1995.¹⁰ Nash was teaching a large section of the same freshman calculus course that several graduate students were also teaching. All the

sections had a prescribed and identical final and all the A344 tests were graded together. A test, signed J. Forbes Hacker, Jr., with all wrong answers, came back, "hacker" being a double-entendre referring both to Nash's favorite putdown, which was "hack," and MIT slang for jokester. (It was hackers, for example, who one night removed a car belonging to Donald Spencer, who was briefly an instructor at MIT before the war, from its parking

-----345

space on Massachusetts Avenue, deconstructed it, and left it for him to find when he walked into his classroom the next morning, once again fully assembled.) On another occasion, messages appeared on several blackboards around Building Two: THIS IS HATE JOHN NASH DAY! his

Still, Nash could be charming to students he regarded as mathematically talented, and such students found much to admire. To a select few, often undergraduates, Nash made himself "very, very available for chatting about mathematicsea" Barry Mazur, a number theorist at Harvard who first encountered Nash during his freshman year at MIT, recalled. "It was amazing what he was willing to talk about. There was a sense of infinite time in every conversation."

Once Mazur and Nash were chatting in the common room. Someone mentioned a classical theorem by a disciple of Gauss, Peter Gustave Lejeune Dirichlet, that states that there are an infinite number of prime numbers in certain arithmetic progressions. "It's the kind of thing that one just accepts or perhaps goes off and looks up afterwardsea" Mazur said. Nash, however, jumped up, went to the board, and "for hours and hours elegantly

-----346

thought through the proof from first principles"for Mazur's benefitdd12

Outside the classroom, Nash alternated between the sort of behavior for which he was famous at Princeton -- pacing in Building Two's cavernous hallways whistling Bach comand bouts of sociability. By day, he spent very little time in the office suite

that he shared with the other Moore Instructors. Mostly, he spent his time in the mathematics common room coma far cry from the one in Fine Hall, a ratty and nondescript lounge directly below the instructors` offices, at the bottom of a flight of stairs.

The social atmosphere of the MIT common room resembled some of the more raucous scenes from the cult movie If, about a British

public school that is taken over by its "boys." Nash imported the Princeton practice of a regular tea hour to MIT, but not any of its more genteel customs. "He wanted to be the quickestea" Isadore M. Singer, a fellow Moore Instructor, recalled in 1994. "He was a real competitor." 14

just as he had at Princeton, Nash liked jumping

-----347

into a conversation, throwing out challenges and being challenged. He liked solving problems.

Students and an occasional professor played games, including go, chess, a great favorite of Wiener's despite lack of skill at the

gamee"and bridge. (Nash, Singer recalled, was hopeless at A347
 bridge. "It was absurd ` "Singer said. "He had no sense of the
 laws of probability in cards.0gg16 Many of the games, however,
 were made up on the spur of the moment. One day a group made up
 an index of eccentricity by which various department members were
 ranked. Wiener, not Nash, drew the highest score. I I Another
 time, everyone played a version of charades that involved drawing
 abstract pictures representing people around the department. A
 graduate student drew a highly elaborate picture of what appeared
 to be a taxi. Nobody could guess who it was supposed to be. The
 picture, it turned out, was meant to be a Nash,
 the car manufactured in the 1940's and 1950's, and was supposed
 to signify Nash the Hack, again, a reference to Nash's favorite
 putdown of those he regarded as plodders."`

The crowd in the common room was dominated by a handful

-----348
 of fast-talking, wisecracking veterans of Stuyvesant High School
 and the Bronx High School of Science math teams and the City
 College "Math Table"- a once-famous table in City's cafeteria at
 which an entire generation of math students, mostly working-class
 Jews and immigrants, honed their skills in problem solving and
 reparteedd19

It was a brasher, rougher crowd, less uptight and more tolerant
 than the one in Fine Hall, and an audience more to Nash's liking.
 Showing off wasn't regarded
 as

a crime if you knew your stuff. Lack of social graces was
 considered part and parcel of being real mathematicians. "Their
 attitudes were famously nonbourgeois, exhibitionistic,
 dissoluteea"Felix Browder recalled.` If anything, all of them
 placed a certain premium on eccentricity and outrageousness,
 although by today's standards what went for unconventional
 behavior and manners was, by and large, mild comdepending on
 certain turns of phrase, brands of humor, and little deviations
 in dress. One fellow insisted on wearing pants with fly buttons
 with a button or two

-----349
 undonedd"One graduate student recalled: "At that time we thought
 of eccentricity and being good in math as going together. We were
 all enjoying ourselves by being a little bit wild. We thought of
 ourselves as taking advantage of being bright

143
 by ignoring conventions we didn't like. We turned ourselves a

little bit into charactersdd011

In this circle, Nash learned to make a virtue of necessity, styling himself selfconsciously as a "free thinkerdd" He announced that he was an atheistdd" He created his own vocabularydd14 He began conversations in midstream with "Let's take this aspectdd" He referred to people as "humanoids." Nash picked up the mannerisms of other eccentric geniuses. For example, Wiener, who was terribly nearsighted, would keep one of his fingers in the groove in the walls between the wall tiles and the plaster, as he navigated his way hesitantly through the corridors. Nash did the same thingdd"D. J. Newman condemned all music after Beethoven.

Nash would stalk into the music library and tell anyone A349
 who was listening to anything more modern, "That's junkdd016
 Levinson, whose daughter suffered from manic depression, hated
 psychiatrists. Nash

-----350

adopted a similarly vehement stance against the
 professiondd"Warren Ambrose detested conventional greetings like
 "How are you""Nash followed suit."

Marvin Minsky, whom Nash had known during his final year in
 Princeton and whom he regarded as the most intelligent
 "humanoid"of all, recalled: "We shared a similarly cynical view
 of the world. We'd think of a mathematical reason for why
 something was the way it was. We thought of radical, mathematical
 solutions to social problems. At one point, Nash suggested a
 complete transfusion for something. If there was a problem, we
 were good at finding a really ridiculously extreme solutiondd0211
 One time he said that parents should "self-destruct," that is,
 commit suicide, and hand over all their holdings to their
 children. It would be not only convenient but principled, Nash
 said, according to Herta Newman, the wife of Nash's friend Donald
 Newmandd10 Another time he told a class of undergraduates that
 American citizens' voting rights should be made proportional to
 their income (or perhaps it was wealth)dd"In many ways Nash's
 views were more suited to nineteenth-century England's elitist
 political landscape than to the predominantly

-----351

left-wing counterculture of the MIT math department of the
 1950's.

Nevertheless, he adopted a touch of flamboyance about his dress.
 He wore translucent white Dacron shirts sans undershirt, others
 thought, to show off his powerful physique." He bought a camera
 and spent much of his time browsing through photography
 booksdd"Fora time, he read and talked a great deal about
 experimenting with mind-altering drugs like heroin-although there
 is no evidence that he ever tried anydd14 His growing
 heterogeneity of interests and heterodoxy could, with hindsight,
 be seen as the first overt signs of a growing alienation from
 convention and society that would later evolve into a radical
 sense of separateness and disconnection.

But, at the moment, these postures enhanced rather than detracted
 from Nash's social appeal. Nash's status as an instructor and his
 growing reputation as a mathematician brought him newfound
 respect. He was now considered interesting

company. His arrogance was seen as evidence of his genius, and so was his eccentricity, a source of both amusement and grudging respect, the other side of the genius coin, as it were. Fagi Levinson, the department's den mother, said in 1996: "For Nash -----352

to deviate from convention is not as shocking as you might think. They were all prima donnas. If a mathematician was mediocre he had to toe the line and be conventional. If he was good, anything went."" Jerome Neuwirth, a graduate student at MIT, said, "When your solution turns out to be right, we give you your due. We give you a lot of leeway. Had Nash been less of a mathematician,

he wouldn't have gotten away with his nastiness." A352

16

Donald Newman added, "People were annoyed with him because he was flippant, but not really annoyed. They considered him a bad boy, but a great one, a great golden boy."

37

The gang around Nash included Newman, aka D.J., a Harvard graduate student who spent most of his time at MIT hanging out with his old friends from City College and with Nash, because "Harvard was too snooty." Other members of the group included Walter Weissblum, a brilliant sad sack, drunk, and hunchback with a heart of gold, who never finished his degree; 19 Harry Gonshor, who later became a professor at Rutgers, an

-----353

oddball who wore Coke-bottle glasses, looked as if he were floating on air, and once proved a theorem so that it could be stated as "AFL equals CIO";

40

Gustave Solomon, the most humane of the group, later a coinventor of the Reed-Solomon codebb41 Leopold "Poldy" Flatto, an inveterate peoplewatcher and storytellerbb41 and, after 1952, Jacob Leon Bricker, the group's Woody

Allendd41

Neuwirth, a latecomer to the group, said, "Who were we? What were we trying to do? Every group has its own currency. Our only currency is what we were thinking. Who's smart? Who's doing what? What can you solve? How far did you get? It doesn't sound nice but it was excitingdd044

Nash's closest equal, in brains, competitiveness, and general superciliousness, was Newman. Newman was considered a genius and the best problem solver of the groUpdd41 A big, brash, blond swaggerer, Newman had the distinction, very impressive to Nash, of being a three-time Putnam winner. He was already a husband and father, with

-----354

responsibilities that, however, did little to cramp his flamboyant style. He drove a flashy white Thunderbird with red leather seats that he liked to drag race along Memorial Drive in the middle of the night. As an undergraduate at City College, he'd been famous for stunts like turning up in the class of some unfortunate mathematics professor bearing an enormous tree branch, leaves and all, that he claimed was for a biology class. Nash and Newman immediately recognized each other as kindred

spirits. "They loved to spark each other's sarcasm" Arthur Singer recalled⁴⁶ "They admired each other's sarcasm" said Mattuck. "It was all good-natured. But D.J. could make cracks much faster. He had instant recall when it came to mathematics. People used to say that D.J. could solve any problem that could be done in twenty-four hours. Newman didn't have the power of Nash's sustained concentration. Nash could think about a problem for half a year⁴⁷ Newman went to a seminar given by Nash. "I sat in on some of Nash's lectures" said Newman, who was intrigued rather than put off. "It was different,

kind of exciting. He wandered, unlike most lecturers, 355
because he liked to explore a lot of things at once. It was kind
of nice.... We chewed each other outea"Newman recalled. "Nash and
I were friendly friendsdd041

Thanks to the acceptance of Newman and his friends, Nash acquired
a real social life. The crowd often ate lunch together in Walker
Memorial, but it also gathered after hours at various cheap
restaurants, coffee shops, and beer halls that were as plentiful
in 1950's Cambridge and Boston as they are today, places that
didn't mind if you nursed a beer all night and were willing to
write separate checksdd49 They included famous Boston restaurants
like Durgin Park, which served generous helpings of traditional
New England dishes, including a sinfully delicious roast beef and
Indian pudding; Jake Wirth, an old-style German establishment
with a mammoth oak bar; and the Wursthaus in Harvard Square.
Other favorites were Cronin's, Chez Dreyfus, and the Newbury
Steakhouse. The Hayes-Bickford and the Waldorf, which were both
Horn and Hardart-style coffee shops, open most of the night, were
also frequent gathering places. At other times,

-----356
everybody would hang out at some graduate student's apartment, or
go to parties given by the Martins, Levinsons, and in the
mid-1950's, the Minskys.

Within his new circle, Nash strove to constantly underscore his
own uniqueness, superiority, and self-sufficiency. "I'm Nash with
a capital Nff"his whole manner shouted

.50

He was always saying that only one or two people in the
departmentWiener was always one of these -- were up to his
standard. His putdowns were legendary. "You're a childea"was a
favorite expression. "You don't know crap. How trivial! How
stupid! You'll never do anythingff"he would say."

He loved to perform. At parties, he acted rather than conversed.
Once, at the Minskys', Nash demanded that his listeners challenge
him with a difficult mathematical problem. He said, "I've had a
few drinks. Are my thinking powers stronger or weaker on drink?"
He was not above dissembling slightly to wow an audiencedd"He
would pout if he was bested in an argumentdd14 And he hated being
challenged by someone he considered to be an inferior. One day in
the common

-----357
room, a group of students was talking about a famous World War 11
logistics puzzle, the "Jeep" problem.

15

The essence of the jeep problem is that you want to cross the two-thousand-milewide Sahara desert but the Jeep's gas tank holds only enough gas to travel two hundred miles. The only way to cross the desert is to follow a two-steps-forward, one-step-back strategy: to load up the jeep with cans of gasoline, drive, say, one hundred miles, drop off the cans, and go back to the starting point. Then you get more cans of gas, go one hundred miles, unload some and use some to top off the gas in the tank, go another one hundred miles, and go back, picking up some more gasoline. The question is, how many

gallons would be needed?

A357

There is no optimal solution to the problem, as it turns out.

Everybody was proposing solutions. Nash threw out a number.

Nash's grader that term, Seymour Haber, proposed a number half as big. Nash contemptuously dismissed Haber's solution. When Haber insisted that he prove it, Nash said, "My solution's much better."

-----358

Haber recounted: "I didn't see it. I insisted that he prove it.

He didn't want to. He said it was obvious. I still wouldn't

accept his assertion. So he did the calculation. He turned out to be mostly right, but he was extremely annoyed with me. He was angry for my having forced him to do this grungy work when it was perfectly clear all along what the answer was. He was angry with me for some period afterward."

Nor was he above putting the audience down. A typical example: at lunch one day, a graduate student was describing an axiomatic approach to a problem outlined by one of his professors. Nash fairly exploded, "Don't give me all that crap! Tell me how you'd solve the problem. You haven't learned anything. All these concepts don't mean a thing.""

Nash's putdowns of other mathematicians earned him the sobriquet "Gnashdd" Nash responded, "G obviously stands for genius. In fact, there are few geniuses these days here at MIT. Me, of course, and also Norbert Wiener. Even Norbert may no longer be a genius, but there is evidence that he once wasdd" Af that, he referred to Gnu (Newman) and C-squared (Andrew

-----359

Gleason, a young Harvard professor who had just solved Hilbert's fifth problemgg.17

When John McCarthy, whom Nash knew from Princeton, gave a seminar in the department, Nash pulled him aside afterward and said,

"There are too many journals. There are too many trashy papers being published. There are too many guys doing research. Only a few of us should be in research. The rest of them should be in sin x"-a snide reference to the tables at the back of high-school trigonometry books."

Nash flaunted his social snobbery, a legacy of his Bluefield upbringing. He implied that he came from old moneydd19 He would sniff wine at a party and say, "This is an adequate Chiantidd060 Nowhere was his snobbery more evident than in his reaction to being "a non-Jew in a definitely Jewish atmospheredd061 Later, when Nash became paranoid and embraced all sorts of strange

delusions, he wrote letters to Newman and others addressed to "Jewboy," became obsessed with the state of Israel, and talked about "Krypto-Zionist conspiracies."

61

But in the early 1950's, his attitude was merely

-----360

one of social superiority. He frequently told Newman that he looked "too Jewish." 61 Like Groucho Marx, he was inclined not to admire any club that accepted him. Nash displayed a contempt for people and things he considered beneath him. As Fred Brauer, another instructor at MIT, put it forty years later, "That

covered a lot of territorydd064

A360

RAND, Summer 1952

ONE

AFTERNOON-DURING

Nash's second summer in Santa Monica, he and Harold N. Shapiro, another mathematician from RAND, were swimming in the surf off Santa Monica Beach just south of the pier. The ocean was fairly rough. Below the breakwater, Santa Monica Beach was a narrow and steep strip of sand with breakers that were usually six to ten feet high. It was a favorite of body surfers.

Nash and Shapiro were far from shore when they were caught in a powerful current that swept them farther out. Both men were strong swimmers. Nash was "built like a Greek god," Shapiro recalled, and he, too, was sturdy and muscular. But Shapiro remembers being dragged under the waves, briefly

-----361

overpowered by the current, and very frightened. Nash seemed to be struggling as well. "It was hard work getting back to shore," Shapiro said. When the two young men finally reached the beach, they threw themselves on the sand, exhausted and breathing heavily. Shapiro recalled lying there, thinking how lucky they were not to have drowned. To his amazement, however, Nash jumped to his feet after a moment or two and announced he was going back into the water. I wonder if that was an accidentea"Nash said in a calm and detached tone. "I think I'll go back in and see."

At the beginning of that second summer, Nash had driven cross-country from Bluefield to Santa Monica in a rusty old Dodge. He and John Milnor, who was by now a graduate student at Princeton, made the trip together, though Milnor drove his own car. Traveling with them were Nash's younger sister Martha and Ruth Hincks, a journalism major at the University of North Carolina in Chapel Hill, who joined them at the last minute. They met in Chapel Hill, then drove on to Bluefield. Hincks remembers being warned not to let slip that Martha would be sharing the apartment with Milnor as well as Nash. She recalled in 1997 that this secretiveness struck her

-----362

as strange. As they started out, Ruth drove with Nash, Martha with Milnor. Ruth was struck by Nash's complete indifference to her. "I was slim, attractive, intelligenttea"she recalled in 1997. Nash "never even noticed that I was thereea"she said. She was

also struck by the seemingly distant relationship between Nash and Milnor. "They just sort of stood around. They could have met the day before. They never referred to shared experiences. They didn't seem to really know each otherdd"Even the relationship between brother and sister seemed disa little standoffish, not affectionate at allea"said Ruth. "I don't think I saw any affection from anybody on that trip."

They traveled on U.S. 40, which took them through Kansas and Nebraskaddbled They stopped once for a day in Grand Lakes, Colorado, where they all went horseback riding, and also in Salt Lake City, where they visited the Mormon Temple, The men put the

young women in charge of divvying up all the motel, A362
restaurant, and gas bills. All should have been fine for these
young people, privileged as few were, in 1952, to be traveling
cross-country on their own. Yet before the trip was over, Nash
and Ruth had quarreled, and Martha, who had been riding with
-----363

Milnor, was forced, reluctantly, to ride with her older brother
for the remainder of the journey.`

It started as a fine adventure. Martha had just graduated from
Chapel Hill, and had traveled very little before

.6

Tall and striking like her brother, Martha was extremely
intelligent. In spite of a fierce determination not to be
regarded as an egghead and an oddball, Martha had won a
Pepsi-Cola scholarship by beating every boy at Beaver High on the
SAT's and had received invitations to apply to Radcliffe, Smith,
and other top women's schools. Her father, however, had turned
down the scholarship on her behalf, saying that the family could
afford tuition at a nearby school, and Martha wound up at St.
Mary's, a junior college attended mostly by well-to-do southern
girls who brought fur coats with them, rode horses, and were
themselves being groomed not for the job but for the marriage
market. After graduating from St. Mary's, she went on to the
University of North Carolina, where she completed a teaching
degree.

John had persuaded his parents that it would be good for

-----364

Martha to spend a summer in Santa Monica, suggesting that he
could get more work done if Martha kept house for him

.7

Martha, who had never been away from home except at college, was
eager to go. Once the plans were made, John also made no secret
of his hope that his sister and John Milnor would take an
interest in each other.

It was Nash who had proposed that they all travel together.
Milnor and Nash, of course, had known each other since Milnor was
a freshman at Princeton four years earlier. Though he had not yet
completed his dissertation, Milnor had already been asked by
Princeton to join its faculty. Nash confessed to Martha that he
was jealous of Milnor's abilities, but he was clearly also
charmed by Milnor's selfeffacing personality, his brilliantly
lucid mind, and the younger man's lanky good looks.
Ruth said her good-byes as soon as the quartet arrived in Santa

Monica. Martha, Nash, and Milnor rented a small furnished apartment at the top of a rambling Spanish-style villa on Georgina Avenue, a stately street in the old

-----365

section of Santa Monica and ten minutes' walk via Palisades Park from RAND. Nobody did much cooking or housekeeping. A guest who had been invited for lunch said: "The place hadn't been cleaned comever. There were dust balls and dirty dishes. After looking around -- they obviously hadn't prepared a meal -- I decided to ask for eggs. John pushed the remnants of a previously fried egg aside in the frying pan. 'Very nice people,'

I thought to myselfdd09 Martha got a job in a bakery. She A365
hardly saw her two roommates, who seemed to spend most of their
waking hours inside the RAND headquarters. Martha tried to visit
their offices one day but was barred by the guards because she
had no security clearance. 10 She and Milnor went out to dinner
once in the first week or two, but despite their many hours
together in the car, Milnor was uneasy and painfully tongue-tied,
and it became clear to Martha that no romance was in the offing."
The two men worked mostly on their own. Milnor wrote a lovely
paper called "Games Against Nature.0"Nash dabbled with games that
could be played using a computerdd"He was, by this time,

-----366
chiefly concerned with mathematical problems that arise in the
study of fluid dynamics. A paper on war games was merely a
half-hearted effort, designed to justify his employment at RAND
and to be hastily drafted before he returned to Cambridge at the
beginning of September.

14
But Nash and Milnor did collaborate on one project, an experiment
on bargaining involving hired subjects, that was to become,
unexpectedly, a much-cited classicdd"The experiment, designed
with two researchers from the University of Michigan who were
also at RAND for the summer, anticipated by several decades the
now-thriving field of experimental economics.

The RAND experiments grew more or less directly out of the habit
of playing games that the mathematicians indulged in their spare
time. Inventing new games and trying them out, always with the
inventors as subjects, had been a popular pastime at Princeton.
Many of the players had, like Nash, only recently outgrown
boyhood passions for chemistry and electricity experiments. The
idea of recording the play to see whether people played the way
the theory predicted was already a bit of a tradition at

-----367
RAND, inaugurated by the famous Prisoner's Dilemma experiment.
Martha was astonished to learn that the volunteers were earning
fifty dollars a day "to play games."

16
The experiment, which was conducted over a two-day period, was
designed to test how well different theories of coalitions and
bargaining held up when real people were making the
decisionsdd"Von Neumann and Morgenstern, with their interest in
games with many players, focused on coalitions, groups of people
who act in unison. They argued that rational players would

calculate the benefits of joining every possible coalition and choose the best one. It is, the one that was most advantageous to them. Whether they were business executives intent on collusion or workers who wanted to join a union.

Nash, Milnor, and the other researchers hired eight subjects, college students and housewives. They devised different games, mostly with four rotating players, one with as many as seven. The game mimicked the general, "n-person" game of von Neumann's theory. Subjects were told they could win cash by forming coalitions, and the specific amounts that would be awarded

to each possible coalition. To be eligible to win, however, 368
the coalition partners had to commit in advance to a given
division of the winnings.

According to A] Roth, a leading experimental economist, the
experiment yielded two insights that proved highly influential."
For one thing, it drew attention to information possessed by
participants: If the same players play the game repeatedly, the
authors concluded, players tend to "regard a run of plays as a
single play
of
a more complicated game." Second, like the Prisoner's Dilemma
experiment devised by Melvin Dresher and Merrill Flood in 1950,
it showed that players' decisions were often motivated by
concerns about fairness. In particular, in situations in which
neither player had a privileged position, players typically opted
to "split the difference." For the designers of the experiment,
however, the results merely cast doubt on the predictive power of
game theory and undermined whatever confidence they still had in
the subject. Milnor was particularly disillusioned. 19 Though he
continued at RAND
as a
consultant for another decade, he lost interest in

-----369
mathematical models of social interaction, concluding that they
were not likely to evolve to a useful or intellectually
satisfying stage in the foreseeable future. The strong
assumptions of rationality on which both the work of von Neumann
and Nash were constructed struck him as particularly fatal. After
Nash won the Nobel Prize in 1994, Milnor wrote an essay on Nash's
mathematical work in which he essentially adopted the widespread
view among pure mathematicians that Nash's work on game theory
was trivial compared with his subsequent work in pure
mathematics. In the essay, Milnor writes:

As with any theory which constructs a mathematical model for some
real-life problem, we must ask how realistic the model is, Does
it help us to understand the real world? Does it make predictions
which can be tested? ...

First let us ask about the realism of the underlying model. The
hypothesis is that all of the players are rational, that they
understand the precise rules of the game, and that they have
complete information about the objectives of all of the other
players. Clearly, this is seldom completely true.

One point which should particularly be noticed is the

linearity hypothesis in Nash's theorem. This is a direct application of the von Neumann-Morgenstern theory of numerical utility-, the claim that it is possible to measure the relative desirability of different possible outcomes by a real-valued function which is linear with respect to probabilities.... My own belief is that this is quite reasonable as a normative theory, but that it may not be realistic as a descriptive theory. Evidently, Nash's theory was not a finished answer to the problem of understanding competitive situations. In fact, it should be emphasized that no simple mathematical theory can provide a

complete answer, since the psychology of the players and A370
the mechanism of their interaction may be crucial to a more
precise understandingdd10

Nevertheless, decades later, economists, differing with Milnor,
came to regard
this "failure" of an experiment as a very worthwhile one. Casual
as the experiment was in one sense, it became a model for a new
method of economic research, one that had never before been tried
in the two hundred years since Adam Smith dreamed up the
Invisible Hand. The feeling was that even if the

-----371
experiments weren't sophisticated enough to show how people's
brains work, watching the way people played games could draw
researchers' attention to elements of interaction comsch as
signaling or implicit threats comt couldn't be derived
axiomatically."

By the time the experiment was run the relationship between Nash
and Milnor had become strained, and Milnor had moved out of the
Georgina Avenue apartment. Milnor says now that Nash made a
sexual overture toward him. "I was very naive and very
homophobic" said Milnor. "It wasn't the kind of thing people
talked abthen
dis022

But what Nash felt toward Milnor may have been something close to
love. A dozen years later, in a letter to Milnor, Nash wrote:
"Concerning love, I know a conjugation: amo, amas, amat, amamus,
amatis, amant. Perhaps amas is also the imperative, love! Perhaps
one must be very masculine to use the imperative
dis021

Spring 1953

Now, the thing I think would interest the committee ver ygreatly,
ifyou could possibly explain to them
...

-----372
Doctor... howyou can account for what would seem to be an
abnormally Jarge percentage ofcommunistsat MIT?- ROBERT L.
Kuationzic, Counsel, HUAC, April 22,1953

TE

COLD

WAR-PROMISED to be the sugar daddy of the MIT mathematics
department, but McCarthyism -- which blamed the setbacks in that
war on sinister conspiracies and
domestic subversion

comthreatened to devour it.

While Nash and his graduate student friends were shooting each other down and playing games in the mathematics common room, FBI investigators were fanning out around Cambridge, rifling through trash cans, placing individuals under surveillance, and questioning neighbors, colleagues, students, and even children¹. Their targets, as Nash and everyone else at MIT would learn in early 1953, included the chairman and the deputy chairman of the MIT mathematics department, as well as a tenured full professor of mathematics, Dirk Struik—all three one-time

members, indeed, leading members, of the Cambridge cell of the Communist Party. All three were subpoenaed by the House Un-American Activities Committee. It was a state of siege and everyone in the mathematics department felt the threat.

At the time, Nash was no doubt far more preoccupied with the draft commission to mention growing complications of his personal life compared with the possible repercussions for himself of the persecution of his benefactors. Nevertheless, the whole episode was a warning that the world he and other mathematicians inhabited was an extremely fragile one. A congressional committee could destroy your career, just as your draft board could send you halfway around the world.

The whole thing had begun as a farce. McCarthy's original list of communists, announced in February 1950, was stuffed with academics, including the father of Nash's friend Lloyd Shapley, Harvard astronomy professor Harlow Shapley, whom McCarthy incorrectly identified to reporters as "Howard Shipley, astrologer." As the red hunt gathered momentum, the entire scientific community felt vulnerable. Princeton's Solomon Lefschetz would be identified as a possible communist sympathizer by an investigative body. Within a year, Robert Oppenheimer, head of the Manhattan Project, one of the most revered scientists in America and the director of the Institute for Advanced Study, would be humiliated by the McCarthyites.

When the subpoenas were issued, nobody knew how MIT would handle the matter. Other universities had responded with immediate firings and suspensions. "McCarthyism was a big threat to these schools," Zipporah Levinson, Norman Levinson's widow, recalled. "During the war the government had started pouring money into them. The threat was that the research money would dry up. It was a bread-and-butter issue." Martin and Levinson were certain that they were about to lose their jobs and wind up blacklisted for good, like so many others. Levinson talked about becoming a plumber and specializing in the repair of furnaces. The investigators had their eye on the three Browder boys, sons of former Communist Party head Earl Browder, who had all studied or were studying mathematics at MIT and were scholarship recipients, as

-----374
well did

"MIT was turned topsy-turvy" Mrs. Levinson recalled. "The faculty debated and debated how to prove that MIT was patriotic. There was strong pressure to name names." I As it turned out, Karl Compton, the president of the university and an outspoken liberal who was a supporter of the Chinese revolution and a critic of Chiang Kai-shek, may have felt that he himself would soon be subpoenaed. He hired a white-shoe Boston law firm, Choate, Hall and Steward, to defend Martin, Levinson, and the others for a minimal fee. By April, when Martin and Levinson were forced to testify,

The Tech

was running daily stories and anti-McCarthy sentiment was A375
running high on campus."

There is no evidence that the FBI ever questioned Nash or any
other students or faculty in the department, or asked for
depositions, in an effort to establish a link between Levinson's
and Martin's Communist Party membership and classified defense
research coma link that probably never existed, given that both
left the party soon after the end of the war. The graduate
students and junior faculty in the

-----376

department stood on the sidelines and watched lives and careers
ruined and homes, even car insurance, lost. "By that time, young
people had prospects, jobs, optimism" Mrs. Levinson recalled.
"The younger people -- Nash's group -- didn't want to be too
friendly. They were scared. They distanced themselves" I I
Martin and several others named their former associates. Norman
Levinson refused to name anyone who had not been previously
named. "Ted and Izzy Amador hemmed and hawed. Norman knew that
Ted Martin and Izzy would cooperate. They spilled all the names.
Norman said he'd talk freely about the party but that he wouldn't
name names. The lawyer told Norman, no you don't have to say any
names. He'd cooperate, but he wouldn't give any names" 011 Martin
gave a pathetic, frightened performance. Levinson's testimony, by
contrast, demonstrated the qualities of intellect and character
that made him such a force in the mathematics community. In a
series of forceful and eloquent answers to direct questioning, he
managed at one and the same time to defend the youthful idealism
that led
him into the party, attack the intellectual poverty of communism,
and, implicitly, call into question the

-----377

committee's assumption that communism was a threat to the nation.
He spoke out against the hounding of former party members and
asked the committee to take a stand against the blacklisting of
Browder's oldest son, Felix, who had finished his Ph.D. and was
unable to obtain an academic post.
Thanks to MIT's support and the compromises they struck, Levinson
and the others kept their jobs. But the whole dispiriting affair,
which had been preceded by months of harassment and threats, left
deep scars on everyone involved. Martin, in particular, was
shattered and deeply depressed, and was unable, nearly forty-five
years later, to talk about it" Levinson's younger daughter, a
student in junior high school, suffered a breakdown and was

diagnosed with manic depression. Levinson and his wife blamed it partly on her being harassed by the FBI. 14 And those on the periphery, ostensibly unaffected, learned a lesson, namely that the world they so very much took for granted was dangerously fragile and vulnerable to forces beyond its control.

Nash took no part in the heated discussions among some of the graduate students over the morality of the mathematicians' decision to cooperate with the government." Any discussion of morality raised for

him the specter of hypocrisy. But the angry, frightening, 378
turbulent time would supply him with some of the prosecutory
demons that came to haunt him laterdd16

There are two kinds of mathematical contributions. work that
important to the history of mathematics and work that simply a
triumph of the human spirit -

PAUL COHEN,

1996

IN

THE SPRING OF

1953, Paul Halmos, a mathematician at the University of Chicago,
received the following letter from his old friend Warren Ambrose,
a colleague of Nash's:

There's no significant news from here, as always. Martin is
appointing John Nash to an Assistant Professorship (not the Nash
at Illinois, the one out of Princeton by Steenrod) and I'm pretty
annoyed at that. Nash is a childish bright guy who wants to be
"basically original" which I suppose is fine for those who have
some basic originality in them. He also makes a damned fool of
himself in various ways contrary to this philosophy. He recently
heard of the unsolved

-----379

problem about imbedding a Riemannian manifold isometrically in
Euclidean space, felt that this was his sort of thing, provided
the problem were sufficiently worthwhile to justify his efforts;
so he proceeded to write to everyone in the math society to check
on that, was told that it probably was, and proceeded to announce
that he had solved it, modulo details, and told Mackey he would
like to talk about it at the Harvard colloquium. Meanwhile he
went to Levinson to inquire about a differential equation that
intervened and Levinson says it is a system of partial
differential equations and if he could only [get] to the
essentially simpler analog of a single ordinary differential
equation it would be a damned good paper-and Nash had only the
vaguest notions about the whole thing. So it is generally
conceded he is getting nowhere and making an even bigger ass of
himself than he has been previously supposed by those with less
insight than myself. But we've got him and saved ourselves the
possibility of having gotten a real mathematician. He's a bright
guy but conceited as Hell, childish as Wiener, hasty as X,
obstreperous as Y, for arbitrary X and Y I
Ambrose had every reason to be both skeptical and

-----380

annoyed.

Ambrose was a moody, intense, somewhat frustrated mathematician in his late thirties, full, as his letter indicates, of black humor.` He was a radical and nonconformist. He married three times. He gave a lecture on "Why I am an atheist." He once tried to defend some left-wing demonstrators against police in Argentina comand got himself beaten up and jailed for his efforts. He was also a jazz fanatic, a personal friend of Charlie Parker, and a fine trumpet player.` Handsome, solidly built, with a boxer's broken nose-the consequence of an accident in an elevator! -- he was one of the most popular members of the

department. He and Nash clashed-from the start. A380

Ambrose's manner was calculated to give an impression of stupidity: "I'm a simple man, I can't understand this" Robert Aumann recalled: "Ambrose came to class one day with one shoelace tied and the other untied. 'Did you know your right shoelace is untied?' we asked. 'Oh, my God; he said, 'I tied the left one and thought the other must be tied by considerations of symmetry.'"

-----381

The older faculty in the department mostly ignored Nash's putdowns and jibes. Ambrose did not. Soon a tit-for-tat rivalry was under way. Ambrose was famous, among other things, for detail. His blackboard notes were so dense that rather than attempt the impossible task of copying them, one of his assistants used to photograph them. Nash, who disliked laborious, step-by-step expositions, found much to mock. When Ambrose wrote what Nash considered an ugly argument on the blackboard during a seminar, Nash would mutter, "Hack, Hack" at the back of the room.

Nash made Ambrose the target of several pranks. "Seminar on the REAL mathematics" read a sign that Nash posted one day. "The seminar will meet weekly Thursdays at 2 P.M. in the Common Room." Thursday at 2:00 P.M. was the hour that Ambrose taught his graduate course in analysis. On another occasion, after Ambrose delivered a lecture at the Harvard mathematics colloquium, Nash arranged to have a large bouquet of red roses delivered to the podium as if Ambrose were a ballerina taking her bows.

Ambrose needled back. He wrote "Fuck

-----382

My" on the "To Do" list that Nash kept hanging over his desk on a clipboard. It was he who nicknamed Nash "Gnash" for constantly making belittling remarks about other mathematicians. And, during a discussion in the common room, after one of Nash's diatribes about hacks and drones, Ambrose said disgustedly, "If you're so good, why don't you solve the embedding problem for manifolds?" - a notoriously difficult problem that had been around since it was posed by Riemann. So Nash did.

Two years later at the University of Chicago, Nash began a lecture describing his first really big theorem by saying, "I did this because of a bet." Nash's opening statement spoke volumes about who he was. He was a mathematician who viewed mathematics not as a grand scheme, but as a collection of challenging

problems. In the taxonomy of mathematicians, there are problem solvers and theoreticians, and, by temperament, Nash belonged to the first group, He was not a game theorist,

157

analyst, algebraist, geometer, topologist, or mathematical physicist. But he zeroed in on areas in these fields where essentially nobody had

-----383

achieved anything. The thing was to find an interesting question that he could say something about.

Before taking on Ambrose's challenge, Nash wanted to be certain

that solving the problem would cover him with glory. He A383
 not only quizzed various experts on the problem's importance,
 but, according to Felix Browder, another Moore Instructor,
 claimed to have proved the result long before he actually
 hadd "When a mathematician at Harvard confronted Nash, recalled
 Browder, "Nash explained that he wanted to find out whether it
 was worth working on."

14

"The discussion of manifolds was everywherea"said Joseph Kohn in
 1995, gesturing to the air around him. "The precise question that
 Ambrose asked Nash in the common room one day was the following:
 Is it possible to embed any Riemannian manifold in a Euclidean
 space?"

15

It's a "deep philosophical question"cccerning the foundations of
 geometry that virtually every mathematician comf Riemann and
 Hilbert to Elie-Joseph Cartan and Hermann Weyl comworking in the
 field of differential geometry for the

-----384

past century bad asked himself." The question, first posed
 explicitly by Ludwig Schlifli in the 1870's, had evolved
 naturally from a progression of other questions that had been
 posed and partly answered beginning in the mid-nineteenth
 century." First mathematicians studied ordinary curves, then
 surfaces, and finally, thanks to Riemann, a sickly German genius
 and one of the great figures of nineteenth-century mathematics,
 geometric objects in higher dimensions. Riemann discovered
 examples of manifolds inside Euclidean spaces. But in the early
 1950's interest shifted to manifolds partly because of the large
 role that distorted space and time relationships had in
 Einstein's theory of relativity.

Nash's own description of the embedding problem in his 1995 Nobel
 autobiography hints at the reason he wished to make sure that
 solving the problem would be worth the effort: "This problem,
 although classical, was not much talked about as an outstanding
 problem. It was not like, for example, the four-color
 conjectured "I I

Embedding involves portraying a geometric object as-or, a bit
 more precisely, making it a subset of-some space in some
 dimension. Take the

-----385

surface of a balloon. You can't put it on a blackboard, which is
 a two-dimensional space. But you can make it a subset of spaces

of three or more dimensions. Now take a slightly more complicated object, say a Klein bottle. A Klein bottle looks like a tin can whose lid and bottom have been removed and whose top has been stretched around and reconnected through the side to the bottom. If you think about it, it's obvious that if you try that in three-dimensional space, the thing intersects itself. That's bad from a mathematical point of view because the neighborhood in the immediate vicinity of the intersection looks weird and irregular, and attempts to calculate various attributes like distance or rates of change in that part of the object tend to blow up. But put the same Klein

bottle into a space of four dimensions and the thing no longer intersects itself Like a ball embedded in three-space, a Klein bottle in four-space becomes a perfectly well-behaved manifold.

Nash's theorem stated that any kind of surface that embodied a special notion of smoothness can actually be embedded in Euclidean space. He showed that you could fold the manifold like a silk

-----386

handkerchief, without distorting it. Nobody would have expected Nash's theorem to be true. In fact, everyone would have expected it to be false. "It showed incredible originality" said Mikhail Gromov, the geometer whose book

Partial

Differential Relations

builds on Nash's work. He went on:

Many of us have the power to develop existing ideas. We follow paths prepared by others. But most of us could never produce anything comparable to what Nash produced. It's like lightning striking. Psychologically the barrier he broke is absolutely fantastic. He has completely changed the perspective on partial differential equations. There has been some tendency in recent decades to move from harmony to chaos. Nash says chaos is just around the corner. 19

John Conway, the Princeton mathematician who discovered surreal numbers

and invented the game of Life, called Nash's result "one of the most important pieces of mathematical analysis in this century."

It was also, one must add, a deliberate jab at then-fashionable approaches to Riemannian

-----387

manifolds, just as Nash's approach to the theory of games was a direct challenge to von Neumann's. Ambrose, for example, was himself involved in a highly abstract and conceptual description of such manifolds at the time. As Jergen Moser, a young German mathematician who came to know Nash well in the mid-1950's, put it, "Nash didn't like that style of mathematics at all. He was out to show that this, to his mind, exotic approach was completely unnecessary since any such manifold was simply a submanifold of a high dimensional Euclidean space."

Nash's more important achievement may have been the powerful technique he invented to obtain his result. In order to prove his

theorem, Nash had to confront a seemingly insurmountable obstacle, solving a certain set of partial differential equations that were impossible to solve with existing methods.

That obstacle cropped up in many mathematical and physical problems. It was the difficulty that Levinson, according to Ambrose's letter, pointed out to Nash, and it is a difficulty that crops up in many, many problems -- in particular, nonlinear problems. Typically, in solving an equation, the thing that is given is some function, and one finds

estimates of derivatives of a solution in terms of 388
 derivatives of the given function. Nash's solution was remarkable
 in that the

a priori

estimates lost derivatives. Nobody knew how to deal with such
 equations. Nash invented a novel iterative method -- a procedure
 for making a series of educated guesses -- for finding roots of
 equations, and combined it with a technique for smoothing to
 counteract the loss of derivatives." Geometry

159

Newman described Nash as a "very poetic, different kind of
 thinkerdd014 In

this instance, Nash used differential calculus, not geometric
 pictures or algebraic manipulations, methods that were classical
 outgrowths of nineteenth-century calculus. The technique is now
 referred to as the Nash-Moser theorem, although there is no
 dispute that Nash was its originatordd"Jfirgen Moser was to show
 how Nash's technique could be modified and applied to celestial
 mechanics comthe movement of planets comespecially for
 establishing the stability of periodic orbitsdd16 Nash solved the
 problem in two steps. He

-----389

discovered that one could embed a Riemannian manifold in a
 three-dimensional space if one ignored smoothnessdd17 One had, so
 to speak, to crumple it up. It was a remarkable result, a strange
 and interesting result, but a mathematical curiosity, or so it
 seemed.`., Mathematicians were interested in embedding without
 wrinkles, embedding in which the smoothness of the manifold could
 be preserved.

In his autobiographical essay, Nash wrote: So as it happened, as
 soon as I heard in conversation at MIT about the question of
 embeddability being open I began to study it. The first break led
 to a curious result about the embeddability being realizable in
 surprisingly low-dimensional ambient spaces provided that one
 would accept that the embedding would have only limited
 smoothness. And later, with "heavy analysis"the problem was
 solved in terms of embedding with a more proper degree of
 smoothnessdd19 Nash presented his initial, "curious"result at a
 seminar in Princeton, most likely in the spring of 1953, at
 around the same time that Ambrose wrote his scathifig letter to
 Halmos. Emil Artin was in the audience. He made no secret of his
 doubts.

-----390

"Well, that's all well and good, but what about the embedding theorem""said Artin. "You'll never get it."

"I'll get it next weeke"Nash shot back." One night, possibly en route to this very talk, Nash was hurtling down the Merritt Parkwaydd"Poldy Flatto was riding with him as far as the Bronx. Flatto, like all the other graduate students, knew that Nash was working on the embedding problem. Most likely to get Nash's goat and have the pleasure of watching his reaction, he mentioned that Jacob Schwartz, a brilliant young mathematician at Yale whom Nash knew slightly, was also working on the problem. Nash became quite agitated. He gripped the steering wheel and

almost shouted at Flatto, asking whether he had meant to say that Schwartz had solved the problem. "I didn't say that," Flatto corrected. "I said I heard he was working on it." "Working on it?" Nash replied, his whole body now the picture of relaxation. "Well, then there's nothing to worry about. He doesn't have the insights I have." "Schwartz was indeed working on the same problem. Later, after Nash had produced his solution, Schwartz wrote a book

-----391
on the subject of implicit-function theorems. He recalled in 1996:

I got half the idea independently, but I couldn't get the other half. It's easy to see an approximate statement to the effect that not every surface can be exactly embedded, but that you can come arbitrarily close. I got that idea and I was able to produce the proof of the easy half in a day. But then I realized that there was a technical problem. I worked on it for a month and couldn't see any way to make headway. I ran into an absolute stone wall. I didn't know what to do. Nash worked on that problem for two years with a sort of ferocious, fantastic tenacity until he broke through it." Week after week, Nash would turn up in Levinson's office, much as he had in Spencer's at Princeton. He would describe to Levinson what he had done and Levinson would show him why it didn't work. Isadore Singer, a fellow Moore instructor, recalled:

He'd show the solutions to Levinson. The first few times he was dead wrong. But he didn't give up. As he saw the problem get harder and harder, he applied himself more, and more and more. He was motivated just to show everybody how good he was, sure, but on the

-----392
other hand he didn't give up even when the problem turned out to be much harder than expected. He put more and more of himself into it."

There is no way of knowing what enables one man to crack a big problem while another man, also brilliant, fails. Some geniuses have been sprinters who have solved problems quickly. Nash was a long-distance runner. If Nash defied von Neumann in his approach to the theory of games, he now took on the received wisdom of nearly a century. He went into a classical domain where everybody believed that they understood what was possible and not possible. "It took enormous courage to attack these problems," said Paul Cohen, a mathematician at Stanford University and a Fields

medalistdd14 His tolerance for solitude, great confidence in his own intuition, indifference to criticism-all detectable at a young age but now prominent and impermeable features of his personality comserved him well. He was a hard worker by habit. He worked mostly at night in his MIT office -- from ten in the evening until 3:00 A.M.
- and on weekends as well, with, as one observer said, "no references but his own mind"and his "supreme

selfconfidencedd"Schwartz called it "the ability to 393
continue punching the wall until the stone breaks."

161

The most eloquent description of Nash's single-minded attack on the problem comes from Moser: The difficulty [that Levinson had pointed out], to anyone in his right mind, would have stopped them cold and caused them to abandon the problem. But Nash was different. If he had a hunch, conventional criticisms didn't stop him. He had no background knowledge. It was totally uncanny. Nobody could understand how somebody like that could do it. He was the only person I ever saw with that kind of power, just brute mental power."

The editors of the

Annals of Mathematics

hardly knew what to make of Nash's manuscript when it landed on their desks at the end of October 1954. It hardly had the look of a mathematics paper. It was as thick as a book, printed by hand rather than typed, and chaotic. It made use of concepts and terminology more familiar to engineers than to mathematicians. So they sent it to a mathematician at Brown University, Herbert

-----394

Federer, an Austrian-born refugee from Nazism and a pioneer in surface area theory, who, although only thirty-four, already had a reputation for high standards, superb taste, and an unusual willingness to tackle difficult manuscripts. 16

Mathematics is often described, quite rightly, as the most solitary of endeavors. But when a serious mathematician announces that he has found the solution to an important problem, at least one other serious mathematician, and sometimes several, as a matter of longstanding tradition that goes back hundreds of years, will set aside his own work for weeks and months at a time, as one former collaborator of Federer's put it, "to make a go of it and straighten everything

oUtd017

Nash's manuscript presented Federer with a sensationally complicated puzzle and he attacked the task with relish.

The collaboration between author and referee took months. A large correspondence, many telephone conversations, and numerous drafts ensued. Nash did not submit the revised version of the paper until nearly the end of the following summer. His acknowledgment

-----395

to Federer was, by Nash's standards, effusive: "I am profoundly indebted to H. Federer, to whom may be traced most of the

improvement over the first chaotic formulation of this work.""
Armand Bore], who was a visiting professor at Chicago when Nash
gave a lecture on his embedding theorem, remembers the audience's
shocked reaction. "Nobody believed his proof at first" he
recalled in 1995. "People were very skeptical. It k looked like a
[beguiling] idea. But when there's no technique, you are
skeptical. You dream about a vision. Usually you're missing
something. People did not chal-
lentionge him publicly, but they talked privatelydd019
(Characteristically, Nash's report to' his parents merely said
"talks went well.0gg40

Gian-Carlo Rota, professor of mathematics and philosophy A395
at MIT, confirmed Borel's account. "One of the great experts on
the subject told me that if one of his graduate students had
proposed such an outlandish idea he'd throw him out of his
officedd041

The result was so unexpected, and Nash's methods

-----396

so novel, that even the experts had tremendous difficulty
understanding what he had done. Nash used to leave drafts lying
around the MIT common roomdd41 A former MIT graduate student
recalls a long and confused discussion between Ambrose, Singer,
and Masatake Kuranishi (a mathematician at Columbia University
who later applied Nash's result) in which each one tried to
explain Nash's result to the other, without much successdd43
Jack Schwartz recalled:

Nash's solution was not just novel, but very mysterious, a
mysterious set of weird inequalities that all came together. In
my explication of it I sort of looked at what happened and could
generalize and give an abstract form and realize it was
applicable to situations other than the specific one he treated.
But I didn't quite get to the bottom of it eidd44 Later, Heinz
Hopf, professor of mathematics in Zurich and a past president of
the International Mathematical Union, "a great man with a small
build, friendly, radiating a warm glow, who knew everything about
differential geometry," gave a talk on Nash's embedding theorem
in New Yorkdd41 Usually Hopfs lectures were

-----397

models of crystalline clarity. Moser, who was in the audience,
recalled: "So we thought, `NOW we'll understand what Nash did.`
He was naturally skeptical. He would have been an important
validator of Nash's work. But as the lecture went on, my God,
Hopf was befuddled himself. He couldn't convey a complete
picture. He was completely overwhelmedddd046

Several years later, Jargen Moser tried to get Nash to explain
how he had overcome the difficulties that Levinson had originally
pointed out. "I did not learn so much from him. When he talked,
he was vague, hand waving, `You have to control this. You have to
watch out for that.` You couldn't follow him. But his written
paper was complete and correCtdd047

Federer not only edited Nash's paper to make it more accessible,
but also was the first to convince the mathematical community
that Nash's theorem was indeed correct. Martin's surprise
proposal, in the early part of 1953, to offer Nash a permanent

faculty position set off a storm of controversy among the
eighteen-member mathe-were matics

faCU-LTYDD41

Levinson and Wiener were among Nash's strongest

-----398

supporters. But others, like Warren Ambrose and George Whitehead,
the distinguished topolob gist, were opposed. Moore

Instructorships weren't meant to lead to tenure-trAk positions.

More to the point, Nash had made plenty of enemies and few
friends, in

163

his first year and a half His disdainful manner toward his A398 colleagues and his poor record as a teacher rubbed many the wrong way.

Mostly, however, Nash's opponents were of the opinion that he hadn't proved he could produce. Whitehead recalled, "He talked big. Some of us were not sure he could live up to his claimsdd049 Ambrose, not surprisingly, felt similarly, Even Nash's champions could not have been completely certain. Flatto remembered one occasion on which Nash came to Levinson's office to ask Levinson whether he'd read a draft of his embedding paper. Levinson said, "To tell you the truth I don't have enough background in this area to pass judgment.""

When Nash finally succeeded, Ambrose did what a fine mathematician and sterling human being would do. His applause was as loud as or louder than anyone

-----399

else's. The bantering became friendlier and, among other things, Ambrose took to telling his musical friends that Nash's whistling was the purest, most beautiful tone he had ever heard

.51

PART TWO

Separate Lives

Nash was leadingall these separate lives Completely separate lives

comARTHUR MA-NVCK,
1997

ALL

THROUGH HIS CHILDHOOD,

adolescence, and brilliant student career, Nash had seemed largely to live inside his own head, immune to the emotional forces that bind people together. His overriding interest was in patterns, not people, and his greatest need was making sense of the chaos within and without by em ploying, to the largest possible extent, the resources of his own powerful, fearless, fertile mind. His apparent lack of ordinary human needs was, if anything, a matter of pride and satisfaction to him, confirming his own uniqueness. He thought of himself as a rationalist, a free thinker, a sort of Spock of the starship

-----400

Enterprise.

But now, as he entered early adulthood, this unfettered persona was shown to be partly a fiction or at least partly superseded. In those first years at MIT, he discovered that he had some of

the same wishes as others. The cerebral, playful, calculating, and episodic connections that had once sufficed no longer served. In five short years, between the ages of twenty-four and twenty-nine, Nash became emotionally involved with at least three other men. He acquired and then abandoned a secret mistress who bore his child. And he courted -- or rather was courted by -- a woman who became his wife. As these initial intimate connections multiplied and became ever-present elements in his consciousness, Nash's formerly solitary but coherent existence became at once richer and more discontinuous, separate and parallel existences that reflected an emerging adult but a fragmented and

contradictory self. The others on whom he now depended A400
occupied different compartments of his life and often, for long
periods, knew nothing of one another or of the nature of the
others' relation to Nash. Only Nash was in the know. His life
resembled a play in which successive scenes are acted by only two
characters.

-----401

One character is in all of them while the second changes from
scene to scene. The second character seems no longer to exist
when he disappears from the boards.

More than a decade later, when he was already ill, Nash himself
provided a metaphor for his life during the MIT years, a metaphor
that he couched in his first language, the language of
mathematics: $B^2 + RT^2 = 0$, a "very personal"
equation Nash included in a 1968 postcard that begins, "Dear
Mattuck, Thinking 168 A BEAUTIFUL MIND

that you will understand this concept better than most I wish to
explain The equation represents a three-dimensional hyperspace,
which has a singularity at the origin, in four-dimensional space.
Nash is the singularity, the special point, and the other
variables are people who affected him -- in this instance, men
with whom he had friendships or relationships. Inevitably, the
accretion of significant relationships with others brings with it
demands for integration comthe necessity of having to choose.
Nash had little desire to choose one emotional connection over
another. By not choosing, he could avoid, or at least minimize,
both dependence and demands.

-----402

To satisfy his own emotional needs for connectedness meant he
inevitably made others look to him to satisfy theirs. Yet while
he was preoccupied with the effect of others on him, he mostly
ignored -- indeed, seemed unable to grasp -- his effect on
others. He had in fact no more sense of "the Other" than does a
very young child. He wished the others to be satisfied with his
genius-I thought I was such a great mathematician," he was to say
ruefully, looking back at this period comand, of course, to some
extent they were satisfied. But when people inevitably wanted or
needed more he found the strains unbearable.

Santa Monica, Summer 1952

Away from contact with a few specisl sorts of individuals Ism
lost, lost completely in the wildemess... so, so, so, i6 been a
h3rd life in many ways.

comJOHN FoRBE's NASH, JR.,

1965

AFTER

JOHN NASH LOST EVERYTHING- family, career, the ability to think about mathematics comhe confided in a letter to his sister Martha that only three individuals in his life had ever brought him any

-----403

real happiness: three "special sorts of individuals"with whom he had formed "special friendships."

Had Martha seen the Beatles' film

A Hard Dqy Night?

"They seem very colorful and amusingea"he wrote. "Of course they

are much younger like the sort of person I've A403
mentioned.... I feel often as if I were similar to the girls that
love the Beatles so wildly since they seem so attractive and
amusing to me."

Nash's first loves were one-sided and unrequited. "Nash was
always forming intense friendships with men that had a romantic
qualityea"Donald Newman observed in 1996. "He was very
adolescent, always with the boys."` Some were inclined to see
Nash's infatuations as "experimentsea"or simple expressions of
his immaturity coma view that he may well have held himself. "He
played around with it because he liked to play around. He was
very experimental, very try-outishea"said Newman in 1996. "Mostly
he just kissedddd0bled

Newman, who liked to joke about his past and future female
conquests,` had firsthand knowledge because Nash was, for a time,
infatuated with him-with predictable

-----404

results. "He used to talk about how Donald looked all the
timeea"Mrs. Newman said in 1996.6 Newman recalled: "He tried
fiddling around with me. I was driving my car when he came on to
medd"D.J. and Nash were cruising around in Newman's white
Thunderbird when Nash kissed him on the mouth. D.J. just laughed
it offdd7

Nash's first experience of mutual attraction com"special
friendshipsea"z he called them-occurred in Santa Monica.` It was
the very end of the summer of 1952,
after Milnor had moved out and Martha had flown back home. The
encounter must have been fleeting, coming in the last days of
August, just before he was due to leave for Boston, and very
furtive. But it was nonetheless decisive because for the first
time he found not rejection but reciprocity. Thus it was the
first real step out of his extreme emotional isolation and the
world of relationships that were purely imaginary, a first taste
of intimacy, not entirely happy, no doubt, but suggestive of
hitherto unsuspected satisfactions.

The only traces of Nash's friendship with Ervin Thorson that
remain are his description of him as a

-----405

"special"friend in his 1965 letter and a series of elliptical
references to Tin letters in the late 1960'sddd9 Few if any of
Nash's acquaintances met him; Martha recalled a friend of Nash's
who once spent the night on the couch of their Georgina Avenue
apartment, but not his name. 10 Thorson, who died in 1992, was

thirty years old in 1952.¹¹ He was a native Californian of Scandinavian extraction. Nash described him to Martha as an aerospace engineer, but he may in fact have been an applied mathematician. He had been a meteorologist in the Army Air Corps during the war. Afterward, he earned a master's degree in mathematics at UCLA and went to Douglas Aircraft in 1951, just a few years after Douglas had spun off its RandD division to form the RAND Corporation.¹² At that time, Douglas was mapping the future of interplanetary travel for the Pentagon, and Thorson, who eventually led a research team, was very likely involved in these efforts." His great passion, conceived twenty years before

the United States launched
Viking,
was the dream of exploring Mars, his sister Nelda Troutman
recalled in 1997.

A405

-----406
Thorson was, his sister said, "very high strong, not a social
person at all, very bright, knew a lot, very very academic."
14

Nash could easily have met him -- given the close ties between
Douglas and RAND, which was also heavily involved in studies of
space exploration comat a talk or seminar, or perhaps even at one
of the parties that John Williams, the head of RAND's mathematics
department, gave.

If Thorson, who never married, was a homosexual, his surviving
sister did not know itdd"With his family, at any rate, he was
unusually closemouthed, not just about his work, which was highly
classified, but about all aspects of his personal
life. 16

Given the mounting pressure to root out homosexuals in the
defense industry during the McCarthy era, Thorson would have had
to practice great discretion in any case; his career at Douglas
was to last for another fifteen years." When he abruptly resigned
from Douglas in 1968, he apparently did so at the age of
fortyseven because he feared dying. Several of his colleagues had

-----407
recently died of heart attacks and Thorson, who had some sort of
mild heart condition, decided he couldn't cope with the stress
and overwork anymore. He moved back to his hometown of Pomona and
became a virtual recluse except for an active involvement in the
Lutheran church, living with his parents for the next twenty-five
years until his death.

Whether Nash and Thorson saw each other again when Nash returned
A Special Friendship

171
to Santa Monica for a third summer two years later or on one of
his trips to Santa Monica during his illness in the early and
mid-1960's is not known. But Nash continued to think of Thorson
and to refer to him obliquely until at least
1968.

These mathematicians are very exclusive. They occupy a very high
terrain, from which they look down on everyone else. That makes
their relationships with women quite problematic. -- ZIPPORAH
LEVINSON, 1995

ASH WAS BACK in Boston in his old quarters by Labor Day. Number 407 Beacon Street was

-----408

an imposing brick row house built before the turn of the century facing the Charles. Its current owner, Mrs. Austin Grant, was the widow of a Back Bay physician. She liked to point out her home's opulent features to her lodgers, such as the carriage room where its original owners once waited for their horsedrawn carriages to be brought around. And she often bemoaned the neighborhood's decline. "Don't leave your bags on the street while you come in; they might not be there when you come out

again"she said to Nash the day he moved in. A408
 Nash occupied one of the front bedrooms, a large, comfortably
 furnished room with a fireplace. Lindsay Russell, a young
 engineer who had recently graduated from MIT, lived next door.
 Mrs. Grant regularly took Russell aside to remark on Nash's
 idiosyncrasies. Nash acquired a huge set of barbells and began
 lifting weights. When Nash made the dining-room chandelier, which
 hung directly below his bedroom, vibrate with his exertions, Mrs.
 Grant would say, "What does he think this is? A gymnasium""Nash's
 mail also received comment, particularly the postcards from his
 mother expressing the

-----409

hope, as Russell recalled, that "in addition to the pursuit of
 mathematics and other intellectual pursuits, he would make
 friends and engage in social activities."
 With one single exception, however, Nash never had any visitors.
 Russell remembers once waking up in the middle of the night.
 There was a sound coming from Nash's room. It was a giggle. The
 giggle of a woman.
 The pretty, dark-haired nurse who admitted Nash to the hospital
 on the second Thursday in September was named Eleanor.` He was
 due to have some varicose veins removed I and seemed awfully
 nervous -- and young, more like a student than a professorddbled
 Eleanor knew his doctor to be a notorious incompetent.` And a
 drunk. She was curious how an MIT professor had wound up with a
 quack like that. Nash told her that he'd chosen the doctor at
 random by closing his eyes and running his 173
 fingers down the list of physicians in the lobby. She felt, she
 recalled, rather protective of him. Nash was on the ward for only
 a couple of days. Eleanor thought he was cute and sort of sweet,
 but when he left, she hardly expected to see him again.

-----410

Somehow or other, they bumped into each other on the street not
 long afterward. It was a Saturday afternoon and Eleanor was on
 her way to meet a friend to buy herself a good winter coat. "I
 didn't chase him. He chased me. He kept pestering meea"Eleanor
 recalled, "I wound up going shopping with
 hiMdd06

They walked over to Jay's Department Store together. Nash
 followed her up to the coat department, which was on the second
 floor. He kept staring at her, not saying much, waiting for her
 to choose a coat. She started to enjoy herself "John was very
 attractiveea"Eleanor recalled, laughing. "When I saw him, I

thought he was something specialdd" She began pointing to the ones she wanted to try on, and with elaborate courtesy he held out each coat for her to slip into. She thought she liked a purple one best. Nash started clowning around. He pretended he was her tailor, flung himself on his knees before her, loudly made believe he was measuring her coat for alterations comand generally made a fool of himself Embarrassed, Eleanor blushed, protested, and tried to hush him up. "Get up quickff" she whispered. Secretly, however, she was quite thrilled.

At twenty-nine, Eleanor was an attractive, hardworking, 411
tenderhearted woman. A friend of Nash's later described her as
"dark and pretty, quite shy, a good person" of "ordinary
intelligence" with "simple manners" and "a very peculiar way of
speaking." By that the friend meant that her accent was pure
New England. Life hadn't been very kind to her. She'd grown up in
Jamaica Plain, a dreary blue-collar section of Boston. She'd had
a hardscrabble childhood, a harsh mother, and the burden, far too
heavy for a young girl, of caring for a younger half-brother. She
missed a great deal of school as a result. She was, on the whole,
grateful to be able to take up a profession, practical nursing,
that she enjoyed and that provided her with steady work. Her
mother died of tuberculosis when Eleanor was eighteen. Her early
experiences endowed her with a soft heart. She had a deep
appreciation, which stayed with her all her life, for what it was
like to be poor and vulnerable. It brought out a tenderness in
her, toward patients, neighbors, other people's children, and
stray animals. She was the kind of woman who, later in life,
would literally give coats to strangers and invite people who had
nowhere else to stay into her home.

-----412

Shy and lacking confidence, Eleanor also tended to be suspicious
and guarded, especially around men. She said, in an interview, "I
wasn't a bad girl. I didn't run around with a lot of men. In
fact, I was really good. I was a little afraid of men. I didn't
want to be involved with them sexually. I thought it was kind of
disgusting." But Nash disarmed her from the start. Yes, he was
an MIT professor, yes, he came from an upper-class sort of
background, yes, he did top-secret work for the government. But
he was also very young, five years Eleanor's junior, and
there was a sweetness about him, a lack of guile. She sensed,
moreover, that he was, if anything, less experienced than she
was.

After that Saturday afternoon, Nash took her out for cheap meals
and drove her around in his beat-up car. He talked about himself,
his work, the department, his friends commendably. He hardly
asked her anything about herself, something that relieved rather
than distressed her. She wasn't eager to share the rather
dispiriting details of her modest background, particularly as
Nash hinted that his own ancestry was rather distinguished. He
pressed her to let him come up to her apartment. She wouldn't let
him at first. She didn't want to seem easy. But

-----413

she finally agreed to go to his place. She found him eager, ardent, but not frightening.

That Nash, who had preferred dancing with chairs to dancing with girls as an adolescent and who had given the pretty Ruth Hincks not so much as a real glance, progressed so swiftly and had so suddenly and at that particular moment found his way into a woman's arms suggests either love at first sight or some resolution "to take the plunge." The encounter with Thorson might have provided the impetus. Nash may have been looking to repeat a loving experience, or he may have been looking for confirmation of his own "masculinity." On a number of occasions he asked

Eleanor to provide him with steroids. "There were always A413
big bottles of stuff around the places I worked as a nurse," said
Eleanor. "Although she later said that she never acceded to Nash's
requests, she believed that 'he delved into drugs' hoping that
they 'would make him more manly.' He wasn't proving his interest
in women to the world, however; he kept his liaison with Eleanor
a deep dark secret for years, even while he displayed his
infatuation with various men more or less in public.
Caught up as he was with teaching, seminars, and work on his
embedding problem that fall, Nash nonetheless

-----414
managed to see Eleanor frequently. He confided in her. He enjoyed
being alone with her. He liked going over to her place and having
her cook him dinner. She cooked very well. She fussed over him.
Most of all, she was womanly, full of warmth and artless
affection. For Nash, who had never even known a woman other than
his mother and sister, it was a novel experience.
As for the gulf between their educations and social statuses,
what more time-honored formula for romance and eventual
marriage than Eliza Doolittle meets Professor Higgins? For
Eleanor, Nash was a chance for a life she could not possibly have
achieved on her own; for Nash, she was the prospect of retaining,
to put it bluntly, the upper hand. It was a compelling fantasy
and a highly practical arrangement rolled into one. And the same
thing went for the difference in temperaments. Matches between
egocentric and childish men and self-abnegating and maternal
women abound in the history of genius. Nash was looking for
emotional partners who were more interested in giving than
receiving, and Eleanor, as her entire life testified, was very
much that sort.

Nash thought about introducing Eleanor to his mathematical
friends and about taking her around to one of the

-----415
department parties. But he decided against
it. The fact that nobody at MIT knew that Eleanor existed made
the affair even more delicious.
By election day in early November, Eleanor strongly suspected
that she was pregnant. On Thanksgiving, when she invited Nash to
come to her place, she was absolutely certain, having missed a
second period by then.
Nash seemed, oddly enough, more pleased than panicked. He seemed
proud of fathering a child. In fact, he made it clear that he
found the notion of progeny quite attractive. (Later, when such

things became fashionable, he talked about joining a sperm bank for geniuses in California.)

14

He hoped that the baby would be a boy. He wanted the baby to be called John. He did not, however, say anything about marriage, Eleanor's future, or, for that matter, how she and the baby would manage. Eleanor hardly knew what to make of his reaction. She had hoped, of course, that he would see the pregnancy as a crisis to be solved by an offer of marriage. When

this was not forthcoming, she did her best to hide her 416
 disappointment from him. She comforted herself with the thought
 that he was, after all, a remarkable young man. She told herself
 that, of course, he loved her and would do the right thing "in
 the end." In any case, she found that the idea of having a baby
 made her feel quite sentimental. The subject of an abortion --
 illegal but available if one had the money comnever came up.
 Before long, however, the relationship between the lovers lost
 its playful and lighthearted quality. That winter, Eleanor was
 often tense and tired. She fretted a great deal about the
 symptoms of pregnancy and the long hours at the hospital. Nash's
 mind was, more often than not, elsewhere. Soon, he and Eleanor
 were engaged in a tug of war that occasionally turned quite ugly.
 When Eleanor irritated him with her complaints, Nash would needle
 her. He called her stupid and ignorant. He made fun of her
 pronunciation. He reminded her that she was five years older.
 Mostly, however, he made fun of her desire to marry him. An MIT
 professor, he would say, needed a woman who was his intellectual
 equal. "He was always putting me down," she

-----417

recalled. "He was always making me feel inferior."

15

She, in turn, began to resent what she called his superior airs
 and lack of sensitivity. Their evenings together frequently
 degenerated into nasty spats. Eleanor, a friend of Nash's later
 reported, once complained that Nash had pushed her down a flight
 of stairs."

But there were also tender moments comwhen, for example, Nash
 told her that he liked the way she looked with her big belly
 comand Eleanor's feelings about Nash were, on the whole, loving.
 She was convinced that he loved her and would do right by the
 baby, whom he seemed to be looking forward to with great
 eagerness. She still recalled that period of their relationship
 as "beautiful."

17

She excused his
 cruelty by telling herself that it was occasional, that "he
 didn't know how to livedd" She put it down to his having achieved
 extraordinary success at too young an age. "That can be
 overwhelmingea" she later said." In the late spring when she could
 no longer work, Eleanor moved into a home for unwed mothers.
 Around that

-----418

time, Nash finally introduced her to one of his friends from MIT, a graduate student. 19 Eleanor took this as an encouraging sign. John David Stier was born on June 19, 1953, six days after Nash's twenty-fifth birthday. Nash rushed to the hospital and was greatly excited when Eleanor presented him with their sondd10 He stayed as long as the nurses would let him and came back at every opportunity. But he did not offer to put his name on his son's birth certificateea"and he did not offer to pay for the baby's delivery."

Mother and son came home to an apartment Nash had moved to on Park Drive. It wasn't a happy homecoming. Nash wouldn't buy any

baby clothes, Eleanor recalled. "He didn't want us to stay," she said years later. Eleanor finally managed to find a live-in position with an employer who would let her keep her infant with her. Despite the employer's insistence on "no male visitor," Nash came over frequently. "He wanted to be around him all the time," Eleanor recalled. But he still did not offer to marry Eleanor or to support her, although his professor's salary and frugal habits surely

-----419
would have made that possible.

His visits eventually resulted in Eleanor's being fired. The simultaneous loss of her job and her living arrangements created an immediate crisis. With Nash still unwilling to care for her and the baby, Eleanor was finally forced to place John David in foster care.

Like some hapless heroine of a Victorian melodrama, Eleanor left her baby with a series of families, one in Rhode Island, another in Stoneham, Massachusetts, and, finally, at an orphanage whose sentimental name, the New England Home for Little Wanderers, only underscored the Dickensian realities into which she and her son were plunged. Founded during the Civil War, the home was on the southern outskirts of Boston, across the Charles River from the Veterans' Hospital, a good hour by bus from her apartment in Brookline. Eleanor visited her son on Saturdays and Sundays. John Stier remembers standing in the stairwell landing there, peering out of the window, feeling a terrible loneliness and homesickness. Sometimes she brought him back to her apartment where she kept a large supply of toys and baby books. Being separated from the baby nearly drove Eleanor

-----420
mad. More than anything that had gone on before, it made her feel real bitterness toward Nash, who, she believed, left all the anguish and the worry to her and gave no sign that he understood, even remotely, what such a separation might mean for a mother or her child. "I should have been home to take care of him," Eleanor said in 1995. "I was so worried. [Nash] never worried."

Yet the affair continued. They visited the baby, wherever he was, on Sundays. Eleanor came over to Nash's apartment and cooked and, when he demanded it, cleaned for him. Nash also went around to her place for meals. "He continued to oscillate between sweetness and outbursts of cruelty. He continued to keep his affair with Eleanor under wraps, told no one at first except Jack Bricker, who was enjoined to keep the secret. "He never told anyone about

us," said Eleanor, still unable to fathom his behavior."Most of the MIT mathematics community, in fact, did not learn of the existence of his first family until years later.

When John David was a year old, Nash introduced Eleanor to another friend in the department, Arthur Mattuck, without, however, revealing the baby's existence."He and Eleanor sometimes had

-----421

Mattuck, who seemed to like Eleanor, over to dinner. They told Mattuck afterward that they always had a good laugh after he left because Mattuck never noticed all the baby things around the

apartment. It was, to say the least, a strange state of affairs. A421

Or was it? Eleanor was in love with Nash. "People told me never to see him again `\"said she. \"It's better if you have a normal man. Not one who's all puffed up by his own importance. One of my friends said that you didn't see a thing in his face. It was I ike a dead person. I didn't think so, though."

14

She mused many years later: "Did I love him? I wouldn't have gone with someone I didn't love. He was awkward. His awkwardness seemed standoffish. But ... he could be very sweet. He was very attractive in a way. Love is foolish."" As late as 19 5 5 and 19 56, after Nash introduced Mattuck to Eleanor, Eleanor's attitude toward Nash was "adoringdd"Mattuck recalled: "Eleanor realized Nash was a total egoist, but she was dazzled by his brilliance. He thought he was a genius. She was sleeping with one of the

-----422
smartest men in America. Did he love her? She didn't know. She didn't ask. In those days, it wasn't "Talk to me! If you slept with a man, you assumed he loved youUdd016

Eleanor also continued to hope that Nash would marry her, if only for the sake of their son. Nash wasn't, she was sure, seeing another woman. Nash's failure to disappear from her life, despite his tantrums and complaints about her, must have seemed to Eleanor powerful evidence that he did, after all, love her, and would ultimately come around. How else to explain her passivity-her unhappy acceptance, but acceptance nonetheless, of his refusal to pay for her and the baby's support comuntil it was, as it were, too late, until a rival appeared on the scene? She might have threatened him with exposure, or with a lawsuit, but, because she believed he would marry her eventually, she feared alienating him and thus ruining her chances for good. It was only much later, in 1956, after Eleanor discovered that Nash was having an affair with an MIT physics student and concluded that he intended to marry the girl compossibly even before Nash himself reached that decision -- that she took more aggressive action.

Nash's behavior is a bit more mysterious. Why

-----423
did he keep coming around, even though he had reached the conclusion that Eleanor wasn't good enough for him or his social circle? Perhaps he simply hadn't made up his mind. In the late summer of 1954, for example, he was carrying a photograph of

Eleanor and John

David in his wallet, and he told at least one person, "This is the woman I plan to marry and our son."

17

Perhaps he felt that the decision to have the child was strictly Eleanor's. Quite possibly, Eleanor's passivity in the face of his own bad behavior might have signaled to him that she was content to be his mistress and resigned to living apart from her child. Perhaps each, by his or her actions, misled the other. Whether Nash ever intended to marry Eleanor is a matter of dispute. Arthur Mattuck believes he did, but that he was talked out of it

by Bricker.`., Bricker's recollection differs radically. A423
 He remembers having tried to persuade Nash but said that "Nash's
 mind was made updd019 We aren't likely to learn which account is
 the more accurate. Perhaps both were, at different points in
 time. Nash didn't marry Eleanor, despite his stated

-----424
 intentions on at least one occasion.

One likely reason was Nash's snobbery, the roots of which went
 back to his Bluefield upbringing. Not for him a wife, however
 adoring, who pronounced words incorrectly, whose manners were
 simple, and whose sense of social inferiority would have made it
 difficult for her to mingle comfortably with the other wives in
 the Cambridge mathematical community. Unconventional as he was,
 Nash's obsession with class and surface propriety were as strong
 as his father's. This certainly was Eleanor's perception, and
 while that perception was no doubt colored by resentment, it
 seems accurate.

It wasn't only social snobbery, though. Nash didn't believe that
 Eleanor was educated enough to be a good mother to his children.
 His own mother was a schoolteacher who devoted a great deal of
 time to seeing that her children spoke grammatically, after all.
 Moreover, he may simply have found Eleanor boring, a thesis that
 Arthur Mattuck put forward and that gains some credence from the
 fact that Nash ultimately married a young woman who never cooked
 but possessed a degree in physics and career ambitions. Eleanor
 said as much: "He wanted to marry a real intellectual girl. He
 wanted to marry somebody

-----425
 in the same capacity as he
 wasdd040

Vv tever went through Nash's mind regarding marriage in the four
 years that Eleanor was his mistress, he did at one point make a
 proposal that suggested that he had made up his mind he wouldn't
 marry her.

Nash suggested to Eleanor that she give John David up for
 adoption. He more or less told her openly that John David would
 be better off if she gave him up. "He wanted to have John
 adoptedea"Eleanor later said bitterly. ``We'd always know where
 he was,` he'd saydd041

It was a cold-blooded suggestion, and it all but killed any
 remaining love Eleanor felt for Nash. One only hopes that among
 Nash's considerations in putting it forward -- apart from
 eliminating any financial responsibility he might face for his

child, which prompted Eleanor to say that Nash "wanted everything for nothing"-

179

might have been a genuine belief that John David's chances in life would be greater with some middle-class couple than with his single, working mother.

-----426

"Eveyybody wanted himea"Eleanor recalled. "Some people even offered me a lot of money to let them have him. It was frightening. There were these wealthy people who were taking care of John David. They were going to move to California. If they'd

gone to California, I would never have seen him againdd041 A426

For the first six years of John David's life, during which time the little boy was shifted from home to home, father and son saw each other from time to time. One photograph, taken in what appears to be a city park, of the two-year-old with his long face framed by a woolen hat with funny flaps, standing tall like a little soldier, hand in hand with his sweet-faced, girlish-looking mother, bareheaded, wearing a trim woolen coat, smiling into the eyes of the camera held, no doubt, by her lover, evokes the flavor of these brief visits. "She shouldn't have had a baby, she shouldn't have been so gullibleea" John Stier later said

'41

but somehow, looking at the evidence of that scene, it is impossible for him, or anyone else, to deny the feeling that this little trio, out on a Sunday outing, was indeed a family in every sense but a legal one. Nash displayed a rather curious inconsistency in his

-----427

attitude and behavior toward his son, At the time of his birth, he had reacted in neither of the ways one might have expected of a young man confronted with the pregnancy of a woman with whom he has recently begun sleeping, eschewing both the high road that would have led to a shotgun wedding, as well as the more commonly elected low road of flat-out denying his paternity and simply vanishing from his girlfriend's life.

He doubtless behaved selfishly, even callously. His son and others later attributed his acknowledgment of paternity and desire to maintain a bond, even while failing to protect his child from poverty and periodic separation from his mother, to a pure narcissism. But even if this is partly true, it is natural to conclude, that Nash, like the rest of us, needed to love and to be loved, and that a tiny, helpless infant, his son, drew him irresistibly.

In 1959, when Nash suddenly disappeared from John David's life altogether, a badly wrapped, broken-up package arrived one day containing a smashed

but beautifully made wooden airplane, "a lovely thing," as John David later recalled. "There was no return address, or note or

-----428

anything, but I knew it was from my fatherdd014 I

1ASH MET JACK BRICKER

in the fall of 1952 in the MIT common room. Bricker, a first-year graduate student from New York, knew Newman and some of the others from City College's math table and quickly became one of the regulars in the common room) just two years Nash's junior, Bricker was immediately dazzled by Nash. He was "mesmerized,0"hypnotized"and "enamored" a few of the words contemporaries used to describe his reaction to Nash. Bricker "was overwhelmed by Nash's smartness "Mattuck said in 1997. "Nash was the smartest person he'd ever met. He worshiped Nash's intellect." It wasn't only Nash's intellect, though. It was everything else too: the southern breeding, Princeton

pedigree, good looks, and selfconfidence. Bricker, by A428 contrast, was short, skinny, full of angst.` He had grown up poor in Brooklyn; he still dressed badly, was often broke, and fretted over his lack of experience with girls. Although he was undeniably bright comthe logician Emil Post considered him the best mathematician in his class at

-----429

City comhis self-doubt bordered on the pathological. "There's no hope"and "It's useless" were his most-oftenused expressions. Yet he was endearing in his own way. His sense of humor comdark, self-deprecating, very New York comwas always on tap even when he was depressed, which was much of the time. People liked talking to him because he was interested, acute, and responsive. Awkward as he was, he had a way of putting others at their ease. He was, as Gus Solomon once described him, "the world's greatest audience."

Perhaps for this reason, Bricker caught Nash's eye. Nash, usually so disdainful of lesser minds, made a point of getting Bricker off by himself. Bricker liked to play Lasker coma board game named after a chess champion that became popular in the late 1940's comand Nash started playing with him. "We became Lasker partnersea"said

Bricker in 1997. "That's how we got to know each otherdd0bled Soon they were taking long, aimless rides in Nash's Studebaker, with Nash behind the wheel, playing with the back of Bricker's neck as he drove. I They became friends comand then more than friends. Donald Newman and the rest of the MIT crowd

-----430

watched Nash and Bricker with amused tolerance and concluded that the two were having a romancedd6 "They were importantly interested in each otherea"Newman said; they made no secret of Ja Ck

their affection, kissing in front of other peop] Cdd7

"Bricker hero-worshipped Johnea"Eleanor recalled. "He was always hanging around. They were always patting each other."` Nash himself, in his 1965 letter, described his relationship with Bricker as one of three "special friendships"in his lifedd9 The special friendship with Bricker lasted, on and off, for nearly five years until Nash married.

Once Nash had told Herta Newman, Donald's wife, that he realized "there was something that happened between people that he didn't experience.0"What was missing from Nash's life, to a singular degree, was what the biographer of another genius called "the

strong force that binds people together." Now he knew what that was.

It was this sense of vital connection that Nash referred to in his letter to Martha when it dawned on him that away from special sorts of individuals, the Brickers in his life, young men who were "colorful,0"amusingea"and

-----431

"attractive," he was "lost, lost, lost completely in the wilderness ... condemned to a hard hard hard life in many waysdd011

The experience of loving and being loved subtly altered Nash's

perception of himself and the possibilities open to him. A431
 He was no longer an observer in the game of life, but an active participant. He was no longer a thinking machine whose sole joys were cerebral. Yet his was not a passionate nature. Love, though thrilling, did not suddenly banish detachment, irony, and the desire for autonomy, but merely served to modulate them. Nor did it banish other compelling imperatives such as his desire for fatherhood and family. Nash did not think of himself as a homosexual. Alfred Kinsey's report on the sexual behavior of white American men was published, amid great publicity, in 1948 when Nash was a graduate student at Princeton, and Nash was no doubt aware of its conclusion that a large fraction of heterosexual men had, at one time or another, same-sex relationships." Besides, he was ambitious, and he wished to succeed on society's terms. He carried on as before. Even as his emotional involvement with Bricker grew, he continued

-----432

to see Eleanor and continued to weigh the pros and cons of marrying her.

The relationship between Nash and Bricker was not an especially happy one. Nash revealed more of his private self to Bricker than he had to any human being. But each act of self-exposure stimulated a defensive, self-protective reaction. Nash wrapped himself, as he later wrote to Martha with considerable regret, in the mantle of his own superiority to Bricker, the mantle of "the great mathematician."

14

He took to belittling Bricker just as he belittled Eleanor. "He was beautifully sweet one moment and very bitter the next" Bricker recalled in 1997.¹¹

For most of that first year, Bricker was completely unaware of Eleanor's existence, like everyone else at MIT. At the end of the spring term, Nash finally let Bricker in on his secret, telling him in somewhat melodramatic tones, "I have a mistress" Nash even engineered a meeting between the two, Bricker recalled, just weeks before Eleanor was due to give birth.

The revelation of a competitor for Nash's affections

-----433

produced more strains. Among other things, Bricker grew increasingly disturbed by, and critical of, Nash's treatment of Eleanor, he later said. He, Eleanor, and Nash would have dinner together in Nash's apartment, and Bricker became a frequent witness to what he later called Nash's "mean streak" and temper

tantrums. When Bricker tried to intervene Nash would lash out at him. To make things even more difficult, Eleanor began turning to Bricker for sympathy and advice. She would call him to complain about Nash's treatment of her.

Nash could indulge in jealousy himself. Jerome Neuwirth had dinner with Nash and Bricker and some other mathematicians in Boston in early August 1956. Neuwirth, a graduate student, had arrived at MIT that day and was particularly pleased to see Bricker, whom he knew from City. He recalled the evening vividly: "They weren't embracing, but they were always looking at each other. Nash was very hostile. He kept throwing angry looks at me.

He couldn't stand anyone talking to Bricker."

A433

16

The relationship with Nash "was a very disturbing thing"ffBricker, said Neuwirth. "Bricker

-----434

didn't know what to do. He was having a terrible timedd"Mrs. Neuwirth advised him to see a psychiatrist.

And the very thing that had attracted him so powerfully in the first place, Nash's genius, only heightened Bricker's sense of inadequacy. That first year, Bricker managed to perform reasonably well in his courses. But later he was hardly able to work." He dropped courses. He finally managed to pass his preliminary exams in November 1954, but his ability to concentrate on his courses had all but evaporated at that point. However, he waited until February 1957, by which time Nash was away on sabbatical, before dropping out of graduate school and relinquishing his dream of becoming an academic. Nash's game was just too painful to play any longer.

They saw each other for the last time in 1967 in Los Angeles, where Bricker was working in private industry. By that time Bricker was married, and Nash was terribly ill. "He was very wildea"recalled Bricker in 1997. "He sent me a lot of letters. They were pretty disturbing.""

Only one postcard, unsigned and dated August 3, 1967, survivedddd19 The only message

-----435

is "No to No"and presumably came after Bricker had told Nash "Nodd"Af that, Nash's constant references to Bricker suggest both Bricker's importance comBricker is always B to some power, 2 or 22- and Nash's resentment. "Dear Mattuckine, It has obviously been Mr. B who has caused me the largest personal injury," he wrote to Mattuck in 1968.11 But even then, there are sad notes of regret. "All along since 1967 I've been afraid to write to Bricker except in an indirect fashion. As yet this trouble persists however the reasons why change. There is a feeling of impropriety, etc."

Jack

183

Traces of past affection, however, remained. In 1997, by which time Bricker

himself was ill and in virtual isolation, his first questions were "How is Nash? Is he better?0"B he was unwilling to talk much about his past relationship with Nash. "I don't want to discuss

it furthered he said."

Pdd4ND, Summer 1954

INETEEN FIFTY-FOUR

-----436

was to be Nash's last summer at RAND. After an episode that captured some of the most vicious currents of an increasingly paranoid and intolerant era, RAND abruptly withdrew Nash's security clearance, canceled his consulting contract, and effectively banned him from the select community of Cold War intellectuals.

That August,

The Evening Outlook

A436

was full of the Senate's censure of Joe McCarthy, the polio epidemic in the Malibu Bay area, and the news that LA's noxious smog resulted from the chemical action of sunshine on auto exhaust.

Meanwhile, a heat wave drew tens of thousands of Angelenos to the Santa Monica beaches. Nash, too, was drawn to the beach. He spent hours at a time walking on the sand or along the promenade in Palisades Park, watching the bodybuilders on Muscle Beach, the crowds on the pier, the surfers nearby. He rarely swam. He preferred to watch and ruminate. Quite often he would still be walking past midnight.

One morning at the very end of the month, the head of

-----437

RAND's security detail got a call from the Santa Monica police station, which, as it happened, wasn't far from RAND's new headquarters on the far side of Main. It seemed that two cops in vice, one decoy and one arresting officer named John Otto Mattson had picked up a young guy in a men's bathroom in Palisades Park in the very early morning. He had been arrested, charged with indecent exposure, a misdemeanor, and released. The man, who looked to be in his mid-twenties, claimed that he was a mathematician employed by RAND. Was he?

The RAND lieutenant immediately confirmed that Nash was indeed a RAND employee. He took down the details of the arrest, thanked the cop for the backchannel heads-up, and, as soon as he'd hung up the phone, practically ran down the hall to the office of Richard Best, RAND's manager of security.

Best was a tall, good-looking Navy man who had survived the baffle of Midway only to suffer a prolonged and nearly fatal bout of tuberculosis. After his discharge, he wound up at RAND soon after RAND had moved to Fourth and Broadway and was assigned to the "front office"

-----438

where RAND's handful of top executives was clustered. Discreet and capable, Best had an easy manner that made him popular both with his bosses and with RAND's rank and file. His first assignment was to set up RAND's library, but he quickly adopted the role of general factotum and troubleshooter. In 1953, after the new Eisenhower security guidelines were issued, Best somewhat reluctantly agreed to accept the job of security manager. He disliked the McCarthy hysteria over spies and security leaks and thought all the poking around in individuals'

private lives was nasty and not altogether necessary. But he felt he owed RAND, which had kept him on after he suffered a relapse of his illness, and he recognized that RAND couldn't afford any public-relations disasters.

Best listened carefully, but what was going to happen next was clear. Nash had a top-secret security clearance¹⁰ He'd been picked up in a "police trap"¹¹ He'd have to go. Best was a Truman liberal who didn't like the McCarthy witch hunts, and he couldn't understand what would make a young cop join a "dirty detail like vice." But he was responsible for enforcing the new security guidelines and the guidelines specifically forbade

anyone suspected of homosexual activity to hold a security 439
clearance. Criminal conduct and "sexual perversion" were both
grounds for denying or canceling a clearance. Vulnerability to
blackmail-which was thought to apply to all homosexuals
regardless of whether they were open or not and, indeed, any
behavior hinting at a "reckless nature indicating poor
judgment"-were also grounds."

In its early days, RAND had been rather nonchalant about security
matters. It hired Nancy Nimitz, the admiral's daughter, even
though she had gone to too many communist front meetings at
Radcliffe and Harvard to have a prayer of working for the CIA as
she had wished.

14

It had done its best to defend the mathematician Richard Bellman,
a flamboyant character who not only had a wife who had been in
the Communist Party but had somehow managed to befriend a cousin
of the Rosenbergs on an airplane flight." One of its top
mathematicians in the late 1940's and the author of a book on
game theory that is still cited was J. C. C. McKinsey, an open
homosexual. But McKinsey was one of the first

-----440

victims of the increasingly suspicious and intolerant attitude.
No matter that McKinsey was completely open about his homosexual
lifestyle and that his research was highly theoretical, thus
making him an unlikely target for blackmail. McKinsey was forced
to leave RAND. The de facto prohibition against homosexuals and
suspected homosexuals was so strong, then and later, that the
director of the national security program testified in 1972 that
"it was conceivable that an ongoing [sic] homosexual might be
granted a security clearance, but that he could not think of a
single case where it had been granted" in the two decades since he
had been in his job." Nash's arrest was a crisis that
had to be dealt with on the spot. Best told Williams the bad
news. Williams was genuinely regretful though not especially
shocked. Best recalls Williams as being "very open, very relaxed,
but appalled that such a valuable researcher as Nash would be
lost to RAND." Williams told Best
that Nash was "a nut, an eccentric" but an extraordinary
mathematician, one of the most brilliant he had encountered. But
he did not question for a minute that Nash would have to go.

-----441

Nash was not the first RAND employee to be caught in one of the
Santa Monica police traps. Muscle Beach, between the Santa Monica

pier and the little beach community of Venice, was a magnet for bodybuilders and the biggest homosexual pickup scene in the Malibu bay area¹⁹ In the early 1950's, the Santa Monica police were running regular undercover operations to entrap homosexuals with the aim of driving them out of town. "One cop follows a guy into the head and makes a remark. If he's accepted, a second cop comes in and arrests him," explained Best. The police rarely stopped at the arrest itself but, in an act of special vindictiveness, almost always notified the man's employer¹⁰ "We lost five or six people to police programs over a period of several years" said Best.

Normally the department head, in this case Williams, would A441
fire the employee personally. However, Best and his boss, Steve
Jeffries, went around to Nash's office and confronted him with
the bad news themselves." Nash, for a change, was at his desk. He
did not ask what they were doing there but just stared at them.
The two men closed the door and said they had something to
discuss. Best's manner was

-----442

unthreatening but direct and he proceeded calmly. RAND would be
forced immediately to suspend Nash's Air Force clearancedd"The
Air Force would be notifiedddd"And -- this was the bottom line --
Nash's consulting arrangement with RAND was over for good.

"You're too rich for our blood, John,"he concluded.

Best was nonplussed by Nash's reaction. Nash did not appear
shaken or embarrassed, as Best had anticipated. Indeed, he seemed
to be having trouble believing that Best and Jeffries were
serious. "Nash didn't take it all that hard," said Best. "He
denied that he had been trying to pick up the cop and tended to
scoff at the notion that he could be a homosexual. "I'm not a
homosexualea"Best quotes Nash as saying. "I like women." He then
did something that puzzled Best and shocked him a little. "He
pulled a picture out of his wallet and showed us a picture of a
woman and a little boy. `Here's the woman I'm going to marry and
our son.`"

Best ignored the picture. He asked Nash what he'd been doing in
Palisades Park at

2:00 A.m.

Nash responded by saying that he had merely been

-----443

engaging in an experiment. The phrase Nash kept repeating was
something to the effect that he was "merely observing behavioral
characteristics."

24

Best recalled retorting, "But John, the police picked you up. You
were found doing such and so." Best repeated what he knew of the
police report in detail. Recalling the incident in 1996, Best
said: "Nash was charged with `indecent exposure! That's going
into a public head., and making a come-on to another man. That
means taking out your penis and masturbating. That's the
come-ondd"Best made it clear that it didn't really matter whether
the cops were telling the truth or not. "The very act of charging
you malks it impossible for you to continue hereea"he told Nash.
Jeffries and Best told Nash that he would have to leave his

office right away.

The Arrest

187

They escorted him from the building. They would clear out his desk and send his personal papers and belongings, they said. It was all done very politely, with no hint of vindictiveness. Nash had the option of working in quarantine, the preclearance room located just beyond the

-----444

main lobby. Or, if he preferred, he could finish up whatever he was working on at home. What was Nash's reaction? Due to leave

Santa Monica in another week or so anyway, he did not A444
 decamp immediately, though Best doesn't remember whether he
 returned to the RAND building. "He left in a week or two weeks.
 Not helterskelterea"Best recalled. Mat was going through Nash's
 mind in that interval? Was he angry? Depressed? Frightened? Was
 he thinking of approaching Williams or Mood with his version of
 events? Did he try to have RAND's decision reversed? Generally,
 of course, people did not. Fearful of scandal and aware of the
 contempt with which any hint of homosexuality was viewed, people
 in Nash's shoes were usually only too happy to slink away without
 a murmur of protest.

In the end, Nash did what he had learned to do in less extreme
 circumstances. He acted, weirdly, as if nothing had happened. He
 played the role of observer of his own drama, as if it were all a
 game or some intriguing experiment in human behavior, focusing
 neither on the emotions of people around him nor on his own, but
 on moves and countermoves. In his first postcard home that

-----445
 September, he described it with remarkable detachment as another
 kind of storm: "The hurricane was a fascinating experience." At
 some point he told his parents he'd had trouble with his RAND
 security clearance, blaming it on the fact that his mentor at
 MIT, Norman Levinson, was a former communist who had been hauled
 before HUAC that year.

Meanwhile, the highly efficient RAND machinery ground on. Best
 said: "We withdrew his clearances and notified the Air Force of
 the charges that had been made." RAND negotiated with the Santa
 Monica police, who wound up dropping the charge in return for
 RAND's assurance that Nash had been fired and was leaving the
 state for good. According to Best, such deals were typical. In
 any case, the arrest did not make The Evening Outlook
 and any record of it has long since been expunged from police
 files and court records. Alexander Mood didn't try to keep the
 arrest a secret, it was impossible given Nash's sudden eviction
 from his office, but he concocted a cover story to the effect
 that Nash had simply been strolling in Palisades Park trying to
 solve a mathematical problem when he was picked up. "He

-----446
 told the officers he was just thinking and ... they finally
 learned that what he had told them was true." Mood said later.
 Most RAND employees learned nothing different. It was after all
 close to Nash's normal departure date in any case. But his name
 was abruptly crossed off the list of consultants. "Nash never

bothered to deny the arrest." And Lloyd Shapley and others in the math division learned about it because Nash had called Shapley from the police station to bail him out.¹⁹ Shapley later told another mathematician that Nash had been playing some kind of game."²⁰ In any case, with so many mathematicians shuffling back and forth between RAND, Princeton, and other universities, news of the arrest soon leaked back to Princeton and MIT, adding to Nash's already considerable reputation for quirkiness, if not downright instability. Nobody protested his treatment. He was not the easiest person to sympathize with, and few people, even in the mathematical

community, questioned the government's attitude toward A446
homosexuals. Homophobia was, after all, widespread in a society
increasingly paranoid and fearful of nonconformity of any kind.
Williams, true to form, used the

-----447

incident in one of his homilies on managing mathematicians. In a
memorandum to the mathematics division, written a year or two
later, he asked the rhetorical question: "What can mathematicians
do to hurt us""One of his examples was alluded to only with a
phrase com"He could get arrested for solicitationdd"Williams's
punch line, however, was "the worst thing a mathematician could
do to RAND is to leave.

32

Although Nash appeared unscathed, the arrest was a turning point
in his life. Aloof, ambitious, coolly indifferent to others as he
often appeared, Nash was by no means a true loner. Living in a
tolerant ivory tower, he had been lulled into believing that he
could do as he liked. Now he learned, in a particularly brutal
fashion, that the emotional connections he sought threatened to
destroy all else that he valued his freedom, his career, his
reputation, success on society's terms. Contradictory imperatives
can engender tremendous fear. And fear can be subtly destructive.
An individual's vulnerability to schizophrenia, researchers now
believe, lies in his genes. But psychological stresses are
thought

-----448

to be catalysts. Psychologist Irving 1. Gottesman at the
University of Virginia, whose studies of twins helped discredit
the old Freudian theories of schizophrenia, puts it this way:
"Each case is different, with a different mix of genetic and
psychological factors. Certain events are definite stressors, but
it's not famine or war. It's idiosyncratic. It's things that get
to the soul and self-identity and expectations of oneself.0"R
than a single trauma, a string of events from childhood through
young adulthood produces strains that mount like straws on the
proverbial camel's back. "It's things that build up, things that
lead to a lot of brooding' "says Nikki Erlenmeyer-Kimling, a
professor of genetics and development at Columbia Universitydd14
Like the effects of the teasing he endured in childhood and
adolescence, the damage from his arrest would only become
apparent with time.

The arrest preceded the onset of Nash's illness by more than four
years. Stories of other mathematicians who were caught up in the

meanness and bigotry of those times illustrate how
disequilibrating being harassed and humiliated can be. J. C. C.
McKinsey

-----449

committed suicide in 1953 within two years of being fired by
RANDDD15 Alan Turing, the mathematical genius who cracked the
Nazi submarine code, was arrested, tried, and convicted under
Britain's anti-homosexual statutes in 1952; he committed suicide
in the summer of 1954 by taking a bite of a cyanidelaced apple in
his laboratorydd36 Others, less well known, less obviously
brutalized,

The Arrest

A449

189

had breakdowns that led to their giving up mathematics and living on the margins of society.

The biggest shock to Nash may not have been the arrest itself, but the subsequent expulsion from RAND. His initial reaction after Best confronted him suggests that he simply assumed Williams would overlook the incident. He was after all, one of RAND's resident geniuses. But like McKinsey, Turing, and others, Nash learned that life was more precarious, and he was more vulnerable, than he had previously imagined coma dangerous lesson.

HAVING

She had this steely determination. I liked it. I found it very interesting. She

-----450

always

had some agenda, some goal, -- Emma DuchANE,

1997

RETURNED TO

Cambridge in an anxious, uneasy frame of mind that made the dull task of preparing his lectures even more impossible than usual, Nash escaped to the music library almost every afternoon. The library, on the first floor of Charles Hayden Memorial, had an impressive collection of classical recordings and soundproofed, private cubicles where one could sit and play records, surrounded by deep-blue walls that made one feel as if one were floating in water. Nash would go into one of these and listen to either Bach or Mozart for hours on end.

On his way into the library he would stop at the desk to exchange a few bantering remarks with the music librarians-a mode of interaction that kept people at a distance, much as in the games he liked to play. On one of the first afternoons, he was surprised to see a young woman who had been his student the previous year standing behind the librarian's desk. He had encountered her in the library from time to time before, but now it seemed

-----451

she was actually working there. She too had seemed a bit startled when she saw him come in, but had given him a sweet smile and had greeted him by name. When he walked away from her he felt her eyes following him.

There was only a handful of coeds at MIT at the time, and the

twenty-one-year-old Alicia Larde glowed like a hothouse orchid in this otherwise drab, barrackslike environment. Delicate and feminine, with pale skin and dark eyes, she exuded both innocence and glamour, a fetching shyness as well as a definite sense of self-possession, polish, and elegance. Always perfectly groomed, she wore her short black hair like Elizabeth Taylor's in Butter6enceld 8, was almost always seen in very full skirts cinched tightly around her tiny waist and very, very high heelsddbled She carried herself like a little queen. The student newspaper, The Tech,

once included a reference to her beautiful ankles in the A451
annual feature on MIT coeds.` She was bright, vivacious, playful,
and talkative comoccasionally sarcastic and often very sharp
compopular with the

-----452

"little boys," as she called the male students, and mad about
191

movies.

6

Her origins were exotic. One of her friends described her as "an
El Salvadoran princess with a sense of noblesse oblige
dis07

The Lardes were, in fact, an aristocratic clandd"Their origins,
like those of all the families which composed Central America's
elite, were European, primarily French. Eloï Martin Larde, a wine
grower in Champagne, escaped from France during the revolution
and settled in Baton Rouge. His son Florentin Larde moved to
Central America, first to Guatemala, and ultimately to San
Salvador, where he, his wife, and son Jorge became hoteliers and,
eventually, owners of a large cotton-growing hacienda.

The Larde men were handsome and the women exceptionally
beautiful. A photograph of Alicia's father, Carlos Larde Arthes,
and his nine siblings, taken a few days after their mother's
death in 1911, might have

-----453

been of the Romanovs. The family's history had romantic
overtones. Alicia's uncle Enrique believed himself to be the
bastard son of one of the Austrian Hapsburgs, Archduke Rudolf.
Family legend also included a link with an aristocratic French
family, the Bourdonsdd9 The Lardes, mostly doctors, professors,
lawyers, and writers, belonged to the intelligentsia rather than
the landed oligarchy that dominated El Salvador's indigo and
coffee economy. But they mingled with presidents and generals
and, in Carlos Larde's generation, were prominent in public life.
They were well educated, spoke French and English as well as
Spanish, and traveled widely. Their interests ran to artistic and
literary subjects as well as science and philosophy.

Carlos Larde got his medical training in El Salvador but spent
several years studying abroad, in America and France, among other
placesdd10 His early career had been full of promise: He held a
number of public posts, including that of head of El Salvador's
Red Cross and, before World War 11, was chairman of a League of
Nations committee. Once he served as

El Salvador's consul in San Francisco. His second wife, Alicia Lopez Harrison, came from a wealthy, socially prominent family; Alicia's maternal grandmother was the wife of an English diplomat. Mrs. Larde was not only beautiful but also warm, a wonderful cook, a charming hostess, and a popular aunt with her nieces and nephews. I I Alicia, or Lichi, as her family called her, was born on New Year's Day, 1933, in San Salvador. She was the second of Carlos and Alicia's children. Her brother Rolando, five years older, was eventually confined to an institution. A half-brother from her father's first marriage lived with them as

well. Treated as an only child by her doting older A454
 parents, Lichi was by all accounts a lovely child, with blonde
 ringlets. She grew up, amidst aunts, uncles, cousins, and
 servants, in a lovely villa near the center of the capital.
 The idyll ended abruptly a year before the end of World War II,
 when Alicia was eleven. In 1944, in the midst of a yearlong
 popular insurrection against dictator Hernandez Martineza12
 Alicia's uncle Enrique had suddenly left for Atlanta with his
 wife and five

-----455
 young children one night, in the middle of bomb blasts, in a
 station wagon draped with a white sheet to signal their civilian
 status. Carlos Larde followed him not long afterward, leaving his
 wife, daughter, and two sons behind temporarily. He joined his
 brother in Atlanta, but then moved on to Biloxi, Mississippi, on
 the Gulf of Mexico, where he obtained a position as a staff
 doctor at a veterans' hospital. Some weeks later, Mrs. Larde and
 Alicia joined him, after making the long journey by train through
 Mexico and stopping in Atlanta to visit Enrique and his family."
 What motivated Carlos Larde to follow his brother to the United
 States at age forty-six isn't entirely clear. Possibly he feared
 the outbreak of a full-scale civil war. Possibly he saw a chance
 to revive his medical career, having apparently suffered a series
 of professional setbacks. But very likely a major reason for
 emigrating comandthe one given Alicia by her parents-was his
 health. Carlos Larde was suffering from a number of increasingly
 debilitating physical ailments, among them a severe stomach
 ulcer, and working as a doctor in the United States would give

-----456
 him access to top-notch medical care. Whatever the reason, the
 move turned out to be permanent. Enrique went back to El Salvador
 after a few years, but Carlos Larde was to remain in this country
 until his death in 1962. Alicia Lopez-Harrison de Larde stayed
 for another decade after her husband's death.
 Hot, dank, slightly seedy, Biloxi lay sprawled on that shallow,
 murky stretch of the gulf between Mobile and New Orleans, among
 its barrier islands and river mouthsdd14 It was known for shrimp
 fishing, illegal gambling, and being a favorite wintering place
 for Chicago mobsters. Rationing made day-to-day life difficult.
 Carlos was often exhausted and ill and Alicia's mother was
 plainly distressed by their new surroundings and terribly
 homesick. Later, the mother of a friend of Alicia's would
 describe Mrs. Larde as a "very sad, very stoical person." Alicia

learned English quickly and easily but suffered pangs of dislocation and isolation on top of the ordinary anxieties of early adolescence. It was not a happy time. For consolation, she turned to schoolwork and the movies.

The Lardes did not stay in Biloxi for long. Less than a year after the war ended, they followed

-----457

Enrique's family to New York, where Enrique took a job as an interpreter at the United Nations. Once again, Alicia and her mother lived with Enrique's family until Carlos found a position at the Pollak Hospital for Chest Diseases in Jersey City and a

house for them to live in. Alicia commuted to Prospect A457 High School, a Catholic school in Brooklyn. Alicia wasn't to stay trapped in the lower-middle-class environs of Prospect High for long. At the beginning of her sophomore year, the Lardes enrolled her at the Marymount School, an exclusive Catholic girls' school in New York.

Marymount, which was operated by one of the oldest European orders, the Sisters of the Sacred Heart, occupied three adjacent Beaux Arts mansions, on the southeast corner of Eighty-fourth Street and Fifth Avenue, directly across from the Metropolitan Museum of Art and Central Park. It was another world. The student body, mostly day pupils from the surrounding Upper East Side, were from New York's Catholic elite." Many of the girls were daughters of celebrities like Joe DiMaggio,

-----458

193

Jackie Gleason, Paul Whiteman, and Pablo Casals. Alicia's best friends there included the daughter of an Italian count. Tuition was several times what most private universities charged at the time, easily equivalent, once inflation is taken into account, to \$15,000 today. Admission was based strictly on families' social standing; the El Salvadoran ambassador wrote Alicia's letter of reference, attesting to the Larde family's social positiondd16 The school's atmosphere, appropriately to girls being groomed to become wives of Catholic leadersea"was cosmopolitan and culturedddd17 The girls' uniforms included stylish blazers and black high heels. Parents insisted that the school "keep up the social end of thingsdd"Alicia took riding and tennis lessons in Central Park, played basketball, helped out on plays and musicals, and went to parties. She went to her senior prom, and afterward to the Stork Club, with her friend Chicky Gallagher's brother."

She looked, on graduation day, just like the other girls, only more beautiful, wrapped in the same

-----459

white tulle and cradling the same three dozen long-stemmed roses, like a debutante before a coming-out ball. Much, however, separated Alicia from her wealthy schoolmates. Outwardly she was gay, charming, unruffled, and compliant, but her appearance veiled a keen intelligence, an outsider's ambition, and what a future friend called steely determination. Self-controlled and reluctant to confide her real feelings to anyone, a legacy of her Latin upbringing, she hid a great deal from view. As a woman who

got to know Alicia several years later said, "You have to keep the times in mind, Women dissembled then. Alicia behaved like a fifties ditz, but that doesn't mean she was one. She was flirtatious but she was saying quite serious things. She always had some agenda, some goaldd019 As a child, she'd dreamed of becoming a modern-day Marie Curiedd" Alicia was twelve years old when she huddled with her father near the radio in their Biloxi apartment and listened with him to the broadcast about Hiroshima." It was for her, as for so many scientifically inclined youngsters, a defining moment. Within weeks, the Japanese surrender and the War Department's revelation of the

three hidden "atomic" cities in the southwestern desert A459
turned

-----460

anonymous men like Oppenheimer and Teller into public heroes. Instantly, the image of the "nuclear physicist" seized the popular imagination the same way that "rocket scientist" did after Sputnik.

Alicia, already showing signs of her father's talent and interest in scientific subjects, knew what she wanted to be. "The world was physics. It was what kids with a talent for, and interest in, math and science aspired to," a fellow physics major at MIT said in 1997. "To Carlos Larde it was the top, and it was for Alicia too.""

Her aptitude for mathematics and science had long been evident and became more so at Marymount. By the late 1940's, the school was already something more than a fancy finishing school. It had always had an exceptionally well-trained faculty, Jay and religious, but during Alicia's tenure the school was run by a forceful young Irish graduate of the London School of Economics -- Sister Raymond -- who was not only an ardent Keynesian, but a gifted educator determined to raise the educational standards of the place. Sister Raymond improved the caliber of students by introducing scholarships and gave more

-----461

intellectual heft to the school's curriculum by adding serious science and mathematics courses. Alicia had a choice between a classical education emphasizing the arts and languages and one focusing on science and mathematics. She was one of the few girls who chose the latter and, as a consequence, took biology, chemistry, and physics as well as three years' worth of mathematics, often in tiny classes of two or three girls. Sister Raymond recalled her as a gifted and willing student: "Very intelligent. Not too pushy. Very very interested in her studies.""

By her senior year, Alicia was quite definite about wanting to pursue a career in science. "I wanted a career, so I wanted to study something definite" she said. Carlos Larde, who was delighted by his daughter's ambitions, wrote an eloquent and touching letter to Sister Raymond urging her to make every effort to help Alicia realize her dream of becoming a nuclear scientist by helping her gain admission to a first-rate technical university." Alicia was accepted at MIT, one of only seventeen women and two female physics majors in the class of 1955.¹⁶

The Lardes were no less thrilled than Alicia. Carlos Larde, who had studied at the University of Chicago and Johns Hopkins, particularly appreciated what an MIT degree would mean, but he drew the line at her going off to a virtually all-male engineering school on her own. Alicia's mother, it was decided, would accompany Alicia in order to watch over and take care of her." Besides the natural protectiveness toward a precious daughter, the arrangement may have reflected a wish on the part of Alicia Lopez-Harrison de Larde to escape her ailing, difficult husband. Alicia's friends at MIT were struck, later, by the fact

that mother and daughter never referred to Carlos Larde A462
and that he never came to visitdd" In any event, in the late
summer of 19 5 1, the two women rented a tiny furnished apartment
in Boston19 not far from Beacon Street where John Nash had just
found a room, across the river from MIT and not far from the
Harvard Bridge.

It was marvelous being an MIT coed in the early 1950's, an era
famous for its celebration of mothers and dumb blondes, because
the coeds were so special and had, as it were, the best of both
worlds: it was serious,

-----463

but there were lots of men. There were girls who wore cocktail
dresses and high heels while dissecting rats in the labdd10 A
date wasn't going dancing and sipping Manhattans, it was going to
a lecture and out to coffee afterward, or maybe having a boy take
you to his parents' house and showing you, through a telescope,
everything Galileo had seen. Alicia was to tell her girlfriends
that being there made her feel like a "Queen Beedd"X was also a
chance to meet, finally, other women who didn't think that having
brains and ambitions was a major liability. "We were a
self-selected group of fairly strong womenea"said Joyce Davis, a
native New Yorker and the only other female physics major in the
class of 1955. "We had our own culture. It wasn't
normal American female culture, the `you can't be as good as the
boys` culture, which we were always trying to escape. And it
wasn't the MIT boys' culture either.""

Alicia spent most of her time with the other coeds either at the
dorm or on the campus. She studied with the other girls in the
Cheney room, the coed lounge, ate breakfast and lunch with her
friends at Pritchett lounge every day, and generally was up for
whatever the girls

-----464

felt like doing, whether it was playing basketball or organizing
a charity fair." She attended a great many concerts and plays,
thanks to the coeds' wealthy patroness, a Mrs. McCormick, who
showered them with tickets and even paid for them to take taxis
across the Harvard Bridge in winter.

MIT's academic program was brutally demanding, especially for
physics majors. Class schedules were heavy, spread over six days,
and consisted mostly of required courses. All the girls lived in
healthy fear of flunking out. Alicia, who had sailed through her
science and math courses at Marymount on native ability, found
that this was no longer enough. Much to her dismay, she had to

struggle to maintain a C average (which was a respectable performance in those days before grade inflation turned a C into a subaverage mark). "You either had to buckle down or accept just getting by," said Joyce, Alicia's best friend. "Alicia never really buckled down."

Alicia's ambition survived her freshman year intact, despite a fair amount of teasing, especially in her chemistry class, from boys and instructors who were sure that she would not make the

-----465

cut. In a letter to Joyce, in the summer of 1952, Alicia wrote:
Dear Joyce,

By this time you must be wondering whether I'm dead, dying A465
 or have nearly [sic] been kidnaped judging from the amount of
 communication you have received from me; the sad truth of course
 is my laziness. Except for one week that I went to Canada with
 Betty Sabin and her parents I have spent the Summer working as a
 sales girl in a small store (I hate to say 5 plus 10) behind the
 ribbon counter; I have done all but strangled the customers with
 "our" fine products. But life hasn't been all tears (I hate to
 think of my report card) we have fortunately moved to a new
 apartment half a block away from Kenmore Square. And so I will be
 able to walk home with you (the dorm is only about a block and
 1h
 away).

By now you must be beginning to believe the malicious rumors that
 I bribe my English teachers; not to mention the grammar and the
 spelling is atrocious (get me!). My report card was the same as
 last term with the unhappy exception of a B in English;

-----466

my cum. is still above 3 though; .02 above that is. I'm unhappy
 that we won't be in the same section this year but c'est la vie!
 I wanted to take French instead of German in order to make my
 life easier but I'm not sure I can because of my hope for a Ph.D.
 in physics ... remember all

I
 was going to study this summer? Well, I've gotten to page 17 of
 the Physics book and that's all; I am however many movies wiser.
 Give my regards to your mother and answer soon (do as I say not
 as I do)

.14

A profile, a look, a voice can capture a heart in no time at all.
 Alicia gave away hers in the space of a single calculus lecture.
 She was sitting, her best friend Joyce beside her, in the front
 row of M 3 5 1, Advanced Calculus for Engineers, a course
 required of all physics majors. John Nash arrived late wearing a
 haughty and bored expression. Without so much as a glance or a
 word to the assembled, he closed all the windows, flipped open
 his copy of Hildebrand, and embarked on a lackluster

-----467

exposition of the properties of ordinary differential equations.
 It was mid-September, Indian summer weather, and as Nash droned
 on, the room got quite hot. First one, then several students
 interrupted Nash to complain and to ask that he let them open the
 windows. Nash, who had obviously shut the windows to prevent any

outside noise distracting anyone, ignored them. "He was so wrapped up in himself that he wouldn't pay attention to what we wanted. His attitude plainly said, `Shut up and take notes,`" Joyce recalled. At that point, Alicia jumped up from her seat, ran over to the windows in her high heels, and opened them one after another, each time with a toss of her head. On her way back to her seat, she looked straight at Nash, as if daring him to reverse her action. He did not. Joyce thought Nash an indifferent lecturer and insensitive besides. "He presented the material but that was it. He was sort of cold." Joyce transferred out of the section after the first

class, but Alicia surprised her by staying. "She thought A467
he looked like Rock Hudson", said Joyce.

To see Nash through Alicia's eyes during their first encounters
as student and professor conveys much about the

-----468
elementary force that was to bind her to him. In MIT's
intellectual hierarchy-where "mathematics was the highest thing,"
as Joyce was to say-Nash was the closest thing to royaltydd16 It
was his good looks, however, that made Alicia's heart beat
faster. "A genius with a penis. Isn't that what we all want""an
actress once quipped, and the quip captures the combination of
brains, status, and sex appeal that made Nash so irresistible.
Herta Newman, Donald's wife, said the same thing in less bald
terms: "He was going to be famous. He was also cutedd017 Emma
Duchane, a physics major two years behind Alicia at MIT, said,
"Alicia thought he was gorgeous. She thought he had beautiful
legs.0"Nash wasn't scruffy like many of the mathematicians. He
was always neatly combed, pressed, and shined. His haughty manner
and cool indifference only confirmed his desirability. His name,
two monosyllables that advertised his Anglo-Saxon ancestry, added
to his appeal. "He was very, very good-looking;" Alicia later
said. "Very intelligent. It was a little bit of a hero worship
thingdd019

Nash took no notice of her, but Alicia was quite prepared to woo
him. All that

-----469
year, she would seek him out. "Come with me to the music library,
Joyceea"or, "Come with me to Walker Memorial. I want to see
Nashdd040 "She set her cap for himea"Joyce recalled. "She had a
campaign going."

Her grades suffered. She got two Ds and for the first time in her
MIT career her grade point average slipped below a C. The
following April, Joyce wrote to her parents: "Alicia is still not
doing to [sic] well since she is in LOVE. She goes around with a
faraway expression on her facedd041

When the calculus course was over, Alicia got a job in Nash's
favorite haunt, the music library. It is a measure of her
lovesickness that she found it a far more interesting place to
work than Lincoln Laboratories, where she also had a job. "Work
here isn't very stimulating; what I do mostly is count 'tracks`
seen thru a microscopeea"she wrote to Joyce during the summer. "I
only work 15 hrs a week here but what tires me out is the
overtime; I keep seeing the little monsters every time I close my

eyes. Music librarjproves more interesting, so far several
strange

-----470

boys ha ve tried to pick me

up.

"42

Alicia was still playing the field, but with less enthusiasm than
her letter to Joyce implied: "A few more weeks now and I expect
to be seeing `blondie` again. It seems peculiar but I feel so
indifferent about him now."

She continued this letter a few weeks later:

I am writing in the music library now (obviously). A470
 Something funny J"J happened to me here the other day. A boy I
 know came to talk to me while one of the ones I am out "gunning"
 for was sitting out there; or so I thought. In order to seem
 attractive to the one out there I began pouring on the charm"on
 my little friend; then in my loudest possible voice I announced
 my working hours in the ML; they must have heard me over the
 radio. Well, the persecuted one seemed to be getting the idea
 while I became bolder and bolder. Finally he came over. Then,
 boy, was I mortified. The moral of the story is "wear
 glassesdd"Needless to say he wasn't the "one."
 Nash, of course, was at RAND most of that summer. When Nash
 started coming around the library again that fall,

-----471

Alicia engaged him in conversation and studied him as minutely as
 any fan studies his or her favorite star. She found out that he
 played chess. She found out that he was a science fiction fan.
 She made it her business to learn chess and, in addition to her
 job in the library, she took to sitting in the science library
 near the science fiction collection. "My activities besides the
 music library include the science library where I read science
 fiction (John likes it)ea"she wrote to Joyce. Despite Alicia
 Larde's crush, which seemed to have erased the earnest student of
 science, she was playing a serious game. Her romantic dreams of
 becoming a famous scientist herself hadn't survived the harsh
 reality test provided by MIT. As she put it later, "I was no
 Einstein
 dis041

Pragmatically, she recognized that marriage to an illustrious man
 might also satisfy her ambitions. Nash seemed to fit the bill.

198 A BEAUTIFUL MIND

"John could give her a lot of things she didn't haveea"observed
 John Moore, a mathematician who fell in love with Alicia some
 years later.

44

-----472

Sadly, the romantic girl whose favorite song was "Lady of Spain"
 would most agonizingly disappear in just a few years.

ASH STARTED

to make occasional references to "the music librarian"in his
 conversations with Mattuckdd1 He was at a crossroads. The dangers
 of his sexual experiments had become suddenly, devastatingly
 obvious. Marriage was a possible answer and he had, at his most

frightened, almost convinced himself that he would marry Eleanor. Now that he was back in Boston and seeing her again, however, he could not bring himself to take any practical steps in that direction. Alicia came along at the right moment. Moreover, Nash liked what he saw. The son of a beautiful mother would be drawn by the classical symmetry of Alicia's features and the slenderness of her frame. Alicia's aristocratic lineage and social ease appealed to his own sense of superiority. The effect of her intelligence on him should not be underestimated. Nash was easily bored. He found her interesting company, liked the fact

that she set her own compass, and was amused by her flashes of sarcasm

A472

-----473

and irreverence.

It was part of Nash's genius to choose a woman who would prove so essential to his survival. He took her willingness to pursue him, to make every effort, not merely as flattery, to which he was no less immune than the next man, but as a sign that she was prepared to take him as he was. He saw her determination to have him as a real key to her character, suggesting that she knew what she was getting and expected nothing more.

They shared a good deal. Both were close to their mothers. Both had emotionally distant but intellectually stimulating fathers. Both had grown up in households where intellectual achievement and social status, rather than emotional intimacy, were the coin of the realm. Both, on account of their intellectual precocity, had somewhat delayed adolescences. Both felt that they were, in different ways, outsiders and compensated for this by seeking status for themselves. There was a coolness, a calculation, that guided their actions.

Nonetheless, the progress of the courtship was slow. Nash finally asked Alicia out during the spring. In July 1955 she wrote to Joyce that they were seeing each other "on and offdd" I She said that he had

-----474

introduced her to his parents some three weeks earlier. But she made it clear that they were not sexually intimate. The significance of his having introduced her to his parents, given his mother's chronic concern over Nash's social life, wasn't clear. Alicia, who must have taken it as a hopeful sign, did not admit to taking it that way. I've been making slight progress with JFN but can't tell just yet if it's significant. I don't think he's really too interested but more or less can take me or leave me. About 3 weeks ago I met his parents who'd come up to visit him for a week. I've been seeing him on and off and last Saturday we went to the beach together comI had fimdd3 Alicia hinted at one reason why Nash remained lukewarm: "He still thinks I'm too innocent but has now condescended to accept me as is and just let my `sweet innocent little self develop."

And in her own mind, Alicia was still playing the field, though it was clear that she was distracting herself and hoping in the process to pique Nash's interest. I've picked up a few admirers

this summer including that junior that Marolyn was talking about.
I keep refusing dates with him but he doesn't seem

-----475

to get the idea and just follows me around, so far he has written
a couple of cute poems that I'm keeping as souvenirs (sic]. I
realize that I'm sounding quite egocentric with all this but not
much else has been happening.

Whether because of preoccupation with Nash or simply because of a
waning interest in physics, Alicia failed to graduate with her
class. She had to stay on to make up a number of courses. But the
shock of not graduating on time, and the unpleasant business of

having to admit this to her father, did little to refocus A475
her attention on her studies. She says in the letter to Joyce
that she is making up M39 but that "so far I'm up to page 10 in
Hildebrand."

Nash and Alicia saw more of each other in the fall. He took her
to a math party. Then another. And out to the Newmans' house or
to Marvin Minsky's. "Let's go Minskify," he would say to a
groupddbled Sometimes they double-dated with one of Alicia's
friends. On those occasions, he almost ignored her once they had
arrived and the introductions were made, going off to join the
circle of men

talking about

mathematics. Sometimes Alicia would stand at the edge of the
circle listening to Nash say things like "Who are

-----476

the great geniuses: Wiener, Levinson, and me. But I think maybe
I'm the best." Other times she found herself among
mathematicians' wives talking about their children. There was no
flirtation, no going off in a corner to hold hands, but in fact
the relationship was more intoxicating for those reasons. The
other women treated her with the deference accorded to the genius
consort, which made Alicia feel rather smug. As for Nash, he
could not help but be aware that the other men, impressed and
surprised, envied him this adoring, gorgeous creature.

Other times they would go out for lunch, usually with someone
else. Bricker often joined them, and also Emma Duchane. Bricker
recalled Alicia as "very

The Courtship

bright"and "quite sarcasticdd"I Emma recalled, "She was not
deferential at all. She never stopped talking.

"6

True, Nash was not especially nice to Alicia. Among other things,
he called her unflattering nicknames, including "Leech," a nasty
play on her childhood nickname, Lichidd1 He never paid for her
meals, dividing every restaurant check down to the penny. "He was
not infatuated with herea"Emma

-----477

recalled in 1996. "He was infatuated with himself"I

To Nash, Alicia was part of the background, charming and
decorative. He treated her the way other mathematicians treated
their women. But Alicia wasn't looking for companionship either.
Later Emma said: "We wanted intellectual thrills. When my
boyfriend told me e to the pi times i equals negative 1, 1 was

thrilled. I felt the absolute joy of the ideadd"Nash was no less fun to be with than the other mathematicians,

A February 1956 letter from Alicia to a friend doesn't mention Nash at all. But at the end of that month Alicia's mother would move to Washington (Carlos Larde had gotten a position at Glendale Hospital in Maryland), a move that Alicia anticipated with some glee.

It was probably sometime that spring that Nash and Alicia began sleeping together, at the end of those evenings in company where they barely exchanged three words. Nash was still involved with both Bricker and Eleanor. Indeed, he may have continued, even at

this late date, to think of Eleanor as his likely wife. A477

Alicia and John were in bed one evening when his doorbell rangdd10 John answered the door.

-----478

It was not Arthur Mattuck, who sometimes dropped by unannounced. It was Eleanor, indeed, an angry and shaken Eleanor. She said nothing but walked right past Nash into the apartment. She acted as if she'd come to talk things out with him.

When she realized Nash was not alone, she began shrieking and crying and threatening until finally she had cried herself out and Nash drove her home. Alicia, meanwhile, white-faced, left. The next day, Nash went into Arthur Mattuck's office, told him the story, grabbed his head with both hands, and moaned, genuinely pained, over and over, "My perfect little world is ruined, my perfect little world is ruined."

Eleanor called Alicia and told her that she was stealing another woman's man. She told her about John David. She told her that Nash was planning to marry her and that she, Alicia, was wasting her time. Alicia invited Eleanor to her apartment for a meeting. Eleanor came; Alicia was waiting with a bottle of red wine. "She tried to get me drunkea"Eleanor recalled. "She wanted to see what I was like. We talked about Johndd011

And, having met her, and realizing that Eleanor was an LPN, that she was practically thirty, that the affair

-----479

had been going on for nearly three years, Alicia concluded that it wasn't going anywhere. She was not shocked. Men had mistresses, they even had children by them, but they married women of their own class. Of that she felt quite confident. Eleanor had called her up to complain. Alicia was pleased. She took it as a sign that, as her friend Emma said, "she was beginning to matterdd011

Nash was due for a sabbatical the following year. He had won one of the new Sloan Fellowships, prestigious three-year research grants that would let the recipients spend at least one year away from teaching and, for that matter, away from Cambridge." He could go where he liked. He was, perhaps unreasonably, still worried about the draft, as he had confided to Tucker in a letter a year earlier. 14 He decided to spend that year at the Institute for Advanced Study." He was beginning to think seriously about various problems in quantum theory and thought that a year at the institute might stimulate his thinking. Alicia meanwhile complained in a letter to Joyce that February that she was "just

vegetatingdd"She mentioned a vague desire (which she did not say
was connected with Nash) "to get a job in New York instead of

-----480

staying on at the Institute [MIT] to attend graduate school."

16

At the end of the spring term, Nash took Alicia to the math
department picnic in Boston. The picnics were always held during
reading week and often on the commons. Wiener came, as did all
the graduate students. It was an unusually warm day, and Nash was
in high spirits. Nash did something curious that engraved itself
on the memories of another instructor, Nesmith Ankeny and his

wife, Barbara. It was, of course, Nash's notion of a joke. A480
 He wished to show everyone that he was the master of this
 gorgeous young woman, and that she was his slave. At one point,
 late in the afternoon, he threw Alicia to the ground and placed
 his foot on her neckdd17

But despite this display of machismo and possessiveness, Nash
 left Cambridge in June without suggesting marriage or even that
 she move to New York.

Indeed, at the start of that summer, in June, another friend of
 Alicia's described Alicia as being in Cambridge and "in an
 unbelievable state of depression, due to a certain instructor at

-----481

MIT."

18

Summer 1956

ASH LEFT CAMBRIDGE

for Seattle in mid4une with the light heart of a man making a
 temporary escape from a tangle of personal and professional
 dilemmas.` Travel always lifted his spirits and this trip was no
 exception. The month-long summer institute at the University of
 Washington was exactly what he wanted. A top-notch crowd of
 mathematicians working in differential geometry would be there:
 Ambrose, Bott, Singer, as well as Louis Nirenberg and Hassler
 Whitney. Nash expected that his embedding work would make him one
 of the centers of attention. And he was looking forward to
 hearing Busemann's seminar on the state of Soviet mathematics
 because everyone knew that the Russians were doing great things,
 but the authorities were no longer allowing even abstracts of
 their mathematics articles to be translated into English.

The signal event of the summer institute turned out to be the
 surprise announcement, within a day or two of the start of the
 meetings, of Milnor's proof of the existence of exotic
 spheresdd2;For the

-----482

mathematicians gathered there, it had the same electrifying
 effect as the announcement of a solution of Fermat's Last Theorem
 by Andrew Wiles of Princeton University four decades later. It
 stole Nash's thunder.

Nash reacted to the news of Milnor's triumph with a display of
 adolescent petulance.` The mathematicians were all camping out in
 a student dormitory and eating their meals in the cafeteria. Nash

protested by grabbing gigantic portions. Once he demolished a pile of bread. Another time, he threw a glass of milk at a cashier. And on one occasion, during a sailboat outing, he got into a shoving match with another mathematician.

Nash didn't immediately recognize Amasa Forrester, who looked like a shaggy bespectacled bear with the hint of a double chin, a haphazardly shaven face, and glasses, and who even walked like a bear with a slightly forward-leaning gait, when the latter buttonholed him after a talk

.4

Forrester had to remind Nash that they'd been at Princeton A482 together, Forrester having been a first-year graduate student during Nash's final year. After they starting talking, however, Nash remembered

-----483

Forrester as a Steenrod student who was always holding court in the Fine Hall common room, waving a water pistol around. Despite his somewhat unprepossessing appearance, Forrester had interesting things to say. He was fast, aggressive, and seemed to know everything about everything that came up in their conversation. Forrester explained some of the details of Milnor's work to Nash. They also talked, then and later, about Nash's embedding papers, which Forrester appeared to know quite well. Forrester invited Nash to come to see his living quarters, moored on Lake Union, between Lake Washington and Puget Sound in downtown Seattle. To Nash, Forrester was "a different sort." He would later refer to Forrester, who went by the name Amasa, in the same terms that he used when he compared Thorson and Bricker to the Beatles com"young,0"colorful,0"amusing," and "attractive"-someone who made him feel like "the girls who love the Beatles so wildly."

There was much to draw them together. Forrester, who had just turned thirty, was as brash and brilliant as Nash .6

He'd had a stellar graduate-school career. Steenrod, who was on his dissertation committee, had

-----484

given him spectacular references. He was disorganized and sloppy but he had a photographic memory and wide-ranging interests. He hadn't done much since arriving in Seattle in 1954 and, indeed, hadn't been able to publish his dissertation because it turned out to contain a substantive flaw, but he was still full of enthusiasm, or at least so it seemed to Nash. He shared Nash's predilection for insult and one-upmanshipat Princeton he'd been referred to as King of the Common Room for that reason-and was given to sweeping judgments of the kind Nash admired. Once, for example, when a listener tried to question him after a talk, he responded by claiming, "It's easier to predict what mathematicians will be talking about fifty years from now than what they'll be interested in next year." His obvious eccentricity made him seem like a kindred spirit. This was a young man who had once managed to get himself permanently banned from the dining rooms of the Graduate College by Sir Hugh Taylor, the dean, for having deliberately broken dishes and crockery in

the breakfast room. And his relationship with his mother was fodder for all kinds of stories. Former friends recall that a family record of worldly success and an overbearing mother both

-----485

weighed heavily on him. Arthur Mattuck, who was at Princeton with Forrester, recalled: "`Amasy, Amasy, Amasy!" his mother would say. `Oh, mom, you know how much I love you; Amasa would coo back in a falsetto."

Forrester was also openly homosexual. It's unlikely that his graduate-school professors or Sir Hugh were aware of this, but "he was fairly

open about his homosexuality at Princeton and everybody at A485
 the Graduate College knew," said John Isbell, a professor of
 mathematics at the State University of New York at Buffalo and a
 fellow graduate student at Princeton." Initially, Forrester had
 been quite circumspect with his colleagues at the University of
 Washington, but by the time Nash ran into him—perhaps because
 things were beginning to loosen up even in Seattle—he had
 concluded that he no longer had to pretend to be what he was not.
 Robert Vaught, a retired logician at the University of California
 at Berkeley, shared a house with Forrester during their first
 year as instructors in Seattle. He recalled:
 It wasn't that he "discovered" his homosexuality

-----486

then. It was very difficult for homosexuals then. In those days
 people thought the best thing to do was to get rid of it by some
 act of will. He sort of decided that he had to be a homosexual.
 Sometime during his third year in Seattle he bought himself a
 houseboat—there was a far-out group living on the waterfront—and
 gradually he began to let people know about his homosexuality. 10
 Nash always found the people who could give him what he needed.
 Forrester was the kind of smart, verbal, quick-witted man Nash
 was frequently attracted to. Forrester was also emotionally
 available. Under his eccentric, sometimes brash and loud exterior
 Forrester was an exceptionally sweet man. "Kind and gentle, much
 loved by his students" was the description given by Albert
 Nijenhuis, another of Forrester's colleagues." Forrester also had
 an unusual capacity for connecting with troubled individuals.
 When Vaught, who, as a student, had endured repeated
 hospitalizations for episodes of mania and depression, first came
 to Seattle, Forrester was amazingly kind. Vaught recalled: "He
 was a
 very fine
 man. I was a manic-depressive long before lithium came along. He
 was very helpful to me.

-----487

Amasa encouraged me to find a psychiatrist in Seattle. I could
 talk to him. 0" In his first year at Seattle, Forrester "adopted" a
 mentally ill graduate student—a computer genius who had suffered
 some kind of psychotic breakdown—and tried to care for him,
 recalled John Walter, a mathematician at the University of
 Illinois who shared the house with Vaught and Forrester. "It was
 one of his projects.""
 It would have been obvious to Forrester that Nash, arrogant and

aloof as he might appear, would respond to his sympathetic interest. "Amasa was pretty sharp. He would have seen through the veil," said Walter.

14

Nash and Forrester hardly had much time to spend together- Nash was in Seattle P

only a month. Although Nash referred to Forrester, either by name or simply by the letter F, in letters until the early 1970's, there is no evidence to suggest that Nash and Forrester corresponded regularly or saw much of each other in subsequent years. Forrester stayed very much on Nash's mind, however. Eleven

years later, on a pilgrimage that took A487

-----488

him to Los Angeles and San Francisco, Nash spent nearly a month in Seattle."

Forrester was still living in his houseboat with dozens of cats for company and was by then almost entirely cut off from his former mathematical friendsdd16 He had never lived up to his early promise, had been denied tenure, and had left the University of Washington in 1961. He worked briefly at Boeing and later at the giant Atomic Energy Commission plant in Hanford, Washington, before dropping out of the mathematical community in the mid-1970's. Later, he made his living tutoring and, on one occasion, acting as a live-in tutor for some children on a ranch. Nijenhuis, who ran into him a final time at a mathematics congress in Vancouver, British Columbia, in 1974, recalled that Forrester had told him that he'd worked as a goatherd. For years he would drop by the mathematics and physics library, looking progressively more seedy and disheveled. He died in 1991. This once-promising mathematician did not even merit an obituary in the Seattle Times.

If, for Nash, Forrester's was the road not taken,

-----489

one would have to argue that Nash, on this occasion, was perceptive about human beings.

Nash knew immediately that something was wrong when someone fetched him from the dormitory. The Nashes communicated exclusively by letter and postcard. A long-distance telephone call indicated that something was amiss."

John Sr. was on the line. He sounded unnaturally grave. Nash's first thought was that he was calling with some bad news about his mother or sister, but he heard anger rather than sorrow or anxiety in his father's voice.

Eleanor Stier had contacted them and revealed the existence of their grandson, John Sr. said. The shock was enormous.

"Don't come home;` John Sr. told him sternly. "Go right to Boston and make this right. Marry the girl."

Nash was too stunned to argue. The secret he was so anxious to keep from his parents was out. There was nothing to be done now. He agreed not to come to Roanoke. In a postcard dated July 12, he wrote his parents that he was "thinking of going back to

BeanTowndd011

Nash did go back to Boston in mid-July and

stayed for two weeks. He spent most of his time either with Bricker or working in his office late nights. 19 He turned to Bricker for advice on what to do about Eleanor. She had hired a lawyer. She wanted regular child support payments. The attorney, Nash found out, was threatening to go to the university. Nash, as Bricker recalled in 1997, was inclined to refuse to pay. Bricker, as usual, found himself in the middle. Eleanor had been calling him regularly. She was devastated by Nash's abandonment and bitter over his refusal to
Seattle

207

A490

support their son. Bricker remonstrated with Nash. "He didn't want to pay child support. I told him, This is terrible. This is your son. If nothing else, do it for your own future. If the university got wind of this it'll ruin your career. You owe it to herdd021 Nash, to Bricker's surprise, agreed to pay.

1956-57

ALTHOUGH

NASH WAS TO SPEND

the year at the Institute for Advanced Study, he

-----491

decided to live in New York instead of Princeton. Within a day or two of coming to the city in late August, he found an unfurnished apartment on Bleecker Street in Greenwich Village just south of Washington Square Park, a street lined with jazz clubs, Italian caf6's, and secondhand book shops. The apartment was a typical railroad flat, small, dingy, and suffused with smells of his neighbors' cooking. Nash bought a few pieces of used furniture from a local junk dealer and sent his parents a postcard proclaiming a sentiment that they would be sure to approve, namely, that he'd rather save money than live luxuriously.

But his reasons for choosing a five-story walk-up in downtown New York over a spartan flat on Einstein Drive in quasirural Princeton were more romantic than practical. The towering scale of the city, with its frenetic rhythms, ever-present crowds, and round-the-clock activity -- "the wild electric beauty of New York" I seemed wonderful to him, always had, from the first time Shapley and Shubik had invited him, when all three were living in the Graduate College at Princeton, to come up for a weekend. After he'd moved to Boston, he

-----492

had seized every opportunity to return, sometimes staying with the Minskyseabled just to reexperience that sensation of simultaneous connectedness and anonymity. The bohemian enclave around Washington Square had long been a magnet for those who were sexually and spiritually unconventional, and Nash too was attracted to its crooked streets, Old World charm, and implied promise of freedom.

If the decision to move to Bleecker Street meant that Nash was toying with adopting a different sort of life from the one he had hitherto imagined for himself, it was not to be. John Sr. and Virginia announced that they too were coming to New York. John

Sr. had some business to transact for the Appalachian. Nash feared that they would confront him again on the subject of Eleanor. But the Nashes were even more preoccupied with the precarious state of John Srdd`s health at that moment. When Nash met them at the McAlpin Hotel, a few blocks from Penn Station, he tried to demonstrate that he was a loyal son by urging his father, several times in the course of the evening, to consult a specialist in New York. He told his father he ought to consider an operation.` It was the last time Nash saw his father. In early September, John Sr. suffered a

massive heart attackdd7 Virginia had a difficult time 493
reaching Nash, who had no telephone. By the time she got a
message to him, his father was already dead. Thereafter, he would
think of fall as a season of "misfortunes."

John Sr., who was sixty-four at the time of his death, had been
ill on and off all year. That Easter Sunday he had been feeling
too unwell to go to Martha and Charlie's house for dinner (Martha
had married in the spring of 1954). And in late summer when he
and Virginia were in New York, he suffered from a spell of
weakness and nausea in the hoteldd9 The news of his father's
death shocked Nash. He couldn't fathom its suddenness, its
finality. He was convinced that the death had not been
inevitable, might have been prevented if only John Sr. had gotten
better medical care, if only ... 10

Nash rushed to Bluefield to attend the funeral, which was held at
Christ Episcopal Church on September 14, two days after John Sr.
died."

There was no outpouring of grief, no sign that Nash's unnatural
calm was shakenddB the death of his father produced another
fissure in the foundation of

-----494
Nash's perfect little world." The loss of a parent before one has
really stepped fully into one's own adult life in the same role
is a one-two punch comlosing the father and having to step into
the father's shoes.

There was, for starters, a newfound sense of responsibility for
Virginia's welfare. It may not have signified much in practical
terms, given that Martha lived in Roanoke and, as the female
offspring, would have been expected to look after Virginia, but
emotionally Nash was now in the hot seat. Suddenly, his mother's
wishes regarding him, in particular her intense desire that he
adopt what she regarded as a "normal" life -- that is, that he
marry -- weighed more heavily on him than at any time since he
had left home for college. For Nash this dilemma comand it was a
dilemma, as his father's shoes were not exactly the ones that he
felt prepared to step into -- was compounded by the particular
circumstances of the summer. Nash's misbehavior with regard to
Eleanor and John David lay between him and Virginia. The thought
that he had hastened his father's death must have occurred to
him. Or, if it didn't-and this is certainly possible given Nash's
inability to imagine how his actions affected other people

-----495
the thought surely occurred to Virginia, who may have

communicated it, indirectly or directly, to Nash. Virginia was not just grief-stricken but deeply angry. She wrote Eleanor a letter accusing her of causing her husband's death. It is quite possible that she said something similar to her son, or implied as much."

Such guilt would be a heavy burden to bear. More likely, it was not just the feeling of guilt, but also the more potent threat of losing his mother's love on the heels of the actual loss of his father, that would have placed tremendous pressure on Nash to act. Virginia felt that Nash was duty bound to legitimize his relationship to his son. John Sr. had an abhorrence of scandal

and a strong belief in doing one's duty. Whether, by the time of her husband's death, Virginia still persisted in the demand that Nash marry Eleanor isn't clear. It may be that her contact with Eleanor including the evidence of Eleanor's lower-class origins, her lack of education, or her threats to make trouble for Nash --

convinced her that even a temporary marriage was out of the question. She may have feared that Eleanor would never agree to a divorce. Or simply, she may have realized that she had no way of forcing Nash to do something

-----496
that he did not wish to do.

If Virginia reacted so to Nash's mistress and illegitimate son, how might she react to the far more disturbing facts of Nash's liaisons with other men? As a practical matter, the likelihood of her ever finding out about the arrest seemed negligible. Yet that too must have crossed Nash's mind. His confidence that he could keep his secret lives completely separate and keep his parents in the dark as well was jolted by Eleanor's betrayal. He must have felt on his neck the hot breath of other potential discoveries. In addition to commuting to the Institute in Princeton, Nash was spending a good deal of time at New York University, whose campus began a block north of Bleecker Street, at the Courant Institute of Mathematical Sciences. One afternoon, very soon after his father's funeral, Nash stopped at the desk of the beautiful Natasha Artin, the wife of Emil Artin and one of Richard Courant's assistants. A famously gorgeous creature, Natasha had a doctorate from the University of Berlin, where she'd been a student of Artin's before they married. Everyone knew that she was the latest object of Courant's infatuation. Nash liked to chat with her on his way up

-----497
to tea.

"I wonder how easy it is to get a divorce in New Jersey," he said out of the blue one day to her. Natasha immediately took this for a declaration that he intended to get married. She found it quite typical of Nash to investigate the exit doors even as he was hovering near the entrance.

On another occasion, Nash gave a lecture at Chicago and had dinner afterward with Leo Goodman, a mathematician he knew from the graduate-school days in Princeton. He told Goodman that he thought Alicia would make a fine wife. Why? Because she watched so much television. That meant, he felt, that she wouldn't

require much attention from himdd"The exchange brings to mind Eleanor's oft-repeated remark about Nash: "he always wanted something for nothing."

Alicia has insisted that she cannot remember when Nash proposed or whether he did so in person or by letterdd"They simply had an understanding, she said. But Alicia's actions that fall belie her later account. After Nash had left Cambridge in June, Alicia stayed on, desperately unhappy. All this suggests the opposite of any understanding."

Alicia's letter to Joyce Davis on October 23, 1956, does 498
not mention Nash at all. Presumably, if they'd gotten formally
engaged by that date, Alicia would have announced the fact to
Joyce.

As you might know I've been looking for a job in New York and had
applied to several places. At first I was afraid things might
prove difficult but so far I've already had offers from
Brookhaven, as a junior physicist with the reactor group, and
from the Nuclear Development Corporation of America also in the
reactor field. I'm accepting the latter at \$450 per month. I'm
told I might get \$500 some other place but I think N.D.C. offers
good experience and I've always wanted to do nuclear physics
specifically."

It's possible that Alicia would have left school and gotten a job
regardless of the state of her relationship with Nash. She was
increasingly unenthusiastic about attending graduate school. "I'm
tired of the studying and procrastinating routine. ... All I know
is I want to 'Live.'" Since she had gone to high school in New
York, it would have been natural for her to think of returning

-----499

there to work. But Alicia herself said later that she moved to
New York on Nash's account. She may have gone there in the hopes
of renewing her relationship with him. She may have gone at his
express invitation.

Alicia moved into the Barbizon Hotel, the legendary hotel for
young women that is the setting of Sylvia Plath's fifties novel
The Belljar.

References were required to obtain lodging there. And the rooms,
tiny and white with metal beds, were only for sleeping, Alicia
complained in a PS to Joycedd18 "This hotel-the Amazon-was for
women onlyea"writes Plath, who spent the summer of 1952 in
residence, "and they were mostly girls my age with wealthy
parents who wanted to be sure their daughters would be living
where men couldn't get at them and deceive them; and they were
all going to posh secretarial schools like Katy Gibbs, where they
had to wear hats and stockings and gloves to class, or ... simply
hanging around in New York waiting to get married to some career
man or otherdd019

Whether or not Alicia came to New York as Nash's fiancée at
the end of October, she

-----500

visited Nash's family in Roanoke that Thanksgivingdd20 Nash did
not give her a ring, however. He had some idea, typically odd and

pennypinching, that he wanted to buy one in Antwerp, directly from a diamond wholesaler²¹ Virginia found Alicia charming and dignified and was impressed by Alicia's obvious devotion to Nash, but at the same time she thought her quite different from the sort of girl she had imagined for her son's bride

.²¹

She thought the relationship between the two strange. Alicia was a physicist who talked about her job at a nuclear reactor company and displayed no interest in anything domestic, a young woman completely out of Virginia's ken. While Virginia and Martha busied themselves in the kitchen,

Alicia and Nash spent most of Thanksgiving Day sitting on the floor of Virginia's living room poring over stock quotations. Martha's reaction was similar to her mother's. (At Virginia's insistence, and thinking it might turn Alicia's head in the right direction, Martha took Alicia shopping in Roanoke one afternoon to buy a hat.)

The wedding took place on an unexpectedly

-----501

mild, gray February morning in Washington, D.C., at St. John's, the yellow-and-white Episcopal church across Pennsylvania Avenue from the White House." Nash, by then an atheist, balked at a Catholic ceremony. He would have been happy to get married in city hall. Alicia wanted an elegant, formal affair. It was a small wedding. There were no mathematicians or old school friends present, only immediate family, Charlie, his brother-in-law, whom Nash hardly knew, was best man. Martha was matron of honor. Bride and groom were both late, having been held up at the portrait photographers. Nash and Alicia drove to Atlantic City for a weekend honeymoon on the way back to New York. It wasn't a success. Alicia hadn't been feeling well, Nash wrote in a postcard to his mother

In April, two months later, Alicia and Nash threw a party to celebrate their marriage. They were living in a sublet apartment on the Upper East Side, around the corner from Bloomingdale's. About twenty people came, mostly mathematicians from Courant and the Institute for Advanced Study and several of Alicia's cousins, including Odette

-----502

and Enrique. "They seemed very happy" Enrique Larde later recalled. "It was a great apartment. They were just showing off their new marriage. He looked very handsome. It seemed very romantic"

PART THREE

A

Slow Fire
and Washington Square
1956-57

Mathematical ideas originate in empirics... But, once they are so conceived, the subject begins to live. Its peculiar life of its own and is better compared to a creative one, governed almost entirely by aesthetical motivations... As a mathematical discipline travels, after much isolation in breeding, [it] is in danger of degeneration.... whenever this stage is reached, the only remedy

seems to me to be the rejuvenating return to the source. the
reinjection of more or less directly empirical ideas comJoHN
voation NE-UMANN

TE

INSTITUTE FOR ADVANCED STUDY, nestled on Princeton's fringes on
what had been a farm, was

-----503

a scholar's dream. It was bordered by woods and the
Delaware-Raritan Canal, its lawns were immaculate, and one of its
streets was Einstein Drive. It was also blessedly free of
students. The atmosphere in the Fuld Hall common room resembled

that of a venerable men's club, with its newspaper racks A503
and mingled scents of leather and pipe tobacco; its doors were
never locked and its lights burned far into the night.

In 1956, the Institute's permanent faculty were not many more
than a dozen mathematicians and theoretical physicists. They
were, however, outnumbered sixfold by a host of distinguished
temporary visitors from around the globe, prompting Oppenheimer
to call it "an intellectual hotel." For young researchers, the
Institute was a golden opportunity to escape the onerous demands
of teaching and administration, and, indeed, the tasks of
everyday life. Everything was provided the visitor: an apartment
less than a few hundred yards from an office, an unending round
of seminars, lectures, and, for those so inclined, parties where
the booze was plentiful and where one could glimpse Lefschetz
balancing a martini glass in an artificial hand, or witness a
very drunk French mathematician

-----504

displaying his mountaineering skills by rope-climbing up and over
the fireplace mantel.

Some found the idyllic setting, carefully designed to remove all
impediments to creativity, vaguely disquieting. Paul Cohen, a
mathematician at Stanford Univer-
sity, remarked, "it was such a great place that you had to stay
at least two years. It took one year just to learn how to work
under such ideal conditions." By 1956, Einstein was dead,
Gödel was no longer active, and von Neumann lay dying in
Bethesda. Oppenheimer was still director, but much humbled by the
McCarthyite inquisitions and increasingly isolated. As one
mathematician said, "The Institute had become pure, very pure." Cathleen Morawetz, later president of the American Mathematical
Society, put it more bluntly: "The Institute was known to be
about the dullest place you could find."

By contrast, the Courant Institute of Mathematical Sciences at
New York University was "the national capital of applied
mathematical analysis."

Fortune

-----505

magazine was soon to inform its readers. Just a few years old
and vibrant with energy, Courant occupied a nineteenth-century
loft less than a block to the east of Washington Square in a
neighborhood that, despite the university's growing presence, was
still dominated by small manufacturing concerns. Indeed, Courant
initially shared the premises with its fire escapes and creaky

old-fashioned freight elevator comwitha number of hat
factoriesdd8 Financing for the institute had come from the Atomic
Energy Commission, which had been hunting for a home for its
giant Univac 4 computer. At the time, this great mass of vacuum
tubes, with its armed guard, occupied 25 Waverly Placedd9
The institute was the creation of one of mathematics' great
entrepreneurs, Richard Courant, a German Jewish professor of
mathematics who had been driven out of Gbttingen in the
mid-1930's by the Nazis." Short, rotund, autocratic, and
irrepressible, Courant was famous for his fascination with the
rich and powerful, his penchant for falling in love with his

female "assistants;` and his unerring eye for young A505
 mathematical talent. When Courant arrived in 1937, New York
 University had no

-----506
 mathematics worth speaking of. Undaunted, Courant immediately set
 about raising funds. His own stellar reputation, the
 anti-Semitism of the American educational establishment, and New
 York's "deep reservoir of talent `was enabled him to attract
 brilliant students, most of them New York City Jews who were shut
 out of the Harvards and Princetons. I I The advent of World War
 11 brought more money and more students, and by the mid-1950's,
 when the institute was formally founded, it was already rivaling
 more established mathematical centers like Princeton and
 Cambridge." Its young stars included Peter Lax and his wife,
 Anneli, Cathleen Synge Morawetz, Jargen Moser, and Louis
 Nirenberg, and among its stellar visitors were Lars Hbrmander, a
 future Fields medalist, and Shlomo Sternberg, who would soon move
 to Harvard. The Courant Institute was practically on Nash's
 doorstep and, given its lively atmosphere, it was not surprising
 that Nash was soon spending at least as much time there as at the
 Institute for Advanced Study. At first Nash would stop by for an
 hour or two before driving down to Princeton, but he soon found
 himself staying the whole day." He never

-----507
 came too early, for he liked to sleep late after
 Olden Lane and Washington Square
 217
 working into the wee hours at the university librarydd14 But he
 was almost always there for teatime in the lounge on the
 building's penultimate floor." As for the Courant crowd, a
 friendly, open group with little taste for the competitiveness of
 MIT or the snobbery of the Institute, it was happy to have him.
 Tilla Weinstein, a mathematician at Rutgers, who recalled that
 Nash liked to pace around on one of the building's fire escapes,
 said, "He was just a delight. There was a wit and humor about him
 that was thoroughly unstandard. There was a wonderful playful
 quality, a lightnessdd011 Cathleen Morawetz, the daughter of John
 Synge, Nash's professor at Carnegie, assumed Nash was just
 another postdoctoral fellow and found him "very charming an
 attractive fellow,0"a lively conversationalistdd011 Hbrmander
 recalled his first impressions: "He wore a serious expression.
 Then he'd break out into a sudden smile. He was an
 enthusiastdd"Is Peter Lax, who had spent the war at Los Alamos,

was

-----508

interested in Nash's research and "his own way of looking at thingsdd019

At first, Nash seemed more interested in the political cataclysms of that fall

Nasser

nationalized the Suez Canal, prompting an invasion by England, France, and Israel, the Russians crushed the Hungarian uprising, and Eisenhower and Stevenson were again baffling for the presidency comthan in pursuing mathematical conversations. "He'd

be in the common room"one Courant visitor recalled, A508
 "talking and talking of his views of the political situation.
 From the afternoon teas, I remember him as voicing very strong
 opinions on the Suez crisis, which was going on at that time." 10
 Another mathematician remembered a similar conversation in the
 institute dining room: "When the British and their allies were
 trying to grab Suez, and Eisenhower had not made his position
 unmistakably clear (if he ever did), one day at lunch Nash
 started in on Suez. Of course, Nasser wasn't black, but he was
 dark enough for Nash. `What you have to do with these people is
 to take a firm hand, and then once they realize you mean it. . .`
 "I'

-----509
 The leading lights at Courant were very much at the forefront of
 rapid progress, stimulated by World War 11, in certain kinds of
 differential equations that serve as mathematical models for an
 immense variety of physical phenomena involving some sort of
 change"0The mid-fifties, as Fortune
 noted, mathematicians knew relatively simple routines for solving
 ordinary differential equations using computers. But there were
 no straightforward methods for solving most nonlinear partial
 differential equations that crop up when large or abrupt changes
 occur-such as equations that describe the aerodynamic shock waves
 produced when a jet accelerates past the speed of sound. In his
 1958 obituary of von Neumann, who did important work in this
 field in the thirties, Stanislaw Ulam called such systems of
 equations "baffling analytically" saying that they "defy even
 qualitative insights by present methods."0"Z Nash was to write
 that same year, "The open problems in the area of non-linear
 partial differential equations are very relevant to applied
 mathematics and science as a whole, perhaps more so than the open
 problems in

-----510
 any other area of mathematics, and this field seems poised for
 rapid development. It seems clear however that fresh methods must
 be employed."

14

Nash, partly because of his contact with Wiener and perhaps his
 earlier interaction with Weinstein at Carnegie, was already
 interested in the problem of turbulence." Turbulence refers to
 the flow of gas or liquid over any uneven surface, like water
 rushing into a bay, heat or electrical charges traveling through
 metal, oil escaping from an underground pool, or clouds skimming

over an air mass. It should be possible to model such motion mathematically. But it turns out to be extremely difficult. As Nash wrote:

Little is known about the existence, uniqueness and smoothness of solutions of the general equations of flow for a viscous, compressible, and heat conducting fluid. These are a non-linear parabolic system of equations. An interest in these questions led us to undertake this work. It became clear that nothing could be done about the continuum description of general fluid flow without the ability to handle non-linear parabolic equations and that this in turn required an

a priori

511

estimate of continuitydd16

It was Louis Nirenberg, a short, myopic, and sweet-natured young prot6ong6 of Courant's, who handed Nash a major unsolved problem in the then fairly new field of nonlinear theory." Nirenberg, also in his twenties, and already a formidable analyst, found Nash a bit strange. "He'd often seemed to have an internal smile, as if he was thinking of a private joke, as if he was laughing at a private joke that he never [told anyone about].0"B he was extremely impressed with the technique Nash had invented for solving his embedding theorem and sensed that Nash might be the man to crack an extremely difficult outstanding problem that had been open since the late 1930's.

He recalled:

I worked in partial differential equations. I also worked in geometry. The problem had to do with certain kinds of inequalities associated with elliptic partial differential equations. The problem had been around in the field for some time and a number of people had worked on it. Someone had obtained such estimates much earlier, in the 1930's in two dimensions. But the problem was open for [almost] thirty years in higher

-----512
dimensionsdd19

Nash began working on the problem almost as soon as Nirenberg suggested it, although he knocked on doors until he was satisfied that the problem was as important as Nirenberg claimedddd"Lax, who was one of those he consulted, commented recently: "In physics everybody knows the most important problems. They are well defined. Not so in mathematics. People are more introspective. For Nash, though, it had to be important in the opinion of othersdd"I I

Nash started coming to Nirenberg's office to discuss his progress. But it was weeks before Nirenberg got any real sense that Nash was getting anywhere. "We Olden Ldd7tione dnd Washington Squqre

219

would meet often. Nash would say, `I seem to need such and such an inequality. I think it's true that. . .` "Very often, Nash's speculations were far off the mark. "He was sort of groping. He gave that impression. I wasn't very confident he was going to get through."

12

Nirenberg sent Nash around to talk to Lars Hbrmander, a tall,

steely Swede who was already one

-----513

of the top scholars in the field. Precise, careful, and immensely knowledgeable, Hörmander knew Nash by reputation but reacted even more skeptically than Nirenberg. "Nash had learned from Nirenberg the importance of extending the Holder estimates known for second-order elliptic equations with two variables and irregular coefficients to higher dimension" Hörmander recalled in 1997.¹¹ "He came to see me several times, 'What did I think of such and such an inequality'" At first, his conjectures were obviously false. [They were] easy to disprove by known facts on

constant coefficient operators. He was rather inexperienced in these matters. Nash did things from scratch without using standard techniques. He was always trying to extract problems ... [from conversations with others]. He had not the patience to [study them]."

Nash continued to grope, but with more success. "After a couple more times" said Mirmander, "he'd come up with things that were not so obviously wrong."

14

By the spring, Nash was able to obtain basic existence, uniqueness, and continuity theorems once again using novel methods of his

own invention. He had a theory that difficult problems couldn't be attacked frontally. He approached the problem in an ingeniously roundabout manner, first transforming the nonlinear equations into linear equations and then attacking these by nonlinear means. "It was a stroke of genius," said Lax, who followed the progress of Nash's research closely. "I've never seen that done. I've always kept it in mind, thinking, maybe it will work in another circumstance

35

Nash's new result got far more immediate attention than his embedding theorem. It convinced Nirenberg, too, that Nash was a

Hörmander's mentor at the University of Lund, Lars Gårding, a world-class specialist in partial differential equations, immediately declared, "You have to be a genius to do that."

Courant made Nash a handsome job offer" Nash's reaction was a curious one. Cathleen Synge Morawetz recalled a long conversation with Nash, who couldn't make up his mind whether to accept the offer or to go back to MIT. "He said he opted to go to MIT because of the tax advantage" of living in

Massachusetts as opposed to New York

Despite these successes, Nash was to look back on the year as one of cruel disappointment. In late spring, Nash discovered that a then-obscure young Italian, Ennio De Giorgi, had proven his continuity theorem a few months earlier. Paul Garabedian, a Stanford mathematician, was a naval attaché in London. It was an Office of Naval Research sinecure In January 1957, Garabedian took a long car trip around Europe and looked up young mathematicians. "I saw

some oldtimers in Romeea"he recalled. "It was a scene. You'd talk mathematics for half an hour. Then you'd have lunch for three hours. Then a siesta. Then dinner. Nobody mentioned De Giorgidd"B in Naples, someone did, and Garabedian looked De Giorgi up on his way back through Rome. "He was this bedraggled, skinny little starved-looking guy. But I found out he'd written this paper." De Giorgi, who died in 1996, came from a very poor family in Lecce in southern Italydd41
Later he would become an idol to the younger generation.

He had no life outside mathematics, no family of his own or 516 other close relationships, and, even later, literally lived in his office. Despite occupying the most prestigious mathematical chair in Italy, he lived a life of ascetic poverty, completely devoted to his research, teaching, and, as time went on, a growing preoccupation with mysticism that led him to attempt to prove the existence of God through mathematics.

De Giorgi's paper had been published in the most obscure journal imaginable, the proceedings of a regional academy of sciences. Garabedian proceeded to report De Giorgi's results in the Office of Naval Research's European newsletter.

Nash's own account, written after he had won the Nobel for his work in game theory, conveys the acute disappointment he felt: I ran into some bad luck since, without my being sufficiently informed on what other people were doing in the area, it happened that I was working in parallel with Ennio De Giorgi of Pisa, Italy. And De Giorgi was first actually to achieve the ascent of the summit (of the figuratively described problem)

-----517
at least for the particularly interesting case of "elliptic equationsdd041

Nash's view was perhaps overly subjective. Mathematics is not an intramural sport, and as important as being first is, how one gets to one's destination is often as important as, if not more important than, the actual target. Nash's work was almost universally regarded as a major breakthrough. But this was not how Nash saw it. Gian-Carlo Rota, a graduate student at Yale who spent that year at Courant, recalled in 1994: 1"en Nash learned about De Giorgi he was quite shocked. Some people even thought he cracked up because of thatdd041 When De Giorgi came to Courant that summer and he and Nash met, Lax said later, "It was like Stanley meeting Livingstone."

44

Nash left the Institute for Advanced Study on a fractious note. In early July he apparently had a serious argument with Oppenheimer about quantum theoryserious enough, at any rate, to warrant a lengthy letter of apology from Nash to Oppenheimer written around July 10, 1957: "First, please let me apologize for my manner of speaking when we discussed quantum theory

-----518
recently. This manner is unjustifiably aggressivedd045 After calling his own behavior unjustified, Nash nonetheless

immediately justified it by calling "most physicists (also some
mathemati-

Olden Lane and Washington Square

221

cians who have studied Quantum Theory) . . . quite too dogmatic
in their attitudes,?-plaining of their tendency to treat "anyone
with any sort of questioning attitude or a belief in `hidden
parameters` as stupid or at best a quite ignorant person." Nash's
letter to Oppenheimer shows that before leaving New York, Nash
had begun to think seriously of attempting to address Einstein's
famous critique of Heisenberg's uncertainty principle:

Now I am making a concentrated study of Heisenberg's original 1925 paper ... This strikes me as a beautiful work and I am amazed at the great difference between expositions of "matrix mechanics," a difference, which from my viewpoint, seems definitely in favor of the original "I embarked on [a project] to revise quantum theory" Nash said in his 1996 Madrid lecture. "It was not a priori absurd for a non-physicist. Einstein had criticized the

-----519
indeterminacy of the quantum mechanics of Heisenberg.
"47

He apparently had devoted what little time he spent at the Institute for Advanced Study that year talking with physicists and mathematicians about quantum theory. Whose brains he was picking is not clear: Freeman Dyson, Hans Lewy, and Abraham Pais were in residence at least one of the terms Nash's letter of apology to Oppenheimer provides the only record of what he was thinking at the time. Nash made his own agenda quite clear. "To me one of the best things about the Heisenberg paper is its restriction to the observable quantities," he wrote, adding that "I want to find a different and more satisfying under-picture of a non-observable reality

-----049
It was this attempt that Nash would blame, decades later in a lecture to psychiatrists, for triggering his mental illness-calling his attempt to resolve the contradictions in quantum theory, on which he embarked in the summer of 1957, dispossibly overreaching and psychologically destabilizing "10 What the matter with being a loner and innovative? Isn't that line? But the flone genius] has the

-----520
same wishes as other people. If he were back in high school doing science projects, fine. But if he too isolated and he disappointed in something big, it's frightening, and fright can precipitate depression. comPA-UL HowARD, McLean Hospital
ORGEN

J
MOSER
had joined the MIT faculty in the fall of 1957 and was living with his wife, Gertrude, and his stepson, Richy, in a tiny rented house to the west of Boston in Needham near Wellesley College. Needham was then more exurb than suburb, still predominantly rural, a lovely place for walking, boating, and stargazing, all of which Moser, a nature lover, was fond. That October and

November, Moser would go outside every evening at dusk with eleven-year-old Richy, climb a great dirt mound behind their house, and wait for

Sputnik-a

tiny silvery dot reflecting the sun's last rays-to pass slowly over Boston.` Having calculated the satellite's precise orbit,

-----521

Moser always knew when it would appear on the horizon.

Very often, he would still be thinking of the afternoon's conversation with Nash. Nash drove out to Needham often. Despite

their very different temperaments, Nash and Moser had great respect for each other. Moser, who thought Nash's implicit function theorem might be generalized and applied to celestial mechanics, was eager to learn more of Nash's thinking. Nash, in turn, was interested in Moser's ideas about nonlinear equations. Richard Emery recalled in 1996: "I remember Nash being very much a part of our life. He used to come to the house and talk with Jargen. They would walk and talk together and spend time in the study. The intensity of it was unimaginable. There could be no interruptions. An interruption was an absolute sin, a violation most serious. It was met with real wrath. When Jargen and Nash met, it was very intense. I always had to be quiet."

Returning to Cambridge in late summer, Nash and Alicia found an apartment with some difficulty. They each paid half the rent, for they had decided not to pool their funds. Alicia got a job as a physics researcher at Technical Operations, one of the small high-tech companies that were springing up

-----522
along Route 128. She also enrolled in a course on quantum theory taught by J. C. Slater.

They quickly settled into the pleasant private and social rituals of a newly married academic couple. Alicia almost never cooked. She would meet Nash on the campus after work, they would eat out with one or more of Nash's mathematics friends, and often spend the evening at a lecture, concert, or some social gathering. Alicia made sure that they were always surrounded by amusing people, sometimes Nash's old graduate-student friends, including Mattuck and Bricker, sometimes Emma Duchane and whomever Emma happened to be dating, and, increasingly, other young couples like themselves, including the Mosers, the Minskys, Hartley Rogers and his wife, Adrienne, and Gian-Carlo Rota and his wife, Terry. When they were with other people, Nash talked to the mathematicians, Alicia to the wives or Emma. Yet her attention was always focused on Nash: what he was saying, how he looked, how others reacted to him. He too, seemed always aware of her, even when he appeared to be ignoring her. That he wasn't

-----523
especially nice to her, or generous, mattered less than that he was interesting and made things happen.

Their friends accepted Nash's new status as a married man with more or less good grace. Some found Alicia "ambitious, strong-willed," others quite the opposite. Rogers recalled in

1996 that "Alicia subordinated herself to John. She wasn't there to compete with him. She was totally dedicated to his support."` Some of their acquaintances found their relationship oddly cool, but others came away with the impression that marriage suited Nash well and that Alicia was having a good effect on him. "Somehow, he was relating a little better," Rogers recalled. Zipporah Levinson agreed: "John was awkward. Alicia made him behave."` Photographs of Alicia taken in those months show a radiant young woman. It was, as Alicia would say many years later, "a very nice time of my lifedd09 Nash continued to work on the problem he had solved the previous

year at Courant. There were some small gaps in the proof, A523
and the paper Nash had begun to write, laying out a full account
of what he had done, was in very rough shapedd10 "It was," a

-----524

colleague said in 1996, "as if he were a composer and could hear
the music, but he didn't know how to write it down or exactly how
to orchestrate it."" As it turned out, it would take most of the
year, and a collective effort, before the final product comwh
some mathematicians regard as Nash's most important work comwas
finally ready to be submitted to a journal.

To complete it, Nash came as close as he ever had or would to an
active collaboration with other mathematicians. "It was like
building the atom bomb," recalled Lennart Carleson, a young
professor from the University of Uppsala who was visiting MIT
that term. "This was the beginning of nonlinear theory. It was
very difficult.0"Nash knocked on doors, asked questions,
speculated out loud, fished for ideas, and at the end of the day,
got a dozen or so mathematicians around Cambridge interested
enough in his problem to drop their own research long enough to
solve little pieces of his puzzle. "It was a kind of factory,"
Carleson, who contributed a neat little theorem on entropy to
Nash's paper, said. "He wouldn't
tell us what he was after, his grand design. It was amusing to
watch how he got all these great egos

-----525

to cooperatedd011

Besides Moser and Carleson, Nash also turned to Eli Stein, now a
professor of mathematics at Princeton University but then an MIT
instructor. "He wasn't interested in what I was doing` "recalled
Stein. "He'd say, `You're an analyst. You ought to be interested
in this!

"14

Stein was intrigued by Nash's enthusiasm and his constant supply
of ideas. He said, "We were like Yankees fans getting together
and talking about great games and great players. It was very
emotional. Nash knew exactly what he wanted to do. With his great
intuition, he saw that certain things ought to be true. He'd come
into my office and say, "This inequality must be true! His
arguments were plausible but he didn't have proofs for the
individual lemmas -- building blocks for the main proofdd011 He
challenged Stein to prove the lemmas.

"You don't accept arguments based on plausibilityea"said Stein in
1995. "If you build an edifice based on one plausible proposition

after another, the whole thing is liable to collapse after a few steps. But somehow he knew it wouldn't. And it didn't."

-----526

16

Nash's thirtieth year was thus looking very bright. He had scored a major success. He was adulated and lionized as never before."

Fortune

magazine was about to feature him as one of the brightest young stars of mathematics in an upcoming series on the "New Math." 11

And he had returned to Cambridge as a married man with a beautiful and adoring young wife. Yet his good fortune seemed at

times only to highlight the gap between his ambitions and A526 what he had achieved. If anything, he felt more frustrated and dissatisfied than ever. He had hoped for an appointment at Harvard or Princeton. 19 As it was, he was not yet a full professor at MIT, nor did he have tenure. He had expected that his latest result, along with the offer from Courant, would convince the department to award him both that winterdd"Getting these things after only five years would be unusual, but Nash felt that he deserved nothing less." But Martin had already made it clear to Nash that he was unwilling to put him up for promotion so soon. Nash's candidacy was controversial, Martin had told him, just as his initial appointment had been." A number of people in

-----527

the department felt he was a poor teacher and an even worse colleague. Martin felt Nash's case would be stronger once the full version of the parabolic equations paper appeared in print. Nash, however, was furious.

Nash continued to brood over the De Giorgi fiasco. The real blow of discovering that De Giorgi had beaten him to the punch was to him not just having to share the credit for his monumental discovery, but his strong belief that the sudden appearance of a coinventor would rob him of the thing he most coveted: a Fields Medal.

Forty years later, after winning a Nobel, Nash referred in his autobiographical essay, in his typically elliptical fashion, to his dashed hopes:

It seems conceivable that if either De Giorgi or Nash had failed in the attack on this problem (or .7 priori

estimates of Holder continuity) then that the Jone climber reaching the peak would have been recognized with the mathematics` Fields medal (which has traditionally been restricted to persons less than 40 years old)."

-----528

The next Fields Medal would be awarded in August 1958, and as everyone knew, the deliberations had long been under way.

To understand how deep the disappointment was, one must know that the Fields Medal is the Nobel Prize of mathematics, the ultimate distinction that a mathematician can be granted by his peers, the trophy of trophies.

14

There is no Nobel in mathematics, and mathematical discoveries,

no matter how vital to Nobel disciplines such as physics or economics, do not in themselves qualify for a Nobel. The Fields is, if anything, rarer than the Nobel. In the fifties and early sixties, it was awarded once every four years and usually to just two recipients at a time. Nobels, by contrast, are awarded annually, with as many as three winners sharing each prize. Tradition demands that recipients of the Fields be under forty years of age,
a
practice designed to honor the spirit of the prize charter, which stipulates that the purpose of the honor is "to encourage young

mathematicians"and "future work."" The incentive, A528
 incidentally, is of an

-----529
 intangible variety, as the cash involved, in contrast to the
 Nobel, is negligible, a few hundred dollars. Yet since the Fields
 is an instant ticket in midcareer to endowed chairs at top
 universities, ample research funds, and star salaries, this
 seeming disadvantage is more apparent than real.

The prize is administered by the International Mathematical
 Union, the same organization that organizes the quadrennial world
 mathematical congresses, and the selection of Fields medalists
 is, as one recent president of the organization put it, "one of
 the most important tasks, one of the most taxing
 responsibilities."

16

Like the Nobel deliberations, the Fields selection process is
 shrouded in greatest secrecy.

The seven-member prize committee for the 1958 Fields awards was
 headed by Heinz Hopf, the dapper, genial, cigar-smoking geometer
 from Zurich who showed so much interest in Nash's embedding
 theorem, and included another prominent German mathematician,
 Kurt Friedrichs, formerly of Gbtingen, and then at Courantdd"The
 deliberations got under way in late 1955 and were concluded early

-----530
 in 1958. (The medalists were informed, in strictest secrecy, in
 May

1958 and actually awarded their medals at the Edinburgh congress
 the following August.)

All prize deliberations involve elements of accident, the biggest
 one being the composition of the committee. As one mathematician
 who took part in a subsequent committee said, "People aren't
 universalists. They're horse trading.", In 1958, there were a
 total of thirty-six nominees, as Hopf was to say in his award
 ceremony speech, but the hot contenders numbered no more than
 five or sixdd19

That year the deliberations were unusually contentious and the
 prizes, which ultimately went to Ren6 Thom, a topologist, and
 Maus F. Roth, a number theorist, were awarded on a four-three
 votedd10 "There were lots of politics in that prize;` one person
 close to the deliberations said recentlydd"Roth was a shoo-in; he
 had solved a fundamental problem in number theory that the most
 senior committee member, Carl Ludwig Siegel, had worked on early
 in his career. "It was a question of Thom versus Nashea"said

Moser, who heard reports of the deliberations from several of the

-----531

participants.0"Friedrichs fought very hard for Nash, but he didn't succeed;` recalled Lax, who had been Friedrichs's student and who heard Friedrichs's account of the deliberations. "He was upset, As I look back, he should have insisted that a third prize be given.""

Chances are that Nash did not make the final round. His work on partial differential equations, of which Friedrichs would have been aware, was not yet published or properly vetted. He was an outsider, which one person close to the deliberations thought

"might have hurt him" Moser said, "Nash was somebody who didn't learn the stuff. He didn't care. He wasn't afraid of moving in and working on his own. That doesn't get looked at so positively by other people." Besides, there was no great urgency to recognize him at this juncture; he was just twenty-nine.

No one could know, of course, that 1958 would be Nash's last chance. "By

1962, a Fields for Nash would have been out of the question," Moser said recently. "It would never have happened.

I'm sure nobody even thought about him any-

A measure of how badly Nash wanted to win the

-----532

distinction conferred by such a prize is the extraordinary lengths to which he went to ensure that his paper would be eligible for the 136cher Prize, the only award remotely comparable in terms of prestige to the Fields. The B6cher is given by the American Mathematical Society only once every five years. It was due to be awarded in February 1959, which meant that the deliberations would take place in the latter part of 1958.

Nash submitted his manuscript to

Acta Mathematica,

the Swedish mathematics journal, in the spring of 1958.¹¹ It was a natural choice, since Carleson was the editor and was convinced of the paper's great importance. Nash let Carleson know he wanted the paper published as quickly as possible and urged Carleson to give it to a referee who could vet the paper in a minimum of time. Carleson gave the manuscript to Hörmander to referee.

Hörmander spent two months studying it, verified all the theorems, and urged Carleson to get it into print as quickly as possible. But as soon as Carleson informed Nash of the formal acceptance, which was, in any case, largely a foregone conclusion, Nash withdrew his paper.

-----533

When the paper subsequently appeared in the fall issue of the American Journal of Mathematics,

Hörmander concluded that Nash had always intended to publish the paper there, since the 136cher restricted eligible papers to those published in American journals or, worse, had submitted the paper to both journals,

The Bomb Factory

227

a clear-cut breach of professional ethics. "It turned out that Nash had just wanted to get a letter of acceptance from Acta to be able to get fast publication in the Arnerican Journal of Mathematics. ?` H6rmander was angry at what he felt was 1`very improper and most unusual dis039 It's possible, though, that Nash had simply submitted the paper to Acta before learning that doing so would exclude it from consideration

for the Bbcher, but that upon discovering this fact, he A533
was willing to antagonize Carleson and Mirmander in

-----534
order to preserve his eligibility. He may therefore not have used
Acta

quite so unscrupulously. Withdrawing the paper after it had been
promised to

Acta, and
after it had been refereed, would have been unprofessional, but
not as clear a violation of ethics as Hbrmander's scenario
suggests. However, it still showed bow very much winning a prize
meant to Nash. Summer 1958

It struck me that I knew every-thing; everj4hing was revealed to
me, all the secrets of the world were mine during those spacious
hours. -

GERARD DE NERVAL

ASH TURNED THIRTY

that June. For most people, thirty is simply the dividing line
between youth and adulthood, but mathematicians consider their
calling a young man's game, so thirty signals something far more
gloomy. Looking back at this time in his life, Nash would refer
to a sudden onset of anxiety, "a fear"t the best years of his
creative life were over.`

What an irony that mathematicians, who live so much more in their
minds than most of humanity, should

-----535
feel so much more trapped by their bodies! An ambitious young
mathematician watches the calendar with a sense of trepidation
and foreboding equal to or greater than that of any model, actor,
or athlete.

The Mathematician Apology

by G. H. Hardy sets the standard for all laments of lost youth.

Hardy wrote that he knew of no single piece of first-rate
mathematics done by a mathematician over fifty.` But the age
anxiety is most intense, mathematicians say, as thirty draws
near. "People say that for better or worse you will probably do
your best work by the time you are thirtyea"said one genius. "I
tend to think that you are at your peak around thirty. I'm not
saying you won't equal it. I would like to think that you could.
But I don't think you will ever do better. That's my gut
feeling."` Von Neumann used to say that "the primary mathematical
powers decline at about twenty-sixea"af which the mathematician
must rely on "a certain more prosaic shrewdnessdd0bled

Compounding the irony is that the act of creating new mathematics, which appears so solitary from the outside, feels from the inside like an intramural competition, a race. One never forgets the crowded

-----536

field. And one's relative standing, vis-...-vis past and present competitors, is what counts. Again, Hardy best conveyed what motivates many mathematicians, including himself. He wrote that he could not recall ever wanting to be anything but a mathematician, but also that he could not remember feeling any passion for mathematics as a boy. "I wanted to beat other

boys, and this seemed to be the way in which I could do so A536
 most decisivelydd"I More ambitious than most, Nash was also more
 age-conscious than most comor perhaps simply more frank about it.
 "John was the most age-conscious person I've ever metea"recalled
 Felix Browder in 1995. "He would tell me every week my age
 relative to his and everybody elseSdd06

His determination to avoid the draft during the Korean War
 suggested not just a desire to avoid regimentation, but also an
 unwillingness to take time out of the race.

The most successful are the most vulnerable to the feeling that
 time is running out. Such fears may be exaggerated, but they are
 quite capable of producing real crises, as the history of
 mathematics amply attests. Artin, for example, switched
 frantically from field to field trying to catch hold

-----537

of something that would equal his early accomplishments.`
 Steenrod slipped into a deep depression. When one of his students
 published a note on "Steenrod's Reduced Powers"- the reference
 was, of course, mathematical, not personal -- other
 mathematicians smirked and said, "Oh, yes, Steenrod's reduced
 powers!"" Nash's thirtieth birthday produced a kind of cognitive
 dissonance. One can almost imagine a sniggering commentator
 inside Nash's head: "What, thirty already, and still no prizes,
 no offer from Harvard, no tenure even? And you thought you were
 such a great mathematician? A genius? Ha, ha, ha!" Nash's mood
 was odd. Periods of gnawing self-doubt and dissatisfaction
 alternated with periods of heady anticipation. Nash had a
 distinct feeling that he was on the brink of some revelation. And
 it was this sense of anticipation, as much as his fear, as he put
 it, of "descending to a professional level of comparative
 mediocrity and routine publicationea"t spurred him to begin
 working on two great problemsdd9 Sometime during the spring of
 1958, Nash had confided to Eli Stein that he had "an idea of an
 idea"ab how to solve the Riemann Hypothesisdd"T summer, he wrote
 letters to Albert E. Ingham,

-----538

Atle Selberg, and other experts in number theory sketching his
 idea and asking their opiniondd"He worked in his office in
 Building Two for hours, night after night.

Even when a genius makes such an announcement, the rational
 response is skepticism. The Riemann Hypothesis is the holy grail
 of pure mathematics. "Whoever proves or disproves it will cover
 himself with gloryea"wrote E. T. Bell in 1939. "A decision one

way or the other disposing of Riemann's conjecture would probably be of greater interest to mathematicians than a proof or disproof of Fermat's Last Theorem.""

Enrico Bombieri, at the Institute for Advanced Study, said: "The Riemann Hypothesis is not just a problem. It is the problem. It is the most important problem in pure mathematics. It's an indication of something extremely deep and fundamental that we cannot grasp.""

Whole numbers that are evenly divisible only by themselves and one comsocalled prime numbers -- have exerted a fascination for mathematicians for two thousand years or more. The Greek

mathematician Euclid proved that there were infinitely many primes. A538

-----539

The great European mathematicians of the eighteenth century -- Euler, Legendre, and Gauss -- began a quest, still under way, to estimate how many primes there are, given a whole number n , less than

not.

14

And since 1859 a string of mathematical giants -- G. H. Hardy, Norman Levinson, Atle Selberg, Paul Cohen, and Bombieri, among others--have attempted, unsuccessfully, to prove the Riemann Hypothesis. George Polya once gave a young mathematician who had confided in him that he was working on the Riemann Hypothesis a reprint of a faulty proof of the conjecture by a Göttingen mathematician who thought he'd solved the problem. "I think about it every day when I wake up in the morning," the young mathematician had said, and Polya delivered the reprint the following morning with a note: "If you want to climb the Matterhorn you might first wish to go to Zermatt where those who have tried are buried."

16

Before World War I, a German banker endowed a

-----540

prize, lodged in Göttingen, for whoever proved or disproved the hypothesis. The prize was never awarded and, indeed, vanished in the inflation of the 1920's.

Nash's first encounter with Georg Friedrich Bernhard Riemann and his famous conjecture took place when Nash was fourteen, probably lying on the den floor in front of the radio, reading Bell's *Men of Mathematics*.

Riemann, the sickly son of an impoverished Lutheran minister, was also fourteen and preparing to follow in his father's footsteps when a sympathetic headmaster, who sensed that the boy was more suited to mathematics than the ministry, gave him a copy of Legendre's

Théorie des Nombres

to read. As Bell tells it, the young Riemann returned the 859-page work six days later, saying, "That is certainly a wonderful book. I have mastered it." The episode, which took place in 1840, was likely the origin of Riemann's lifelong interest in the riddle of prime numbers and, as Bell theorizes, Riemann's Hypothesis may have originated in his

later attempt to improve upon Legendre.

In 1859, at the age of thirty-three, Riemann wrote an eight-page paper,

Veber die Anzahl der Primzahlen unter einer gegebenen Groesse" ("On the number of prime numbers under a given magnitude"), in which he laid out his famous conjecture com"one of the outstanding challenges, if not the outstanding challenge to pure mathematics."

Here is how Bell explains the conjecture:

The problem concerned is to give a formula which will state how

many primes there are less than any given number not. In A541 attempting to solve this Riemann was driven to an investigation of the infinite series $1 + \frac{1}{2^s} + \frac{1}{3^s} + \dots$ in which s is a complex number, say $s = u + iv$ (i equals where u and v are real numbers, so chosen that the series converges. With this proviso the infinite series is a definite function of s , say $\zeta(s)$ (the Greek zeta is always used to denote this function, which is called "Riemann's zeta

-----542

Secrets

231 function"); and as s varies $\zeta(s)$ continuously takes on different values. For what values of s will $\zeta(s)$ be zero? Riemann conjectured that .711 such values of s for which

u lies between 0 and 1 are of the form

112

plus

iv , namely, all have their real part equal to 112.10

When Riemann died of tuberculosis at thirty-nine, he left behind a vast legacy, including the abstract, four-dimensional geometry that Einstein would employ in formulating his general theory of relativity. Just as geographers had to go from two-dimensional plane geometry to three-dimensional solid geometry to create an undistorted map of the earth, Einstein, to map the cosmos, went from three-dimensional to four-dimensional geometry. But it was for his tantalizing conjecture that Riemann is best remembered. Proving or disproving it would settle many extremely difficult

-----543

questions in the theory of numbers and in some fields of analysis. As Bell put it, "Expert opinion favors the truth of the hypothesis."

It is impossible to say how long Nash had been contemplating his own attempt, but it seems likely that his interest crystallized sometime toward the end of his year in New York. Jack Schwartz recalled conversations with Nash on the subject in the Courant common room." Jerome Neuwirth, a second-year graduate student at MIT in 1957-58, remembered that Nash had developed a very proprietary feeling about the problem around that time." Neuwirth recalled that Newman, perhaps to tease Nash, told Nash that

Neuwirth, too, was working on the Riemann Hypothesis. Nash came roaring into Neuwirth's office. "How dare you""he said. "What's a guy like you doing?" It quickly became a running joke. Every time Nash saw Neuwirth he'd say, "Well, did you get anywhere yet""And Neuwirth would answer, "Almost got it. I'd tell you about it, but I've got to run."

As Stein recalled it, Nash's idea was "to try to prove the hypothesis by logic, by internal consistency of the system. Some proofs are based on

analogies, on rules of logic whereby something is proved 544
[indirectly]. If one could show that the structure of two
problems was in some sense identical, one could show that the
logic of one proof had to apply to the other. It's a proof by
logic and it doesn't relate to the real context. It's not proving
that one object is related to another objectdd014

Stein was dubious. "He told me this very sketchy thing. It was an
idea of an idea about how he was going to prove this thing. He
was going to find another number system in which it was true. I
thought, 'It's wild, it doesn't hang together! This struck me as
simply unbelievable. This was as opposed to my earlier
conversations with him about parabolic equations, which struck me
as daring but probably right.'"

Richard Palais, a professor of mathematics at Brandeis
University, recalls some particulars: "Nash was considering
so-called pseudoprime sequences, i.e., increasing sequences
 π, p, p, p, \dots

\dots of integers that have many of the same distribution
properties as the sequence 2, 3, 5, 7, \dots of prime numbers.
For each of these one can

-----545
associate in a natural way a 'zeta function,' which for the case
of the true primes reduces to the Riemann zeta function. As I
recall, Nash claimed to be able to show that for 'almost all' of
these pseudoprime sequences the corresponding zeta function
satisfied the Riemann Hypothesisdd016

Bell warned that "Riemann's Hypothesis is not the sort of problem
that can be attacked by elementary methods. It had already given
rise to an extensive and thorny literaturred017 By the time Nash
turned to it seriously, that literature had grown several-fold.

Both Ingham and Selberg, possibly others as well, warned Nash
that his ideas had been tried before and hadn't led
anywheredd"Eugenio Calabi, who was in touch with Nash in this
period, said: "For a person who is not a library hound, it's a
very dangerous area to go into. If you have a flash of an idea
with a scenario and think you may get a result, in the first
flash of illumination you think you have a revelation. But that's
very dangerousdd019

There was, as Nash suggested, nothing absurd in his attempting to
solve
the
outstanding problems in pure mathematics and

-----546

theoretical physics. The skepticism with which his early formulations were greeted was, after all, merely a replay of the skepticism voiced by experts toward his earlier efforts, and has no doubt been exaggerated in hindsight. When those problems are solved it will be by a young mathematician who attacks them with the hubris, originality, raw mental power, and sheer tenacity that Nash brought to bear on his greatest work, Yet the timing of Nash's decision to pursue these problems, just as he turned thirty and while he was licking various wounds to what he would later call his "merciless superego"¹⁰ suggests that a fear of failure lay behind his willingness to take unusual

risks. Stein's impression of Nash during their conversations about the Riemann problem is interesting: "He was a little ... on the wild side. There was something exaggerated about his actions. There was a flamboyance in the way he talked. Mathematicians are usually more careful about what they will assert to be true." But, of course, hubris is not exactly uncommon. As Hormander, who went on to win a Fields Medal in 1962, put it: "It's part of life that not all things one works on work out. You overestimate your own abilities. After

A546

-----547
solving a big problem, nothing smaller is good enough. It's very dangerous." Later, quite possibly because of the effects of shock treatments, Nash had absolutely no recall of his attempt to solve Riemann's conjecture. But, as it was, Nash's compulsion to scale this most difficult, most dangerous peak proved central to his undoing.

There were other signs that Nash felt, at that particular juncture, a growing pressure to prove himself as well as a newfound taste for taking risks. Nash had always been obsessed with money, even trivial amounts. Nash had made friends with Samuelson, Solow, and a number of other young economists at MIT. Samuelson recalled in 1996 that Nash told him about a bank with no checking charges at all.

"Do they give you stamped, self-addressed envelopes too?" Samuelson shot back. Nash, who didn't get the joke, immediately replied: "No. Do you know a bank that gives you stamped self-addressed envelopes?"

14

Privately, Samuelson thought it was all a bit pathological. Norman Levinson, who complained to Samuelson about Nash's parsimony, apparently

-----548

once told him "to cut out his cheese-paring ways." Levinson said: "One extra theorem will earn you more than all that stuff." Everyone thought it was weird. Nash was able to convince Martin and a few others in the math department to switch their accounts to the Peoples National Bank of Rocky Mount, Virginia, which charged no fees on checking accounts!) That summer Nash's somewhat compulsive attitude toward money blossomed into an obsession with the stock and bond markets. Solow recalled: "It seemed he had a notion that there might be a secret to the market, not a conspiracy, but

a theorem comsomething that if you could only figure it out, would let you beat the market. He would look at the financial pages and ask, `Why is this happening? Why is that happening?` as if there had to be a reason for a stock to go up or downdd016 Martin, the chairman of the mathematics department, also recalled that "Nash liked to chat about the stock market. He had the idea you could get rich."" Nash had some notion of arbitraging July 1999 bonds against September 1999 as well as various ideas about over-the-counter stocksdd"Solow was aghast to learn that

Nash was investing his mother's savings. "I was 549
 horrified" he recalled. "That's something else" said Samuelson.
 "It's vanity. It's like claiming you can control the tides. It's
 a feeling that you can outwit nature. It's not uncommon among
 mathematicians. It's not just about money. It's me against the
 world. A lot of traders start that way. It's about proving
 yourself."

In late July, against this backdrop of grand designs, the Nashes,
 who had not yet gone on a proper honeymoon, left Cambridge for
 Europe. They sailed from New York on the
de France

Their ultimate destination was Edinburgh, where the World
 Congress of Mathematics was to take place in the second week of
 August. Nash was giving a lecture on nonlinear theory. Many
 colleagues from MIT and Princeton would be there, and Nash was
 able to pay for his trip partly out of Sloan funds.

But first they went to Paris. There, having calculated that
 importing a used car from Europe was a bargain, Nash purchased an
 olive-green Mercedes 180 diesel. He and Alicia then drove south
 over the Pyrenees to Spain, back to Italy, and up to Belgium. The
 trip was a success. "We were

-----550
 young" Alicia recalls. "It was fun." Another of his plans was
 to buy Alicia the diamond that he had promised her. Antwerp was
 the center of the world diamond market, and Nash had the idea
 that it would be advantageous to buy a stone directly from a
 wholesaler. Eli Stein's father had been a diamond merchant
 there before the war and that is what may have given Nash the
 idea in the first place. If Nash had hoped for a bargain, he was
 disappointed; the yellow stone that he purchased was no cheaper
 than it would

have been in the States, he recalled in 1996. From Belgium, they
 drove to the North Sea, crossed over into Sweden, and visited
 Lund and Stockholm before crossing back to England.
 They rendezvoused with Felix and Eva Browder in London and drove
 to Scotland with them. The men ignored the women, who sat
 together in the backseat gossiping (at that time, Eva recalled,
 "Nash wouldn't talk to women"). On the second, rainy day of
 the drive, Felix managed to dent the Mercedes, prompting Nash to
 repeat incessantly for the rest of the trip that "this car has
 been Browderized."

There were, as Alicia later said, "lots of

-----551

famous people arounddd044 Nash seemed very much his usual self He pouted a bit when Milnor gave his invited half-hour lecture, a great honor. He got into a loud argument with Olga Ladyshenskaya from the University of St. Petersburg, an expert on a priori estimates of parabolic equations and the leading female mathematician of her generation. Nash was picking her brains and she, somewhat paranoid, reacted rather violently."` The Nashes held a party in their hotel room. Nash raised eyebrows by complaining at great length that Alicia took too long to get

dressed and that she was always latedd46 But he showed no A551
emotion when, as he and Alicia sat in the balcony with the
Browders, Moore, Milnor, and others, the Fields prizes were
awarded.

Fall 1958

The growing consciousness is a danger and a disease.

- FwEDR-ICH NYE7ZSCHE

TE

NASHES WERE BACK-IN

Cambridge and Nash was already teaching when Alicia discovered,
half with joy, half with dismay, that she was

-----552

pregnant. Alicia, who liked her job and her paycheck, would
have preferred to wait a few years. It had been Nash's wish that
they start a family right away.` He stopped short of saying that
his desire for another child had been his motive for marrying,
but he reminded Alicia often that the whole purpose of marriage,
in his view, was to produce children.` Now that his wish was to
be realized, Nash was on the whole rather pleased, passing the
great news on to Albert Tucker in a postscript to a letter in
early October by referring to "a 'new addition` that we are
expecting."` He demanded that Alicia stop smoking. When she lit
up at a math party he told her to put out her cigarette and made
a scene after she refusedddbled But otherwise, all seemed to be
well. Nash was teaching a graduate course. The course number
comM711, a sly reference to craps-was Nash's idea and helped draw
enough students to fill a small amphitheater.` Nash's first
assignment also reflected his high spirits. He asked his students
to invent a way to grade each other's papers so that he, Nash,
wouldn't have to be bothered.

Nash was at that moment preoccupied with his own future and
feeling increasingly restless. Martin had assured

-----553

him that he was coming up for tenure that winter.` The promise of
a decision mollified him somewhat: Nash wrote to Tucker that the
situation at MIT had "reached a modus vivendi condition
which is an impro vem en t o ver early 1958. his

7

But the sense that others were deciding his future oppressed him.
And he was more convinced that he didn't belong at MIT. "I do not
feel this is a good long-term position for me," he wrote to
Tucker, saying that he was afraid of becoming isolated within the
department like Wiener. "I would rather be one of a smaller

number of more nearly equal colleagues."` His sister Martha recalled that "he had no intention of staying at MIT. He wanted to go to Harvard because of the prestigedd09
Meanwhile, the University of Chicago was putting out feelers about Nash's possible interest in moving there."` Chicago had gone a long time without making any senior hires, even after Andre Weil had left for the Institute for Advanced Study. Now the math department had a new chairman, Adrian Albert, and some cash." Albert was looking at a young Harvard professor, John Thompson, who

had done brilliant work in group theory"and also at Nash, 554 who had a number of strong supporters in the department, including Shiingshen Chern.

Nash felt the pressure from these decisions acutely and decided, in any case, that he wanted to get away the following year for a separate sabbatical. He wanted to spend the fall term of 1959 in Princeton at the Institute for Advanced Study and the spring term in Paris at its French equivalent, the Institut des Hautes 9mentudes Scientifiques, which, like the Institute, was dominated by mathematicians and theoretical physicists. Around the end of October, he began the process of applying for various grants, including those from the National Science Foundation, the Guggenheim Foundation, and the Fulbright program. He also applied to the Institute for a membership. He wrote: "This is part of the plan. The other part is to learn Frenchdd"I I

Albert Tucker was supportive. He wrote to the Fulbright program on October

8 that "Nash is eager to talk mathematics with others he thinks are up to snuff... He is often rather rough on those less able ... but this is standard

-----555

practice in France ... Nash should do well with energetic give and take ... benefit from relationship with Leray."

14

His letter of recommendation to the National Science Foundation called Nash "one of the most talented and original mathematicians in the US ... in his final year of a Sloan fellowship. One of two or three best men who ever got a Sloan." I I His November 26 letter to the Guggenheim Foundation was couched in similarly laudatory terms."

What Nash planned to work on isn't clear. He was at the time thinking about several different problems, including quantum theory and the Riemann Hypothesis. His desire to go to Paris may or may not have been motivated by Leray's presence at the College de France. Gian-Carlo Rota recalled: "He was bragging that he had enough fellowships to survive three or four yearsdd011 One particularly unpleasant episode occurred in the early fall. His investments had proved disastrous,"ffsay the least, and he had to confess his failure to Virginia. He also had to promise to repay her. "I'll forward my debt," Nash was

-----556

forced to write Virginia that fall. The amount wasn't huge, but the whole thing was quite upsettingdd19

Everything, in short, seemed suddenly to be in flux-which may be why Nash found himself drawn to another young man. That summer a brilliant mathematician, six years Nash's junior, turned up at MIT. By the mid-1960's, Paul Cohen would be famous for solving a logical puzzle posed by Gbdel -- a result so stunning that The New York Times reported it?-and would win both a Fields and a Schemes 136cher

.2 1

But in the fall of 1958, Cohen was a fiercely ambitious, enormously frustrated upstart. Cohen, who had grown up poor in

New York, had been on the math team at Stuyvesant High School, and had just earned his Ph.D. at the University of Chicagodd" B his thesis had not been well received and as a consequence he had been unhappily marooned at the University of Rochester. Desperate to get away, he had begged

-----557

his old friend from Stuyvesant, Eli Stein, to help him get an instructorship at MIT." This Stein had managed to do, and Cohen had come to Cambridge as soon as class inines ended at Rochester. Big, slightly feline in his movements, his eyes burning with fiery intensity under a high dome of a forehead, Cohen was self-obsessed, suspicious, aggressive, and charming by turns. He spoke several languages. He played the piano. His ambitions were seemingly unlimited and he spoke, from one moment to the next, of becoming a physicist, a composer, even a novelist. Stein, who became a close friend of Cohen's, said: "What drives Cohen is that he's going to be better than any other guy. He's going to solve the big problems. He looks down on mathematicians who do mathematics for the sake of making incremental improvements in the field

dis024

He was as fast as Newman, ambitious as Nash, arrogant as the two put together, and he very quickly fell in with the other two. Cohen was competitivewildly competitiveea"z one fellow instructor put it. "He was good at tearing people

-----558

down," Adriano Garsia recalled in 1995.¹¹ They challenged each other with problems. "Well, Nash what kind of garbage are you working on now""Cohen would say. "What wrong theorems did you prove today? Okay ... you want a real problem? I'll give you a problemff" They ragged the chess players mercilessly. As Carsia recalls, "They were always eager to show how much better they were at whatever game it was that other people were playing. They engaged in horseplay ... playing tunes on beer bottlesdd" D.J. and Paul typically got the better of Nash, but not always. Cohen was the more articulate. But occasionally Nash could shut them up. "He could say an enormous amount in three wordsea"said Garsia. They delighted in ganging up on a graduate student struggling with a dissertation, dissecting a problem that some poor guy had been working on for two years and springing their own solution on him. They liked to argue that theirs was more powerful, but in fact they abjured elegance for brute force. "They wanted to solve it any way at allea"said Garsia.

Nash "cultivated" Cohen, according to the latter. It was disunusualea" Cohen recalled. "Maybe I liked him because he liked me. He'd ask me to lunch.

-----559

He was not a friend of mine, though. I don't know that he had any friendsdd016 Still, Cohen was intrigued. He used to go to dinner with the Nashes, speaking Spanish to Alicia, wondering how Nash had won this beautiful girl, and aware that Alicia was somehow "concerned"ab Nash's paying so much attention to Cohen. Nash never made any advances or ever said anything personal to Cohen. But he dropped hints. He'd say things like "So and So was

a homosexual" Cohen recalled. Or he'd say a word and ask Cohen if he knew what it meant. If Cohen said no, Nash would come back with "Oh, you don't know what so and so means" "People around the department were soon gossiping that Nash was in love with Cohen." Cohen was flattered, even fascinated, by Nash's interest, but he took special delight in rubbing Nash's face in the disparity between the grandiose claims and reality. He was critical, to the point of viciousness, of Nash's hubris. Later, Cohen would say, "Mathematically I didn't interact with him. I didn't feel I could talk to him about mathematics."

But they did talk a good deal about Nash's ideas on the Riemann Hypothesis. "Nash thought he could

-----560
work on any problem he wanted" said Cohen in a tone of mild outrage. "He wrote a letter to Ingham, and he passed it around. I shot it down. What he was trying to do, you couldn't do. I would have been very unsympathetic to Nash's notion. The Riemann Hypothesis can't be solved as stated. He came by with this letter. But any expert would have said these ideas are naive. What I admired is the enormous self-confidence to even conjecture. If he's right, this guy's intuition is in the stratosphere. But it turned out to be just another wrong idea."

A year later, after he had been hospitalized, some blamed disappointed love and the intense rivalry with a younger man for Nash's breakdown "Ironically, Cohen's career wound up mirroring Nash's. After his great success, he turned to the Riemann Hypothesis and physics. He did publish, but rarely and never anything that rivaled the work he did before age thirty. "Nothing was worthy of his notice," said a mathematician who knew him at MIT. "He sat in glorious isolation" "There is a kindling. A slow fire burning." JosEPH BRENNER, psychiatrist, Cambridge, Massachusetts, 1997

-----561
SOMEONE
WAS CALLING, "It's time to play charades. It's time to play charades" "A crowd of costumed guests filled the entire ground floor of the Mosers' small frame house in Needham. Outside, snow had been falling for hours. Inside, the atmosphere was thick with smoke, liquor, jazz. Everyone was talking, laughing a little louder than usual, heads close together, waving cigarettes, posing for the camera, still a bit self-conscious but already loosening up in the carnival-like atmosphere. The Mosers were

dressed as pirate and Indian squaw. Karin Tate, Artin's musician daughter, was dressed as a black cat. Her husband, John, the algebraist, came as the Vector Space Man, wearing a metal cap with bobbing antennae and arrows all over his chest. Gian-Carlo Rota looked as elegant as ever in his monk's tunic, his dark-haired wife, Teresa, dashing in her Spanish bolero and slim black pants.

Richy Emery, the Mosers' son, watched through the dining-room window as a big dark car pulled into the driveway and a virtually naked man got out. There was a pounding on the kitchen door and Richy ran

to open it. As Nash came striding into the room, followed 562
by Alicia, heads turned, eyebrows shot up, and conversation
suddenly quieted. Alicia was laughing excitedly and Nash wore a
smirky smile as they surveyed the astonished guests. He was
barefoot and entirely naked except for a diaper and a sash, which
was draped across his powerful chest, that had the numerals 1959
written on it. Having stolen the show, Nash grinned and bowed,
waved a baby bottle full of milk at the assembled company, which
was laughing loudly at this point-and then sauntered into the
living room to join in the game of charades.

Jargen and Gertrude were just dividing the guests into two teams.
Nash was on one team, Richy on the other. When it was Richy's
turn, Nash walked over to him and whispered in his ear the name
of the character that he was supposed to act out. Richy was
delighted. He adored Nash, who was much younger and more animated
than most of Jorgen's math friends. Richy's pantomime initially
mystified everyone. Finally a woman, the best player in the room,
read his eleven-year-old
mind:

The Critique of Pure Reason!

-----563

Richy looked over at Nash, who shrugged his shoulders and gave
him a big grin.

Between that New Year's Eve, December 31, 1958, and the last day
in February, as his fellow mathematicians and friends looked on
in puzzlement, Nash would undergo a strange and horrible
metamorphosis. But on New Year's Eve, he was, by all accounts,
simply his flamboyant, eccentric, and slightly off-key self,
playful and mischievous. Alicia was in high spirits as well. The
idea for Nash's costume had been hers. She was the one who sewed
it, draped his sash, and choreographed the entrance a moment past
midnight. There is no hint of unease or premonition in the
photograph of Nash sprawling somewhat drunkenly, with a laughing,
gleeful Alicia on his lap, her arm on his shoulder. Most of the
evening, though, it was Nash who was curled up in Alicia's lap.
Some of the other partygoers found it extremely bizarre, "really
gruesome," "disturbing."

Nash had already crossed some invisible threshold. The feverish
activity and the fierce competition with Cohen and Newman in the
common room, so noticeable in the early fall, had already slowed.
He seemed a trifle more withdrawn, a little spacier. A

-----564

graduate student who had just come into Nash's orbit recalled his

not being able to keep up with Cohen and Newman. Paul Cohen recalled in 1996 that that fall Nash would make little jokes, little offhand remarks about world affairs, interesting license numbers, and the like. They were funny-Nash was always very bright and very witty-but they showed that something was not all right. "I'd think, 'That's going a little too far,' "Cohen said.` Nash started singling out individuals. One was a senior named AJ Vasquez, who had never taken a course from Nash and was something of a prot6ong6 of Paul Cohen's. "I'd see him in the common room. He'd say something. It wasn't a conversation. More like a monologue. He gave me preprints of his articles and asked me

strange questions about themdd0bled

A564

But none of this was especially alarming or suggested outright illness, just another stage in the evolution of Nash's eccentricity. His conversation, as Raoul Bott put it, had "always mixed mathematics and myth." His conversational style had always been a bit odd. He never seemed to know when to speak up or shut up or take part in ordinary give and take. Emma Duchane recalled in 1997 that

-----565

Nash always, from their earliest acquaintance, which dated back to Nash and Alicia's courtship, told interminable stories with mysterious, off-key punch linesdd6

In his game-theory course, Nash behaved like his usual self, according to students who were in the class. On the first day, he said to the class, "The question occurs to me: Why are you here?," a remark that caused one student to drop the course. Later, he gave a midterm without announcing it in advance. He also paced a great deal and he sometimes fell into reveries in the middle of lecturing or answering a student's question. just before Thanksgiving, Nash had invited his TA from the game theory course, Ramesh Gangolli, and Alberto Galmarino, a student from the course whom he was helping to choose a dissertation topic, to accompany him on a walk. As they walked over the Harvard Bridge on the Charles River late one afternoon, Nash embarked on a lengthy monologue that was difficult to follow for the two, who had just come to the United States. It concerned threats to world peace and calls for world government. Nash seemed to be confiding in the two young men, hinting that he had been asked to play some extraordinary role. Gangolli recalled that he

-----566

and Galmarino were quite disturbed and that they wondered briefly if they should inform Martin that something was not quite right.

Awed as they were by Nash, and new as they were to America comand so reluctant to form any judgments comthey decided to say nothing.

Also around that time, Atle Selberg, one of the masters of analytic number theory, gave a talk in Cambridge. Nash, who was in the audience, seemed to think that Selberg knew some secret that he was holding back. Selberg recalled, "He asked some questions I thought were in a sense, to my way of thinking, somewhat inappropriate to the subject. He seemed to see something quite different than what I had intended.... [His] questions were

formulated as if I had some hidden, not fully disclosed, agenda that he wanted to discover. The lecture was about the rigidity of several locally symmetric spaces. He asked some questions that seemed to imply I had a hidden, secret motive. He suspected it had something to do with the Riemann Hypothesis, which of course it did not. I was rather taken aback. This was something that had nothing to do whatsoever [with the Riemann Hypothesis]."

After the New Year's party, people around the department started talking about Nash. Classes resumed

January 4. A week or ten days later, Nash asked Galmarino 567
to teach a couple of his classes. He was going away, he said.
Galmarino, who was flattered by Nash's confidence in him, readily
agreed. Nash showed up at Rota's apartment on Sacramento Street
on his way out of town. Then he disappearedddd10
Cohen disappeared at around the same time. After a few days, the
scuttlebutt among the graduate students was that Nash and Cohen
had run away togetherdd"Z it happens, Cohen had gone to visit his
sister. He was terribly upset when he returned to hear what the
others had been saying about him and Nash. Nash, meanwhile, had
driven south, ultimately to Roanoke, but perhaps also to
Washington, D.C.

A couple of weeks later Nash slouched into the common room.
Nobody bothered to stop talking. Nash was holding a copy of
The New York Times.
Without addressing anyone in particular, he walked up to Hartley
Rogers and some others and pointed to the story on the upper
left-hand corner of the
Times
front page, the off-lede, as

-----568
Times
staffers call it." Nash said that abstract powers from outer
space, or perhaps it was foreign governments, were communicating
with him through
The New York Times.
The messages, which were meant only for him, were encrypted and
required close analysis. Others couldn't decode the messages. He
was
being allowed to share the secrets of the world. Rogers and the
others looked at each other. Was he joking?
Emma Duchane recalled driving with Nash and Alicia. She recalled
that "he kept shifting from station to station. We thought he was
just being pesky. But he thought that they were broadcasting
messages to him. The things he did were mad, but we didn't really
know it.""
Nash gave one of his graduate students an expired license,
writing the student's nickname --
St. Louis -- over his own. He called it an "intergalactic
driver's license." He mentioned that he was a member of a
committee and that he was putting the student in charge of Asia.
The student recalled, "He seemed to be joking around."

His manner took on a certain furtiveness.

-----569

Another student, an undergraduate, recalled, "I have this impression of him darting about. I'd walk into a stairwell and he'd disappear as if he'd been lurking there' 11

Nash showed up at the apartment of John and Karin Tate one evening. Everybody was horsing around and finally they settled down to play a game of bridge. Nash's partner was Karin Tate. His bidding was bizarre. At one point he bid six hearts when, as it turned out, he held no hearts at all. Karin asked him, "Are you crazy""Nash responded quite calmly, explaining that he somehow

had expected her to read his bids. "He expected me to understand. He genuinely thought I could understand. I thought he was pulling my leg, but it became obvious that he wasn't. I thought he was doing some sort of experiment."

16

Some people continued to think Nash was engaged in some elaborate private joke. There was a lot of discussion about it.

Nash's recollections of those weeks focus on a feeling of mental exhaustion and depletion, recurring and increasingly pervasive images, and a growing sense of revelation regarding a secret world that

-----570

others around him were not privy to. He began, he recalled in 1996, to notice men in red neckties around the MIT campus. The men seemed to be signaling to him. "I got the impression that other people at MIT were wearing red neckties so I would notice them. As I became more and more delusional, not only persons at MIT but people in Boston wearing red neckties [would seem significant to

meldd1117

At some point, Nash concluded that the men in red ties were part of a definite pattern. "Also [there was some relation to] a crypto-communist partyea"he said in 1996.

Things started happening fast. Alicia Nash later compared Nash's disintegration to that of a man who is conversing quite normally at a dinner party, suddenly starts arguing loudly, and finally has an all-out temper tantrum."

He told Cohen: "People are talking about me. You've heard them. Tell me what they're sayingdd"Cohen recalled: "It had a nasty edge. I told him I didn't know what he was talking about, that I hadn't heard anythingdd019

Nash was still working on the Riemann problem. Once

-----571

Nash accused Cohen

of rifling through his trash can. Was he trying to steal Nash's ideas about Riemann? Again, it sounded like a bit of an over-the-top joke, but it upset Cohen sufficiently so that he repeated the incident to a studentdd21

In mid-February, Harold Kuhn, who was on a Fulbright in London with Estelle and his children, spent a few days in Paris where he visited a French mathematician, Claude Berge. Berge showed Kuhn a letter from Nash, written in four colors of ink, complaining that his career was being ruined by aliens from outer spacedd21

Possibly, the event that triggered Nash's strange letter to Berge was the announcement of the winner of the 1959 136cher Prize, Louis Nirenberg, the Courant professor who had suggested the partial differential equation problem to Nash. Paul Cohen later recalled that Nash's reaction was furious. He told Cohen that he deserved the prize and that the fact that an older mathematician had won it was merely a sign that these things were "political."

12

Nash also approached Neuwirth about his work. "He said he was giving this lecture on the Riemann

Hypothesisea"Neuwirth recalled. "But when he started 572
talking it was gibberish. Probability is everything!!! I knew
that was crazy. I mentioned it to Newman, who brushed
it offdd021

On yet another occasion, Nash wandered into Moser's office,
unannounced as always. Moser, always affable, suppressed a
feeling of irritation and waved him in. Nash stood at the
blackboard. He drew a set that resembled a large, wavy baked
potato. He drew a couple of other smaller shapes to the right.
Then he fixed a long gaze on Moser. "Thisea"he said, pointing to
the potato, "is the universedd"Moser nodded. Moser was at that
time engaged in trying to apply Nash's implicit function theorem
to certain problems in celestial mechanics. "This is the
governmentea"Nash said, in the same tone that used to say, "This
is an elliptic equation.0"Th is heaven. And this is helldd`. 14
Ted and Lucy Martin had been in Mexico on a winter vacation. When
Martin returned, Levinson took him aside and told him that Nash
was having a nervous breakdown. "Tell me about itea"said Martin,
who said later that he "almost didn't believe in these

-----573
thingsdd"Martin recalled, "Levinson said, `He's very paranoid. If
you go down to his office, he won't want you between him and the
door.` Sure enough, when I went down to his office that Sunday
night, Nash edged himself over between me and the door.""
Strange letters began turning up in the department mail. Ruth
Goodwin, the department secretary, would put them aside and show
them to Martindd16 They were addressed to ambassadors of various
countries. And they were from John Nash. Martin panicked. He
tried to retrieve the letters, not all of which were addressed
and most of which weren't stamped, from mailboxes around the
campus.

What was in the letters? None have survived, but various people
recalled
hearing from Martin that Nash was forming a world government.
There was a committee that consisted of Nash and various students
and colleagues in the department. The letters were addressed to
all the embassies in Washington, D.C. The letter said he was
forming a world government. He wanted to talk to the ambassadors.
Later he would talk to the heads of statedd21

Martin was in a most awkward position. The faculty, after some
internal dissension, had just voted

-----574
on Nash's promotion, and it was now before the president of the

university. He dithered and delayed.

Meanwhile, Adrian Albert, the chairman of the mathematics department at the University of Chicago, called Norman Levinson. What was Nash's state of mind? he asked Levinson. Chicago had made an offer of a prestigious chair to Nash, Nash was scheduled to give a talk, and now he had received a very odd letter from Nash." It was a refusal of the Chicago offer. Nash had thanked Albert for his kind offer but said he would have to decline because he was scheduled to become Emperor of Antarctica. The letter, Browder recalled in 1996, also contained references to Ted Martin's stealing Nash's ideas. The affair came to the

attention of MIT president Julius Stratton, who, upon A574
seeing a copy of Nash's letter, is supposed to have said, "This
is a very sick man."

The spring term began February 9. Shortly after Washington's
birthday, Eugenio Calabi, who was a member that year at the
Institute for Advanced Study in Princeton, gave a seminar at MIT.
Undergraduates, even very bright ones,

-----575
didn't normally attend departmental seminars, but Also Vasquez, a
senior, decided he would go. He put on a sport coat and tie for
the occasion. Feeling rather self-conscious, he sat a few rows
from the rear and hoped that he looked less conspicuous than he
felt.

He had noticed, as he sat down, that Nash was sitting in the row
behind him. In the middle of Calabi's lecture, Nash started
speaking rather loudly, although he did not appear to be
addressing Calabi. After a few moments, Vasquez realized that
Nash was talking to him. "Vasquez, did you know that I'm on the
cover of

Life
magazine""Nash kept repeating until Vasquez turned arounddd19
Nash told Vasquez that his photograph had been disguised to make
it look as if it were Pope John the Twenty-third. Vasquez, he
said, also had his picture on a

Life
cover and it too was disguised. How did he know that the
photograph, apparently of the pope, was really of himself? Two
ways, he explained. First because John wasn't the pope's given
name but a name that he had

-----576
chosen. Second, because twenty-three was Nash's "favorite prime
number."

Almost the strangest thing, Vasquez later recalled, was that
Calabi kept on lecturing as if nothing untoward were happening,
and the rest of the audience too ignored the interchange,
although it must have been audible to everyone in the
room.

Nash and Calabi knew each other from their graduate-school days
at Princeton, Before Calabi had come up to Cambridge, Nash had
telephoned him at his apartment on Einstein Drive and asked
whether the Calabis could put him and Alicia up for a few
daysdd10 He wanted to spend a few days at the institute
consulting with Atle Selberg, the number theorist, and preparing

a talk that he was scheduled to give at the upcoming regional math society meeting.

Calabi and the Nashes went out to dinner after Calabi's talk.

Both Nashes seemed unusually nervous, Calabi recalled. "At one point, Nash made a wrong turn and Alicia began yelling hysterically. He was somewhat anxious."

The next day, the Nashes left for Princeton

-----577

while Calabi stayed on in Cambridge. A day or two later, Calabi got a call from his wife, Giuliana, who said that Nash was behaving very strangely and would he come home? On one occasion,

Nash had walked into another apartment, used the bathroom, A577 and walked out again. All the apartments on Einstein Drive looked virtually identical from the outside and mistakes were commonplace, but even afterward Nash didn't seem to be aware that he had been in the wrong apartment.

On the afternoon of February 28, Nash was even more agitated. Calabi had just returned. "He was acting much more nervous than usual. Very agitated. At the moment of leaving, he was misplacing notes, running back and forth between the car and the house.

Alicia was trying to calm him downdd"Calabi watched, full of misgivings. Speaking of Nash's mathematical investigation, he said, "I knew in that area that problem was not going to yield to a flash of inspirationdd011

Nash's consultations with Selberg apparently came to naught. Selberg had merely been irritated by Nash's persistence, as he later recalled, and told Nash, in even harsher terms, that the probabilistic approach he was pursuing had been

-----578

tried before and had already been demonstrated to be fruitless."

One can only imagine the fear and confusion that Nash felt that afternoon as he stood before the 250 or so mathematicians who came to his lecture, sponsored by the American Mathematical Society, in a Columbia University auditorium."

Harold N. Shapiro, a professor at the Courant Institute and a number theorist who had known Nash since the summer they spent together at RAND in 1952, introduced Nash.

There was in fact an air of tremendous expectation in the hall. Regional AMS meetings were essentially job meetings. The audience consisted both of job seekers and established mathematicians, among them many who knew Nash and his work intimately. "Here was a great young mathematician with a proven ability for tackling the most difficult problems about to announce what he felt was a likely solution to the deepest problem in all of mathematicsea"recalled Shapiro. "I remember hearing that he was interested in prime numbers. Everybody's reaction was that if Nash turns to number theory, number theorists

-----579

better watch out. There was a buzz."

14

Peter Lax, a professor at the Courant Institute, described it as "a very strange adventure."

Lipman Bers reminded me, as we were listening to Nash's talk, that Heifetz gave his first concert at Carnegie (accompanied by

the pianist Godowski). An older violinist, turning to the musician seated next to him, said, "It's very hot in here." "ation for the pianist" came the answer. It must have been hot in there, but only for the number theorists in the audience. It was work in progress. I couldn't judge it. Mathematicians don't usually present unfinished work."

At first, it seemed like just another one of Nash's cryptic, disorganized performances, more free association than exposition. But halfway through, something happened. Donald Newman recalled in 1996:

One word didn't fit in with the other. I was at Yeshiva.

Rademacher, who had worked on the Riemann Hypothesis, was present. In fact, he wrote a brilliant paper on How Not to Solve the Riemann Hypothesis. It was

A579

-----580

Nash's first downfall. Everybody knew something was wrong. He didn't get stuck. It was his chatter. The math was just lunacy. What does this have to do with the Riemann Hypothesis? Some people didn't catch it. People go to these meetings and sit through lectures. Then they go out in the hall, buttonhole other people, and try to figure out what they just heard. Nash's talk wasn't good or bad. It was horrible

Cathleen Morawetz, who had enjoyed joking around with Nash at Courant two years earlier, ran into Nash in the stairwell after the talk: "He was laughed out of the auditorium" she recalled.

"I felt terrible. I said something nice to him, but I was disturbed. He seemed very depressed. Later Cathleen used the phrase "heaping scorn on him" to describe the audience reaction.)

37
Nash had been invited to give a talk at Yale as well on his way back to Cambridge. It was his second talk at Yale that year, but he couldn't find his way there. He kept calling Felix Browder, then teaching at Yale, and telling him that he couldn't understand how to get off the Merritt Parkway.

-----581

Nash talked about the Riemann Hypothesis just as he had at Columbia. Again, it was a disastrous performance, as recalled by Browder, who contrasted his

The Emperor of Antartica

247
performance with the earlier one. "The preceding year there was no hint of trouble. That is when he finished the parabolic equations proof [In fact] he completed the proof during a talk. I [had] asked him if he wanted to come and give another talk at Yale. It wasn't coherent. I thought something was wrong."

38

Spring 1959

It was like a tornado. You want to hang on to what you have. You don't want to see everything go. comAL-RCIA NA-SH

DISPITE

ALICIA's apparent elation on New Year's Eve, her state of mind in the preceding months had been anything but carefree. Since returning from their European holiday, her starry-eyed view of her new life had given way to a darker, more somber perspective.

She and Nash had moved out to West

-----582

Medford, a small industrial city north of Cambridge, and Alicia felt cut off and isolated. Her goal of establishing a career seemed more distant than ever. Her feelings about her pregnancy were ambivalent, and her initial hopes that it would draw her and Nash closer were disappointed. Her husband had become, if anything, more cold and distant. As the weather turned colder and the days shorter, she felt more and more dispirited, anxious, and alone-so much so that she was thinking of consulting a psychiatrist.`

That had been before Thanksgiving. Since then, Nash's A582 behavior, rather than her own low mood, had become her chief source of distress. Several times, Nash had cornered her with odd questions when they were alone, either at home or driving in the car. "My don't you tell me about it?" he asked in an angry, agitated tone, apropos of nothing. "Tell me what you knowea"he demanded.` He behaved as if she knew some secret but wouldn't share it with him. The first time he said it, Alicia thought Nash suspected her of having an affair. When he repeated it, she wondered whether he might not be having an affair himself. That would account for his growing secretiveness and air of abstraction. Might he not

-----583

be trying to deflect attention from himself by accusing her? By New Year's Day, the day she turned twenty-six, Alicia was sure that "something was wrong."` Nash's behavior had become more and more peculiar. He was irritable and hypersensitive one minute, eerily withdraWD the next. He complained that he "knew something was going on"and that he was being "buggeddd" And he was staying up nights writing strange letters to the United Nations. One night, after he had painted black spots all over their bedroom wall, Alicia made him sleep on the living-room couch .4

Alarmed, Alicia searched for explanations rooted in their dayAo-day life. Her first thought was that Nash was unduly worried about the impending tenure decision. She suspected that the prospect of a baby, with all the new responsibilities that implied, was another source of pressure. And she wondered whether marriage to someone "different"l her wasn't proving too much of a strain for a southern WASP.`

Alicia vainly tried to reassure Nash. She told him, over and over, that his worries about tenure

-----584

were unfounded, that he was the department's fair-haired boy, that Martin, after all, was confident that the decision would be favorable. She reasoned with him, pointing out that the letter writing "could undermine his professional credibility"and might even jeopardize his tenure. When that failed, she remonstrated with him. "You can't act sillyyea"she would say. Then Nash did a number of things that frightened her-and made inescapable the conclusion that he was suffering some sort of mental breakdown. He started to threaten to take all of his savings out of the bank and move to Europe

.6

He had some idea, it seemed, of founding an international organization. And he began to stay up, night after night, long after she had gone to bed, writing. In the morning, his desk would be covered with sheets of paper covered in blue, green, red, and black ink. They were addressed not just to the U.N. but to various foreign ambassadors, the pope, even the FBI.

It was in mid-January, while classes were still in session, that Nash took off for Roanoke in the middle of the night after a wild scene. Seeing no alternative, Alicia broke her silence and

telephoned Virginia to warn her. She told her mother-in-law 585
 very little, though, as Martha recalled, other than that Nash was
 suffering from stress and was behaving somewhat irrationally.
 When he arrived in Roanoke, Virginia and Martha were frightened
 by his agitated state. At one point, he struck Virginia on the
 armdd7

When Nash returned, he continued to badger Alicia in private.
 Once he threatened to hit her "if you don't tell medd"I
 Alicia was initially more worried about Nash and their future
 together than about any physical threats to herself. Her
 immediate, overwhelming instinct was to prevent the university
 from finding out about Nash's difficulties. "I didn't want the
 bad things to get out."

She quit her job at Technical Operations and took one at the
 Computer Center on campus. She began to watch Nash all the time,
 to stick very close to him, to keep him more to herself She would
 stop by the mathematics department every afternoon after work and
 pick him up. She no longer invited others to join
 them when they ate out. She particularly tried to avoid Paul
 Cohen, although Nash's insistence sometimes made this impossible.
 "Alicia wanted

-----586
 to save his career and preserve his intellectea"a friend of
 Alicia's later recalled. "It was in her interest to keep Nash
 intact. She was extremely tough.""

Until the Roanoke episode, Alicia had confided in no one. Now she
 consulted a psychiatrist from the MIT medical department, a Dr.
 Haskell Schell." She also asked Emma to have lunch with her alone
 a few times and, although reluctantly and holding much back, told
 her friend some of what had been happening.

At the beginning, it seemed to Alicia that her psychiatrist was
 more intent on asking her questions -- about her upbringing, her
 marriage, her sex life --
 than on offering practical advice on how to cope. "At first
 Alicia trusted them because it was MITEA"Emma recalled. "But it
 was a very Freudian time. The psychiatry department was
 ultra-Freudian. They wanted to treat Alicia. She wanted practical
 helpdd"Emma continued:

They asked Alicia a lot of questions. She got very impatient.
 Nash was threatening to go off to Europe, to withdraw all their
 money, to start an international organization. She was looking
 into the laws. She found

-----587

out that you could have somebody committed for a limited time with the signature of two psychiatrists. To keep them longer, you had to have a court hearing."

Emma was working with Jerome Lettvin, a former psychiatrist who was now pursuing research in neurophysiology at MIT. She asked Lettvin what Alicia should do. The result was that Alicia got very conflicting advice. On the one hand, Lettvin was urging her, through Emma, to consider shock treatments. "Lettvin's idea was that when somebody was delusional the sooner he was shocked out of it the better," Emma recalled. On the other hand, Schell was recommending that Nash go to McLean Hospital, an ultra-Freudian

institution that eschewed shock treatments
in

A587

favor of psychoanalysis and new antipsychotic drugs like Thorazine. Alicia rejected the notion of shock treatment. "She was very concerned with preserving his genius." Emma stated in 1997. "She wasn't going to force anything on him. She also wanted there to be nothing that would interfere with his brain. No drugs. No shock treatments."dd011

In January, the department voted to give Nash

-----588

tenure. A few weeks later, Martin, now aware that Nash was suffering some sort of "nervous breakdown," decided to relieve Nash of his teaching duties for the coming semesterdd14 Although distressed that the university had found out about Nash's problems, Alicia was greatly relieved. She hoped that this move would lift some of the pressures on Nash and that he would improve spontaneously.

Deciding what, if anything, to do was so difficult because Nash often seemed

251

quite normal. The on-again, off-again nature of his symptoms also convinced some of his colleagues and graduate students in the department that nothing was seriously wrong. Gian-Carlo Rota recalled that Nash's personality "didn't seem very different;" although "his mathematics no longer made sense." Some days everything looked just as it always had, and Alicia found herself wondering, until the next outburst of bizarre behavior, whether she had been exaggerating, unnecessarily alarmed, premature in her judgments.

In mid-March, two weeks after the disastrous New York trip when Nash had given his lecture on the Riemann Hypothesis, Nash was writing

-----589

reassuring letters home. "My talk in New York went reasonably well," he wrote Virginia on March 12, urging her to come up to Boston to visit him and Alicia.

16

On the same day, he even wrote a long letter to Martha in which he complained of boredom. Nash wrote, "Since she has become pregnant Alicia does not like to go out. She enjoys TV and movie magazines. These things tend to bore me. The level is too low."dd017

But these periods of lucidity and calm soon gave way to an

eruption that Alicia later compared to a "tornado." 11 The episode that convinced Alicia that she had no choice but to seek treatment for Nash occurred around Easter. Nash took off for Washington, D.C., in his Mercedes. He was, it appeared, trying to deliver letters to foreign governments by dropping them into the mail slots of embassies. 19 This time Alicia went with him. Before they left, she telephoned her friend Emma and asked her to contact the university psychiatrist if they did not return within a week or so. Emma

recalled in 1997 that Alicia was afraid Nash might harm 590
 her. Curiously, her concern, at least in Emma's recollection, was
 less for herself than for Nash: "She wanted the world to know
 that Nash was mad. She was worried about Nash. She worried that
 if she came to harm that he'd be treated like a common criminal,
 so she wanted to be sure that everyone knew that he was
 insane

When Emma did call Schell he refused to come to the telephone and
 had a nurse tell her that "Dr. Schell doesn't discuss his
 patients" She added, "I was interviewed at Lincoln Labs about
 Alicia. I was asked whether she was afraid of her husband. But
 she wasn't. He was just very sick." Emma's impressions to the
 contrary, Alicia was afraid, though she managed to hide her fear
 from almost everyone. Paul Cohen, however, recalled that "she was
 afraid of him." A few weeks later she would tell Gertrude Moser,
 who questioned her decision to have Nash hospitalized, that, in
 Gertrude's words, "Something had happened in the middle of the
 night and she had to save herself and the child." It was fear
 for her own safety, as well as her psychiatrist's warning that
 Nash would continue to deteriorate unless he got treatment, that
 prompted her to seek commitment, at

-----591

least for observation. She wished, however, to conceal what he
 would inevitably regard as an act of treachery. So she turned to
 her mother-in-law and asked her to come to Boston.

252

A BEAUTIFUL MIND

George Whitehead, one of Nash's colleagues, had temporarily moved
 to Princeton with his wife, Kay. In mid-April, the Whiteheads
 drove up to Boston to have their car, which was still registered
 in Massachusetts, inspected. It was an annual ritual. That
 evening they went to a party at the home of Oscar Goldman in
 Concord. Most of the MIT mathematics department was there. Kay
 recalled in 1995: "The word was `Tomorrow, Alicia is having John
 committed! Obviously, there was a lot of talk about

it

in Bowditch Hall

McLean Hospital, April-May 1959

This is the way day breaks in Bowditch Hall at McLean 'Kaking in
 the Blue,"

Life Studies,

ROBERT LOWELL

V V HEN A STRANGER in a suit knocked

on Paul Cohen's office door to inquire whether he had seen Dr. Nash that afternoon, the man's slightly unctuous, selfimportant manner made Cohen wonder whether this was the psychiatrist who was going to have Nash "locked up." I For days the younger people in the department had been speculating- based on hints dropped by Ambrose and some of the other senior faculty comt Nash's wife was about to have him committed. Furious controversies had broken out over whether Nash was truly insane or merely eccentric, and over whether, insane or not, anyone had the right to rob a genius like Nash of his freedom.` Cohen, who felt that he had been somehow

unfairly implicated in the whole affair, had pretty much A592 steered clear of these debates, but he nonetheless felt a certain morbid fascination. To the stranger, however, he merely said no, he hadn't seen Dr. Nash all day.

So when Nash showed up at Cohen's door not very long afterward, seemingly oblivious to whatever machinations were under way, Cohen was more than a little surprised. Nash wanted to know if Cohen would like to go for a walk with him. Cohen agreed, and the two wandered around the MIT campus for an hour or more. As they walked, Nash spoke in a fitful monologue while

-----593

Cohen listened, perplexed and uncomfortable. Occasionally Nash would stop, point at something, and whisper conspiratorially: "Look at that dog over there. He's following us." He frightened Cohen a bit by talking about Alicia in a way that made the younger man feel that she might be in danger. After they parted, Cohen learned later, Nash was picked up and taken to McLean Hospital.

It was not difficult to get someone into McLean even if they did not want to go. Nash's involuntary commitment to a mental hospital for observation was likely arranged by MIT's psychiatric service, probably in consultation with the president of the university as well as Martin and Levinson. Given Nash's acute paranoia, his bizarre letter writing, his inability to teach, and the potential that he might carry out his threats to harm Alicia, the pressure to intervene would have been great. One imagines that before taking the drastic measure of involuntary commitment, one of the psychiatrists in MIT's employ attempted to convince Nash to obtain treatment voluntarily first. Merton J. Kahne, a professor of psychiatry at MIT who ran McLean's admissions ward during the 1950's, said in 1996:

-----594

They would have tried to figure out how to get him into therapy without coercion. A lot of heads would have been put together to try to find a solution. In those days, there was an attempt to maintain some respect for the human being, whether they were crazy or not. They weren't interested in peremptorily putting someone in the hospital against their will. The stigma was enormous. The decision was an especially tricky one because of Nash's prominent position at the university, and because, as is often the case, it was inherently controversial. As Kahne put it, "The more powerful or exceptional the individual, the more controversial the decision."

The mechanics, however, were fairly straightforward. Any psychiatrist could apply to a mental hospital to have a patient taken for a ten-day observation period. A university psychiatrist would have signed a temporary care order coma so-called pink paper comasking McLean to take Nash on the grounds that he was a danger to himself or others (although a simple inability to care for oneself was sufficient grounds). The pink paper gave MIT the right to pick Nash up and transport him to McLean. Technically, it was the hospital that made the decision to hold a patient, initially for a ten-day

period.

595

That April evening, some hours after Nash and Cohen parted company, two Cambridge policemen arrived at the Nash's West Medford house. As Nash recalls, "they as if arrested me. . . dis"I The use of police officers was, by all accounts, an extreme measure; it suggested that the university psychiatrists were expecting trouble. Most cases of involuntary commitment involving university personnel were handled far more discreetly, in a manner designed to avoid scandal and humiliation, by out-of-uniform campus police driving a gray Chevrolet station wagon, marked only with maroon lettering, whose interior was equipped as an ambulancedd6 As it happened, Nash refused to go and a scuffle ensued. "I actually struggled with them in resistance at first," he recalled. Resistance was useless, however. Big and strong as he was, Nash was quickly overpowered and bundled into the back of the police cruiser. The drive from West Medford to Belmont took less than half an hour. One Hundred Fifteen Mill Street, Belmont, Massachusetts, was, and still is, a verdant 240-13re expanse of rolling lawns and winding lanes and a scattering of buildings of old

-----596

brick and ironwork nestled among majestic trees or perched airily on rises coma precise copy, that is to say, of a well-manicured New England college campus of late-nineteenth-century vintage.` Many of its smaller buildings were designed to resemble the homes of wealthy Boston Brahmins -- long the bulk of McLean's clientele. A psychiatrist who reviewed the hospital for the American Psychiatric Association in the late 1940's recalled, "There were all these little two-story homes with suites comkitchen, living room, bedroom. They had suites for the cook, the maid, the chauffeur."` Upham House, a former medical resident recalled, had four corner suites per floor and on one of its floors all four patients turned out to be members of the Harvard Club!

McLean was, as it still is, connected to Harvard Medical School. So many of the wealthy, intellectual, and famous came there -- Sylvia Plath, Ray Charles, and Robert Lowell among them9-that many people around Cambridge had come to think of it less as a mental hospital and more as a kind of sanatorium where high-strung poets, professors, and graduate students wound up for a

-----597

special kind of RandR.

The resident on duty that evening urged Nash to sign a "voluntary paperdd"Nash refused. There was a great movement for world peace, he said, and he was its leader. He called himself "the prince of peace."" He was informed of his legal rights, including his right to file a petition for release. A tentative diagnosis was made, but this was not discussed with him. And a document applying to a judge for a ten-day commitment was filled out. He was then escorted to the admissions ward in BeInap One, a low brick building on the north side of McLean's campus, just beyond the administration building. Nash used the pay telephone in the lounge. He did not call a

lawyer, but rang Fagi Levinson instead. "John wanted to A597 know how he could get out of therea"she said. "He said he wanted a shower. 'I stink,' he saiddd"I I

Virginia Nash traveled up from Roanoke to see her son. She was devastated. She wept and wept, Emma Duchane recalled, saying over and over that she could not "bear to see Johnny in this situation."" She seemed close to a breakdown herself She did not offer Alicia any help, financial or

-----598

otherwise. Alicia, who was very short of funds, about to give birth, and mad with worry, was bitterly disappointed. She had counted on Virginia for support, but it was obvious that Virginia needed even more help than she did. Nash was soon transferred to Bowditch Hall, a low white frame building at the edge of the McLean campus. Bowditch was a locked facility for men. Within a couple of weeks, Robert Lowell, the poet, joined him there." Lowell was already famous, a dozen years older than Nash, and a manic depressive who was now enduring his fifth hospitalization in less than ten years. For Lowell, it was "a mad month"spent "rewriting everything in my three books," translating Heine and Baudelaire, reworking Milton's "Lycidasea"wh he believed he had himself written, feeling "I had hit the skies, that all cohered."

14

"Thrown together like a bundle of kindling, [unable] to escapea"z Lowell's widow, Elizabeth Hardwick, later put itea"Lowell and Nash spent a good deal of time together. When Arthur Mattuck came to visit Nash, he found fifteen or twenty people crowded in Nash's narrow shoebox of a bedroom.

-----599

16 In what turned out to be an oft-repeated scene, Lowell was sitting on Nash's bed, surrounded by patients and staff sitting at his feet on the floor or standing against the walls, delivering what amounted to a long monologue in his unmistakable voice com"weary, nasal, hesitant, whining, mumbling." Nash was hunched over beside him. Mattuck recalled in 1997: "I don't remember anything of the conversation except that it was general. In other words, only one person spoke at a time and that was most of the time Lowell. Basically he was holding forth on one topic after another, and the rest of us were appreciating this brilliant man. Nash said very little, like the rest of us."

Once a women's residence where no man had "apparently entered since perhaps 1860ea"Bowditch was, in Lowell's words, now

designated for "ex-paranoid boys"

17 comthe

ones who thought there was nothing wrong with them and couldn't
be trusted not to bolt. As such, it was oddly genteel. At

Bowditch, Nash and his fellow inmates were treated "to a maze of
tender fussy attentions suitable to old ladies.""" The crew-cut

-----600

Roman Catholic nurses, many of them Boston University students,
brought him chocolate milk at bedtime, inquired about his
interests, hobbies, and friends, and called him Professor."`

"Hearty New England breakfast[so]" were followed by ample lunches

and homey dinners; everybody got fat. Nash had a private A600 room "with a door that shutea" a "hooded night lightea" and a view. There were no screams, no violent episodes, no straitjackets. His fellow patients, "thoroughbred mental casesea" were polite, full of concern, eager to make his acquaintance, lend him their books, and clue him in to "the routinedd" They were young Harvard "Cockggs] of the walk" slowed down by massive injections of Thorazine, yet "so much more intelligent and interesting than the doctorseaz Nash confided to Emma Duchane when she came to visit." There were also old Harvard types "dripping crumbs in front of the TV screen, idly pushing the buttons.0gg Nearly half of McLean's patients were geriatric, like Lowell's "BobbiestPorcellian `29ea" who strutted around Bowditch late at night "in his birthday suit.") I I

-----601

Yet, there Nash was, stripped to his underwear, his belt and shoes taken away, standing before a shaving mirror that was not glass, but metal. As for his view the next morning, in Lowell's words, "Azure day/makes my agonized blue window bleakerdd" The days must have seemed very long: "[H]ours and hours go bydd" Above all, there was the terrible awareness when visitors came that they were free to go back through the locked doors through which they had come while he could not. It was in no way horrible; he was merely, as another inmate of a mental hospital once put it, "considered beyond reasoning with ... and treated like a child; not brutally, but efficiently, firmly, patronizingly.0" He had merely relinquished his rights as an adult human being. Like Lowell, he must have asked himself, "What good is my sense of humor?"

Alicia urged everyone they knew to visit Nashdd" Fagi Levinson organized a visitor's schedule

.14

The feeling was that with the support of friends, Nash would soon be on his feet again. "Everyone at MIT felt responsible for trying to make Nash better" recalled Fagi in 1996. "At

-----602

McLean, all felt the more companionship and support he had, the quicker he would recover." One afternoon, Also Vasquez ran into Paul Cohen, who was extremely upset. He had been out to McLean to visit Nash. And he'd been turned away. What had happened, he told Vasquez, was that McLean had some sort of list of verboten visitors. "He was on the list ``" Vasquez recalled. "And I was on it too. I was really shockedddd011 Vasquez -- along with most of

the students in the department -- hadn't even known that Nash was in the hospital.

It was a list of some sort of committee. I remember Cohen being very upset. That was the first time I was aware that Nash had been hospitalized. I have a memory of about twenty people [on the list], almost all of whom were in the math department. Cohen must have told me some of the names. It was the hospital that wouldn't let people on the list see Nash. I called it "The Committee to Rule the World."

At first, Nash, who found it strange shuffling around without his shoes, was furious. "My wife, my own wife. . . "he said to

Adriano Garsia, one of the first to visit. He threatened to sue Alicia for divorce, to "take away her power." 16

-----603

Jargen and Gertrude Moser recall a similar conversation. "He was very resentfulea" Moser remembered, "[but] otherwise not very different. Gertrude was initially very sympathetic and somewhat outraged at the way Nash was being treated. `He doesn't seem crazy; she saiddd017 Emma Duchane, who also visited Nash in Bowditch, recalled that Nash was nicer to her than he had ever been. "He was saying such reasonable thingsea"she said."` When Gian-Carlo Rota and George Mackey, a Harvard professor, came, Nash joked about the oddness of locked doors, remarked how strange it was to be held there, and told them, in the most rational tone, that he was aware that he had been having delusionsdd19 When Donald Newman came to visit him, Nash asked him half-jokingly, "What if they don't let me out until I'm NORMAL"010 To Felix Browder, Nash complained that staying in the hospital was too expensive (the daily rate that spring was thirty-eight dollars)."

Some of his visitors wondered what he was doing there. Donald Newman was the most vehement that Nash was sane. "There's no discontinuityff"he kept repeatingdd12 Garsia recalled in 1995: "1 was

-----604

totally appalled by the fact that his wife had done this. I couldn't believe my idol was under the thumb of some stupid nurse who had total power over him."

33

The medication -- initially, an injection of Thorazine immediately upon admission comcalmed Nash down, made him drowsy and slow of speech comb did nothing to dispel "the deep underlying unrealitydd014 Nash told John McCarthy, who also came out, despite his horror of hospitals and illness, "These ideas keep coming into my head and I can't prevent itdd031

He told Arthur Mattuck that he believed that there was a conspiracy among military leaders to take over the world, that he was in charge of the takeover. Mattuck recalled, "He was very hostile. When I arrived, he said, `Have you come to spring me?` He told me with a guilty smile on his face that he secretly felt that he was the left foot of God and that God was walking on the earth. He was obsessed with secret numbers. `Do you know the secret number?` he asked. He wanted to know If I was one of the

initiated."

-----605

36

For the first two or three weeks-during which time McLean had applied to a judge for an extension of the observation period for another forty days comNash was watched, studied, and analyzed." A biography was written. A young psychiatrist was assigned to construct Nash's life story, a complete catalog of his personality covering no fewer than 205 separate topics. All that led up to this disaster was included: family, childhood, education, work, past illnesses, and so forth. When it was done,

the history was presented to a case conference attended by A605 McLean's senior psychiatrists, and a more definitive diagnosis was arrived at.

From the start, there was a consensus among the psychiatrists that Nash was obviously psychotic when he came to McLeandd"The diagnosis of paranoid schizophrenia was arrived at very quickly. "If he was talking about cabalsea"said Kahne, "it would have been almost inevitable019 Reports of Nash's earlier eccentricity would have made such a conclusion even more likely. There was some discussion, of course, about the aptness of the diagnosis. Nash's age, his accomplishments, his genius would have made the doctors question whether he might not be suffering from

-----606
Lowell's disease, manic depression. "One always fudged it. One couldn't be sure," said Joseph Brenner, who became junior administrator on the admissions ward shortly after Nash's hospital izati on.

41
But the bizarre and elaborate character of Nash's beliefs, which were simultaneously grandiose and persecutory, his tense, suspicious, guarded behavior, the relative coherence of his speech, the blankness of his facial expressions, and the extreme detachment of his voice, the reserve which bordered at times on muteness comall pointed toward schizophrenia. Everyone was talking about which events the psychiatrists believed had produced Nash's breakdown. Fagi recalled that Alicia's pregnancy was thought to be the culprit: "It was the height of the Freudian period comall these things were explained by fetus enVydd041 Cohen said: "His psychoanalysts theorized that his illness was brought on by latent homosexualitydd041 These rumored opinions may well have been held by Nash's doctors. Freud's now-discredited theory linking schizophrenia to repressed

-----607
homosexuality had such currency at McLean that for many years any male with a diagnosis of schizophrenia who arrived at the hospital in an agitated state was said to be suffering from "homosexual panicdd041

Nash wasn't privy to any of this. His psychiatrist wouldn't have told him, even if Nash had pressed. But it would have been easy enough for Nash to figure comby going to McLean's library or talking with his fellow inmates comwhat his doctors were thinking.

Everyone was very upbeat. The optimism was part of that "heavily psychoanalytic" era at McLean. Lowell's doctors were telling his wife, Elizabeth Hardwick, that the most serious illnesses, psychotic illnesses, the kind that produced the chronic cases like Lowell's Bobbie, were now susceptible to "permanent cures"dd044

Alfred H. Stanton had been charged by McLean's trustees in 1954 to modernize McLeandd45 Before Stanton arrived in the early 1950's, as Kahne recalled, "The nurses were spending all their time classifying fur coats and writing thank you lettersdd"Moreover, patients spent

most of the day lying in bed as if they were suffering from 608
some physical ailment. Stanton hired a large number of nurses and
psychiatrists, expanded the medical residency program, instituted
an intensive psychotherapy program, and organized social,
educational, and work activities.

McLean's treatment philosophy boiled down to the notion that "it
was impossible to be social and crazy at the same time" 046 The
staff was dedicated to encouraging all new patients, no matter
what the diagnosis, to relate. Along with this

"milieu" therapy, as it was called, intensive, five-day-a-week
psychoanalysis was the main mode of treatment 047 Nobody thought
of Thorazine as anything but an initial aid in preparing the way
for psychotherapy. "Stanton's attitudes harked back to early days
of `moral treatment` of patients" said Kahne, "which included
having expectations of them and having staff become close to
patients. The idea was to involve patients in decision-making and
to abolish some of the hierarchy of medical institutions."

Stanton was a student of Harry Stack Sullivan, a leading American
disciple of

-----609

Freud, and had helped run Chestnut Lodge, a private hospital
outside Washington, D.C., where psychoanalysis was being used to
treat psychotic disorders. He also put an end to the use of
lobotomies and shock therapies at McLean. "Freudianism was pretty
strong at McLean" said Brenner. "It was the dawn of
psychopharmacology. We were desperately creating cures in all
good faith

dis 041

"Our knowledge of schizophrenia was negligible" Fagi remembered
sadly. "I was a dope. All he needed was a good shrink and s
upport and everything would be over soon. Everyone at MIT
pretended that Nash was going to recover in a flash. At McLean
they would cure him with advanced therapy. Norbert was the only
one who sensed the tragedy. He expressed his heartfelt sympathy.
`Its very difficult,` he said to Virginia. She was tearful,
shaken, trying to keep herself in check. She wanted to know as
much as possible. Wiener's eyes filled up with tears 049
Isadore Singer and Alicia came to visit Nash one evening. There
was no one
else in

-----610

the large, rectangular common room. Singer recalled the scene:
We were the only visitors. Robert Lowell, the poet, walked in,

manic as bell. He sees this very pregnant woman. He looks at her and starts quoting the begat sequences in the Bible. Then he started spinning quotes with the word anointed. He decided to lecture us on the meaning of anointed in all the ways it was used in the King James version of the Bible. In the end I decided that every word in the English language was a personal friend of his. Nash was very quiet and almost not moving. He wasn't even listening. He was totally withdrawn. Mrs. Nash was sitting there, pregnant as bell. I focused mostly on the wife and the coming child. I've had that picture in my mind for years. "It's all over for him" I thought."

Perhaps it was the Thorazine, perhaps the confinement, A610 perhaps the overwhelming desire to regain his liberty, but Nash's acute psychosis disappeared within a matter of weeks." On the ward, he behaved like a model patient- quietly, politely, tolerantly comand was soon granted all sorts of privileges, including the freedom to walk around McLean's grounds without supervisiondd "In his therapy sessions,

-----611

be stopped talking about going to Europe to form a world government and no longer referred to himself as the leader of the peace movement. He made no threats of any kind, except divorce. He readily agreed, if asked, that he had written a great many crazy letters, bad made a nuisance of himself to the university authorities, had otherwise behaved in bizarre ways. He denied emphatically that he was experiencing any hallucinations. The two young residents who were assigned to him -- Egbert Mueller, a highly regarded German psychoanalyst, and Jacqueline Gauthier, a more junior French-Canadian -- noted that his symptoms had all but "disappearedea"alth privately they agreed that he was likely merely concealing them."

This was so. In his heart, Nash felt that he was a political prisoner and he was determined to escape his jailers as quickly as possible. With the help of other patients, he quickly figured out the rules of the game. If a patient wished to leave, the law placed the burden of proof on the hospital. Nash's psychiatrists would have had to show convincingly that he was likely to harm himself or someone else. In practice, a patient who was hallucinating or was

-----612

obviously delusional wouldn't stand much chance of getting out. (Later, he would take the position, with respect to his younger son, that it was quite possible for a so-called schizophrenic to control both his delusions and his behavior.)

14

He hired a lawyer, Bernard E. Bradley, to petition for his releaseddd "Bradley worked in the public defender's office at the time, but Nash, who was hardly destitute, was likely his private client. At Nash's suggestion, Bradley hired A. Warren Stearns, a prominent Boston psychiatrist, to examine him and to support his petition for release. Stearns was a prominent researcher as well as a major figure in state mental health and prison polieydd16 He had, at various points in his long career, been dean of Tufts

medical school, director of prisons for the state of
Massachusetts, and associate mental health commissioner. At the
time Nash had Bradley contact him, he was founder and head of
Tufts's sociology department. His views on crime anticipated
those of James Q. Wilson: He held that most crimes were committed
by a small slice of the population, namely, young men

-----613

between the ages of eighteen and twenty-three. His book on the
subject,
The Personality of Criminals, was
considered a classic. Stearns had been involved in all sorts of

famous criminal cases, including that of Sacco and Vanzetti. A613

Stearns went to visit Nash twice, once on May 14 when he was able to see Nash for only a few minutes and a second time, a few days later, when the two men talked for some time. Nash neither spoke of any delusions nor admitted to hallucinations. "I couldn't say he's psychotic" Stearns wrote to Bradley. "He was straightforward and frank and of course is anxious to get out." Around May 20, ten days before the second, forty-day, phase of Nash's commitment was due to expire, Stearns went back a third time to study the commitment papers and the record of Nash's hospital stay.

18

He talked with Mueller and Gauthier, who in spite of their conviction that Nash was merely concealing his delusions admitted that they "doubted Nash was committable" any longer. "I still do not know what is the matter with him" Stearns, who was being paid one

-----614

hundred dollars for rendering his opinion, wrote to Bradley on May 20

.60

He added, however, I certainly recommend his discharge

.1161

Mueller and Gauthier nonetheless recommended that Nash remain in the hospital. At that point, Alicia told them she was unwilling to sign another petition for commitment although she agreed to make arrangements for her husband to be treated by a psychiatrist after his release from McLean

.62

Accordingly, on May 28, after fifty days of incarceration, just over one week after the birth of his son, Nash was once again a free man. May-June 1959

AFTER

NASH WAS COMMITTED,

Alicia couldn't face staying at the West Medford house by herself, and in any case, the lease was due to expire May 1. Alicia telephoned Emma and asked whether they might live together. "One day Alicia just called me up and said she wanted to share an apartment with me" Emma recalled. At first

-----615

Emma was reluctant because she was afraid Alicia would insist on their finding an expensive place, but then it occurred to her that they might rent a house owned by their mutual friend

Margaret Hughes. So, on May 1, Alicia and Emma moved into a tiny saltbox at 181/z Tremont Street, in Cambridge, halfway between MIT and Harvard. Alicia indulged in no tears, hysteria, or unnecessary confidences. She accepted what help she could get. She had very little faith that anyone would come to her aid. She was well aware that everyone, including close friends like Arthur Mattuck, considered Nash her responsibility. She defended herself against criticism of her decision to commit Nash, but only when pressed, as, for example, by Gertrude Moser, who, after visiting Nash at McLean, began to doubt that he was insane and demanded that Alicia justify her decision to have Nash locked up. For a

young woman whose husband was in a lunatic asylum, A615 threatening to hurt her, to divorce her, and to take their money and run off to Europe, she maintained a remarkable calm, The apparently flighty young woman who had, in the throes of lovesickness, sat in the science fiction section of the library, hoping her idol would come in, had

-----616

reserves of strength that she would need to draw on the rest of her life.

Another young woman might have thrown up her hands and gone home to her parents. But Alicia told herself that John's mind and career could be saved. She focused on the crisis at hand as best she could and put herself in the capable hands of Emma and Fagi Levinson. Her ability to focus on her own agenda, her iron self-control, sense of entitlement, deep conviction that her own future depended on this man comand perhaps also the combined energy, optimism, and ignorance of youth comall came to her aid in this very dark hour. All her attention was focused on a single task comn the task of giving birth, but that of saving John Nash. "She never talked about the baby, only about Nashea"Emma recalled. "She

regarded the pregnancy as a problem. Just a danger to Nash. She was worried that it would interfere with her ability to take care of [hirn]."

There was no waiting nursery, no layette, no dog-eared copy of Dr. Spock's new best-selling baby manual sitting on the night table. Alicia had no time or attention for such things. She wished for the pregnancy to end, but she had

-----617

not looked beyond it. She had vaguely assumed that her mother would come and help her, but hadn't bothered to make the arrangements. Nor had she asked Virginia to come again. She barely paid any attention at all, in fact. Even after the baby kept her awake nights with its vigorous kicks, she never talked about it.

Emma recalled, "The observation period [with Nash at McLean] was coming to an end. The psychiatrists were telling Alicia that the crisis was precipitated by her pregnancy. She asked her doctor to induce her labor. He wouldn't."

On May 20, when Alicia's labor began, Nash was still in McLean and she was still living with Emma at 181/2 Tremont Street. The pains began in her lower back. Eventually she crawled into bed. Emma was there. The two of them couldn't decide whether the labor

had started. Later when her sister was about to give birth, Emma would buy an obstetrics textbook and discover that back labor was in fact quite common. But at that moment, the two MIT women were in the dark about such things. Finally, when the pains became more insistent and closer together, either she or Alicia telephoned Fagi, who confirmed that, yes, indeed, it sounded like labor and said she would jump into her car

-----618

right away and drive over. She did and, after taking one look at Alicia, who was by now looking quite scared, told her to get into the car and they'd drive to the hospital immediately.

Alicia gave birth to a baby boy that night. He weighed A618 nearly nine pounds and was 21.5 inches long. She did not give the baby a name. She felt that the naming would have to wait until his father was well enough to help choose one. As it happened, the baby remained nameless for nearly a year.

Alicia had still to bear Nash's anger. The day after the birth, Nash came to the Boston Lying-In Hospital to visit his wife and new son, having gotten permission to leave McLean for the evening. Although Fagi Levinson does not remember doing so, one imagines that it was she who arranged this. Another friend came to see Alicia halfway through Nash's visit. Alicia was lying in bed, looking tiny and wan. Nash was sitting beside her. Her dinner tray was on the table next to the bed. At some point, Nash carefully took the napkin, stood up, and went over to a sign on the wall with the name of the hospital on it and covered up the "In" in the hospital's name so that it read "Boston Lying Hospital." The visitor recalled, "The

-----619

implication was that it was Alicia who was lying. She observed what he was doing. I made no comment. I certainly didn't want the situation to escalate into speechdd"I

Nash's sense of humor had in no way deserted him. On the afternoon of his release one week later, Nash went directly to the mathematics common room. He strolled in, greeted everyone, and said he'd come straight from McLean. "It was a wonderful placeea"he told the graduate students and professors who were sipping tea. "They had everything but one: freedom!"`

A day or two later, Nash was back in the department. He carefully posted hand-printed notices in the hallways announcing a "coming out partydd"The notices read: "All the people who are important in my life are invited! YOU KNOW WHO YOU ARE!" Over the following week, he went around to everyone's office and asked each member of the department if he were coming. If the person said `Yesea"he asked them

"Why"Obled

He referred to the party as a "Mad Hatter's Tea" and he asked people to dress up in costumes.` Whether the event was his idea or Alicia's isn't

-----620

clear. Fagi Levinson, Norman's wife, thought that Alicia comwho was home with a week-old baby had organized it for the purpose of thanking all of those who had visited Nash in McLeandd6 One graduate student, who said he went to New York that weekend to

avoid it, remembered that it was held at Mattuck's apartment. Mattuck doesn't remember it at all. Very likely, it took place at 181h Tremont Street. Fagi remembered it as a "big party." The Nashes held at least one dinner party too. The mystified guest was A] Vasquez, who was about to graduate on June 12, and he remembers it as a sad and depressing event.

In 1997,
he recalled:

It was one of the most bizarre evenings I've ever spent. I went there and there was Alicia, the baby, and Alicia's mother. John was behaving very oddly. Whenever John got up, Alicia's mother

would get up and place herself between him and the baby. A620
 It was a pretty strange dance. It lasted a couple of hours.
 Alicia had no idea who I was. Everybody tried to act like
 everything was normal. The weirdness of this was overwhelming.
 Nash couldn't sit

-----621

still. He'd bolt up and as soon as he did, Alicia's mother would
 jump up and fuss over this and that. But she wouldn't let him get
 anywhere near the
 babydd7

Nash was determined to leave for Europe as soon as possible. He
 wrote to Hbrmander on June I asking whether Hbrmander would be in
 Stockholm during the summer. He was thinking of traveling to
 Sweden that summer, he wrote, and was looking for "(nominal)
 mathematical associations"ffjustify the trip.` And he wrote to
 Armand and Gaby Borel, who were in Switzerland at the time, to
 ask that they help him obtain Swiss citizenshipdd9

Nash was also determined to resign his MIT professorship. Furious
 that MIT had connived in his involuntary hospitalization, Nash
 "dramatically"-z he later put it-submitted a letter of
 resignation" and simultaneously demanded that MIT release a small
 pension fund that had accumulated from the time he joined the
 full-time faculty." Levinson was aghast. With Martin and others,
 he tried to persuade Nash that what he wished to do was mad. He
 told Nash that MIT would not accept his resignation. Levinson
 acted in the

-----622

most altruistic fashion. He was well aware of the heavy expenses
 of medical treatment, and he was anxious for Nash to retain the
 insurance coverage that MIT provided its faculty members. "Norman
 tried to convince him not to do itea"Fagi said. "He felt
 responsible for him."" Martin recalled, "It was a very difficult
 period. By the time he resigned, he couldn't meet his classes and
 people felt that he had no hope of any recovery. We were on the
 spot. I couldn't even talk to him. There was no having a coherent
 conversation with him. Levinson always backed Nash to the hilt.
 There was no pressure on me either [from the administration to
 accept Nash's resignation]dd011 But Nash was intransigent. At
 Levinson's urging, the university administration tried to prevent
 Nash from withdrawing his pension money, but here too Nash
 prevailed. On June 23, James Faulkner, a physician affiliated
 with MIT, telephoned Warren Stearns on behalf of MIT's president,
 James Killian, to say that the universiby

was extremely concerned about Nash's future. 14Ac to Paul Samuelson, Stearns once again took the position that Nash was not insane and was

-----623

fully competent, in a legal sense, to make such decisions." The amount was negligible, but once the check was issued, Nash's last formal tie to MIT was cut.

Shortly after his resignation, he ran into one of his former students from the game-theory course, Henry Wan, telling him that he was now engaged in a study of linguistics. When Wan expressed surprise, Nash said that mathematicians had a unique ability to

"abstract the essence of a field. That is why we can move A623
from one area to another."

16

Nash said that he was sailing on the

Queen Mary

in early July. Alicia tried to dissuade him, but when it became
clear to her that he would go, she made up her mind to accompany
him and to leave their son behind in her mother's care.

Nash had an invitation to spend the year in Paris at the College
de France, the leading French center of mathematics. Alicia hoped
that a few months abroad, away from the pressures of Cambridge
and among new faces, would let Nash forget his dreams of world
peace, world government, and world citizenship; he might settle
down to work again.

-----624

TO Nash, however, the journey seemed to promise a more permanent
escape from his old life. He talked as if they were never to
return. They drove down to New York and said their good-byes to
Alicia's cousins. The occasion was uneventful except that Nash
had refused to eat facing the huge mirror opposite the dining
tabledd17;They left their Mercedes, its trunk full of old

266

A BEAUTIFUL MIND

issues of

The New York Times,

in the Institute parking lot in Princeton. Nash wished to
bequeath both car and newspapers to Hassler Whitney, the
mathematician whom he most admired. 18 They left their baby comn
yet named and therefore referred to as Baby Epsilon, a little
mathematical joke-behind as well, Alicia's mother had already
taken the infant home with her to Washington.", Mrs. Larde, they
had agreed, would join them in Paris with the baby as soon as
they were settled.

PART FOUR

The

-----625

Lost Years

Paris and Geneva, 1959-60

I have a difficult taskaheadofme and I have dedicated my whole
life to it.

- K, in

The Castle,

hy

FRAN-Z KAFKA

I seem as in .7 trance sublime and strange To muse on my own
separate fantasy.

-

PER-CY

ByssHE

SHELLEY,

'Mont Blanc"

SHORTLY

AFTER

Independence Day, Nash and Alicia left from New York harbor on

the A625

Queen Mary,

standing by the rail with the rest of the throng. They watched the pier, then the skyline, then the Statue of Liberty move away from them as they sailed slowly toward the open sea. They looked very much as they had a year earlier when they'd embarked on their honeymoon

-----626

voyage comhe tall, well dressed, and handsome, she slender, small, and delicate comb less animated, more subdued. They were both lost in their own thoughts.

The Nashes reached London on July 18 after a "restful" crossing.`

Two days later they were in Paris.` The beauty of Paris overwhelmed them just as it had a year earlier, "verdure everywhere ... with the giant blue Paris pigeons bolting above it, two by twodd"I For a few hours after they emerged from the Gare Still-Lazare and made their way to a modest Left Bank hotel incongruously named the Grand Hbtel de Mont Blanc, the leaden weight of the miserable months in Cambridge seemed to lift from their shoulders and they felt, briefly, as light as air again.

They set out, that afternoon, for the American Express Office to buy francs and to inquire if they had any mail. As always during the summer, the Place de LccOp6ra was crowded with American tourists. To their delight, they immediately spotted the familiar face of John Moore, a mathematician Nash knew from MIT, who would soon become co-chairman of the mathematics department at Princeton. Moore was sitting outside the Caf6 de la Paix, reading, when he

-----627

looked up and saw the Nashes. "I was surprised, but not surpriseddea"Moore recalled in 1995. "A lot of mathematicians come to Paris. We talked about Edinburgh. I noticed nothing unusualdd0bled

What their real plans were at the time, Alicia was later unable to say. She had followed Nash to Europe, not because she hoped that Paris would provide a cure for his troubles, but because she bad no way of stopping him, and, that being the case, she had not been able to bear seeing him go off to a strange land, alone, without someone to watch over him. But, in those first few days in Paris, the Nashes behaved as if this would be their new home for some time, Alicia enrolled in a French-language course at the Sorbonne and looked around for more permanent lodgings.` Her twenty-year-old cousin Odette, who was planning to spend the year

at the University of Grenoble, happened to be in Paris, too. The two young women went house hunting together until they found a pretty, clean, and spacious flat for the Nashes at 49 Avenue de la R6publique, in a nondescript but perfectly respectable blue-collar neighborhood on the Right Bankdd6 Paris, indeed all of Europe, was sizzling hot

-----628

that July. The newspapers were full of heat-wave stories, including one about a parked car that had burst into flames, a seemingly genuine case of spontaneous combustion. The rear windshield had apparently acted like a magnifying glass and some

papers left on the rear dashboard had ignited. The mood of Paris, always a magnet for alienated and disaffected Americans and full of self-declared exiles of the Silent Generation, was hot as well. The war in Algeria raged on, with its right-wing terrorist bombings, its civilian massacres, its tortures. The city reverberated with mass demonstrations, strikes, and explosions. And the latest word on the nuclear arms race comthe American announcement that it now could match Russia's ICBM's, missile for missile left open the question of whether the world wasn't in for another, more deadly case of spontaneous combustion. If the heat and high political theater influenced Nash's mood, they induced not torpor, but a heightened sense of purpose. Acting on "special" knowledge, Nash was animated by a desire to cut himself off from all vestiges of his former social self. In the rightness of this he believed with absolute certainty, resisting any and all attempts

-----629

by Alicia to persuade him to give up his "silly" notions. Having resigned his professorship, having left not only Cambridge but the United States, and having given up mathematics for politics, he wished, quite simply, to shed the layers of his old identity like so many outworn articles of clothing.

Ideas of world government, and the related concept of world citizenship, were at their heyday during Nash's Princeton graduate-school days and permeated the 1950's science fiction that Nash devoured as a student and afterward, Founded after the collapse of the League of Nations in the 1930's, the one-world movement exploded into the national consciousness within a few years of the end of World War 11. Princeton was a center of that movement, largely because of the presence of physicists and mathematicians comnotably Albert Einstein and John von Neumann comwho acted as midwives to the nuclear agedd"One of Nash's contemporaries in graduate school, John Kemeny-a brilliant young logician, the assistant to Einstein, and later the president of Dartmouth College -- was a leader of the World Federalists. However, the one-worlder who fired Nash's imagination was

-----630

a loner like himself, the Abbie Hoffman of the one-world movement. In 1948, Garry Davis, a leather-jacketed World War 11 bomber pilot, Broadway actor, and son of society band leader Meyer Davis, had walked into the American embassy in Paris, turned in his U.S. passport, and renounced his American

citizenshipdd9 He then tried to get the United Nations to declare him "the first citizen of the worlddd010 Davis, "sick and tired of war and rumors of warea"wished to start a world government.0"E paper headlined the story," the columnist Art Buchwald recalled in his Paris memoirdd"Albert Einstein, eighteen members of the British Parliament, and a slew of French intellectuals, including Jean-Paul Sartre and Albert Camus, had come out in support of Davis."

Nash intended to follow in Davis's footsteps. In the overwrought, hyperpatriotic atmosphere of the America he was leaving behind, Nash was choosing the "path of most resistanceea"and one that

captured his radical sense of alienation. Such "extreme A630 contrariness" aimed at cultural norms has long been a hallmark of a developing schizophrenic consciousness.

-----631

14

In ancestor-worshipping Japan the target may be the family, in Catholic Spain the Church. Motivated as much by antagonism to his former existence as by an urge for self-expression, Nash particularly desired to supersede the old laws that had governed his existence, and, quite literally, to substitute his own laws, and to escape, once and for all, from the jurisdiction under which he had once lived.

While the motivation may have been highly abstract, the plan itself was strangely concrete. To effect his makeover, he wished to trade his American passport for some more universal identity card, one that declared him to be a citizen of the world.

On July 29, a little over a week after his arrival in Paris, Nash went by train to Luxembourg. I I He chose Luxembourg as the site for the renunciation of his American citizenship for prudent reasons, possibly at the advice of the Paris-based World Citizen Registry, an organization founded by Davis. The smaller and more obscure the country, the less likely that turning in his American passport would result in immediate arrest and deportation. France was a

-----632

notoriously bad site for protests of this sort. When Nash arrived at the Central Station in the city of Luxembourg, he walked to the American embassy at 22 Boulevard Emmanuel Servais, demanded to see the ambassador, and announced that he no longer wished to be an American citizen.

Section 1481 of the 1941 Immigration Act contains a clause that permits American citizens to give up their citizenship.

16

It was intended, of course, to allow citizens to resolve cases of dual citizenship. By 1959, some dozens of Americans, also inspired by Garry Davis, were making use of the provision for protest pur-

posesdd"The law is quite clear. It delineates an oath, which must be taken in a foreign country, right hand raised, in the presence of an American diplomat: "I desire to make a formal renunciation of my American nationality ... and pursuant thereto I hereby absolutely and entirely renounce my nationality in the United States and all rights and privileges pertaining, and abjure all

allegiance and fidelity to the United

-----633

States of America.""

Nash's announcement was greeted as one might expect. An embassy official

- not the ambassador! -- made a number of strongly worded arguments to convince Nash that what he wished to do was unwise. Somewhat surprisingly, given the strength of Nash's conviction at that moment, the diplomat convinced Nash to take back his passport. It was a sign, perhaps, of a vacillation and indecisiveness that would become more pronounced with time.

The official's argument made sense to him. As Nash said in A633 his 1996 Madrid lecture: "I wouldn't have been able to leave Luxembourg and return to Paris because I no longer had a passport. They allowed me to retract my action as irrational and insanedd019

When the news of his first attempt to give up his American citizenship reached Virginia and Martha in Roanoke and his former colleagues at MIT, it proved to them that the confinement at McLean had done little to halt the galloping illness. Virginia, who had been deeply depressed on her return from Boston, had been drinking heavily and was headed for a breakdown herself (She would be hospitalized in

-----634

September.) 10 When Armand Borel got back to Princeton from Switzerland at the end of the summer and inquired about Nash, one of his colleagues told him simply: "There is trouble.""

The plan's having been aborted did little to suppress Nash's high spirits when he returned to Paris two days later. The mere fact of having attempted to act sufficed to make him feel that he was, as he wrote on a postcard to Virginia, mailed July 31, well "on the way to becoming a world citizendd012 His mind was full of other aspects of his intended transformation. He was visiting

the "Bibliotekea"t is, the Bibliothque Nationale, which is the French equivalent of the Library of Congress, he wrote to Virginia, and was working on learning French ("part of the planea"z he had written to Tucker nearly a year earlier)." He also confided in his mother that he wished "to take up painting." Before long, however, Nash was afire with a new plan. His objectives, somewhat obscure even to himself until now, were suddenly much clearer. As Paris emptied for the August vacation, Nash decided that he

-----635

preferred to be in Switzerland, a country he associated with neutrality, world citizenship, and Einsteindd14 Einstein, who liked to refer to himself as a world citizen, had adopted Swiss citizenship. Possibly the fact that several European nations had been conducting the longest summit on record that summer in Geneva influenced his thinking." But it appears that the Nashes did not leave Paris as soon as Nash intended. The actual departure was delayed by protests on Alicia's part over the sudden move after having just rented an apartment. Nash's desire to go to Geneva was based, he later said, on his

having heard that Geneva was "the city of refugees." 16 This was absolutely true, in both a historical and a contemporary sense. Hugging the southern shore of the crescent-shaped Lac Lemman, set against a panorama of glaciers, the snowy ridges of Mont Blanc visible on all but the foggiest days, Geneva had once been the beacon of the Protestant Reformation and the refuge of French Protestants as well as freethinking intellectuals, including Voltaire and Rousseau.¹⁷ Mary Wollstonecraft Shelley had spent the summer of 1816 in the suburb of

Cologne writing

636

Frankenstein or The Modern Prometheus."

In the twentieth century, Geneva had become the site of the ill-fated League of Nations and was a major international banking center. The European headquarters of the United Nations and other international enterprises such as the Red Cross were located there. In 1959, Geneva was an overnight train trip from Paris. When the Nashes arrived, they took a room at the H6mentel Athen6ence in the Rue Malganoudd19 Alicia, however, did not stay long. She left almost immediately for Italy where she met Odette and remained for several weeks. Alone for the first time in his life, Nash was "without parents, home, wife, child, commitment or appetite ... and the pride that might be taken in theseea010 and thus completely free to dedicate himself single-mindedly to his quest. His objectives, as suggested by his choice of venue, were shifting. He now wished not only to shed his American citizenship, but to obtain official refugee status comto be declared a refugee from "all NATO, Warsaw, Middle East and SEATO pact countries."" Presumably, these alliances were now fused in his mind with threats to world peace, but the desire for

-----637

refugee status also reflected an expanding feeling of alienation, a sense of persecution, and fear of incarceration. He saw himself as a conscientious objector in danger of being drafted and as an opponent of the kinds of military research American mathematicians were expected to do."

He spent most of his evenings in that loneliest of places, a small blank hotel room in a distant and nondescript part of the city, writing letters that would never be answered, filling out endless forms, applications, and petitions that would be filed away. His days were spent haunting various anterooms and offices. For five solitary months, Nash's ambiguous and self-annulling efforts resembled nothing so much as the anti-quest of the land surveyor in Kafka's novel

The Castle,

probably the most compelling rendering of the schizophrenic consciousness in all of literature. Known only as K, Kafka's hero's sole object in life is to penetrate

11 the shadowy heart of the Castle"wh looms high over a mazelike village K reaches but cannot get beyonddd" In Kafka's novel, K, a man

-----638

whose job it is to measure and estimate, seeks to enter a clouded

locus of authority, not because he desires "to lead an honored and comfortable life"b in order to "gain acceptance by the higher perhaps celestial powers and thereby to discover the reason of things."

14

Nash's lifelong quest for meaning, control, and recognition in the context of a continuing struggle, not just in society, but in the warring impulses of his paradoxical self, was now reduced to a caricature. just as the overconcreteness of a dream is related to the intangible themes of waking life, Nash's search for a piece of paper, a carte d'identit6, mirrored his former pursuit

of mathematical insights. Yet the gulf between the two A638
recognizably related Nashes was as great as that between Kafka,
the controlling creative genius, struggling between the demands
of his self-chosen vocation and ordinary life, and K, a
caricature of Kafka, the helpless seeker of a piece of paper that
will validate his existence, rights, and duties. Delusion is not
just fantasy but compulsion. Survival, both

-----639

of the self and the world, appears to be at stake. Where once he
had ordered his thoughts and modulated them, he was now subject
to their peremptory and insistent commands.

Like K, Nash found himself trapped in a "farce of endless paper
shuffling ... a vast soulless mechanism for the circulation of
papers ... a world cluttered with paper, the white blood of
bureaucracy ... doomed by forces beyond his control]they're
playing with me`), yet also distracted through an inner confusion
of desires.""

Nash appealed to many authorities. Yet he seemed unable to make
much progress. The American consulate, he discovered, was not
prepared to accept his passport or to allow him to take the oath
of renunciationdd16 Smiling, kindly, but seemingly obtuse
diplomats dissuaded and deflected him, offering him excuses and
rationales. Confused and weakened by their lengthy explanations,
Nash would go away again, only to return the next day.

The U.N. High Commission for Refugees, on which he pinned his
hopes, sent him away. It appeared that the commission, its
promising name notwithstanding, had rules that precluded cases
like his. One could claim refugee status only in connection with

-----640

"events occurring in Europe before 1 January 1951"and "owing to a
well-founded fear of being persecuted for reasons of race,
religion, nationality, membership of a particular social group or
political opinion, [and only if one) is outside the country of
his nationality and is unable or, owing to such fear, is
unwilling to avail himself of the protection of the country.0"The
officials of the commission suggested he contact the Swiss
police. At that time, the Swiss federal police handled all
requests for asylum, of which there were perhaps a dozen a year
that fell into the category of "unusual" in the sense that they
involved individuals from countries that typically produced no
refugees. Since Nash claimed to be a conscientious objector who
was fleeing the draft, the police referred him to the military
authorities. These authorities cautiously turned to Berne for

advice, and Berne, in turn, consulted Washingtondd" In September, the Geneva military authority sent a letter to Berne saying of Nash that

disen renonqant ii son passeporte am6ricain, et cela pour la seulc raison qu'il ne d6nessire pas kre appe]6 A faire service dans les forces arm6ences des

-----641

U.S.A., ni rnme prander aux organisations officielles de son pays sons concours en qualit6 de mathematicien, craignant que sa collaboration puisse aider les autorit6's de son pays A maintenir la guerre froide on pr6parer la guerrc0gghe is renouncing his

American passport, for the sole reason that he doesn't want to be drafted into the United States Army, nor lend to official organizations his services as a mathematician, fearing that his collaboration might aid the authorities of his nation in maintaining the Cold War or in preparing for war.¹⁹ In November, the Geneva authorities were informed that Nash was, for all practical purposes, far beyond the American draft age and that he was in no way obligated to do defense-related research. Moreover, Nash had committed none of the acts that would provoke the American government to strip him of his citizenship: "Au surplus, la simple declaration de renonciation au passeport am6ricain n'a en soi pas d'effet juridique"⁴¹ In other words, since he had not signed the oath of renunciation, he was still technically an American citizen. At that point, the police -----642

began threatening Nash with deportation. His sense of himself was now full of the starkest contradictions. On the one hand, Nash's most intimate thoughts and actions seemed to be those of another, controlling psyche com"I am the left foot of God on earth"^{dd} On the other, he felt himself to be at the epicenter of the universe, with outer reality simply a projection of his mind. At times his posture was that of an abject petitioner, at other times that of a "religious figure of great, but secret, importance"^{dd}⁴¹ He spent a great deal of time opening various bank accounts -- usually under false names, including one that he later said was "mystical" and wiring money to various countries. "I shifted money from one bank to another," Nash recalled in his Madrid lecture in 1996.

"I opened an account at a Swiss bank. It was Credit Andorra. The account was in Swiss francs. But I didn't have very much money"^{dd}⁴¹ Many years later, in a limousine going to the center of Stockholm where he would attend the Nobel ceremonies, Nash pointed out a bank in passing to Harold and Estelle Kuhn, saying that he had wired money there as part of an effort to organize a -----643

defense against "an invasion of aliens"^{dd}⁴¹ Such self-contradiction is also characteristic of schizophrenia, every symptom being matched by a "countersymptom." John Haslam comin what is widely regarded as the first psychiatric description of schizophrenic thinking comfocused, early in the nineteenth century, on this peculiar combination of omnipotence and impotence: The person is "sometimes an automaton moved by the

agency of persons ... at others, the Emperor of the whole world"the tendency toward megalomania mixed with feelings of persecution, powerlessness, inferiority. 44

He maintained both positions at the same moment, often, it seems, apparently untroubled by the apparent inconsistency coma flouting of what Aristotle considered the fundamental rule of reason: "The identity principle or law of contradiction that states the impossibility of affirming both p and not peopledd041

It was a cruel, cosmic joke. The man who produced a compelling theory of rational behavior no longer thought in terms of either/or.

It is not true, however, that Nash had lost all contact with reality. The clearest evidence that reality

A643

-----644

in fact pressed heavily and unpleasantly on him is that the frustrations of his situation were beginning to oppress him. His expectant mood turned slowly and inexorably into one of deep disappointment and depression. Nash spent long hours walking around the city, mostly in the parks and along the lake, waiting, endlessly waiting. At the end of September, he wrote to Virginia and Martha: "My life is not exciting at present.... Waiting for favorable developments. I'm somewhat disillusioned with a great many of my former associates, colleagues, friends, etcdd046 His dark mood may have reflected more than his difficult current situation. Martha had written that Virginia had had "a nervous breakdown and spent two weeks in the hospitaldd041 Nash found the news virtually unbelievable. He simply could not imagine his forceful mother ill in this fashion, but he must have sensed, from the tone of Martha's letter, that his mother's distress was linked, in some way, to his own. Finally, in September or October, in a fit of desperation, Nash destroyed or threw away his passport. Alicia later recalled that he had merely "lost" it and while that is certainly possible, later events suggest otherwisedd41 When

-----645

the consulate became aware of this action, an effort was made to persuade Nash to apply for a new onedd41 This he refused to do. In his own mind, Nash was now stateless, a man without a country; in the eyes of the authorities, he was a man without proper documents, which placed him in a vulnerable situation. Nash had, as he later wrote to Lars H6rmander, requested refugee status. This produced difficultiesdd"10 On October 11 he wrote to Virginia and Martha that he was no longer able to travel "because of certain legal formalities," a reference, presumably, to his lack of a passport." In the same letter, he enclosed a long free-style poem about feeding the gulls on the shores of Lac Lemman. He did, however, manage to visit nearby Liechtenstein, where he considered requesting citizenship, on account of the fact that Liechtenstein didn't levy income taxes on foreign residents."

During her Roman holiday, for a few short weeks, Alicia recaptured comforthe last time, it turned out-a bit of her old lighthearted, girlish self. Odette recalled in 199 5 that Alicia, once again, seemed "fun-loving." 11 These two

exceptionally

-----646

pretty, stylish young women had quite a holiday. They visited the Vatican, where they had an audience with Pope John M11. Odette fainted and had to be carried out of the chamber by two young Italian medics who afterward showed the two women around the city. They went to nightclubs, shopped, and were admired and pursued, by Americans as well as Italians, wherever they went. After Rome, they visited Florence and Venice. In Venice, the two young women had a photograph taken of themselves, Odette looking like a young

Audrey Hepburn, Alicia like a young Elizabeth Taylor, A646
standing in their high heels and bouffant hairdos in the Piazza
San Marco surrounded by pigeons.

At the end of August, Alicia returned to Paris and began making
arrangements for her mother and baby to come to France. She may
have gone to Geneva first, but if so, she stayed there only
briefly. She wrote to Nash urging him to come to Paris and
contacted the American embassy for help in getting Nash back from
Switzerland. "Alicia is in Paris expecting `e0"Nash wrote in
early November -- "eea"of course, was John Charles, whom Nash
called Baby Epsilondd14 ("Baby

-----647
Epsilon" was a tongue-in-cheek reference to a well-known
mathematical anecdote about a famous mathematician who believes
that all infants are born knowing the proof of the Riemann
Hypothesis and retain that knowledge until they are six months of
age.)

55
It was Nash's first mention of the baby in his letters to
Roanoke, yet he gave no indication that he intended to join them.
While she waited for her mother and son to arrive, Alicia visited
Odette in Grenoble. "We'd go to my room and eat pastries, baba au
rhumea"Odette recalled. "We'd gossip about the other students. We
went skiing."" Back in Washington, Baby Epsilon was finally
christened with his grandparents and Martha in attendancedd17 The
baby, dressed in a little sweater on a bright fall day when
leaves littered the ground, was named John Charles Martin Nash.
The christening took place at St. John's in Lafayette Square, the
same church where Nash and Alicia had exchanged marriage vows.
(It is not clear who settled on the name John. Nash's first son,
of course, was already called John. It was as if the Nashes and
Lardes wished to obliterate, through

-----648
replacement, the first child.)

In early December, when the frigid north wind called
le hise
swept across Lac Lemman and made walking along its shores a
misery, Nash's mood was bleaker than ever. One can almost feel
his "sense of helplessness in an ice-cold universe.", His
efforts to renounce his citizenship and to obtain refugee status
had been, for reasons baffling to him, frustrated. He spent most
of his time indoors writing letters. His feeling of having chosen
to escape from Cambridge was replaced by one of having been

exiled. He wrote to Norbert Wiener:

I feel that writing to you there I am writing to the source of a ray of light from within a pit of semi-darkness.... It is a strange place where you live, where administration is heaped upon administration, and all tremble with fear or abhorrence (in spite of pious phrases) at symptoms of actual non-local thinking. Up the river [a reference to Harvard], slightly better, but still very strange in a certain area with which we are both familiar. And yet, to see this strangeness, the viewer must be

strangedd19

649

The letter was decorated with silver foil, a newspaper photograph of a Lenin-like character, a story about Nehru's seventieth birthday containing a reference to Khrushchev, and ticket stubs from a trolley.

Even while he described himself as someone capable of inspiring fear in others on account of his "non-local thinking" Nash's reference to "administration ... heaped upon administration" suggests a growing sense of vulnerability, a freefloating anxiety, and a belief that the authorities were toying with him. Shortly afterward, for reasons unknown, Nash changed hotels, moving now to a cheaper and more remote one comthe Hotel Alba in the Rue de Mont BlanCdd61

In this claustrophobic hotel room during what would turn out to be Nash's final week in Geneva, the true dimensions of his tragedy would become clear. He was in Switzerland, free of Alicia, free of external restraint, but as thoroughly immobilized as the hero of another Kafka story, "The Metamorphosis" "who wakes up one morning to discover that he has become a cockroach lying helplessly on its backdd61 Kafka never

-----650

wrote the final chapter of

The Castle,

but confided to his friend and biographer, Max Brod, that he had envisioned a scene in which K is lying on his bed in the inn exhausted to the point of death. "K was not to relax his struggle, but was to die worn out by itdd061

Nash did not relax his struggle either, but he was defeated all the same.

James Glass, a political scientist at the University of Maryland who has studied the delusions of schizophrenia, writes, "Delusion provides a certain, often unbreakable identity, and its absolute character can maneuver the self into an unyielding position. In this respect, it is the internal mirror of political authoritarianism, the tyrant inside the self... an internal domination as deadly as any external tyranny."

63

On December 11, Nash had been held for several hours by the police comapparently in an effort to convince him that "deportation was unavoidable"- and released disunder surveillance," requiring him to report to a police station two or three times every

-----651

daydd64 According to a telegram, dated December 16, from the American consul in Geneva, Henry S. Villard, to Secretary of State Christian A. Herter, the Swiss authorities had issued a deportation order naming Nash as an "undesirable alien" on December 11.61

Throughout, the Swiss authorities evidently were acting with the "full knowledge of Dr. Edward Cox, assistant science advisor" and presumably with tacit approval at higher levels of the State Department.

The final curtain came down on December 15. Nash was arrested, for the

second time⁶⁶ He adamantly refused, as he had at the A651
time of his first arrest, to return to the United States, and
continued to demand to sign the oath of renunciation. On the
morning of the fifteenth, Cox, a kindly, avuncular retired
chemist⁷ity professor from Swarthmore College^{a61} now serving as
assistant science attach⁶ in Paris, arrived in Geneva by
overnight train. He was accompanying an exhausted and
apprehensive Alicia Nash^{dd61} Together they hoped to persuade

-----652
Nash to return directly to the United States. Neither knew what
to expect, and both, in their separate ways, feared the worst.
Secretary Herter was being apprised of the situation in daily
cables, as was the
State Department's science adviser, Wallace Brode. On the
fifteenth, a cable to Washington from Ambassador Amory Houghton
in Paris informed them: "RECEIVED WORD FROM GENEVA TO EFFECT NASH
DESPITE ALL EFFORTS TO DISSUADE HIM DETERMINED TO SIGN OATH OF
CITIZENSHIP RENUNCIATION."

69
Even in jail, Nash refused to return to the United States,
refused furthermore to cooperate in the issue of a new passport,
and continued to demand that he be permitted to take the oath of
renunciation.

At this point, Alicia agreed to take Nash back to Paris with her
where they had, after all, an apartment. The consul general
agreed to issue Alicia a new passport that included Nash. Nash
protested it all. He did not wish to go even to Paris. It was
useless. The police escorted Nash to the train station. He was
hustled onto the

-----653
train and, at 11: 15 P^{ddm.}, it pulled out of the covered station
into the open air. The police inspectors reported that "at train
time Nash [was] still reluctant [to] leave Geneva but no force
[was] required^{dd010} Nash and Alicia celebrated Christmas at 49
Avenue de la R⁶publique. It was, as Nash was to write to
Virginia, "interesting^{dd071} Alicia's mother was there and so was
the eight-month-old John Charles. There was a Christmas tree,
perhaps the first one that the Nashes had ever had, decorated in
the German manner with tiny lady apples and red wax candles. When
they lit them, it scared Alicia's mother terribly. "We kept a
bucket of water nearby" "Odette, who had come to Paris for the
holidays, recalled^{dd71} Alicia, who had occupied herself that fall
with learning to cook, served French hors d'oeuvres. There were

presents for the baby, Nash jealously noted, adding in a letter to Virginia and Martha that "he seems a little attention spoiled now.

On St. Etienne's Day, the day after Christmas, Alicia gave a party attended by several mathematicians, American as well as French. Shiing-shen Chern, a mathematician who had met

-----654

Nash at the University of Chicago and was in Paris for the semester, came. He recalled "an interesting idea" that Nash had then, namely that four cities in Europe constituted the vertices of a squaredd71 The most striking visitor at 49 Avenue de la

R6publique, however, was Alexandre Grothendieck, a A654
brilliant, charismatic, highly eccentric young algebraic geometer
who wore his head shaved, affected traditional Russian peasant
dress, and held strong pacifist
ViewSDD74

Grothendieck had just taken a chair at the new Parisian
mathematics center, the Institut des Hautes tudes Scientifiques
(modeled after Princeton's Institute for Advanced Study), and
would win a Fields Medal in 1966. In the early 1970's, he founded
a survivalist organization, dropped out of academia altogether,
and became a virtual recluse in an undisclosed location in the
Pyreneesdd71 In 1960, however, he was dynamic, voluble, and
immensely attractive. Whether he was mainly interested in the
beautiful Alicia or felt an affinity for Nash's anti-American
sentiments is not clear; in any

-----655

case, Grothendieck was a frequent visitor at the
Nashes' apartment and on a number of occasions attempted to
help

Nash obtain a visiting position at the IHES. That January, Odette
and Alicia would sit around the apartment smoking and gossiping
about Odette's boyfriends, including thirty-four-year-old John
Danskin, a mathematician at the Institute for Advanced Study who
had met the entrancing Odette at the Nashes' wedding party in New
York. He wooed Odette by letter, ultimately proposing to her by
telegram in Russian. Nash would sit in the corner of the living
room poring over a Paris telephone directory, saying little
except to occasionally object to the smoke, which he abhorred, or
to ask a question. Odette recalled:

We were having a wonderful time. We just laughed and gossiped,
tried French cooking and met the people who Alicia invited into
her apartment. We'd be chattering. We'd talk about boys. John
Nash wouldn't even notice. Alicia used to smoke. He used to
complain about it. He couldn't bear it. Occasionally he would
interrupt with a question: "Do you know

-----656

what Kennedy and Khrushchev have in common? No. Both their names
start with a Kdd"I'

Odette soon returned to Grenoble and Alicia's mother left Paris
as well, leaving her daughter and grandson behind. Alicia
struggled to care for the baby and to cope with her husband,
finding both overwhelming." She desperately wanted to return to
the United States and continued, as best she could, to obtain the

help of the American authorities.

A concerted effort was, in fact, under way, led by the State Department's Brode, who dispatched his deputy, Larkin Farinholt, to Paris. Farinholt, a chemist who would subsequently become the director of the Sloan Foundation's fellowship program, vainly tried to convince Nash to return to America voluntarily. The effort was inspired not just by the government's desire to avoid embarrassment, but by a genuine wish that Nash not be lost to the scientific community nor suffer the consequences of his own seemingly irrational behavior. Nash's legal situation was increasingly tenuous. After his deportation from Switzerland, he

had been issued a three-month temporary residency permit A656 by the French. His status in France, as he explained to Hbrmander in a letter in late January,

-----657

was "of Swiss resident or domicileedd'19 As Nash explained in his Madrid lecture, he had wanted to be declared a refugee from all NATO countries, but since he found himself in France he had -- "so as not to be inconsistent" - to settle for declaring himself "only a refugee from the USA." Once again, he applied for asylum. When it became clear that the French were not going to grant it, Nash attempted to obtain a Swedish visa. This, too, was refused. He then turned to H6rmander, who in turn consulted the Swedish foreign ministry and was told that without an American passport Nash had no hope of obtaining a visa. Hbrmander, now impatient, wrote back: "Personally I would strongly advise you to reconsider your views concerning NATO and other countries."

Citoyeatid, Monde

281

Nash then managed a rather extraordinary feat. In early March, he traveled, alone and without passport, to East Germanydd"Hard as it is to believe that an American without documents could get into the DDR in 1960, Nash confirmed in 1995 that he had indeed traveled there, explaining that

-----658

in his "time of irrational thinking"he had gone "places where you didn't need an American passportdd081 What actually must have happened, given the tremendously tight security at the border at that time, was that Nash applied to the DDR for asylum and was then permitted by the authorities to enter the country until the request was decided. In any case, he went to Leipzig and stayed with a family named Thurmer for several days. According to a card he sent Martha and Virginia, he was able-presumably as a guest of the government comto attend a famous propaganda event that happened to be taking place at the time, the Leipzig industrial world fair, which was the Iron Curtain's answer to the Brussels world fair. Later, mathematicians in America would hear from Farinholt that "Nash tried to defect to the Russians"b that the Russians had refused to have anything to do with

hiMdd14

That story, repeated by Felix Browder, is very probably based on Nash's Leipzig adventure. At least no evidence has turned up that Nash ever approached the Soviets. By that point, everyone

involved-the Americans, the French, and presumably the DDR-was aware that Nash's

-----659

actions were those of a very sick man. Apparently, however, the incident would prompt the FBI to raise questions about Alicia's security clearance in the early 1960's when she was working at RCA

.81

In any case, Nash was eventually asked to leave East Germany-or quite possibly Farinholt got him out-and returned to Paris where he wrote to Martha and Virginia that he was "thinking of

returning to Roanoke" but was worried about coming back to A659
the United States when he had no guarantee that he would be able
to leave again

.16

As in Geneva, Nash spent much of his time sitting in the
apartment writing letters. Michael Artin, the son of Princeton's
Emil Artin, found a letter from Nash, after the death of his
father, in his father's files. "It started out plausibly about
mathematicsea" Artin recalled. "But it was stamped all over, with
[Metro] tickets and tax stamps pasted on it. By the end of the
letter it was obvious that it was completely fantastic. It was
about K6chel's numbers for Mozart symphonies. K6chel had
catalogued all of Mozart's works, more than five

-----660

hundred. It was very graphic. It must have affected my father
very much because he had kept it for all those years."" A]
Vasquez, the MIT undergraduate Nash had gotten to know in his
final year in Cambridge, recalled: "His letters were filled with
numerology. I didn't keep them. They weren't just letters. They
were collages, pastiches. Full of newspaper clippings. Very
clever. I was always showing them to people. They contained some
insights. Little patterns, puns."" Cathleen Morawetz recalled
that her father, John Synge, who had taught Nash tensor calculus
at Carnegie, received postcards from Nash at this time and was
frightened by them. They reminded him, he told her, of his
brilliant brother Hutchie, who suffered from schizophrenia and
had quit Trinity College in order to settle in the bohemian
enclaves of Paris before the First
World War. Morawetz said, "The letters Were about things like
Milnor's differential structure of spheres. Nash would quote a
theorem. Then he'd derive a political meaning for itdd019
Money was a growing worry. The Nashes' lodgings were cheap by
American standards, but living, particularly food, was not. Nash
was greatly preoccupied with trying

-----661

to sell his Mercedes, still in the Institute for Advanced Study's
parking lot. The mathematician with whom he had left his car,
Hassler Whitney, had called John Danskin and asked him to deal
with xdd90 John Abbat, a Frenchman who had invented a kind of
bowling pin and was married to Odette's older sister Muyu, got
involved as well. The book value, Danskin recalled, was \$2,300,
but Nash was determined to get \$2,400 or \$2,500. "He was
absolutely unreasonableea"Danskin recalled. "I didn't sell it. It

was still there when he got backdd"F time to time, Nash asked Martha to send Eleanor money."` He also asked Warren Ambrose to visit John David, or perhaps Ambrose offered. Eleanor recalled that John David, now nearly seven, was frightened of Ambrose."` Nash's hair had by now grown long, and he had a full beard. In early April, he sent Martha a photograph of himself, taken in a Chinese restaurant, which he asked her to return to him, labeling it "Picture of Dorian Gray.""" He referred to an "autorisation de s6jour"for April 21 and said that he was planning to leave soon for Swedendd94 On April 21, Virginia

received a telegram from the State Department requesting 662
 funds to bring Nash back to the United Statesdd91 She wired the
 money. Nash was taken from the apartment on Avenue Rue de la
 116publique by the
 French police, who escorted him, under guard, all the way to
 Orlydd96 Nash would later tell Vasquez that he had been brought
 back from Europe, "on a ship and in chains, like a slaveea091 but
 Alicia recalled quite definitely that they came back on a
 planedd91 While the departure repeated the trauma of Geneva, it
 was also a mirror image of their journey to France the previous
 summer. This time it was Nash who was the unwilling one.
 Ironically, in this, too, he was walking in Davis's path, for
 Davis, too, was once forcibly placed on the
 Queen Mary and
 sent back to America confined in first-class quartersdd99
 Princeton, 1960

TE

OLIVE-GREEN MERCEDES

180 was still in the institute parking lot in Princeton. Nash had
 come straight there while

-----663

Alicia and the baby went to Washington to stay with the Lardesdd1
 He hung around Princeton. In June, having heard that his sister
 had had a baby, Nash drove down to Roanoke to visit Martha in the
 hospital. She remembered being frightened by his appearance and
 concealing from him her son's due date, June 13. "I was worried
 that he would put some meaning in itea"she recalled in 1995.1 Her
 recollection is that Nash stayed in Roanoke with Virginia for
 several weeks. Alicia, meanwhile, was looking for work and had
 enlisted, among others, John Danskin -- now married to Odette --
 to help her.

3

Danskin was now teaching at Rutgers, and the newlyweds lived on
 the outskirts of Princeton. Alicia was apparently considering
 staying in Washington, presumably so that her parents could help
 with the baby. She was also thinking of moving back to New York.
 During the summer, Alicia stayed with her old MIT friend, Joyce
 Davis, by now living in Greenwich Village and working in the
 city, and interviewed for various computer programming jobs. As
 she told Joyce in a note she left at her apartment on the day
 that she returned to Washington, she

-----664

got offers from IBM and also from Univac but was undecided over

whether to accept them, saying, "Now I've got a real problem, work in NY or Wash"Obled

Odette urged Alicia to move to Princeton. Nash was also in favor. Alicia thought that her husband would benefit from being around other mathematicians again and hoped that he would be able to find work in Princeton. The upshot was that Alicia turned down the offers to work in New York City and instead took a position with the Astro-Electronics Division of the Radio Corporation of America, which had a big research facility on Hightstown Road between Princeton and Hightstowndd6 Alicia left John Charles in her mother's care once more and rented a small apartment at 58

Spruce Street, on the corner of Walnut, about a mile from A664 Palmer Square. Nash joined her there at the end of the summer. Initially, at least, Princeton seemed to offer a respite after the anxious final months in Paris. Alicia and Nash were very much part of a crowd that had gathered around John Danskin and Odette in the charming enclave near the Delaware-Raritan Canal. Griggstown consisted at that time of

-----665

Tornquist's, a general store, and a few picturesque houses, including the former cider mill where the Danskins lived. It was especially beautiful in the summer, the air heavy with the scent of honeysuckle. Naphthall Afriat, a game theorist who worked with Morgenstern at the time, lived there, as did Jean-Pierre Cauvin, a graduate student in French at Princeton, and a couple that worked at Rutgers, Agnes and Michael Sherman.` The Danskins held frequent parties at which the Milnors, Ed Nelson and his wife, and Georg Kreisel, a logician, were also frequent visitorsdd8 The parties lasted long into the night, with Beethoven sonatas, a great deal of wine, barbecued steaks and shish kebab, nighttime swims in the canal, and bright conversation led by the convivial, cultivated, mercurial Danskin. Cauvin remembered John Nash very vividly. He had a kind of childlike air and disposition, a gentleness, this very vulnerable quality, a kind of helplessness. It blew my mind that someone who gave this appearance of being so simple could be a genius. He was subdued and rather passive. He always spoke very softly and in a monotone. I don't recall him ever initiating a conversation. He would respond

-----666

to a question or remark after a little momentary hesitation. Alicia was very attentive to him.` Alicia was learning to drive. Danskin and Milnor were both giving her lessons, with haphazard success."` They invited her along to a Thursdaynight folk dance group at Miss Fines's School on Route 206 that Danskin and Milnor belonged to. I I "She was very pretty, very quiet. I remember her pulling out a photograph of a cute little boyea"said Elvira Leaderdd"Her husband, Sol, danced with Alicia: "She was weightless," he recalled." Danskin would bring the dancers home afterward. He remembered talking with Nash about mathematics. They'd been drinking by then. Danskin was trying to prove a theorem: He immediately hit you with the hardest point. He was still very sharp. He understood what I was doing. I wanted to avoid the hard way and he caught me. Who in the hell would ask that? You would

if you were proving it yourself, but he was just listening. And understanding.

14

Danskin spearheaded an effort to find Nash a job. Danskin was doing some consulting work for Oskar Morgenstern and Morgenstern, it seemed, was willing

-----667

to hire Nash as a consultant. That fall, Nash was given a one-year consulting contract, with a ceiling of two thousand dollars. Morgenstern indicated to the university that he was making the offer under "a small charitable pressure"b that he

felt "Nash could contribute strongly to his program if he A667
was able to pull out of his present mental depression and
utilizes his faculties to their greatest extent.""

The university balked, "fearing that the appointment might be
based on human kindness, rather than on realistic, technical
needs."

16

It was decided to review Nash's performance after two months. The
contract was dated October 21, 1960.

17

Nash, however, was talking about returning to France. He
contacted Jean Leray, who was visiting at the Institute for
Advanced Study, asking Leray to invite him once more to the
College de France." This time Alicia, much alarmed, intervened.
She asked Donald Spencer, the mathematician at Princeton who
had helped Nash work out the final version of his paper on
algebraic varieties in

-----668

1950 and 1951 came to write to Leray to ask that Leray discourage
Nash from going to France again so soon. "Her advice is not to
invite John to France at the present time since she feels it will
only stir him up again.... If this job [with Oskar Morgenstern]
materializes it will have a quieting effect on her husband. She
feels that remaining in Princeton for a time might possibly bring
him back to mathematical work." By now, Nash had been in the
grip of unremitting psychotic illness for nearly two years. It
had transformed him. The change in Nash's appearance and manner
made it surprising that his old friends from the mathematics
department recognized him at all. The man who walked up and down
the main street of Princeton in the stifling summer of 1960 was
clearly disturbed. He would go into restaurants with bare feet.
With dark hair to his shoulders and a bushy black beard, he had a
fixed expression, a dead gaze. Women, especially, found him
frightening. He looked no one in the eye.

Nash spent most of his time hanging around the university,
including Fine Hall. Most days he wore a smocklike Russian
peasant garment." He seemed, as one graduate student

-----669

at the time remembered, to "talk to the squirrels." He carried
around a notebook, a scrapbook entitled ABSOLUTE ZERO in which he
pasted all sorts of things, presumably a reference to the
rock-bottom temperature at which all activity ceases." He was
fascinated by bright colors.

He was often in the common room where he "liked to spectate, to watch people playing Kriegspiel, and to make cryptic little remarks." On one occasion, when William Feller was standing nearby, for example, Nash said, to no one in particular: "What would we do with an overweight Hungarian?" On another, "What do Spain and the Sinai have in common?" It was after Israel's takeover of the Sinai.) He answered his own question, "They both start with S."

14

Everyone around Fine knew who he was, of course. The senior faculty tended to avoid him, and the Fine Hall secretaries were

slightly afraid of him, as his size and strange manner A669
gave him a somewhat threatening air. On one occasion, Nash
disquieted the formidable Agnes Henry, the departmental
secretary, by asking her for the sharpest pair of

-----670
scissors she possesseddd"Henry was taken aback and consulted A]
Tucker about what to do. Tucker, who was walking with a cane at
that time and would hardly have been Nash's match, said, "Well,
give it to him and if there's trouble I'll handle itdd"Nash
grabbed the scissors, walked over to a phone
book that was lying out, and cut out the cover, a map of the
Princeton area in primary colors. He pasted it in his notebook.
He found a few graduate students to talk to. Burton Randol, then
a first-year mathematics graduate student, recalled: "I wasn't
bothered by his strangeness and I wasn't afraid of him
physically. I was willing to have conversations with him. In some
sense we enjoyed each otherdd016 He and Nash would take long,
rambling walks around Princeton, and Randol particularly recalled
Nash's wry sense of humor, which he remembered as "intentional,
self-referential, and self-deprecating. He knew he was crazy and
he made little jokes about it."

He referred to himself, obliquely and usually in the third
person, as one Johann von Nassau, a mysterious figure whose name
was curiously similar

-----671
to John von Neumann's and suggested a connection with Nassau
Street, the main street of Princeton, as well as Nassau Hall, the
main building on the university campus. He talked, in rather
lofty terms, of world peace and world government, making it clear
he was in touch with these ideas on some very grand scale
comthough he rarely, if ever, alluded to his actual experiences
in Paris and Geneva. The job with Morgenstern fell through. As
Danskin recalled, Nash refused to fill out the necessary W-2
formseaeclaiming that he was a citizen of Liechtenstein and not
subject to taxes.

I got him a job in the economic research group by calling Oskar
Morgenstern. Oskar said fine. I got an application. It called for
his social security number and asked whether he was a citizen of
the U.S. He wouldn't cooperate, so he didn't get the
jobdd21

Whether this was why the contract was canceled in early December,
or whether by then it was obvious that Nash was far too sick to
work, is unclear.

Nash was also writing all sorts of letters to people. When he heard that Martin Shubik was applying game theory to the theory of money, he sent Shubik a

-----672

Richie Rich comic bookdd21 He sent Paul Zweifel, his friend from Carnegie, postcards in care of the French charg6 d'affaires at the French embassy in Wasbingtondd19

Nash was also making a great many telephone calls, usually, as Martha recalled, using fictitious names. Ed Nelson recalled, "I did my partea0talking to John on the telephone during those years." He used to call me a lot." And Armand Borel recalled: "I

got unending phone calls from Nash. Harish-Chandra also A672
often got calls. It was unending. It was all nonsense.
Numerology. Dates. World affairs. This was really painful. It was
very often."

Nash's bizarre behavior was attracting the attention of
university officials. Danskin recalled:

He was irritating the president of the university. He was talking
about something that was going on in the Gaza Strip. He was
playing hopscotch on campus. Goheen's secretary called me. He
wasn't threatening anyone, but he was behaving crazily. He would
go into the offices. The young women would be frightened. At my
house, he'd play with my stereo and screw it up. He frightened
people. But he was the gentlest

-----673
person imaginable."

Alicia was beside herself. She had become quite depressed.
Members of the folkdancing group remember her sad expression, her
showing them pictures of her baby, and her sadness at being
separated from her son. She began seeing a psychiatrist at the
Princeton Hospital, Phillip Ehrlich, who urged her to have her
husband hospitalized, against his will if necessary. He
recommended a nearby state hospitaldd"Odette recalled, in 1995:
"It was awful that such a strong and handsome man should be
locked up. Alicia had some guilt trips. We talked it over, back
and forth. The doctors advised her. She didn't understand. It was
very painful."

14
Alicia had initially asked John Danskin to commit Nash. Danskin
refused. She then turned to Virginia and Martha.
A day or two before the police picked Nash up, Nash showed up on
campus covered with scratches. "Johann von Nassau has been a bad
boy"he said, visibly terrified. "They're going to come and get
me now."

kenton State Hospital, 1961
-----674

Reposing in the midst of the most beautiful scenery in the valley
of the Delawdre, conihmingall the inEuences which huroanartand
skill can command to Ness, soothe, and restore the wandering
intellects thatare gathered in its hosom. comFirst annual report
of the New Jersey State Lunatic Asylum, 1848
bn as ifleft to rot in a "Tower of Silence, "with anti-Promethean
vultures gnawirgaway at my vitals. comJoHN NA-SH, 1967
AT

THE END OF JANUARY, ten months after Nash's return from Paris, a much-aged Virginia Nash and her daughter Martha boarded a train in Roanoke and traveled north all day, arriving in Princeton in the late afternoon. The last time they had made this trip together was a decade earlier, to attend Johnny's graduation, and the contrast between that trip and the present one was much on their minds. As they disembarked, tearful and weary, John Milnor, now a full professor in the Princeton mathematics department, was waiting for them. It was nearly dark and already snowing lightly. After a few awkward exchanges, Milnor showed them his car, turned over the keys, and gave them directions to West

Trenton.

675

Martha took the wheel and the two women drove in silence down Route 1, the car slipping and sliding on the thin layer of slick ice that now covered the road. They were almost thankful for the distraction. They dreaded what lay ahead. Johnny was already at the Trenton State Hospital. He had been picked up earlier in the day by the police, taken first to Princeton Hospital, a small general hospital, and then transported by ambulance to Trenton State. Now they were going down to talk to the doctors, sign the necessary forms, and, if possible, see Johnny. They would see Alicia, at whose apartment they were staying, afterward. Full of doubt and self-reproach, they felt they had little choice but to accede to another commitment. N"atever hope they had that Johnny's settling in Princeton, in familiar surroundings and among old mathematical acquaintances, would bring about some improvement in his condition had been shattered weeks before. Alicia's telephone calls had become increasingly frantic. The psychiatrist whom Alicia had been in touch with had tried, without success, to convince Johnny to go into the hospital on his own. Johnny had been dead set

-----676

against the idea. Finally, the three women had agreed among themselves that there was no other way. He would have to go. And this time it wouldn't be to a private hospital. As Martha recalled in 1995: "At first, we had thought that thirty days at McLean would straighten him out. By then we knew there were no short-term answers. We were concerned that John's illness would eat into Mother's capital and that she couldn't afford a private hospital."

In the moonlight and freshly fallen snow, the gray stone building, with its white marble dome and tall columns, set atop a gentle wooded slope, looked reassuringly solid and respectable. Institutions like the Trenton State Hospital owed their existence to the same mid-nineteenth-century reform movements that opposed slavery and advanced women's suffragedd1 Many, in fact, owed their existence to the efforts of Dorothea Dix, a fiery, single-minded Unitarian who made the appalling plight of the insane -- condemned to almshouses, prisons, and the streets -- her life's crusadeddbled When she was old, ill, and penniless, Dix lived on the ground floor of Trenton's administration building in an apartment set aside for

-----677

her by the trustees of Trenton State until her death in 1887.

Like all such institutions, Trenton hardly evolved as its founder anticipated. In particular, it was soon overwhelmed by the sheer numbers of people who sought comor whose families sought on their behalf comshelter there. During World War 11, Trenton State, long since expanded from a single large building into a large complex, had an average of four thousand patients.` The census dropped sharply after the war, but was rising rapidly in the late 1950's. By 1961, there were nearly twenty-five hundred patients, ten times as many as at a private hospital like McLean. Staffing was minimal, and consisted mostly of young foreign residents. The six hundred patients in the so-called West hospital, for example,

were cared for by six psychiatrists; the five hundred chronic patients in the annex-predominantly senile or epileptic-were cared for by just one doctor. The presence of a large number of chronic patients obscured the fact that most patients who came to Trenton stayed a relatively short time, perhaps three months.

"You really were not close to patients" said Dr.

-----678

Peter Baumecker, who worked at both the hospital's insulin unit and the rehabilitation ward during Nash's stay. The poorest and sickest patients wound up at Trenton. "I remember very few patients specifically" Baumecker said. "There was one patient who gouged out the eye of another. There was another patient who'd lost his eye when the police beat him up after he'd killed his father. But that was very exceptional"

"There were good wards and bad wards. Trenton was not as plush as other

places. As a matter of fact, Trenton was pretty crummy" recalled Baumecker in 1995. "But I remember a lot of warmth, a lot of caring. We helped an awful lot of people"

Later Nash would recall, with great bitterness, the fact that he was assigned a serial number at Trenton, as if he were an inmate of a prison. To occupy a room shared by thirty or forty others, to be forced to wear clothes that are not your own, to have no place, not even a locker, for your things, even your own soap or shaving cream, is an experience that few people can imagine. Yet this is how Nash came to be a man who craved, because of his nature and the nature of his

-----679

illness, solitude and mobility lived for the next six months, surrounded by strangers. If he had dreaded military duty, what must this have been like for him?

Nash would have been brought to Payton One, the men's admitting ward, on the ground floor of Payton, off to the right of the main administration building. Baumecker was in charge of admissions then and conducted the initial interview. "Nash was my patient," said Baumecker. "He didn't like me because my name started with a T. He had something against the letter B"

The admission interview took place in a small admitting room that had a cot, a couple of chairs, a desk, and a small window.

Baumecker asked Nash the usual questions, such as "Do you hear voices?" He tried to find out whether Nash had delusions and

whether they were elaborate. He watched his expressions to see whether the emotions he showed were appropriate to what he was saying, The hijacking of a Portuguese ocean liner, the Santa Maria, off Caracas that week and the subsequent efforts of the hijackers, who turned out to be anti-Salazar rebels, to obtain asylum in Brazil comwas, it

-----680

seemed, very much on Nash's mind; he had his own private theory about it."

The following morning, Nash's "case" was presented to the staff,

and he was interviewed in the dormitory before a group of A680 residents. That was when the preliminary diagnosis was reached, treatment was decided upon, and he was assigned a psychiatrist. One wound up in Trenton if one had no money or insurance, or was too sick for a private institution to handle. The decision to commit Nash to an overcrowded, underfunded, and understaffed state institution seems puzzling in retrospect. Alicia had at least some insurance coverage through her position at RCA, and Virginia, although by now worried that her son's treatment would eat into her capital, was surely able to pay for some private care. Martha and Virginia certainly had their misgivings: "We went down to talk to them, to beg them to put a red flag on the case and pay special attention to John. It was the only state hospital that John ever stayed indd"I I

John Danskin recalled:

I had heard he was in Trenton. I called his family and said, for God's sake, do something. I drove down to Trenton State. I wanted to find

-----681

out what the hell happened. I was shocked. It wasn't brutal but he was being treated rather roughly. The attendant kept calling him Johnny.

I told the people there: "This is the legendary John Nashdd"He was all right too. He gave me no sign at all of being out of his mind. I kept thinking, my God, these shrinks! Who's going to figure out what's wrong with a genius? I resented them."

News that Nash had been committed to a state hospital spread quickly around Princeton. One person deeply disturbed by the notion that a genius like Nash was incarcerated at a state hospital, notorious for its overcrowding and aggressive medical treatments comincluding drugs, electroshock, and insulin coma therapy-was Robert Winters." Winters, a Harvard-trained economist who happened to be the business manager of the physics department at the time, was friendly with both Also Tucker and Don Spencer. Winters contacted Joseph Tobin, the Institute for Advanced Study's psychiatric consultant and director of the Neuro-Psychiatric Institute in Hopewell, which is a few miles from Princeton, calling him in

-----682

late January to say, "It is in the national interest that everything possible be done to bring Professor Nash back to his original productive self."

Tobin suggested that Winters contact Harold Magee, Trenton's medical director at the time. Winters did so and won an assurance from Magee, as he later wrote to Tobin, that "there would be a thorough study of Dr. Nash's condition before any treatment was started at the state hospital."" In truth, this was too much to expect. As Seymour Krim, a beat writer in New York, wrote in 1959 in his essay "The Insanity Bit"ab his own experiences in mental hospitals, that work "in a flip factory is determined by mathematics; you must find the common denominator of categorization and treatment in order to handle the battalions of miscellaneous humanity that are marched past your desk with high

trumpets blowing in their minds." Very soon after that assurance was given, or perhaps even before, Nash was transferred from Payton to Dix One, the insulin unitdd"Ehrlich, the psychiatrist at Princeton Hospital who had recommended Trenton, was convinced that Nash would benefit from the

-----683
treatments available at Trentondd"Whether Alicia, Virginia, or Martha gave explicit consent for insulin coma therapy is not clear. "I don't remember whether the family had to give further permissions beyond the commitmentea"Baumecker recalled. "In those days you could do just about anything without asking anybodydd019 Martha recalled that she was consulted: "That was a drastic decision. We were extra wary of anything that might affect his mental abilities. We discussed this with doctorsdd010 The insulin unit was the most elite unit within Trenton State Hospitaldd"The unit had two separate wards -- one with twenty-two male beds, the other with twenty-two female bedsdd21 Danskin later described it as looking like "the inside of the Lincoln Tunnel.0"Xs chief had the eye and ear of the hospital's directors. It had the most doctors, the best nurses, the nicest furnishings. Only patients who were young and in good health were sent there. Patients on the insulin unit had special diets, special treatment, special recreation. "All the best of what the hospital had to offer was showered on themea"said Robert Garber, who was a staff

-----684
psychiatrist at Trenton in the early 1940's and later president of the American Psychiatric Association. He said, "The insulin patients got a hell of a lot of TLC. In the family's eyes, insulin had great appeal. Patients` relatives were overwhelmeddd014

For the next six weeks, five days a week, Nash endured the insulin treatmentsdd"V early in the morning, a nurse would wake him and give him an insulin injection. By the time Baumecker got to the ward at eight-thirty, Nash's blood sugar would already have dropped precipitously. He would have been drowsy, hardly aware of his surroundings, perhaps half-delirious and talking to himself One woman used to yell, "Jump in the lake. jump in the lake," all the time. By nine-thirty or ten, Nash would be comatose, sinking deeper and deeper into unconsciousness until, at one stage, his body would become as rigid as if it were frozen solid and his fingers would be curled. At that point, a nurse would put a rubber hose through his nose and esophagus and a

glucose solution would be administered. Sometimes, if necessary, this would be done intravenously. Then he would wake up, slowly and agonizingly, with nurses hovering over him. By eleven in the morning, Nash would

-----685

be conscious again. And by the late afternoon, when the whole group would walk over to occupational therapy, he would be among them, the nurses bringing along orange juice in case anyone felt faint.

Very often, during the comatose stage, patients whose blood-sugar levels dropped too far would have spontaneous seizures

comthrashing around, biting their tongues. Broken bones A685
were not uncommon. Sometimes patients remained in the coma. "We
lost one young manea"recalled Baumecker. "We'd all become very
alarmed. We'd call in experts and do all kinds of things,
Sometimes patients would get very hot and we'd pack them in
iCedd016

Good, firsthand accounts of the experience are difficult to find,
in part because the treatment destroys large blocs of recent
memory. Nash would later describe insulin therapy as "torture,"
and he resented it for many years afterward, sometimes giving as
a return address on a letter "Insulin Institute.0"A hint of how
unpleasant it was can be gleaned from the account of another
patient:

Breaking through the first sodden layers of consciousness ... the
smell of fresh wool ... they make me come back every day, day
after day, back from the nothingness. The sickness, the taste of
blood in my mouth, my

-----686

tongue is raw. The gag must have slipped today. The foggy pain in
my head ... this was my unbroken routine for three months ...
very little of it is clear in retrospect save the agony of
emerging from shock every day."

It's true, as Garber said, that insulin patients were coddled
compared to others

at Trenton. Insulin patients got richer and more varied food.
They got special desserts. They had ice cream every night at
bedtime. Most had ground privileges and permission to go out on
weekend visits. All the patients gained weight. That was
considered a good sign. The doctors on the ward were proud that
their patients were in good physical health. "People would put on
a lot of weight because of the insulinea"recalled Baumecker. "The
low blood sugar would make it necessary to give them a lot of
sugar and the sugar had a lot of calories. For some of these
spindly, skinny schizophrenics it wasn't such a bad thingdd019
But patients often hated it. Nash's subsequent obsession with his
diet and weight may well have stemmed from this experience of
being "force-fed."

Treating schizophrenic patients with insulin coma was the idea of
Manfred Sackel, a Viennese

-----687

physician who thought of it during the 1920's and used it on
psychotic patients, especially ones with schizophrenia, in the
mid-1930'sdd10 His notion was that if the brain were deprived of

sugar, which is what keeps it going, the cells that were functioning marginally would die. It would be like radiation treatments for cancer. Some practitioners who used it in the 1950's, when the first effective antipsychotic drugs became available, took the view that insulin shock was more effective than antipsychotics, especially with regard to delusional thinkingdd "No one understood the mechanism, but two large-scale studies in the late 1930's found that insulin-treated patients had better and more lasting outcomes than untreated individuals, but evidence for insulin's efficacy was hardly overwhelming."

It was in any case riskier and far more involved than A687
electroshock, and by

1960, insulin shock therapy had been phased out by most hospitals
as too dangerous and expensive when compared with electroshock.
The conclusion was that insulin wasn't worth the investment of
time and money or the risks.

-----688

The treatments produced at least temporary improvement in many
patients, according to Garber:

They'd see everybody hovering over them, very concerned about
them, a feeling of loving camaraderie. I always thought that was
very therapeutic. For the first time, somebody cared. Patients
became more outgoing, more active. They got to go out on weekend
visits. They got ground privileges. I think it helped. Patients
were brighter, more alert, more conversational." While Nash later
blamed the treatments for large gaps in his memory¹⁴ he also
told his cousin Richard Nash, whom he visited in San Francisco in
1967, that "I didn't get better until the money ran out and I
went to a public hospital."

As dangerous and agonizing as it was, insulin was one of the few
treatments available for serious illnesses like schizophrenia
which, until the middle of the century, often meant lifelong
incarceration. And, like other state hospitals, Trenton was a
laboratory for every "cure"t came along. Before the war, Garber
recounted:

(We] treated all patients with the tools that were available.

Colonic irrigation was still used. So was

-----689

fever therapy. We had a strain of malaria that we would inoculate
patients with. Later on we used a typhoid strain. We'd inject a
typhoid vaccine and within hours patients would experience
nausea, vomiting, diarrhea and fevers of
104 to 105.

We'd do that for eight or ten weeks, two or three days a week. We
did it to take the starch out of disturbed patients.

At Trenton the first order of the day, when I arrived at the
hospital supervisor's office at 8 A.M.

was to see who could be moved out of seclusion to make room for
another eight to fifteen patients who needed to be secluded. [The
rooms] were ten by twelve, lined with glazed tiles, with terrazzo
floors. There was a toilet and a sink and a drain in the middle
of the floor so that if a patient, say, smeared feces around the
room, we could hose it down.

You would do anything to give yourself a handle to bring the patient under control."

After six weeks, Nash, whose insulin treatments were judged to be effective, was transferred to Ward

-----690

Six, the so-called rehab or parole warddd"There was group therapy every day, some recreation, and occupational therapy. "This was the cream of the patient cropea"Baumecker recalled. "There were only about fifteen beds. Other wards had thirty patients per room. Patients got individual attention, went on trips, and were allowed to go home on visits.""

Nash actually began to work on a paper on fluid dynamics while he was on Ward Six. Baumecker recalled, "The patients made fun of him because he was always so up in the clouds. 'Professor,' one of them said on one occasion, 'let me show you how one uses a broom!'"¹⁹ Alicia visited Nash every week. Once he was allowed out on passes, she took him to her folk-dancing group and out to Swifts Colonial Diner.⁴⁰ It was the highlight of Nash's week. He seemed to be in remission, clearly no longer a threat to himself or others. Baumecker recommended him for discharge, pointing out that, contrary to the popular belief, "We had to discharge people as fast as we could to get the census down."⁴¹ He was discharged on July 15, a month after his thirty-third birthday.⁴¹ A few months after Nash got out, -----691

Baumecker called the Institute for Advanced Study and asked to speak to Oppenheimer about whether Nash was now sane, Oppenheimer replied, "That's something no one on earth can tell you, doctor."⁴¹

41 An Interlude of Enforced Rationality

July 1961 comApril 1963

"en I had been long enough hospitalized... I would finally renounce my delusional hypotheses and revert to thinking of myself as a human of more conventional circumstances. comJOHN NA-SH, Nobel autobiography, 1995

AMAN

EXPERIENCING a remission of a physical illness may feel a renewed sense of vitality and delight in resuming his old activities. But someone who has spent months and years feeling privy to cosmic, even divine, insights, and now feels such insights are no longer his to enjoy, is bound to have a very different reaction. For Nash, the recovery of his everyday rational thought processes produced a sense of diminution and loss. The growing relevance and clarity of his thinking, which his doctor, wife, and colleagues hailed as an improvement, struck him as a deterioration. In his

-----692

autobiographical essay, written after he won the Nobel, Nash writes that "rational thought imposes a limit on a person's concept of his relation to the COSMOS." He refers to remissions not as joyful returns to a healthy state but as "interludes, as it were, of enforced rationality." His regretful tone brings to mind the words of Lawrence, a young man with schizophrenia, who invented a theory of

11 psychomathematics"and told Rutgers psychologist Louis Sass:
"People kept thinking I was regaining my brilliance, but what I
was really doing was retreating to simpler and simpler levels of
thought."`

It is possible, naturally, that Nash's feeling reflected an
actual dulling of his cognitive capacities relative not just to
his exalted states, but to his abilities before the onset of his
psychosis.` The consciousness of how much his circumstances in
life, not to mention his prospects, were altered compounded his
distress. At thirtythree, he was out of work, branded as a former
mental patient, and dependent on the kindness of former

colleagues. Excerpts from a letter to Donald Spencer A692
written around the time of Nash's release from Trenton on

-----693

July 15 suggest how modest Nash's view of reality had become:

In my situation and anticipated situation a fellowship ... with
the idea being that I am expected to be doing research work and
studies, etc. seems a better prospect ... than a standard
academic teaching position. For one thing, much of the
conceivable worry over ... the implications of my having been in
a state mental hospital would be thereby by-passedddbled
With the help of Spencer, who was on the Princeton faculty, and
several members of the permanent mathematics faculty at the
Institute for Advanced Study-Armand Bore], Atle Selberg, Marston
Morse, and Deane Montgomery-a one-year research appointment at
the institute was arranged.` Oppenheimer found six thousand
dollars of National Science Foundation money to support Nashdd6
Nash's application, dated July 19, 1961, stated that he wished to
"continue the study of partial differential equations"and
mentioned "other research interests, some related to my earlier
workea"z well.`

In late July, Alicia's mother brought John Charles, a big,
handsome two-yearold,

-----694

to Princeton. Nash called the reunion "a big occasion for me
since I haven't seen our little boy all during 1961ff01 Then, at
the beginning of August, Nash attended a mathematics conference
in Colorado where he ran into a number of old acquaintances and
went on a day-long excursion with Spencer, an enthusiastic
mountaineer, to climb Pike's Peakdd9

Nash and Alicia were living together once more, but not
especially happily. The turbulence of the two previous years had
produced an accumulation of hurts and resentments, and the
resulting coldness lingered and was exacerbated by new conflicts
over money, childrearing, and other issues of daily living. None
of this was made easier by the fact that Nash's in-laws now lived
with them. Carlos Larde's health had deteriorated markedly, and
he and his wife Alicia moved to Princeton that fall. The two
couples shared a house at 137 Spruce Streetdd10 It was a great
help that Mrs. Larde cared for Johnny while Alicia went to work,
but living together created another layer of strain, especially
for Alicia.

They tried to make the best of it. Nash attempted to care for his
son, picking him up at nursery

school and the like. They socialized with the Nelsons, the Milnors, and a few others. Once or twice, they drove up to Massachusetts to visit John and Odette Danskin, who had moved there the previous fall, and to see John Stier." The visits were rather fraught and Eleanor used to call John Danskin afterward to complain about Nash. On one visit, apparently, Nash had come with a bag of doughnuts. "Eleanor kept saying, `How cheap!' "Odette recalled."

In early October, Nash attended a most historic conference in Princetondd"The conference, organized by Oskar Morgenstern, and

attended by virtually the entire game-theory community, A695
amounted to a celebration of cooperative theory. There

An Interlude of Enforced Rationality

297

was little mention of noncooperative games or bargaining. But
John Harsanyi, a Hungarian, Reinhard Selten, a German, and John
Nash, dressed in odd mismatched clothing, mostly silent, were all
there.

14

This was the first time these three men had met, and they would
not meet again until they traveled to Stockholm a

-----696

quarter of a century later to accept Nobel Prizes. Harsanyi
remembers asking one of the Princeton people why Nash said so
little during the sessions. The answer, Harsanyi recalled, in a
conversation in Jerusalem in 1995, was "He was afraid he would
say something strange and humiliate himself."

15

Nash was able to work again, something he had not been able to do
for nearly three years. He turned once more to the mathematical
analysis of the motion of fluids and certain types of nonlinear
partial differential equations that can be used as models for
such flows. He finished his paper on fluid dynamics, begun while
he was in Trenton State hospitaldd"X was titled "Le ProWme de
Cauchy Pour Les Equations Differentielles d'une Fluide
G6tion6rale"and published in 1962 in a French mathematical
journal.

17

The paper, which Nash and others have described as "quite a
respectable piece of work0"I and which the Encyclopedic
Dictionary of Mathematics
called "basic and noteworthy" eventually inspired a good deal of
subsequent work on the so-called

-----697

"Cauchy problem for the general Navier-Stokes equations." In the
paper, Nash was able to prove the existence of unique regular
solutions in local time. 19

"After Nash's hospitalization he came out and seemed OKEA" Atle
Selberg recalled. "It was good for him to be at the IAS. Not
everybody on the Princeton faculty was very friendly. It's true
that he didn't speak. He wrote everything on blackboards. He was
perfectly articulate in writing. He gave a lecture on
NavierStokes equations comwh concern hydrodynamics and partial

differential equations comsomething I don't know much about. He seemed fairly normal for a whiledd010

He was most at ease in one7on-one encounters where his sense of humor came to his aid. Gillian Richardson, who was on the staff of the institute's computer center from 1959 to 1962, recalled eating lunch with Nash in the institute dining hall and Nash's saying all sorts of dry, wry things about psychiatrists. One time he asked, "Do you know a good psychiatrist in Princeton?" - adding that his own psychiatrist ""sat on a throne way above` him, and he wondered if I knew one who didn't

share that peculiaritydd"I I

698

Nash showed up in French 105, the third-semester French course at the university, one day and asked Karl Uitti if he could audit it. He struck the French professor as "the typically dreamy and out-to-lunch mathematician."" Nash attended quite regularly and kept up with the work. He seemed less interested in picking up conversational "tourist French" than in acquiring "a sense of French structure;" Uitti recalled, adding, "He was quite pro-French. He liked the language and the people." Uitti and Nash became rather friendly and met outside class, and on a number of occasions with Alicia. At some point, Uitti asked Nash why he was learning French. Nash answered that he was writing a mathematical paper. "There was only one person in the world who would be able to understand it and that person was French. He wanted, therefore, to write the paper in French." Uitti said. Uitti could not recall Nash's intended audience; chances are it was either Leray, who was at the institute that year, or Grothendieck. After the paper was published, Nash gave it to another member of the Institute to read. The next time he saw the man, Nash asked him, "Did you detect the sexual overtones?" Uitti

-----699

commented in 1997:

That was the time that de Gaulle was in power and strong pressure was being exerted on French scientists to deliver their papers in French. Nash always struck me as very well-bred, very courteous. I'm certain that there was in his mind a sense of respect for whomever he was writing the paper for. It was sweet of him and I liked him for

xdd14

Nash asked Jean-Pierre Cauvin to edit a draft of the paperdd"Cauvin, who was doing quite a bit of translation work at the time, recalled Nash's telling him that "Paris was the center for this kind of mathematics." Nash also turned to a French undergraduate, Hubert Goldschmidt, for helpdd16

Nash had not given up the idea of returning to France. He submitted the Cauchy paper to the Bulletin de la Sociand6 Math6matique de France

on January 19. He was, Cauvin thought, more withdrawn and subdued than ever, and in retrospect it is clear that he was thinking a great deal about leaving Princeton. Very likely, he got in touch with Grothendieck at the Institut des Hautes

-----700

9mentudes Scientifiques. In April Oppenheimer wrote to Leon

Motchane, director of the IHES, to ask Motchane to formally invite Nash to spend the first half of the academic year 1963-64 there. Oppenheimer also asked Leray, who was at the institute that year, to see if he could provide a grant from the Centre de la Recherches Nationale Scientifiques for the second half of the year." At the same time, he noted that Nash would have been welcome to continue at the Institute for a second year: "If [Nash] asked to stay here for the autumn, I think that my colleagues would probably accede; but that is not his choice." Nash did not suggest that Alicia go with him to France, and this time Alicia did not try to dissuade him. Nor did she offer to go.

It was clear that, by some mutual and unspoken agreement, A700 the marriage was over and they were going to go their separate ways.

That winter, Nash spent more and more time in the Fine Hall common room, usually showing up at teatime and staying until evening. "He wore baggy, rumpled An Interlude of Enforced Rationality

299
clothes"Stefan Burr, then a graduate
-----701

student, recalled. "He didn't seem at all aggressive. In some ways his manner was not that different from a lot of mathematicians`dis019 For a while, Burr and Nash were playing endless games of Hex. The board in Fine had been drawn years before on heavy cardboard and was so worn that the lines had constantly to be redrawn with a ballpoint pen. He was beginning to seem less well again. Borel recalled, "He was not quite right. He seemed to me very diminished. His mathematics was not at the same level. I found him odd, unpredictable, nonsensical. It was very painful. The secretaries were afraid of him. He was someone to avoid. You never knew what he would do or say.""

One time the Borels had Alicia and Nash over for tea. "We served tea and cookies"saied Borel. "Nash went into the kitchen. I followed him. `What do you want?` I asked. `Well, I'd like some salt and pepper.`0"Gaby Borel added: "After he put salt and pepper in his tea, he complained that the tea tasted awful."" During the spring, his state of mind had become more angry and restless, and he was beginning again to harp on his old obsessions. He decided, rather suddenly,

-----702
to travel to the West Coast, where he saw, among others, Also Vasquez, who had graduated from MIT and was now a graduate student at Berkeley, Lloyd Shapley, and A] Tucker's former wife, Alice Beckenback, and her new husband. Vasquez recalled: I just walked into the common room [at Berkeley] and he was there. He was as surprised to see me as I was to see him. He didn't announce his visits in advance. I had no idea where he was staying. But he was around for more than just a day or two. He hadn't been looking for me. I had the impression that he'd been in Europe, the East Coast, and that he was traveling around. He talked a lot. He quite explicitly talked about [insulin] shock therapy. He described shock therapy as extremely painful. He also

said he was taken back from Europe on a ship and in chains. Slavery was a word he used a lot. He was very bitter about his experiences.

He was pretty disoriented. He wasn't able to talk about anything else but his obsessions. I was put off. It was odd. I never did understand why he talked to me. He knew me. He wasn't really trying to communicate. He wanted to talk

-----703

elusively. [Yet] it wasn't gibberish. It was even clever at times, full of puns and allusions."

Shapley, to whom Nash had written a great many letters, also

found Nash's appearance in Santa Monica distressing. "He A703
 thought of me as a close friend. One had to put up with it. He
 would send me postcards in colored inks. It was very sad. They
 were scribbled with math and numerology, as if he were not
 expecting a reply. I was much on his mind. He had decayed in a
 very spectacular way" Shapley recalled in 1994. "He was
 groping." 14 Shapley remembered Nash telling him, "I
 have this problem. I think I can straighten it out if I can
 figure out which members of the Math Society did this to me" He
 didn't stay long, Shapley said, adding:

It was a bit frightening. We had two young children. What was
 clear was that there was no way to talk to him or even follow
 what he was saying. He'd switch from topic to topic. It's very
 hard to be a good mathematician if you can't hold a thought in
 your mind."

In June, Nash left for Europe. He was due to attend a conference
 in Paris in the last week in June and the World Mathematical
 Congress in

-----704

Stockholm in early August. He went to London first, where he
 stayed at the Hotel Russell in Bloomsbury, which he described as
 "very grand."

He got himself a private postal box and was once again writing
 letters, some on toilet paper, in green ink, in French. He was
 also sending drawings, including one of a prostrate figure
 pierced with arrows. One, postmarked June 14, contained a scrap
 of paper with the following written on it in green ink: 2 plus 5
 plus 20 plus 8 plus

12 plus 15 plus 18 plus 15 plus 13 equals 78.

The conference at the College de France in Paris was a small and
 intimate affair, very much dominated by Leray, who was very
 excited at that time about nonlinear hyperbolic equations. Ed
 Nelson, who had become quite friendly with Nash over the academic
 year, recalled Leray's saying that it was a scandal that there
 were no global existence theorems. "The feeling he conveyed,"
 Nelson said, "was that we had better get to work, or the world
 might come to an end at any moment."

17 Most

-----705

of the speakers gave their talks in English. Lars Hbrinander, who
 was also there, recalled that "1962 was very different from
 earlier ViSitSdd1131

But Nash insisted on giving his lecture in what he called his

"pidgin Frenchdd019 He did not speak extemporaneously but read from his notes in his very soft voice and with his very strong American accent. H6rmander recalled: "Nash's paper was respectable mathematically. It was a surprise to all of us [that he could have produced it at all]. For us it was like seeing somebody rise from the gravedd040 His behavior, however, was decidedly odd, H6rmander later said: Malgrange, the official conference organizer, had a dinner for the participants. At the table, Nash exchanged his plate with the person next to him. Then he traded yet again until he was satisfied that his food wasn't poisoned. Everybody was very aware

of his bizarre behavior but nobody said a word. Malgrange A705
 had bought a nice big jar of caviar which was being passed
 around. Vhe_tion the jar came to Nash, he tipped the entire thing
 upside down onto his plate. Everybody was very well-behaved and
 -----706

said nothingdd41

An Interlude of Enforced Rationality

301

While Nash was still in Paris, on July 2, his father-in-law died
 suddenlydd41 Alicia attempted, through Milnor and Danskin, to
 contact Nash but was not successful. Carlos Larde was buried in
 the churchyard of St. Paul's on Nassau Street.

Nash, meanwhile, went back to London. What drew him to London is
 not clear, since his original plan had been, presumably, to spend
 the summer, except for the congress in Stockholm, as well as the
 following academic year, in Paris. In any event, Nash was still
 in London on July 24 when he wrote to Martha from the Hotel
 Stefan on Talbot Square

.41

He apparently still intended to travel on to Stockholm.
 Addressing her as E-me-line, Martha's middle name, he wrote that
 he was merely passing the time, with little to do, until the
 mathematical congress in Stockholm and was considering seeing a
 psychologist or visiting some sort of clinic. Danskin recalled
 that someone went looking for Nash

-----707

and finally found him hanging around the Chinese embassy in
 Londond44 The head of the MIT economics department took a group
 of business management people to London that summer. He suddenly
 saw John Nash and asked him, "Where are you now""Puzzled, Nash
 replied, "Where are yOU"041

The International Mathematical Congress took place in the third
 week of August in Stockholmd46 Among the plenary speakers were
 Armand Borel, John Milnor, and Louis Nirenberg. The Fields Medals
 were awarded to Milnor and Lars H6rmander, both of whom had been
 notified in May and instructed to tell no one, leaving each to
 sit on his secret while others around them speculated on the
 year's likely winners.

Nash, who felt that he should have been one of those honored, did
 not, however, go to Stockholm. He went to Geneva instead,
 returning to the Hotel Alba where he had spent his final week in
 December 1959 and writing in French to Martha "chez Charles L.
 Leggdd041 The letter made it clear that he was again thinking

about the question of his identity! He drew an identity card with Chinese characters

-----708

labeled "Des Secrets" He wrote "Could you sign this carte d'identit  ... a man all alone in a strange world" he wrote underneath. He sent Virginia another postcard with a picture of Geneva but mailed it from Paris.

When Nash returned to Princeton at the end of summer 1962, he was extremely ill. A postcard addressed to Mao Tse-tung c/o Fine Hall, Princeton, New Jersey, arrived in the mathematics department. Nash had written only a cryptic remark in French

about triple tangent planesdd48

A708

Alicia let him move back in. He spent much of the fall at home with John Charles watching science-fiction programs on television, like Rod Serling's TwiAghtZonedd49

He was writing a great many letters and making many phone calls to mathematicians in Princeton and elsewhere.

He was still obsessed with the idea of asylum. A letter to Martha and Charlie, postmarked November 19, reads: "Maybe you will say that I'm mad ... request to St. Paul's in Princeton for sanctuary." 10 Nash apparently walked past St. Paul's every day. The letter referred to the

-----709

Ecumenical Council and previous letters he had written to the pastor of St. Paul's earlier in the month. The letter ended with a reference to "past misfortunes, especially in the fall seasondd" In contrast to his letter to Martha from London, Nash no longer interpreted his difficulties as a sign of illness but rather as the results of machinations by the Ecumenical Council. By January, his letters to Martha and Charlie had become nearly incomprehensible, the thoughts skipping from Albanians to Stalin to "secrets can't reveal" and "wood and nails of the true crossdd" I I

Exhausted and dispirited by three years of turmoil and convinced that Nash's condition was more or less hopeless, Alicia consulted an attorney and instituted divorce proceedings. She had married someone who she thought could look after her but couldn't, who resented her bitterly, and who accused her of having malevolent intentions. To Martha and Virginia she wrote that being married was helping to create Nash's problems and that she felt that being freed from the marriage would be better for him as well. 12 Alicia's attorney, Frank L. Scott, a genial Princeton divorce lawyer with an office

-----710

on Nassau Street, filed for a divorce the day after Christmas 1962.11 Alicia had given the formal go-ahead in a deposition a week earlier. According to the petition, Nash was still living with her at 137 Spruce Street. Alicia, meanwhile, temporarily rented a separate apartment on Vandeventer Streetdd14

Alicia's formal complaint read:

On or about March 1959 it was necessary for the Plaintiff herein to cause the defendant to be committed to a mental institution from which the defendant was released on or about June 1959. Despite the fact that said committal was in the best interest of

the defendant, the defendant became very resentful of the Plaintiff for causing his commitment, and declared he would no longer live with the Plaintiff as man and wife. Consistent with the defendant's vow not to again live with the plaintiff as her husband, the defendant did in fact move into a separate room and refused to have marital relations with the plaintiff. In January 1961 defendant was caused to be committed to Trenton State Hospital by his mother from which he was released in June 1961. The defendant's resentment of his wife and insistence that they no longer have

marital relations continued after his release from the
aforementioned commitment, as it had prior to said commitment,
and has continued against the wishes of the plaintiff to the
present date. The time during which defendant has thus deserted
plaintiff and during which defendant was not confined to any
institution but fully able to voluntarily resume marital
relations, which he has not done, exceeds two years past and such
desertion has been wilful, continuous and obstinate. Moreover
defendant has failed to properly support plaintiff."

An Interlude of Enforced Rationality

303

Nash was served with a summons. Scott visited Nash the following
day. On

April 17, Scott once again talked to Nash, who, he said, had "no
plans for changing either his residence or his occupational

statusdd"The judgment was rendered without a trial, granting a
divorce and awarding Alicia custody of John Charles on May

1, 1963.1617inal judgment was rendered August 2, 1963.11

There is no evidence that Nash was opposed to the divorce. While
the petition was a lawyer's

-----712

document and not necessarily true in its particulars comthe
Danskins, for example, maintained that Nash and Alicia never
stopped sleeping tgrNash's animosity toward Alicia was no doubt

very real. He blamed Alicia for engineering his hospitalizations,
he had threatened to divorce her while at McLean, and probably
afterward as well, and he had made plans to live in France

without her. Nash's increasingly disturbed state, and rumors of
his impending divorce, prompted a number of mathematicians to
rally around him that spring. That Nash desperately needed

treatment was not a subject of controversy this time. Once again,
Donald Spencer and Albert Tucker approached Robert Winters."

James Miller, a friend of Winters from Harvard, was in the
psychiatry department at the University of Michigan and was

connected with a university-sponsored clinic run by Ray

Waggonerdd19 Through Miller, Winters succeeded in making a unique
arrangement whereby Nash would be treated at the clinic and also

have an opportunity to work as a statistician in the clinic's
research program.

Tucker at Princeton and Martin at MIT decided to set up a fund to
make the Michigan plan feasible

-----713

.60

Anatole Rappaport and Merrill Flood at the University of Michigan, Jargen Moser at NYU, Alexander Ostrowski of Westinghouse, and others committed themselves to raise funds among mathematicians on Nash's behalfdd61

The Ann Arbor group felt that a stay of two years was necessary. The cost for out-of-state patients was \$9,000 a year or \$18,000 for the entire stay. Virginia Nash offered to guarantee \$10,000 and the group of mathematicians arranged, through the American Mathematical Society, to set up a fund-raising drive for the remaining \$8,000. "If we are successful probably most of it will have to come from mathematicians who have known Nashea"Martin

wrote. "If anything can be done which will enable Nash to A713
return to mathematics, even on a very limited scale, it would of
course be very fine not only for him but also for mathematics
dis061

Albert E. Meder, Jr., the society's treasurer, was enthusiastic
about the proposal, saying that "it would seem to me that it
would be altogether appropriate for the AMS to receive
contributions for the purposes set forth in [Martin's] letter of
March

-----714

25.... I would be inclined to go ahead dis061

Nash's increasingly bizarre behavior was triggering complaints,
including some at the Institute for Advanced Study. Mostly these
had to do with Nash's writing mysterious messages on the
institute blackboards and making annoying telephone calls to
various members. But one day the switchboard operators, who
sat in an office immediately as one entered Fuld Hall, were all
abuzz because each person who was coming through the door was
being doused with water. The institute's dining hall was then on
the fourth floor of Fuld, and it turned out, upon investigation,
that Nash had been pouring water from the window above the main
doordd64

It was Donald Spencer, a man who could not stand to see anyone in
trouble without intervening, who was elected to try to convince
Nash to accept the Michigan offer and enter the clinic
voluntarilydd61 Spencer chose, as he usually did, a bar as his
venue. He invited Nash for some beers in Nassau Tavern, where
Nash had once celebrated passing his generals. They sat in the
booth for hours, Spencer downing warm martinis, Nash nursing a
single beer. Spencer talked and

-----715

talked; Nash appeared to be listening but said very little except
to remark, at various intervals, that he wasn't interested in
doing statistical work. It was no use. Nash didn't believe that
he was ill, and he wasn't prepared to enter another hospital.
Years later, Winters wept when he recounted the story:
I thought I had worked out a perfect solution to a most unusual
problem. I thought I could save a very worthwhile person. I'm
very emotionally tied to this. I thought I was doing something
really wonderful.

Jim Miller told
me
never

let Nash get shock treatments. It takes the edge of genius off. Somebody sent him to Carrier, where they gave him shock treatments [sic], and I think it turned him into a zombie for many years. I consider that one of the worst failures of my life. When I look at the human race all over the world I think there's zero reason for humanity to survive. We're destructive, uncaring, thoughtless, greedy, power hungry. But when I look at a few individuals, there seems every reason for

humanity to survive. He was worth doing the very best 716
fordd66

Meanwhile, Alicia, Virginia, and Martha had agreed among themselves that Nash would have to be committed involuntarily. This time they chose a private clinic near Princeton. Martha wrote to Spencer:

The only reason it has not been done before now is that my mother and I are waiting to hear from Alicia when she has arrangements made.... We really had thought we would do this in March.

We were very hopeful that we could persuade John to go to the University of Michigan and take advantage of the opportunities for research and treatment there. Unfortunately John will not agree that he needs treatment. Since we feel that something must be done for him, we have placed him in Carrier....

He was simply not going to enter ANY hospital voluntarily. Once we were convinced of this we had no choice but to commit him to a hospital in New Jerseydd67

Princeton and Carrier Clinic, 1963-65

TE

CARRIER CLINIC,

formerly a sanatorium for the senile and retarded, was

-----717

one of only two private mental hospitals in New Jersey. Located in the picturesque hamlet of Belle Meade, amidst rolling hills and lush farmland, Carrier was just five miles north of Princeton. Despite its easy proximity, however, it was generally avoided by Princetonians. As Robert Garber, a former president of the American Psychiatric Association who was Carrier's medical director at the time, recalled: "They didn't want to be in a psychiatric facility close to home. It was a disgrace, a terrible stigma, nothing like today. The idea was to get as far away as possibledd"I Princetonians regarded Carrier, which had the look of a slightly seedy boarding school, with some distaste for another reason as well. Carrier had none of the prestige of top-of-the-line institutions like McLean, Austin Riggs, or Chestnut Lodge, whose academic affiliations, psychoanalytical orientation, and long-term approaches based on the "talking cure" were regarded, especially by academics, as more humane and appropriate, especially for the well-educated. Popular views of psychiatry were being shaped by

One Flew Over the Cuckoo Nest, I Never

-----718

Promised You a Rose Garden,

and the libertarian views of Thomas Szasz, who held that insanity was a social construct rather than a symptom of disease.` At the time when these views were gaining popularity, especially on campuses, Carrier had a reputation for the aggressive use of "chemical straitjackets"and electroshock, and short-term cookie-cutter approaches tailored to the time limits set by insurance policies.

The Carrier staff, well aware of such attitudes, defended itself by arguing that its approach was more practical and worked better. "McLean, Austin Riggs, Chestnut Lodge, Shepherd Pratt, and Institute for Living, these were all much fancier," said

William Otis, a psychiatrist on Carrier's staff. "We were A718
very clinical. None of us had any fancy training. None of us were
stars. But the ironic thing is that if you were sick you were
much better off at Carrierdd"I Garber said: "At Carrier we were
proud of the fact that we set ourselves up as a short-term
treatment center. That's why we were so successful. We were able
to treat the patients and get them out, in contrast to McLean and
Chestnut Lodge, which were notorious for having schizophrenic
patients there for four, five, and seven yearsdd0bled

-----719

It was Alicia who, despite the impending divorce, felt
responsible for Nash, and therefore had to face the decision.` It
took a great deal of courage, as anyone who has had to make such
a decision knows. As one psychiatrist at Carrier said,
"Commitments always created terrible conflicts in the family. It
was very hard to find somebody who wanted to take the
responsibilitydd06 Alicia, like everyone else around Nash,
abhorred the idea of involuntary commitment and feared that
treatment, besides being uncertain of success, carried the risks
of irreparable harm, But she also knew that Nash was on a
disastrous course and was convinced that failure to act would
almost certainly lead to further deterioration. The
psychoanalysts at McLean had failed, the effects of the shock
treatments at Trenton had proved short-lived. She was prepared to
try something new. She recognized that the most prestigious
hospitals were unaffordable. At Carrier, patients' families paid
a flat fee of eighty dollars a day plus hourly fees for group and
individual therapy; Virginia was able to pay that. Besides, it
was important to Alicia that Nash be close by, so that she and
his old acquaintances at Princeton could visit him.

-----720

So in the third week of April, after it had become all too clear
that Nash was unprepared to enter treatment at Michigan, she went
ahead with arrangements to have Nash taken to Carrier. Once
again, she asked Martha and Virginia to come up to Princeton and
sign the commitment papers.
From the outset, however, Alicia drew the line at electroshockdd1
"We debated electroshock therapyea"Martha recalled. "But we
didn't want to mess with his memory,
At Carrier, electroshock was frequently used for schizophrenic
patients, who generally got three times as many treatments --
twenty-five versus eight -- as patients suffering from
depression.` Garber said, "What we were trying to do was to gain

control of that patient -- to break through his excitement, panic, depression -- in the shortest possible time." 10
Generally, psychotic patients were initially treated with Thorazine, and those whose disturbed behavior didn't improve quickly were also treated with electroshock. Some of the psychiatrists at Carrier felt that the shock treatments were effective and produced fewer side effects than neuroleptic drugs. In any case, despite the nearly universal belief around Princeton that

Nash received electroshock treatments at Carrier, he 721
apparently did not.

Nash spent most of the next five months of 1963 in Kindred One,
the only locked ward at Carrier. He said later that he made
efforts to overturn his commitment; if so, they were not
successful. Frank L. Scott recalled that Nash went AWOL from
Carrier at least once --
presumably after he got ground privileges --
and that he had to track him down and return him to the
hospital."

Compared to Trenton, however, Carrier was, if no country club, at
least more like a reform school than a prison. There were just
eighty patients, the majority of whom came from comfortable
middle-class homes, many from New York and
Philadelphia, and most of whom suffered from alcoholism, drug
addiction, and depression rather than from psychotic illnesses."
Carrier had a dozen psychiatrists on its staff, a more adequate
nursing staff than at Trenton, and a reasonable complement of
medical doctors, psychologists, and social workers.
Kindred One had single and double rooms. Nash, it seems, had a
room to himself. He had access to a

-----722
telephone. He was allowed to wear his own clothing. Patients were
addressed by their titles and last names, so he was Dr. Nash, not
Johnny as he was at Trenton. Nash's wishes regarding his
vegetarianism comwh "doesn't exclude animal products, for
example, milk, but only the animal products which become
available only at the death (execution of the animal)"-were
apparently respected." Alicia visited regularly, as did a number
of others from Princeton, among them Spencer, Tucker, and the
Borelsdd14

Probably the best thing that happened to Nash at Carrier was that
he met a psychiatrist, Howard S. Mele, who was to play an
important and positive role in his life for the next two
yearsdd"The psychiatrist, who happened to be on duty the night
that Nash was brought to Carrier, was assigned to care for him. A
short, soft-spoken, dapper man of Italian descent who got his
medical degree at Long Island College of Medicine and did his
residency at Mt. Sinai Hospital in New York City, Mele was quiet
and carefuldd"Described by his former colleagues as
disccventional,0"cautious,0"n an exciting man," Mele was, as
later events

-----723

showed, competent and caring¹⁷ He was respected by the nursing staff. Belle Parmet, the institute's social worker at the time, said of Mele and the other staff psychiatrists: "They weren't just pill pushers or prescription writers. They were all humanistic."

Nash responded quite quickly to his initial treatment with Thorazine. If someone responds at all to what are now called "typical" neuroleptics, dramatic changes are usually evident within a week, and the full effect becomes apparent within six weeks. Two weeks after his commitment, Nash wrote a relatively lucid letter to Norbert Wiener, saying, among other things, "My

problems seem to be essentially problems of communications. I don't know how they can be resolved. Perhaps I shall be able to approach their solution as a result of begging for aid. (However, this isn't a begging letter!gg011 At this point, Nash was seeing Mele for therapy sessions and also participating in group therapy, which Mele particularly favoredddd10 There was, however, no thought of releasing him quickly. As Garber said, "Paranoid schizophrenics are not that responsive. Once you do get them under control, you have to satisfy yourself that they've stabilized. You

-----724

don't want a relapse, especially if there's been a commitment because then you and the family would have to start all over." By August, Nash was beginning to look forward to getting out of Carrier. He wrote to Virginia that he was anticipating Alicia's visit on the weekend and was "thinking of getting out.0" He added that "Mele thinks it depends on having a jobdd"Nash admitted that he was ill and in need of treatment but said that "Michigan might have been a better dealdd" He asked Milnor for help in getting a job. On September 24, Nash wrote again saying that Sunday was "a sad day" because Alicia had to work overtime and couldn't come to take him out. He said that the Institute for Advanced Study had decided to offer him a position." A week later, upbeat again, he wrote that he was thinking of buying a car and that there were "good prospects for a reconciliation"with Alicia."

It is a discouraging but well-documented fact that people who suffer from schizophrenia face an extremely high risk of suicide, comparable to those who suffer from severe depressions and one hundred times that of the general populationdd14 This risk is greatest not when the person is sickest, but shortly after a course of

-----725

treatment has been declared a success. Though no one else can truly know the state of mind that leads someone to take his life, one can imagine that this is a time when the absence of delusions allows other feelings, including very painful ones, to emerge and that hopes that one has been nurturing for months collide with harsh reality.

Louisa Cauvin, who married Jean-Pierre Cauvin in the summer of 1963, has a haunting memory, which likely dates from that summer, the only time she ever talked with Nash." They met at a party. (Presumably he was home from Carrier on a pass.) Nash told Louisa

that he didn't feel life was worth living and saw no reason why he should not do away with himself. There is no evidence to show that Nash ever came close to acting on this thought. But he was certainly depressed. His hope for a reconciliation with Alicia, for example, proved overly optimistic. Alicia insisted that Nash live apart from her and Johnny (as John Charles was now called), so, instead of moving back to Spruce Street, Nash found himself in a rented room at 142 Mercer Street, a few doors down from the house occupied by Einstein during his Princeton years.

Once again, Borel and Selberg had arranged a one-year membership at the Institute for Advanced Study, although this time they did so with less hope .16;The 1963-64 membership was probably a rescue mission. Borel later said, "All members are voted by the whole school of people, I did the legwork. It was only to present the case to my colleagues."0"Oppenheimer decided this time to use the Institute's own funds, saying in a note to Selberg, "This enterprise seems to me not too suitable for contract fundsea"implying that, in contrast to the previous 1961-62 appointment, this one was more clearly a charitable exercise

.21

Meanwhile, Nash's old friends outside Princeton had not lost interest in his progress. A letter from David Gale to Deane Montgomery at the Institute, with copies to Milnor and Morgenstern, gives a flavor of the level of interest in and concern about Nash's situation:

We got onto the subject of John Nash and wondered what his present situation was, in particular with regard to his state of his mind. It turned out that none of us knew what was going on

-----727

medically nor did we know of any one else who knew. We had all heard rumors varying from "the doctors say there is no hope"to "he's doing mathematics again."

The thing that disturbed us was not our own lack of knowledge about Nash's condition but the thought that perhaps everyone in the mathematical community was in the same position we were and that consequently Nash might not be getting the best possible medical attention. It is certainly true that the mathematical community has provided fellowships and jobs of various sorts for Nash whenever he has needed them. This is as much as we should be expected to do, provided some other competent, informed and adequately endowed person or persons are looking after the medical situation. Since Nash is now at the Institute, I thought you might be in a position to know whether such a person exists and to reassure us that everything that can be done is being taken care of. If it should turn out that for lack of money, for instance, Nash was not getting the care he ought to have, I'm confident that we could get together a friends of Nash group to see what could be done about

xdd19

To come out, to go through the motions of starting over, to see one's old friends and colleagues again was not easy.

Nash stayed out of sight at the Institute. Few of that year's visitors recalled seeing him there. He complained in the fall of "feeling lonelydd010 He and Alicia still attended parties together, but she resisted any idea of their resuming their marriage. She was having difficulties at her job and found her son hard to handle. But when her mother took John Charles to El Salvador for several months that winter, she missed him terribly. Nash tried to be sympathetic, writing in March that "Alicia is seeing a psychiatrist. She is very depressed. She was cryingdd"I I

Yet he also said that he was "learning new things"and A728
 then, in December, that Selberg was trying to arrange visiting
 positions for him either at MIT or Berkeley." He continued to
 hope for a reconciliation; he and Alicia continued to socialize
 as a couple. Nash seemed, as the fall unfolded, to be in far
 better shape than he had been during his previous interlude at
 the Institute. As he said in his Madrid lecture, he "had an idea
 which is referred to as Nash Blowing UP which I discussed with an
 eminent mathematician named Hironakadd011 (Hironaka eventually
 wrote the conjecture Upddgg14 William

-----729

Browder, who was also visiting at the Institute that year,
 recalled: "Nash was working on real algebraic varieties. Nobody
 else had been thinking about these problems.""
 During the winter, Milnor, by now chairman of the department,
 comand his colleagues became greatly impressed by "some extremely
 interesting ideas [of Nash's] in algebraic geometry."" The new
 work sparked a wave of optimism and renewed a desire to help
 Nash. There was a growing feeling, both at the institute and at
 the university, that Nash might well be able to resume his
 interrupted career. Milnor decided to offer Nash a one-year post
 as research mathematician and lecturer. In April 1964, Milnor
 tentatively proposed that Nash teach one course the following
 fall and perhaps two in the spring."

Milnor consulted Nash's psychiatrist, Howard Mele, who confirmed
 on March

30 that Nash was seeing him regularly for psychotherapy, noting
 that this was the first time that Nash had agreed to seek
 outpatient treatment since the onset of his
 illneSSDD31

Garber recalled: "[Mele] tried to keep him

-----730

on medication. He also helped Nash initiate relationships with
 other people. In my experience, positive relationships plus
 medication does wonders. 'Someone likes me': thafs an experience
 that's almost impossible for a schizophrenic to havedd019
 Mele felt that Nash's recovery was permanent and that he could
 handle one or two courses without difficulty during the next
 academic year. He went on to say: "I cannot guarantee his future
 mental health (any more than I could my own or that of anyone
 else), but I do feel strongly that a recurrence is unlikely in
 his case."

40

Dean of Faculty Douglas Brown wrote to President Goheen, saying, "This is a special situation" adding that Nash "is now recovered.... He needs a chance to get back into teaching gradually and to re-establish his statusdd1141 Brown said that the mathematics department unanimously supported the proposal. "I am strongly inclined to go along. It is a part of our job, I feel, in putting one of our most brilliant Ph.Ddds back into top productivitydd"The appointment was made officially

-----731

on May
1.41

Sadly, just when things looked brightest, and despite all A731
of Nash's hard work, Mele's support, and the outpouring of
goodwill on the part of colleagues and the university, another
storm was gathering. As early as February, Nash began complaining
of sleeplessness and of his "mind [being] filled with the thought
of performing imaginary computations of a meaningless
Sortdd041

A comment, made in early March, that he had "avoided falling back
into delusions" suggests that Nash was already being besieged by
such thoughts." And by the end of that month, Nash, who said he
still hoped for a reconciliation with Alicia, mentioned that he
felt he might have to leave Princetondd45

By the time the Princeton job was offered, Nash was already
convinced that he ought to return to France, clear evidence that
he was nowhere near as well as his behavior suggesteddd41 His
letters home were sufficiently strange to alarm Martha, who
contacted Meledd47

Mele was at first reassuring; he wrote back that Nash was no
longer taking medication, but that Nash was still in therapy and
that the therapy seemed to be working

-----732

Welldd411 Nash also wrote reassuringly, apparently in reply to
questions from an anxious Virginia, that he was still seeing
Meleddbled' But around that time, Nash paid an unexpected call on
his former French professor Karl Uitti. He appeared "rather
anxiousea"Uitti recalled. "He said, 'I'm interested in getting
the addresses of Jean Cocteau and Andr  Gide. I have to write
them letters.' I gently informed him that both Gide and Cocteau
were dead and

that writing letters to them would be impossible. Nash was very,
very disappointedddd010

By May, Nash was complaining that he was having trouble working:
"I have some ideas but many of them don't seem to work out.""

Nash had apparently been in touch with Grothendieck once more.
Grothendieck evidently responded with an invitation to the IHES
for the following year. At the beginning of the summer, Nash
wrote to a colleague in Europe, saying that he wished to spend
the following year in France rather than stay in Princeton and
accept the university's offer."

Nash complained of finding himself in a "troubled situation
saying that he had difficulty when he tried to work on
mathematics, and also that his relations with various

-----733

faculty and students at the university were troubled as well. It is not clear to whom or what he was referring-the job offer from the mathematics department had been supported unanimously by Milnor and the rest of the faculty and Nash's contacts with students were presumably limited to the Fine Hall common room. He wrote that he expected something to change by June 1, but that he wasn't certain of that, adding: "Si ma situation reste essentiell6ment la meme comme c'est de maintenant0ggIf my situation remains essentially the same as it is now), drawing a circle in the middle of the page accompanied by the parenthetical remark, "(Ici-compris ma situation de famille, etc., etc.)"

(Including my family situation). He went on, "Et si je A733
peux travailler effectivement aux mathématiques par lence temps
de l'automne, je pense que je devrais accepter l'offre de
Grothendieck plut6ment que l'off-re de l'Universit6, s'il pourra
encore me donner cet offre d'emploi0ggAnd if I can work
effectively at mathematics by the fall, I think I should accept
Grothendieck's offer over the offer from the university, if he
will still extend me this offer of

-----734
employment).

As far as the institute knew, Nash was planning to spend the
entire summer at Fuld Hall, with the exception of about three
weeks, before going to France in the fall. On May 24, in response
to a note from Oppenheimer granting him funds for the summer
"with the understanding that you will remain at the Institute
during the summer;" Nash wrote that he planned to be away from
June 22 through July

19 at a conference in Woods Hole on Cape Cod, organized by John
Tate, on the theory of singularities, classifications of surfaces
and modules, Grothendieck cohomology, zeta-functions, and
arithmetic of Abelian varieties." According to Tate and other
participants, Nash never went to the conferencedd14 Instead, he
went to Europe.

He sailed on the
Queen Mary,
stopped briefly in London, and went to Parisdd"There he tried to
get in touch with Grothendieck, who evidently wasn't in towndd16
After hanging around a few more days, Nash flew to Rome. He was,
as he later said, thinking of himself as a "great but secret
religious

-----735
figure.0"Th may have

accounted for his desire to be in Rome, where, as he later said,
he visited "the Forum and the catacombs but avoided the
Vaticandd018 The Pope was, in any case, not in Rome at the time.
He was standing in front of the Forum when he began to hear
voices "like telepathic phone calls from private individualsdd019
They seemed to him, at the time, he said in Madrid in 1996, to be
the voices of "mathematicians opposed to my ideas." He wrote in a
letter later in the
1960's:

"I observed the local Romans show a considerable interest in
getting into telephone booths and talking on the telephone and

one of their favorite words was pronto. So ifs like ping-pong,
pinging back again the bell pinged to
medd060

Something odd was happening, he concluded. Harold Kuhn later
said, "The stream of words was obviously being fed into a central
machine where they were translated into English. The machine
inserted the words, now in English, into his brain.""

Nash, however, did send a postcard from Rome, dated September 1,
saying that he was returning

to Paris and that he had attempted to contact Grothendieck 736
 and other mathematiciansdd61 He said he would be staying at the
 Grand H6mentel de Mont Blanc, where he and Alicia had stayed five
 years earlier. Two days later, he was back in Paris, but had not
 yet managed to see Grothendieck, who was apparently awaydd"The
 staff at the IHES "suggested contacting Jean-Pierre Serreea"b
 Serre does not remember Nash's ever getting in touch with hmdd64
 Nash's next postcard home was a collage: a card devoid of any
 writing, with a Parisian scene and a French coin and a long
 number for a return address."

Meanwhile, Nash had not informed the mathematics department at
 Princeton that he was not intending to take their offer. Finally,
 on September 15, Tucker sent a terse note to Dean Brown,
 canceling the appointment and saying that Nash had gone to the
 University of Paris."

Nash hung around Paris a few more weeks until he finally gave up.
 In midSeptember, he wrote to Virginia from Paris that he would be
 returning on the

Queen Mary

on the twenty-fourth, adding a postscript:

-----737

"Situation looks dismal.""

Back in Princeton, Nash took to calling people again and turning
 up at the Institute to write strange messages on the blackboards
 of various seminar rooms. Atle Selberg recalled one such message
 involving several Social Security numbers. "He tried to find
 mysterious patternsea"Selberg recalled. "He claimed that he was
 born in a county named Mercer that had a town named Princeton. He
 seemed to find this a mysterious
 signdd0611

By mid-December, Nash was back in Carrier. Once again, it was
 Alicia who had to make the painful decision. A letter written to
 John Milnor shows how fast Nash's thoughts were racing and how
 one association prompted another comeven as Nash was conscious
 that Milnor would find the letter mad. Labeled "crazy letter for
 your entertainment," it was a fantastic monologue, skipping from
 slave calendars and lunar eclipses to advertising jingles and
 equations from Milnor's papers. 6`

Mele once again took over Nash's care and Nash once again
 responded

quickly and dramatically to antipsychotic drugs.

-----738

He was well enough in early April

1965 to leave Carrier for the day to attend a banquet with John Danskin at another game-theory conference in Princetondd"Z Danskin recalled, "Nash's name was being mentioned a lot at the meeting. I thought it would be nice to produce him.0"Once Nash learned that he would be going, he telephoned Harold Kuhn and asked him to bring a couple of game-theory books to Carrier, which Kuhn did, recalling that "it was a barracks-like place, not much privacy."" Nash stayed on at Carrier until midsummer, his departure delayed until Mele was confident that both a job and a psychiatrist were waiting for his patient. In April Richard Palais, a mathematician at Brandeis, drove down

to the institute to turn in a manuscript. "That day Borel A738
said why not have lunch with Jack Milnor and me. We had lunch;`
he recalleddd71 Halfway through they started talking about Nash.
Milnor and Borel thought Nash was much better now. They thought
it would be a good thing for him to gradually get back to
academic life. They believed Boston would be a good place. MIT
and Harvard would be too difficult after he had insisted on
resigning from MIT and threatened

-----739

to sue the university. The Harvard department was too small.
There was no way they were going to hire him. The Institute in
those days didn't have five-year memberships, and it was almost
unheard of to have someone more than two years

.74

Norman Levinson, who had been in contact with Mele, Milnor, and
Borel, offered to support Nash with his ONR and NSF grants. He
felt that it was too soon for Nash to have an office at MIT.

Palais recalled:

I had a feeling they were on the level in helping him get back to
the mainstream and that it would be better for him to be in
Cambridge, away from Princeton. It was very late. I'm surprised
we were able to do anything. But the [Brandeis] administration
really liked the math department and Joe [Kohn, then chairman]
would go and get what we wanted.

There was a lot of that feeling [about Nash]. People were
expecting an awful lot from this guy. In any four-
or five-year span, there are one or two young bright people who
are recognized as special. Everybody tries to get them. He was
coming into that category. He was very special

.71

-----740

When Nash got out of Carrier this time, in mid-July, he spent a
couple of nights at John Milnor's house and then took a train to
Bostondd71 He was, once again, hopeful and, in contrast to a year
earlier, accepted the likelihood that he might have to start a
new life without Alicia.

Boston, 1965-67

IT

WAS STRANGE-TO

be back in Boston alone and after an absence of half a dozen
years. The city had changed almost as much as Nash himself.
Sundays were the bleakest. Nash's "traditional Sunday[so]" as he
called them, were spent alone, sitting in one of the libraries

trying to work, or, more often, walking for hours at a time, and then stopping to watch the ice skaters and hockey players in the Public Garden.` The evenings were given over, more often than not, to writing letters, one to Alicia, one to Virginia, and one to Martha, with whom Nash had lately developed a warmer, more confidential relationship.` Mailing the letters provided an excuse for a final nighttime stroll.

Weekdays, when he commuted to Waltham in a

ratty old Nash Rambler convertible purchased on his arrival 741 in Boston, were better. He was almost enjoying being at Brandeis. The place was undeniably lively, full of former students and acquaintances from the old days in Cambridge, former MIT undergraduates like Joseph Kohn, now chairman of the math department, and Also Vasquez, now an assistant professor. He liked having an office again, going to seminars, eating lunch with other mathematicians, tossing around ideas and mathematical gossip.

But he was terribly lonely. He missed Alicia and John Charles. He felt his new, humbler status in the mathematical hierarchy most acutely. But he also could see, perhaps for the first time since the onset of his illness, that there was, after all, a future for him, and he entertained hopes of reestablishing himself as an academic and even of finding someone new to share life with.

He had left Princeton almost immediately after being released from Carrier on July

29, traveling to Boston by train and staying in a Cambridge hotel while he found an apartment and a car.` He had seen Norman Levinson, who, in his gruff, taciturn, immensely tactful way, -----742

had let Nash know that he would be paying Nash's salary with National Science Foundation and Navy grants, and that he hoped Nash would be able to pursue his own research ideas, as before. He would have no teaching responsibilities, at least in the fall, which was a reliefddbled

He started to see a thirty-three-year-old psychiatrist, Pattison Esmiol. An affable Coloradan with a medical degree from Harvard, Esmiol had just left the Navy to open a private practice in Brookline. Esmiol prescribed an antipsychotic drug, Stelazine, similar to Thorazine. Nash didn't like the drug and its side effects, worrying that they would prevent him from thinking clearly enough to resume mathematical work. But Esmiol, sympathetic to his client's concerns, kept the doses as low as possible, and Nash was grateful for the dependable human contact of his weekly appointments.

Nash was seeing Eleanor and John David, now a tall, handsome boy of twelve, every week or so.` Nash was glad for the dinners Eleanor cooked him and glad to have the company. The three of

them spent Halloween together, he wrote to Virginia.` However, the old tensions in his relationship with

-----743

Eleanor quickly surfaced again, and there were new and unanticipated tensions between himself and John David. Nash described Halloween as a "sad" occasion, for example, although it was not clear whether the sadness stemmed from friction that arose during the evening, or simply from a realization that his long separation from his son had produced a gulf that he could see no obvious way of bridging. John David was a particularly beautiful boy, musical and obviously bright. But Nash found it

difficult to hide his dismay over his son's faulty grammar A743 and indifferent performance in school comall John David had to do was to let a "you was" slip out and Nash would be all over hm7 this, of course led to flare-ups with Eleanor and a rekindling of all the old resentments. John Stier recalls his father's visits as "frustrating." He was always humming: Stier said. "He'd eat. He'd chill out. He'd leave. He never helped me with my homework or asked how I was doing. He was just very aloof." I Before he became a teenager and he and Eleanor began living in Hyde Park, John Stier lived in two dozen different places, with and without his mother. They included, between infancy and six, a series of foster homes in Massachusetts and Rhode

-----744

Island, an orphanage on the outskirts of Boston, and when finally reunited with Eleanor, the Charden Home for Women and Children, a home for the destitute (no boys over age nine allowed!). In some school years, he attended three new schools and was deemed a "behavior problem." On one occasion, he was held back. The moves were prompted by the calamities that are regular events in the lives of poor families: lost jobs, ill health, lack of childcare, fear of crime. On one occasion, Eleanor recalled, "I had a woman taking care of him. She said John had been bad to her little boy. So she hit him and gave him a black eye. I didn't work for a while. I was always on edge." I

It was, as he said, "a miserable childhood, a shitty childhood." His mother loved him, of course, but was herself desperately unhappy. Eleanor was often ill, suffering at times from severe anemia, frequently lost jobs, and when she was working often held two jobs. John David's illegitimacy was a dirty secret; Eleanor concocted a tale to explain away his fatherlessness and the child was forced to tell it at the different schools and neighborhoods, while living in constant dread of

-----745

discovery. "There was a real stigma," John Stier said. "I had to lie."

In John David's eyes, however, his father's sudden reappearance in his life was a fine thing. Being corrected for the way he spoke and being admonished to work harder in school conveyed not just criticism, but fatherly interest. Nash also promised to pay for John David's college education, explaining that "his educational background will shape the whole future course of his life." Nash sometimes took pains to please his son. On Saturdays,

he would take John Stier and a friend bowling. Afterward, they'd go to a Chinese restaurant for dinner. On John Stier's thirteenth birthday, Nash surprised him by taking him to a neighborhood bicycle shop and buying him a ten-speed racer. The next year, perhaps partly inspired by his father's interest in him, John Stier worked extremely hard in school, took a citywide examination, and got a place in one of Boston's elite "exam" schools.

In January, Nash wrote that "I have less time for Eleanor;` hinting perhaps that he felt his early dependence on her company easing and feeling some relief on this accountdd"Th would have

given Eleanor new grounds for grievance; she may well have A745
felt

-----746

that he was once again using her without much intention of giving her very much in return. But at the end of February, Eleanor and John David were "among my few social contacts." 11 There were repeated flare-ups. "Eleanor was not nice to meea"he wrote after they went to a restaurant togetherdd14 In April when Eleanor moved to a new apartment, several days went by before she was willing to give him her new telephone numberdd"In May there is another reference to Eleanor's not being nice, which again made Nash feel rather "sad."

16

If Nash's reappearance in Boston raised again the possibility of his marrying Eleanor comei in her mind or his comthere is no hint of this in Nash's letters to Martha. Nash still had not completely given up hope of a reconciliation with Alicia.

On that sad Halloween, he had been thinking a great deal of Alicia. "I was very fond of herea"he wrote to Virginiadd"His sadness on that night probably had a good deal to do with the fact that she was discouraging him from visiting her in Princeton, as he had hoped to do, on Thanksgiving. She apparently put him off with excuses, citing among other things "propriety."

11 Nash persisted and Alicia

-----747

continued to discourage him, so that a week before the holiday Nash said that he still had no invitation. Alicia was now talking of his coming down at Christmas, but it is not clear that the visit took place. In and amongst it all, perhaps because he was now aware of John David's discomfort around him, he expressed fear that his younger son, John Charles, was "forgetting his fatherdd019

It was not all that easy to renew his old acquaintanceships, though he saw a bit of Arthur Mattuck and his wife, Joan, as well as Marvin and Gloria Minskydd"P were kind but busy. He was anxious for anything to fill his evenings and went to a great many movies, plays, and concerts by himself." Alicia, who continued gently to discourage any possibility of reconciliation, was encouraging him to find some female companionship. He wrote to Martha: "Alicia doesn't leave much

317

hope.0"In January, Nash was making awkward inquiries about datingdd13 He thought of inviting the Mattucks to his house for a

meal and "making it a foursomedd" Jean Mattuck reintroduced him, apparently, to Emma Duchane, who later could recall none of thdd14 He pursued Emma for

-----748

several weeks, saying to Martha, "She's a good conversationalist, but she isn't pretty really", before discovering that Emma had a fianc6, After seeing

A Hard Dqy Night

one Sunday afternoon in early November, he was seized by a terrible sense of regret that he poured into a poignant and introspective letter to Martha, full of references to the

struggle between his "merciless superego" and "old simple
 medd"Th is the letter in which Nash referred to the "special
 friendships" in his life and his realization, in 1959, of "how
 things had beenddd" He admits that "away from contact with a few
 special sorts of individuals I am lost, lost completely in the
 wilderness. . . . was

Brandeis was lively. A

post-Sputnik

infusion of money and a commitment on the university's part to
 building a serious graduate program in mathematics had attracted
 eight or nine young comers, all in their thirties. "We had lots
 of research money. We had plenty of money to pay for research
 associates and part-time instructors. We did everything together
 ,` recalled Richard Palaisdd11 The atmosphere was friendly and
 informal,

-----749

and Nash felt welcome there. "Everybody was well aware that he
 was a first-class mathematician;` said Palais, adding:

I ate with him most lunches. It was nice to see him more or less
 back. He was pretty sane. He was being treated with antipsychotic
 drugs. He was a much nicer person after he got sick than before.
 I kind of knew him when I was an instructor at Harvard, but not
 personally. I'd ask him a question. He'd be all snotty, proud of
 himself. You'd be afraid to ask him anything. He'd put you down
 without a thought. Typically, I'd say, "I have this problemea" and
 Nash would shoot back, "Oh my God, how can you ask me this
 question? How stupid are you? How come you don't know this?"
 Afterward, he was nice, gentle, lots of fun to talk to. This old
 ego stuff was gone.

Vasquez has similar memories: "When Nash first showed up at
 Brandeis he was pretty zombielike. At the beginning, he said
 nothing. That changed over the course of the year. He got more
 and more normal. He started interacting with people. We mostly
 talked about mathematics. He never talked about his personal
 lifedd016

Nash's renewed appetite for life was most

-----750

evident in the energy with which he was able to work that year.
 During that fall at Brandeis he wrote a long paper, "Analytic-
 ity of Solutions of Implicit Function Problems with Analytic
 Data,0"t pursued to their natural conclusion his ideas about
 partial differential equations. He circulated his draft for
 comments and submitted the paper to the

Annals of Mathematics

in early January" Armand Borel, one of the editors, sent it to J. L. Moser to referee. After a few telephone consultations between Borel and Nash, Nash quickly revised the paper and got a final acceptance from the

Annals

on February 15. Nash was thrilled, writing to Martha on Washington's birthday that the

Annals

was "the most prestigious American mathematical journal"

His renewed productivity produced a rush of self-confidence. He

went to see Oscar Zariski at Harvard to discuss some new ideas -- and possibly to inquire about a visiting position. He made friends with a young German mathematician,

-----751

Egbert Brieskorn, who was visiting at MIT that year. He showed Brieskorn his just-completed paper and talked over ideas for future work. Brieskorn was doing some interesting work in singularities. "Nash had interesting ideas," Brieskorn recalled. "He was always making propositions about what one could do. But I always got the feeling that he either couldn't or wouldn't do them himself." A touch of Nash's old arrogance returned. There was some talk, apparently, of his teaching at Northeastern in the spring. "I'd rather be at a more famous place," was he confided to Martha. He thought he would apply for a position at MIT instead. He wrote Martha that he felt MIT ought to reinstate him, adding, "Of course, MIT isn't the most distinguished ... Harvard ranks much higher." Throughout the spring he would fret about being forced to take a position at a second-rate institution: "I hope to avoid stepping down in social status because it may be difficult to come up again."

As early as the beginning of February, Nash had an idea for a second paper, but two weeks later he wrote to Martha that he was "sad because part of my new math idea fell apart." He was able, however,

-----752

to take the disappointment in stride, and by early April he was already working on another paper on the "canonical resolution of singularities." Many years later he would call this effort "more interesting" than his 1966

Annals

paper. In May he gave a seminar on the subject at Brandeis, and by the end of the month he had completed a draft that he showed to Brieskorn for comments. Nash quite likely submitted this paper to the Annals

as well, but it was never published. A copy finally wound up in Fine Hall Library at Princeton in September 1968. It was regularly cited in the succeeding years and was ultimately published in the

Duke Journal of Mathematics

in 1995 in a special issue in honor of Nash.

The quality of these two papers, the first of which geometer Mikhail Gromov calls "amazing"?--constitutes the single strongest reason for questioning Nash's diagnosis of paranoid

schizophrenia." Producing papers that broke new ground was a remarkable feat for someone who had,

-----753

by 1965, been psychotic for most of six years and suffered substantial memory impairmentdd"Unlike manic depression, paranoid schizophrenia rarely allows sufferers to return, even for a limited period, to their pre-morbid level of achievement, or so it is believed." However, at least one other mathematician with chronic schizophrenia was able, during a brief remission, to produce excellent workea39 and Nash's papers, though superb, were not as ambitious as those that he had planned

to write before he became ill.

A753

At the end of June, Nash moved into Joe Kohn's apartment at 38 Parker Street in a two-family house not far from Harvard Squared40 Kohn was off for a year's sabbatical in Ecuador. The sublet was arranged by Fagi Levinson, who recalled: "Everybody wanted to help Nash. His was a mind too good to waste dis041 Nash enrolled in Operation Match, a Cambridge computer dating service. He was going on blind dates, acutely aware that "I'll need to learn how to behave properly and be polite etcdd"He

-----754

wrote that he was "hopeful and optimistic": "I think I'll develop some good friends and I'll get remarried if not to Alicia and then I'll have a happy family lifedd041 He had an appointment at MIT lined up for the fall: Ted Martin had offered to let him teach a senior seminar in game theory. In May Nash wrote to Kuhn saying that he wanted to "collect appropriate materials and learn about the more recent developments" in game theory and asking Kuhn for suggestionsdd43

Something, however, was no longer quite right. Some of his colleagues at Brandeis recalled an abrupt change sometime in the late spring. Palais recalled: "He sort of lost his balance completely. He went completely haywire."-

Vasquez remembers a more gradual unraveling: "He went right past normal and became hyper. At some point, he wouldn't stop talking and he didn't make any sense. By the summer, he wasn't able to interact any more

.1141

It's hard to say what triggered his relapse. Possibly, Nash had become overconfident and had stopped taking his medication.

-----755

He evidently spent the summer in Cambridge. By September, his letters to Martha were distinctly delusional. In one he referred to "the Indian wheel of life.... If a person is always correct and right ... there is good reason to hope."

46

Alarmed, Martha wrote to Esmiol saying that her brother sounded "optimistic but not Welldd047 She quoted him saying that "I have put my delusions aside"b she was sure that the delusions were now back in full force

.41

Esmiol wrote back in early October saying that he had seen Nash and that "he was about the same as last timedd" He urged her to express her concern directly to her brother

.41

A day later, Nash wrote to Martha reassuring her that his optimism was well-founded but admitting there disare always dangers to worry aboutdd"B in the next breath, he went on to say that he'd had an "interesting"letter from Alicia about "a large gift of moneydd010 Martha later recalled that Nash, in his delusional periods, was always hinting that "something great

-----756
was about to happendd"I I

By November, the tone of his letters had become paranoid, as in one to Virginia: "I'm very disillusioned in the past ... hoping

also that my future relations with all the relatives and especially you and Martha will be much better." At Thanksgiving he wrote: I didn't have much to be thankful for this Thanksgiving. He planned to go to Roanoke for Christmas and to spend New Year's-Alicia's birthday coming in Princeton." Vasquez, who had an apartment near Nash's, was running into Nash wandering around Harvard Square the way he later wandered around Princeton: He was concerned with the politics of Mao Tse-tung, that sort of thing. In Harvard Square, he was talking about a committee that was communicating with foreign governments who manipulated the news in

The New York Times

in order to send messages to him. He had this idea that with this information he could find out how negotiations between various powers were going.

Nash was still attending the Harvard math colloquium on Thursdays. "He was very peculiar," Vasquez recalled. "He believed that there were

-----757
magic numbers, dangerous numbers. He was saving the world." Soon Kohn was getting letters from his neighbors, the landlords of the house, complaining that Nash wasn't taking out the garbage and that his apartment was full of piles of newspapers." Fagi recalled feeling horribly embarrassed and responsible. "Joe wanted to give up the apartment. He tried to reach Norman. He couldn't, so he called me. So I called Nash every hour on the hour. I was worried. I got this crazy idea to call up this minister he had been seeing. The minister told me Nash was out of town." 56

just after the New Year, Nash left Boston for the West Coast. He traveled first to San Francisco where he spent several days visiting his cousin Richard Nash. He called his cousin first, who, in turn, called Martha. "He blamed Martha for hospitalizing him," recalled Richard Nash. "It was very hard for her to take." He came to my office. He was good-looking, very muscular. He was softspoken but his voice was much stronger than now. He was a lot of fun to talk to. He liked to talk a lot late into the night. Sometimes he spoke rationally, almost poetically. He

-----758
was very concerned about not being able to contribute. "I started out so well," he said. "I think of myself as a valuable person. But I'm not contributing." Other times he made no sense. He had these things he was concerned about. He went to see a Catholic

priest in San Francisco. I said, "I thought you were an atheist."

17

Richard Nash, a broker, would drive to work in San Francisco and take Nash with him. Once there, "He'd get on the bus and go all around." Dick Nash expressed astonishment that Nash mastered complex schedules, went all over, but always managed to meet Dick at the appointed place for the return trip at exactly the right time.

After that, Dick Nash recalled, "John called me at odd hours. He had no

awareness of time. I told him to stop calling me after bedtime.

Then I'd get calls with just breathing. I was rude. I wish A758
I'd been nicer."

After leaving San Francisco, Nash went next to Seattle, arriving there on February 3.11 He almost certainly went there to visit Amasa Forrester, the only person he knew in Seattle. He seems to have spent nearly a month with Forrester, because

-----759

he did not arrive in Santa Monica, his next destination, until Easter, which fell in mid-March that yeardd19 There, apparently, Shapley and other acquaintances from RAND refused to see him. Nash visited Jacob Bricker in Los Angeles as well. Bricker recalled that Nash "was acting really

wilddd060

Nash apparently called Esmiol from time to time, although he disregarded Esmiol's pleas that he return to Boston and resume his treatment. Martha also called Esmiol a number of times that month. Esmiol's idea was to use the promise of a job at MIT as a lever to get Nash back into treatmentdd61

Martin was talking about letting Nash teach a section of linear algebra the following

falldd61

Levinson, still hopeful, was planning on Nash's being at MIT. He solicited a letter of recommendation from Armand Borel at the Institute. Borel's letter, dated May 17, was a strong endorsement:

In the last eight years or so, he has been very much hampered by his health problems. Even then, he has

-----760

managed to produce some interesting work.... Nash is clearly one of the most individualistic among the presently active mathematicians. He does not work systematically at long range programs, whose progress along more or less foreseen lines can be rather confidently expected but is more the pioneer type who proceeds along new paths. He is thus rather unpredictable; but in a way it makes it appear more likely that he might score new successes in spite of his ups and downs in health. Any contribution in mathematics on the level of his past work would be extremely valuable, and so I feel strongly that he should be supported .61

It's not clear exactly when Nash returned to Cambridge. But when he did, he was extremely ill. After a terrible scene, John David locked him out on the porch on a freezing nightdd64 Nash told Palais at some point that he'd stopped taking medication. "Why,

when they were making you well, did you stop taking drugs""He answered, "If I take drugs I stop hearing the voices
dis061

A letter from Nash to Moser captures something of
-----761

Nash's state of mind when he returned to Cambridge in late May.
Nash gives his return address as Heilwigklang University, Harbin,
Manchuria.

The Oblast in Russia, on the Manchurian border ... there's the
city of Birbidzhan.... If all the atomic powers of the security
council of the United Nations did an action, and they were

numbered 0, 1,2,3,4 then one would be able to say nobody A761
did it, everybody did it, all did it ...

The letter was signed "Chiang Hsin (New River)dd066

Fagi ran into John on the subway, His manner was slippery, shady,
shy, almost ashamed, a peculiar smile pulling at the corners of
his mouth. She asked where he was going. He answered: "Home to
Roanoke to stay with my mother for a
whiledd067

Nash left Cambridge on June 26, leaving his apartment in a
shambles. He drove to Princeton, stayed in a hotel "for
propriety"r than with Alicia and John Charles, and proceeded to
Roanoke a few days
laterdd61

-----762

Fagi called Joe Kohn and said she'd get a moving van and send
Nash his furniture. "I felt so guilty that I said to myself, I'll
get his stuff moved out. I did, too, everything except the
bathroom scale. I never even went into the bathroomdd069 Anna
Rosa, Kohn's wife, went into the Parker Street apartment: "There
were folded bags, one upon another, and cereal boxes. Not awful,
but signs of compulsiondd010 A few days later, Norman Levinson
wrote to Martha: For the past two years John has been employed as
a research associate on my contract. John doesn't want to live
here and I couldn't convince him to stay. A few days ago John
left 38 Parker Street. There were piles of rubbish. Hints of bank
accounts. Also other accounts here and abroad. John was very
disturbed this past year. But in 1965-1966 he functioned very
well and did fine work."

in a Strange World

Roanoke, 1967-70

And then a Plank in Reason, broke, And I dropped down, and down
An d h it a World, a t e very plunge..

- Emm

-----763

Y DicKmsoation,

Number 280

TE

SUMMER NASH TURNED

forty, in 1968, he looked into the mirror in the bathroom of his
mother's apartment and saw what he later called "a cadaver,
almost." Hollow-cheeked, sunken-eyed, gray-haired, with his
shoulders hunched forward, he looked more like an old man than
one just entering middle age. He wrote to a friend: "You should

pity me ... aging and drying processes have taken their toll." I
Images of death-in-life crowded his mind: in a letter to another
friend he invoked the images of the Parsee "Towers of Silence" in
Bombay, where followers of Zoroaster leave their dead to be
devoured by vultures.`

He had been living in Roanoke for nearly a year. He still had his
Rambler and some savings, but eight years of illness had
exhausted his former wife and friends and ruined much of his
credit with the world. He had nowhere else to go. For him,
Roanoke was a pretty little city at the foot of the Appalachians
and the headquarters of the Norfolk and Western Railroad was

the end of the line.

A763

He lived with Virginia in a small garden apartment

-----764

on Grandin Roadddbled Martha and Charlie lived a few streets away. No one knew him there. The existence of someone with schizophrenia has been compared to that of the person living in a glass prison pounding on the walls, unable to be heard, yet very visible.` Martha recalled in

1994: "Roanoke was not a good place to be. There were no intellectuals there. He'd be too much alone. He would wander around town whistlingdd06

On many days, he simply paced round and round the apartment, his long fingers curled around one of Virginia's delicate Japanese teacups (a souvenir of her long-ago summer in Berkeley), sipping Formosa oolong, whistling Bach.

7

The sleepwalker's gait and fixed, faraway expression gave few hints of the vast and unending dramas unfolding in his mind.

"Apparently I am simply passing time visiting my motherea"he wrote, "but actually I've been under persecutions which I'm hoping will ease."

His daily rounds extended no farther than the library or the shops at the end of Grandin Road, but in his own mind, he traveled to the remotest

-----765

reaches of the globe: Cairo, Zebak, Kabul, Bangui, Thebes, Guyana, Mongolia. In these faraway places, he lived in refugee camps, foreign embassies, prisons, bomb shelters. At other times, he felt that he was inhabiting an Inferno, a purgatory, or a polluted heaven ("a decayed rotting house infested by rats and termites and other vermin"). His identities, like the return addresses on his letters, were like the skins of an onion.

Underneath each one lurked another: He was C.O.R.P.S.E. (a Palestinian Arab refugee), a great Japanese shogun, C 142 3, Esau, Uhomme d'Or, Chin Hsiang, Job, Jorap Castro, Janos Norses, even, at times, a mouse. His companions were samurai, devils, prophets, Nazis, priests, and judges. Baleful deities-Napoleon, Iblis, Mora, Satan, Platinum Man, Titan, Nahipotleeron, Napoleon Shickelgruber-

threatened him. He lived in constant fear of annihilation, both of the world (genocide, Armageddon, the Apocalypse, Final Day of Judgment, Day of Resolution of Singularities) and of himself

(death and bankruptcy). Certain dates

-----766

struck him as ominous, among them May 29.

Persistent, complex, and compelling delusions are among the defining symptoms of schizophre⁹ Delusions are false beliefs, beliefs that constitute a dramatic rejection of consensual reality. Often, they involve misinterpretations of perceptions or experiences. They are thought, nowadays, to arise primarily because of the gross distortions in sensory data and the way thought and emotion are processed deep in the brain. Thus, their convoluted and mysterious logic is sometimes seen as

the product of the mind's solitary struggle to make sense of the strange and uncanny. E. Fuller Torrey, a researcher at St. Elizabeth's in Washington, D.C., and author of *Surviving Schizophrenia*, calls them "logical outgrowths of what the brain is experiencing" as well as "heroic efforts to maintain some sort of mental equilibrium." The syndrome we now call schizophrenia was once called "dementia praecox," but, in fact, the delusional states typical of schizophrenia often have little in common with the dementia associated with, for example, Alzheimer's disease. Rather than

-----767

cloudiness, confusion, and meaninglessness, there is hyperawareness, over-acuity, and an uncanny wakefulness. Urgent preoccupations, elaborate rationales, and ingenious theories dominate. However literal, tangential, or self-contradictory, thought is not random but adheres to obscure and hard-to-understand rules. And the ability accurately to apprehend certain aspects of everyday reality remains curiously intact. Had anyone asked Nash what year it was or who was in the White House or where he was living, he could no doubt have answered perfectly accurately, had he wished to.

A Man All Alone in a Strange World

325

Indeed, even as he entertained the most surreal notions, Nash displayed an ironic awareness that his insights were essentially private, unique to himself, and bound to seem strange or unbelievable to others. "This concept that I want to describe ... will perhaps sound absurde" is the sort of preface of which he was quite capable. His sentences were filled with phrases like "consider, if, may be thought of as," as if he were conducting a thought experiment or realizing that someone reading what he wrote would have to translate it into another language.

-----768

Like all other manifestations of the syndrome, delusions are not unique to schizophrenia; they can be present in a variety of mental disorders, including mania, depression, and a variety of somatic illnesses. But the types of delusions that Nash suffered from are particularly characteristic of schizophrenia, specifically of paranoid schizophrenia, the variant of the syndrome from which Nash apparently suffered. Their content was, as it often is, both grandiose and persecutory, often shifting from one to the other in the space of moments or even including

both at the same time. At different times, as we know, Nash thought of himself as uniquely powerful, as a prince or an emperor; at other times he thought of himself as extraordinarily weak and vulnerable, as a refugee or a defendant in a trial. As is quite typical, his beliefs were what is called referential, in that he believed that a host of environmental clues -- from newspaper passages to particular numbers -- were specifically directed at him and that he alone was capable of appreciating their true meaning. And his delusions were multiple, a particularly common feature of paranoid schizophrenia, although all were organized, in

subtle ways, around coherent themes. Bizarreness is thought to be especially characteristic of schizophrenic delusions. Nash's delusions were clearly implausible, difficult to penetrate, and not obviously derived from life experiences. Yet they were less bizarre, on the whole, than many delusions reported by other people with schizophrenia, and their connections to Nash's life history and his immediate circumstances, though indirect, were often discernible (or would have been had anyone who knew him well been willing to study in the same spirit as the loyal wife of Balzac's Louis Lambert). Many people with schizophrenia believe that their thoughts have been captured by outside forces, or that outside forces have inserted thoughts into their minds, but such beliefs did not seem to play a predominant role in Nash's thinking. Occasionally, as in Rome, he might think that thoughts were being inserted directly into his mind via machines, or, as in Cambridge in early 1959, that his actions were being directed by God. But, by and large, Nash maintained a sense of himself, or selves, as the primary actor. And many of his beliefs -- such as that he was a conscientious objector in danger of being drafted; that he was stateless; that mathematicians belonging to the American

-----770

Mathematical Society were ruining his career; that various persons, posing as sympathizers, were conspiring, with malevolent intent, to have him incarcerated in a mental institution comwere no more implausible than, say, a belief that one is being spied on by the police or the CIA. Thus, in a sense, the breakdown of reality and boundaries between self and outside world had limits for him, even in Roanoke.

In particular, although Nash later referred to his delusional states as "the time of my irrationality" he kept the role of the thinker, the theorist, the scholar trying to make sense of complicated phenomena. He was "perfecting the ideology of liberation from slavery" finding "a simple method" creating "a model" or "a theory" The actions he referred to are mostly feats of mind, or involve language. At most, he was "negotiating" or "petitioning" or trying to persuade. His letters were Joycean monologues, written in a private language of his own invention, full of dreamlike logic and subtle non sequiturs. His theories were astronomical, game theoretical, geopolitical, and religious. And while, years later, Nash often referred to pleasant aspects

-----771

of the delusional state, it seems clear that these waking dreams were extremely unpleasant, full of anxiety and dread.

Before the 1967 Arab-Israeli war, he explained, he was a left-wing Palestinian Arab refugee, a member of the PLO, and a refugee making a "g-indent" in Israel's border, petitioning Arab nations to protect him from "falling under the power of the Israeli state.

14

Soon afterward, he imagined that he was a go board whose four sides were labeled Los Angeles, Boston, Seattle, and Bluefield. He was covered with white stones representing Confucians and

black stones representing Muhammadans. The "first-order" A771
game was being played by his sons, John David and John Charles.
The "second-order, "derivative game was "an ideological conflict
between me, personally and the Jews collectively.""

A few weeks later he was thinking of another go board whose four
sides were labeled with cars that he had owned: Studebaker, Olds,
Mercedes, Plymouth Belvedere. He thought it might be possible to
construct "an elaborate oscilloscope display

-----772
... a repentingness function."

16
It seemed to him also that certain truths were "visible in the
starsdd"He realized that Saturn is associated with Esau and Adam,
with whom he identified, and that Titan, Saturn's second moon,
was Jacob as well as an enemy of Buddha, Iblis. "I've discovered
a B theory of Saturn.... The B theory is simply that Jack Bricker
is Satan. `Iblisianism` is a frightening problem connected to the
Final day of Judgement." 17

At this point, the grandiose delusions in which Nash was a
powerful figure, the Prince of Peace, the Left Foot of God, and
the Emperor of Antarctica were no longer in evidence; instead,
the theme became predominantly persecutory. He discerned that
"the root of all evil, as far as my personal life is concerned
(life history) are Jews, in particular Jack Bricker who is
Hitler, a trinity of evil comprised of Mora, Iblis and
Napoleondd"These were, he said, simply "Jack Bricker in relation
to medd"I I At another point, he said, referring to Bricker,
"Imagine if there would be a person who pats a

-----773
guy on the back ... with compliments and praises, while at the
same time stabbing him in the abdomen with a deadly rabbit
punchdd019 Seeing the picture so clearly, he concluded that he
must petition the Jews and also mathematicians and Arabs "so that
they have the opportunity for redress of wrongs,"

A Man All Alone in a Strange World

327
which must, however, "not be too openly revealeddd"He also had
the idea that he must turn to churches, foreign governments, and
civil-rights organizations for help. In the story of Jacob and
Esau, told in Genesis, Nash saw a parable full of meaning for his
own lifedd20 Jacob and Esau are brothers, the sons of Isaac and
Rebekah, who love each other. Esau is the elder, and his father,
Isaac, loves him, but Rebekah, their mother, loves Jacob more. As

the story unfolds, Esau is twice supplanted by Jacob. First, Jacob tricks Esau into making a bad bargain and selling his birthright. Then, Jacob steals the blessing of the now blind Isaac, who had intended it for Esau. He does so by impersonating his brother. NV-HEN Esau discovers Jacob's deception, Isaac

-----774

rejects his claim: "See, away from the fatness of the earth shall your home be; and away from the dew of heaven on high. / O Yr sword you shall live; and you shall serve your brother; but when you break loose, east shall break his yoke from your neck." Esau, full of hatred for his brother, tells himself, "The days of mourning

for my father are approaching; then I will kill my brother A774
Jacob."

Nash believed that he had been cast out ("I've been in a
situation of loss of favor") and ostracized. He was constantly
threatened with bankruptcy and expropriation: "If accounts are
held for a trustee, in effect, who is as good as defunct, through
lack of `rational consistency! . . . It's as if accounts are held
for persons suffering in an Inferno. They can never benefit from
them because it's as if they were supposed to come from the
Inferno --

to the bank offices -- and collect, but they need, as it were, a
revolutionary ending of the Inferno before having any sort of
possibility of benefiting from their accounts

.1121

There is a presumption of guilt. Punishment, penitence,
contrition, atonement, confession, and repentance are constant
themes -- along with fears of

-----775

exposure and the need for indirection and secrecy comand seem
directly connected, but not limited, to his feelings about
homosexuality. He refers to "the really dubious things that I
have done in all the history of my personal life"including
"draft dodging, truancy."

Arrests, trials, and imprisonment were also recurring themes.

Like Joseph K in Kafka's novel

The Trial,

Nash imagined that he was on trial "sufficiently complete in
absentiad" He recognizes that "it is as if the accused is his own
chief accuser ... the road of self-accusation is a road that
leads to death not redemption." He thinks of a "court of
inquiry" investigating "the life histories and ... interactions"
of Jacob and Esau, whom he identifies as Bricker and himself.

14

These are guilty, fearful dreams. Nash's state of imprisonment
did not, it seems, refer to his illness, for he did not regard
himself as ill except physically. It was existential. To Eleanor
he wrote, "U see, U must sympathize more with the true needs of
liberation, liberation from slavery,

-----776

liberation from 'castration,' libera-
tion from prison, liberation from isolation ... I'm a refugee, in
fact, from false symbols and dangerous symbolsdd021 At times, he
felt that he was in danger of crucifixion.

His own needs, he said, were "to be free, and to be safe and for friendsdd026He was always, he said, "in fear of `death` (Indian style) through an Armageddon with Iblis ... at the Day of Judgement." Even in these very dark hours he clung to a vision of liberation comwh later became, more concretely, a wish for sexual liberation. "I'm hoping fervently to be saved (delivered) before reaching 40 in age" he had written a few weeks before his birthday. "One cannot substitute free life and love of the 40's for the lost possibilities of the 20's and 30's and also teens."" Nash was acutely aware of the passage of time. "It does seem to me that I've been as if the victim of an excessively long wait

for liberation.... It's as if there wasn't a ransom A776
forthcoming, as if from Kuwait, which would have really
substantially shortened the time of waiting for me.""

He was waiting for deliverance: "I see, it seems surprisingly
clearly, how there's as it were, a time

-----777
of grace before that time, a precious time of grace which is
forever lost if not seized carpe them and fully effective in its
significance."

19
Nash was also hearing voices, voices that frightened him: "My
head is as if a bloated windbag, with Voices which dispute
withindd010

Hallucinations can involve any of the senses-hearing, smell,
taste, touch, sight-but voices, one or several, familiar or
strange but distinct from one's own thoughts, are the most
characteristic of schizophrenia." These are quite distinct from
the hallucinations that are part of religious experience, or the
humming inside one's head, hearing one's name called
occasionally, or hallucinations that occur while failing asleep
or waking up. The content of schizophrenic hallucinations can be
benign, but they usually involve ridicule, criticism, and
threats, typically related to the content of the delusional
theme. The integration of voices with thought can produce an
acute sense of reality.

The so-called negative symptoms of schizophrenia are, most
clinicians agree, even more crippling than the delusions and
hallucinations. The terms used to describe them are derived from
the

-----778
Greek: affective flattening, alogia, and avolition. There was no
trace of the sharp looks, the enthusiastic gesturing, the brash
body language that announced, "I'm Nash with a capital Ndd"His
face was blank, his eyes empty, as if the fires of delusion had
consumed everything that was once alive and left an empty husk.
One would feel comforted if one could believe that Nash, at this
terrible time in his life, was at least spared the sight of his
own condition. One of the consequences of chronic schizophrenia,
noted long ago and verified since by numerous studies, is a
curious insensitivity to physical pain. This insensitivity is
often so great that there are high rates of premature deaths from
physical illnesses among A Man All Alone in a Strange World
329

schizophrenics, at least in the era when such people spent most of their lives in institutions. Might there not be a similar dulling that would anesthetize one to psychic pain? Possibly. But for Nash there were moments of lucid self-knowledge, unbearable in their sadness: "So long a time has passed. I feel there are many sad tragedies. Today I feel very sad and depressed."

-----779

It is often difficult to distinguish the effects of disease from those of its treatment. But Nash's condition during the two and a half years he spent in Roanoke was probably almost purely the consequence of his disease. Six years had passed since Nash had

received insulin treatments and well over a year since he A779
 had been taking neuroleptics regularly. While some of his memory
 loss was, no doubt, a result of the insulin treatments of the
 first half of 1961 and some of his-extreme quietness in the early
 months following his return to Cambridge no doubt reflected the
 side effects of Stelazine, his condition in Roanoke is a strong
 testament that lassitude, indifference, and the peculiarities of
 his thought were primarily the consequences of his illness and
 not of the early attempts to treat it. The popular view that
 antipsychotics were chemical straitjackets that suppressed clear
 thinking and voluntary activity seems not to be borne out in
 Nash's case. If anything, the only periods when he was relatively
 free of hallucinations, delusions, and the erosion of will were
 the periods following either insulin treatment or the use of
 antipsychotics. In other words, rather than reducing Nash to a
 zombie, medication seemed to have

-----780

reduced zombielike behavior.

Nash was clearly among the majority of those with schizophrenia
 who benefited from traditional antipsychotics. These drugs were
 the only ones available between 1952 and 1988, when the more
 effective Clozapine arrived on the scene." Peter Newman, an
 economist at Johns Hopkins, was editing a volume of important
 contributions to mathematical economics. He wanted to include
 Nash's NAS note on Nash equilibrium.

The first problem was finding him. I found him teaching or
 something at a small women's college near Roanoke. I wrote to him
 there to ask his permission to reprint the article. What I got
 back was an envelope on which my address was written in
 different-colored crayons. There was also a list of "yous" in
 different languages: Du, Vous, You, etc., and a plea for
 universal brotherhood. There was nothing inside the envelope at
 all. I then asked the in-house editor at the Johns Hopkins Press
 to call Nash. He did and he said it was the strangest telephone
 conversation he'd ever had in his life. Then we tried Solomon
 Lefschetz, since he was the one who sponsored the note.

-----781

Calling Lefschetz wasn't easy either. Lefschetz only said, "Ah
 yes. He is not what he wasdd"S I had to give it up. Later, when
 the book was reviewed, reviewers chided me for not including the
 Nash

equilibriumdd14

Nash was constantly fearful that Martha and Virginia would

hospitalize him again. As he said in one letter, "It is the mechanism of how all the persons involved would collaborate in hospitalizing me which endangers me and which I fear.""

Most letters from this period end with a paragraph like the following:

Let me beg (humbly) of U that U will favor the view that I ought to be guarded against the danger of hospitalization in the mental hospital (involuntarily or "falsely").... simply for personal intellectual survival as a "conscious"and
11 reasonably conscientious"human being ... and "good memory retention."

36 A781

For Virginia, Nash's illness was something that Martha later called, in her tactful and understated way, "a private sorrow." Virginia never talked about it

-----782

with the few acquaintances she had in Roanoke, mostly people she had met playing bridge, and only rarely with Martha. Her friends couldn't possibly have understood what it was like for her. It was also a practical nightmare. Nash was making so many long-distance telephone calls that Virginia had to put a lock on her phone.

Martha, whose second child was born in 1969, was at least angry. "It was so frustrating day by day. You wondered, is this ever going to get any better""She realized, at least, that Roanoke was not a kind environment. "Only one time did I ask for helpea"recalled Martha. "The minister stopped me after church and told me I should be helping my mother more. He didn't ask whether I needed help. Later on I called and asked would he come to call. He didn't come. The retired minister came but he wasn't the one I wanted."

Virginia and Nash were nearly evicted from their apartment at one point. Martha's voice is still full of outrage thirty years later. There had been a fire that started in the incinerator. Nash was home at the time. He called the fire department. "The landlord accused John of setting it `was Martha recalled. He had talked to the neighbors, who were

-----783

up in arms. They found this large, strange man who walked around the grounds of the apartment complex alarming. It was only by begging that Martha was able to convince the landlord to let Virginia and Nash move back in.

Virginia died shortly before Thanksgiving in 1969. Afterward Nash was sure there was something sinister about her death. He also felt that perhaps he had done wrong by going to the corner store to buy her whiskey. Martha recalled, "When Mother died, it was not a good time. We weren't close. He felt threatened. He felt that I would put him in a hospital." At this point, Eleanor got a court order to force Nash to continue child-support payments. When his money had run out, Virginia had taken over the payments. She also left small legacies for both her grandsons.

A Man All Alone in a Strange World

331

Nash then lived briefly with Martha and Charlie, but Martha found

it impossi-
ble to cope with her brother. "Once Mother was gone, I couldn't
clean with him in my home. I was here with the children and he's
wandering around drinking tea and whistling. He'd take ideas and
twist them into something

-----784

strange."

Martha arranged to have Nash committed right after Christmas:
After Mother died, I was afraid he'd leave town. I was hoping to
get the hospital to appoint a committee so he could get Social
Security and also get it for his son.

We went to a judge. We got a court order. The court sent A784 the police to pick him up. We had my mother's lawyer, Leonard Muse. You could get someone committed for observation. You didn't have to establish anything very drastic. In the hospital they decided whether to keep somebody. De Jarnette decided that John had paranoid ideas but that he was capable of maintaining himself.

Nash was released from DeJarnette State Sanitorium in Staunton, Virginia, in February. He wrote a final letter to Martha, breaking off all relations with her because of her role in his hospitalization. Then he boarded a bus for Princeton.

Princeton, 1970's

Much Madness is divinest Sense To a discerning Eye....

- Emm

-----785

Y DxKwsoation,

Number 435

AN

IMPERSONAL NEW GRANITE-CLAD TOWER, built with defense dollars at the height of the Vietnam War, had replaced the old Fine Hall and neighboring Jadwin Hall. Math and physics majors spent most of their waking hours below ground where the architects had situated the library comwh had formerly occupied the highest floor of Old Fine -- as well as the new computer center. Within a few days or weeks, the embryo scientist or mathematician would discover "a very peculiar, thin, silent man walking the halls, night and day,0"with sunken eyes and a sad, immobile face." On rare occasions, they might catch a glimpse of the wraith comusually clad in khaki pants, plaid shirt, and bright red high-top Keds comprinting painstakingly on one of the numerous blackboards that lined the subterranean corridors linking Jadwin and New Fine. More often, students would emerge from an 8:00 A.M. lecture to find an enigmatic epistle written the night before: "Mao Tse-Tung's Bar Mitzvah was 13 years, 13 months and 13 days after

-----786

Brezhnev's circumcision," for exampleddbled Or I agree with Harvard: There is a brain flatdd"I Or a letter from Nikita Khrushchev to Moses with arcane mathematical statements involving the factoring of very long, ten- to fifteen-digit numbers into two large priMeSdd6 "Nobody knew where they came fromea"recalled Mark Reboul, who graduated in 1977. "Nobody knew what they meantdd"I Eventually, some sophomore or junior would clue in the newcomer

that the author of the messages, aka the Phantom, was a mathematical genius who had "flipped" while giving a lecture; while trying to solve an impossibly difficult problem; after discovering that someone else had scooped him on a major result; or upon learning that his wife had fallen in love with a mathematical rival⁸ He had friends in high places at the university, the older student would add. Students were not to bother him⁹

Among the students, the Phantom was often held up as a cautionary figure:

Anybody who was too much of a grind or who lacked social graces

was warned that he or she was "going A786

-----787

to wind up like the Phantom.0"Yet if a new student complained that having him around made him feel uncomfortable, he was immediately warned: "He was a better mathematician than you'll ever beff"I I

Few students ever exchanged a word with the Phantom, although some of the brasher ones occasionally bummed a cigarette or asked for a light, for the Phantom was now a heavy smoker. One new physics student once erased two or three of the messages only to encounter the Phantom in front of the blackboard writing a few days later, "sweating, trembling, and practically cryingdd"The student never erased another."

Students and young faculty members studied the Phantom's messages and sometimes copied them down verbatim. The messages created an aura around the Phantom and confirmed the legends of his genius.

Frank Wilczek, a physicist at the Institute for Advanced Study who lives in Einstein's old house on Mercer Street, was an assistant professor at the university at the time. He remembered feeling "intrigued and impressed"and "in the presence of a great mind.0"Mark Schneider, a physics professor

-----788

at Grinnell who was a graduate student in 1979, recalled: "We all found the remarkable connections, level of detail, and breadth of knowledge ... exceptional, which is why I ... collected a few dozen of the best of these."

14

Shortly after Hironaka won a Fields prize for his brilliant proof of the resolution of singularities, one of Nash's messages read:

$N_1 \text{ plus } 11 \text{ plus } X_1 \text{ plus } 01 \text{ plus } N_1 \text{ equals } 0$

Can Hironaka resolve this singularity?"

Some of the messages seemed purely mathematical, at least until one looked at them more closely, as in this 1979 message:

Open Letter to Prof. Heisuke Hironaka

$0 \text{ equals } E_{11} \text{ plus } V_{11} \text{ plus } E_1 \text{ plus } R_{11} \text{ plus } E_1 \text{ plus}$

$T_{1,9}$

plus T_{10}

$2 \ 3 \ 2$

The above algebraic variety of dimension 6, represented in affine 7-space is singular, having a point singularity at the origin (0,0,0,0,0,0,0) of the coordinates.

-----789

The question is: How singular comparatively, is the above

6-variety, that is, what is the comparative degree of its singularity, compared with other singularities of such a sort as to provide standards of comparison"16

Others contained indirect references to past events: Indian Limbo

B equals (RX) plus (MO) plus (OP) I plus (QU) 4 plus (ME)

3 plus

(OT)

2 plus

AAP

OT suggests "Occupational TheraPY07 as in Dr. O.T. Beetle, M.D.

AAP equals PR (2) -- 1, as a number. 17

And still others were slyly humorous:

A789

True or False Question

Statement: President Jimmy Carter is suffering from the disease of xanthochromatosis, the same disease which previously affected the careers of Nixon and Agnew, so that the disease has presumably jumped the gap of the apparently immune northern republicans Ford and Rockefeller and reinfected

-----790

Air Force One via the person of Jimmy Carter.

The above statement is true. The above statement is false."

During one period, all the messages featured a commentator named Ya Ya Fontana who made mysterious pronouncements about current events, principally in the Middle Eastdd19 In another period, Alexandre Grothendieck's name appeared frequentlydd10 In still another, Diophantine equations comeequations like x-plus y-

z, cdominated."

Margaret Wertheim, author of

Pythagoras' Trousers,

a history of mathematics, has pointed out that "people look to the order of numbers when the world falls apartdd011 Nash's

romance with numerology blossomed when his world was falling apart, suggesting once again that delusions -- like "mystical, cultic religious efflorescence"

- aren't merely the ravings of madmen but conscious, painstaking, and often desperate attempts to make sense out of chaos.

Nash was making up numbers out of names and was often

-----791

extremely worried about what he found. "He was quite agitated

when he thought that the numbers were portents of something

serious `was recalled Peter Cziffra, the head librarian at Fine

Hall. Hale Trotter, a mathematician on the Princeton faculty,

recalled, "I'd say hello and he'd initiate a conversation. I

remember one in which he was very concerned about the similarity

of the telephone number of the United States Senate and the

telephone number of the Kremlin. He was doing the arithmetic

correctly but the reasoning for it was crazy.""

Nash did a lot of telephoning in those years. Early on, Peter

Cziffra remembers, Nash tried to call public figures as well as

people at the university: "It was a little odd.... He wanted to

talk about something that had been in the paper. A crisis in

Russia that he wanted to talk about with somebody.

24

William Browder, who was now chairman of the mathematics department, recalled:

Nash was the greatest numerologist the world has ever seen. He would do these incredible manipulations with numbers. One day he called me and started with the

-----792

date of Khrushchev's birth and worked right through to the Dow Jones average. He kept manipulating and putting in new numbers. What he came out with at the end was my Social Security number. He didn't say it was my Social Security number and I wouldn't admit that it was. I tried not to give him satisfaction. Nash was

never trying to convince anyone of anything. He was doing A792 things from a scholarly point of view. Everything he talked about always had a very scientific flavor. He was trying to gain an understanding of something. It was pure numerology, not applied." One has a distinct sense that Nash's condition had stabilized. To go to the blackboard took courage. To share ideas that Nash felt were important, and yet that might seem crazy to others, implied a willingness to make connections with the community at large. To stay in one place and not to run away, to labor at articulating his delusions in a way that attracted an audience that valued them must be seen as evidence of some progression back to consensual forms of reality and behavior. And, at the same time, to have his delusions seen not just as bizarre and unintelligible, but as having an intrinsic value, was surely one aspect of these "lost years" that

-----793

paved the way for an eventual remission. As James Glass, the author of Private Terror!Public Places and Delusion, put it upon hearing about Nash's years in Princeton: "It seemed to serve as a containing place for his madnessdd016 It is obvious that, for Nash, Princeton functioned as a therapeutic community. It was quiet and safe; its lecture halls, libraries, and dining halls were open to him; its members were for the most part respectful; human contact was available, but not intrusive. Here he found what he so desperately wanted in Roanoke: safety, freedom, friends. As Glass put it, "Being freer to express himself, without fearing that someone would shut him up or fill him up with medication, must have helped pull him out of his disastrous retreat into hermetic linguistic isolation."" Roger Lewin, a psychiatrist at Shepherd Pratt in Baltimore, said, "It seems that Nash's schizophrenia diminished in the way it appeared to others and that his madness became confined to intellectual and delusional projections rather than to wrapping him completely in behavioral

-----794

expressions.0" These are descriptions similar to those Nash himself has given of these years in Princeton: "I thought I was a Messianic godlike figure with secret ideas. I became a person of delusionally influenced thinking but of relatively moderate behavior and thus tended to avoid hospitalization and the direct attention of psychiatrists."

The immense effort -- the reading, computations, and writing --

of producing the messages may have played a role in preventing Nash's mental capacities from deteriorating. The messages had their own history and evolved over time. At some point, probably starting in the mid-1970's, Nash began writing epigrams and epistles based on calculations in base 26.¹⁹ Base 26, of course, uses twenty-six symbols, the number of letters in the English alphabet, just as the base 10 of everyday arithmetic employs the integers zero through nine. Thus, if a calculation came out "rightea"x produced actual words. Here was Nash, who as a boy had delighted in inventing secret codes, with his great mathematical ability and mystical

preoccupations, and with plenty of time on his hands, A794
taking names, converting them into numbers

-----795

based on the letter-number correspondence, factoring the
resulting numbers, and then comparing the primes in the hope of
discovering "secret" messages. Daniel Feenberg, a graduate
student of economics who ran into Nash at the computer center
around

1975, recalled: "Nash had an obsessive concern with Nelson
Rockefeller. He would take the letters, assign numbers to each
letter, get a very large number, and then analyze that number for
hidden meaning. It had the same relationship to mathematics as
astrology to astronomy." 10 This, of course, is not only
time-consuming but remarkably difficult, and the odds of finding
meaningful words or combination of words minute.
Nash worked on one of those old-fashioned Friden-Marchant
calculators with a tiny, glowing, green CRT." He must have
written an algorithm for doing base 26 arithmetic. Performing
these calculations would have been tremendously tedious and would
have required writing down intermediate results as he went along,
since these calculators had very little storage capacity and
weren't programmable. Generating the equations that constituted
the core of his blackboard messages was not just fancy
arithmetic,

-----796

however. As one of the former physics students remarked, "It
would have taken deep abstraction of the sort that real
mathematicians perform.""

On one occasion, Feenberg wrote a computer program for Nash:
He asked me if computer programming was something he should do.
He'd seen me working with computers. He wanted to factor a
twelve-digit number, which he felt was a composite number. He had
already tested it against the first seventy thousand primes on a
desk calculator. He had done it twice. He'd found no mistake, but
he hadn't found a factor. I said we could do it. It took only
about five minutes to write the program and test it. The answer
came back: His number was a composite number that was the product
of two primes."

Nash was beginning to develop an interest in learning how to use
the computer. (If one spent time in the computing center one had
to sit at those ancient
desk calculators by the hour, shuffling decks of computer cards.)
Hale Trotter, who was working half-time in the computer center in

those days, described it: "It was the old days. We fed cards into the computer. There was a large `ready room` with a big counter, a card reader, table, and chairs and

-----797

another room with a calculator. There was always lots of paper arounddd014

At the time, Trotter recalled, he kept track of people's computer time but nobody was billed. At some point the administration decided that he had to charge individual research accounts. Students and faculty alike had to open accounts and get passwords. Trotter initially told Nash that Nash could use his

account number. At weekly meetings, the subject of A797 regularizing the situation with Nash came up. Some students were wondering what was going on with Trotter's name on Nash's output. Someone suggested, said Trotter, "Why not give him his own account?" Everybody agreed to give him a free account. "He never, never made any trouble. If anything, he was embarrassingly diffident. Sometimes if one was having a conversation with Nash, it was hard to break away."

For most of the 1970's, Nash conducted his elaborate researches in the reference room of Firestone Library, where he was known to successive generations of students as "the library crazy man" and later as "the mad genius of Firestone." In the late 1970's, he was often the last to leave the library at midnight. He spent evenings in the

-----798
reference room, his floppy golf hat on the broad wooden table with a neat pile of books. He could spend two or three hours standing at the card catalog.

Charles Gillespie, a historian of science and editor of the Dictionary ofScientific Biography, had an office on the third floor of Firestone Library. Every day Nash would arrive at Firestone, marching down the walk, eyes straight ahead and briefcase in hand. He almost always headed for the third floor stacks, in a section of the library devoted to religion and philosophy. Gillespie always said good morning. Nash was always silent.

16
Nash did, however, occasionally strike up acquaintanceships, as when he got to know two Iranian students during the summer of 1975. Amir Assadi, a big, smiling bear of a man, now on the mathematics faculty at the University of Wisconsin, recalled: My brother spent the summer with me while I was studying for my generals. He used to wait for me in the common room. I'd seen Nash around and heard about

-----799
him, but one day when I walked in he and my brother were talking intensely and I joined him. After that, I always said hello and we talked occasionally. He was extremely gentle and very shy. He seemed just so lonely. We were among the few people who talked to him. But he spoke freely to my brother. I suppose he saw a lonely foreigner.

Usually the conversations were quite short, but sometimes he would go

on and on. It seemed scholarly to us. He didn't act bizarre. He used to read the Encyclopaedia Britannica.

He had enormous knowledge. Nash was interested in Zoroastrian religion. Zarathustra was an ancient Iranian prophet. He wasn't mad. He wasn't someone who "had a yellow camel [i.e., crazy]"The religion he founded was based on three principles: good deeds, good thoughts, good expressions. Fire was holy. Light and darkness were always locked in struggle. Fires always burn in Zoroastrian temples. They are monotheists. Nash would ask us to verify this and that. Occasionally we went and really read

something.

A799

In Iran the sense of sympathy and deep regret for a person being lonely is very great. We felt

-----800

sorry."

Nash's daily rounds in those years followed a predictable pattern. He would get up, not too early, and ride the Dinky into town, buy a copy of The New York Times, walk over to Olden Lane, eat breakfast or lunch at the Institute, and wander back to the university, where he could be found either in Fine or in Firestone. For some time, he became a regular at Fine Hall teas. The year Joseph Kohn became chairman of the math department, 1972, Kohn spent "many sleepless nights" over Nash. Some of the math department secretaries had come to him at various times saying that Nash's behavior worried themdd"Kohn couldn't remember exactly what the behavior was but guessed that it involved stating. In any case, he brushed the women's complaints aside, saying that there was nothing to worry about, but privately he wasn't so sure.

With a few exceptions, such as Trotter, the faculty tended to avoid him. Claudia Goldin, who was on the economics faculty at the time, recalled:

He was an intriguing mystery. He just seemed to be around. Here was this giant and all of us were standing on his

-----801

shoulders. But what kind of shoulders were they? For academics, there's always this fear, All you have is your brain. The idea that anything could go wrong with it is so threatening. It's threatening for everybody, of course, but for academics that's all of xdd19 Mostly it was students who knew a bit of his legend, who generally found him nonthreatening, who sought him out. Feenberg, for example, had lunch with Nash. "Everyone knew he was a great man and just having lunch was an interesting experience. It was sad also. Here was this presence, this very famous person in our midst that people outside of Princeton often thought was deadddd040

in 1978, largely thanks to the kindness of his old classmate from graduate school and RAND, Lloyd Shapley, Nash was finally awarded a mathematical prize. He was awarded the John von Neumann Theory Prize by the Operations Research Society and the Institute for Management Science jointly with Carl Lemke, a mathematician, of Rensselaer Polytechnic Institute

.41

Nash won for his invention of noncooperative equilibrium; Lemke
for his work in computing Nash

-----802

equilibria

.41

Lloyd Shapley was on the prize committee. It was his idea. "I
felt sentiment and nostalgia"he recalled43 Shapley, having
received the honor himself the year before, thought: "Here's a
chance to do something for Nash." He was motivated, he later
said, by the hope that honoring Nash would somehow help Alicia
and Johnny. "My sentiment, such as it was, was based on picturing

him growing up. Here's this kid growing up and his dad A802
isn't there. This might do something to increase his self-esteem.
His father isn't there, but he's great, his work is being
recognized."

44

Nash was not, however, invited to the prize ceremony in
Washingtondd41 Instead, Alan Hoffman, a mathematician at IBM and
the second member of the prize committee, went down to Princeton
to present Nash with the awarddd41 He said: "We gathered in Also
Tucker's office. Al and Harold Kuhn were there, so we chatted a
while. Nash was sitting in the corner. Let me tell you, seeing
this man who was a genius and now functioning at subadolescent
level really was tragic. There's a difference between knowing and
seeingdd041

-----803

Princeton, 1970-90

I have been sheltered here and thus avoided homelessness. comJOHN
NASH,
1992

V VHEN ALICIA OFFERED to let Nash live with her in 1970, she was
moved by pity, loyalty, and the realization that no one else on
earth would take him in. His mother was dead, his sister unable
to accept the burden. Alicia was, divorced or no, his wife.

Whatever her reservations about living with her mentally ill
exhusband, they played no role in her thinking: She was simply
not prepared to turn her back on him.

Alicia also was moved by the conviction that she had something
more to offer Nash than physical shelter. She believed, perhaps
somewhat wishfully, that living in an academic community among
his own kind, without the threat of further hospitalization,
would help him get well. She took Nash's own assessment of his
needs -- for safety, freedom, and friendship --

literally. In a letter to Martha written at Nash's request in
late 1968, when he was convinced that his mother and sister
planned to hospitalize him again, Alicia had argued that
hospitalization was unnecessary and harmful: "Much of his past
hospitalization I now

-----804

feel was a mistake and had no beneficial permanent effects,
rather the opposite. If he is to make a lasting adjustment, I
think this has to be done under normal conditionsdd"I

In 1968, Alicia had attributed her change of heart not just to
the fact that Nash had relapsed despite aggressive treatment but,

more important, to her own experiences since her divorce, which gave her new insights into Nash's plight. She wrote to Martha, "I feel that I now understand his difficulties much better than I ever did in the past, having experienced some of his type of problems personally." I Like many of those who tried to help Nash, Alicia was moved by a very personal and direct identification with his suffering.

Alicia's beauty and vulnerability, a mix made even more potent because of her history of personal tragedy, made it likely that someone would fall in love with her.

Forty-something, a professor of mathematics, John Coleman Moore

might have inhabited the pages of an F. Scott Fitzgerald A804
novel rather than an office at Fine Hall. His dark good looks,
formal manners, and custom-made suits distinguished him from the
rather scruffy ranks of fellow

-----805
mathematicians. And his command of French and intimate knowledge
of his native New York and assorted European capitals lent him a
sophisticated aura. A bachelor, Moore was also a ladies' man.
When they returned from their separate years in Paris, Moore,
Nash, and Alicia sometimes had dinners A trois. But it wasn't
until after the Nashes' divorce, in mid-1963, and after Moore,
described by a former girlfriend as "rigid and
priMbb'3

suffered a devastating mental collapse of his own that the
relationship turned romantic. Plagued by alcoholism and severe
depression, Moore was hospitalized at a swank, psychoanalytically
oriented hospital outside Philadelphia

.4
During two and one-half lonely years in which Moore remained in
the hospital, other than Donald Spencer and George Whitehead, his
thesis adviser from MIT, Alicia was his only regular visitor.
Whitehead, who ran into Alicia a few times there, recalled:
"There were lots of people in P-town who didn't come and see

-----806
him. He was remarkably thankful for visitorsdd"I
The friendship, born out of shared experiences and mutual
sympathy, blossomed into romance .6Moore returned to Princeton
and his teaching duties in the summer of 1965, about the same
time that Nash moved to Boston. He became Alicia's regular escort
at Princeton dinner parties, concerts, and the like. Whether it
was a great love match, as her marriage to Nash had been, isn't
clear. Moore, for all his charm and kindness, had little of the
sort of charisma that had attracted Alicia so wildly to Nash. She
yearned for someone who could take care of her, though. And for
some time it appeared that they would marry.

At the time that Nash left Princeton, Alicia was still working at
RCA. Her mother, who moved in with her after the death of her
husband, kept house for Alicia as she had done in Cambridge years
earlier. Mrs. Larde also helped take care of Johnny, who had
grown into an extremely bright and altogether adorable boy, tall,
sweetfaced, and still very blond.

Things started to unravel when Alicia suddenly lost her job at
RCA. The company's space division

had been periodically buffeted by contract cancellations and layoffs. Alicia, who was frequently absent, often late, or simply too depressed when she was at work to be effective, was particularly vulnerable. She found another job fairly quickly, but it didn't last. She could not seem to get on her feet again. For a grim period that lasted several years, she drifted from job to job and was frequently unemployed, a fact to which she alluded obliquely in her letter to Martha. Alicia was determined to get a job that matched her educational credentials, but few aerospace companies were hiring female engineers in that era, and Alicia

was turned down for more than thirty such positions. A807

"There were times when I was going to interviews every day all day," she later recalled. "But I never got any offers. It was very depressing." I

Things got so bad after her unemployment benefits ran out that she was forced to go on welfare and to use food stamps.⁹ Her hope of marrying Moore came to nothing. He backed away, finding the prospect of taking on a stepson as well as a wife "too much."¹⁰ Her mother "held everything together,"^z Alicia later said, but it was very hard. Alicia and her mother were forced to give up the nice

-----808

house they were sharing on Franklin Street in the heart of Princeton proper." Alicia found a tiny nineteenth-century frame house in Princeton Junction, long ago swathed in Insulbrick, to rent. It was in poor repair, but cheap and convenient for commuting, since it was literally across the road from the railroad station. Johnny, who was twelve by this time, was extremely unhappy over having to leave his school and friends. But Alicia had little choice.

Nash moved to the Junction with her, contributing some of his small income from the trust left by Virginia to pay the rent and household expenses. Alicia referred to him as a "boarder,"[^] but in fact they ate meals together and Nash spent a fair amount of time with Johnny, sometimes helping him with his homework or playing chess with him.¹⁴ Alicia had taught her son, who would later become a chess master, how to play.

Nash was very withdrawn, very quiet. "He was not a troublemaker,"^{ea} Odette recalled.^{dd} "Haphazardly dressed, his gray hair long, his expression blank, he would wander up and down Nassau Street. Teenagers would taunt him, planting themselves in his path, waving their arms, shouting rude things

-----809

directly into his startled face."¹⁶ Alicia was a proud woman, always sensitive to appearances; her loyalty and compassion outweighed her concern for what others might think. She was patient. She bit her tongue. She made very few demands on Nash. Looking back, her gentle manner probably played a substantial role in his recovery.^{dd} "Had she threatened or pressured Nash, he very well might have wound up on the street. This point was made by Richard Keefe, a psychiatrist at Duke University. Contrary to conventional wisdom, which held that families of the mentally ill should "let it all out," more recent

research suggests that people with schizophrenia are no more able to tolerate the expression of strong emotion than patients recovering from a heart attack or cancer surgery."

Alicia is a scrupulously honest person. She says of the role she has played in protecting Nash simply, "Sometimes you don't plan things. They just turn out that waydd019 She does see that it helped him, though, saying, "Did the way he was treated help him get better? Oh, I think so. He had his room and board, his basic needs taken care of, and not too much pressure. That's what you

need: being taken care of and not too much pressure." 810

In 1973, Alicia's circumstances started to improve. She had filed a sex discrimination suit against Boeing, one of the companies that had turned her down for a job in the late 1960's. It was a feisty thing to do, and the suit, which eventually netted her a modest out-of-court settlement, helped boost her morale. She got a programming job at Con Edison in New York City, where her old college friend Joyce Davis was working. "X wasn't easy. She got up every morning at four-thirty to make the two-hour commute from Princeton junction to Con Edison's Gramercy Park headquarters in downtown Manhattan and came home well past eight every evening. She often felt frustrated by the work itself, her boss, Anna Bailey, another acquaintance from MIT, recalled. She felt that her brains and education weren't being sufficiently recognized."

But now that she was making a good salary again, she was able to enroll Johnny in the Peddie School, a private preparatory school in Hightstown, about ten miles west of Princeton." Johnny, who

-----811
had become moody and difficult at home, was nonetheless an excellent student. By the end of his sophomore year, when he won a Rensselaer Medal in a national competition, he had a 4.0 average. And he was showing a marked interest in and a talent for mathematics. "John talked to Johnny a lot about mathematics when he was growing up," Alicia later recalled, adding, "If his father hadn't been a mathematician, Johnny would have been a doctor or a lawyer." "Johnny started hanging around the Fine Hall common room to play chess and go and talk mathematics with various graduate students. Amir Assadi remembered him as "gentle, a nice kid, a tiny bit awkward, like other mathematicians ... until they find their context."

16
Johnny was obviously gifted. Assadi recalled that he was studying disv high-powered math books." Sometimes father and son would come to Fine Hall together. Johnny didn't seem embarrassed, but neither did he ever refer to his father when talking to the students. Assadi recalled, "He disappeared one day. When he came back he'd shaved his head and had become a born-again

-----812
Christian."

In 1976, Solomon Leader was visiting his friend Harry Gonshor-the same Gonshor who had been part of Nash's crowd at MIT, now a professor on the Princeton faculty coming at the Carrier Clinic. 17

As the orderly ushered Leader through the locked door of the ward, a tall, wild-eyed young man suddenly loomed before him, "Do you know who I am?" he shouted right into Leader's face. "Do you want to be saved""Leader noticed he was clutching a Bible. Afterward, Gonshor told him that the man was the son of John Nash.

By the time Johnny was hospitalized at Carrier at his mother's initiative, he had been truant for nearly a year." He had dropped all of his old friends. For many months, he had refused to leave his room. When his mother or grandmother tried to intervene, he lashed out at them. He had begun reading the Bible obsessively

and talking about redemption and damnationdd19 Soon he A812
began hanging out with members of a small fundamentalist sect,
the Way Ministry, and handing out leaflets and buttonholing
strangers on street corners in Princeton."

It was not immediately obvious to Alicia or her mother that
Johnny's troubling behavior was anything more than

-----813

an outburst of adolescent rebellion. In time it became clear that
Johnny was hearing voices and that he believed that he was a
great religious figure. When Alicia tried to get him into
treatment, he ran away. He stayed away for weeks and Alicia had
to go to the police for help in tracking him down and bringing
him back. And then, when her son was in Carrier, Alicia learned
that the thing she most dreaded, had dreaded all along, was true.
Her brilliant son was suffering from the same illness as his
father."

Johnny seemed to improve quickly after the first hospitalization.
But he did not return to school for three yearsdd"Alicia never
talked about him at work except when she was forced to ask for
time off." She never told anyone at Con Edison that John Nash was
living with her again. Like Virginia Nash a decade earlier, she
treated her woes as her private sorrow. She tried to cope with
Johnny's refusal to take medication, his constant running away,
his periodic need for hospitalization, and the terrible drain on
her slender resources without giving in to her own depression.
"You sacrifice so much, you put so much into it, and then it all
goesea"she said laterdd14

-----814

As the trouble with Johnny overwhelmed her, Alicia turned to her
friend Caby Borel for support. Gaby accompanied Alicia on visits
to Carrier, and later to Trenton Psychiatric, talked with her on
the telephone, and invited the Nashes to dinner." Moore confirms
this: "Gaby is the closest female friend Alicia has around here.
Gaby is very good. Nobody else was around consistently."

16

Caby's tribute to Alicia's stoicism holds true to this day: "At
first, you cannot tell anything about her. You do not realize who
she is. She has put a sort of shield around herself. But she is a
very brave and faithful woman.""

In 1977, John David Stier made a cameo appearance in Nash's
lifedd"Father and son had been in touch by letter at least since
1971, John David's senior year in high school. Nash had become
quite concerned about his son's college plans, and Alicia had

written Arthur Mattuck to ask him to advise John Daviddd19 John David enrolled at Bunker Hill Community College and supported himself by working as an orderlydd41 Four years later, he applied to a number of four-year

-----815
schools, was offered several scholarships, and in 1976 transferred to Amherst, one of the most elite liberal arts colleges in the country.

That fall Norton Starr, a professor of mathematics at Amherst, hired a student to do some yard work for hmdd41 Afterward, Starr invited him into the house for a cold drink. As they chatted, the

young man learned that Starr had done his Ph.D. at MIT. A815
 Had he known a mathematician there named John Nash? Only by sight
 and reputation, Starr replied. "He's my father" the young man
 said. Starr looked at him searchingly. He looked at the young man
 again. "My God, you do look just like him," he said. Shortly
 afterward, John David drove down to Princeton to visit his
 father. Alicia was friendly. He met his brother, Johnny, for the
 first time.

The following Christmas, Johnny came up to Boston to stay with
 Eleanor and John David. Eleanor welcomed him warmly, cooked him
 nice meals, fussed over him. He came without a winter coat, so
 Eleanor bought him a down jacket. Johnny was well-behaved around
 his older brother, but could turn nasty when he was alone with
 her. At the end of the holiday, Eleanor recalled, "he didn't want
 to let John go. So John took him back

-----816

to school with

hiMdd041

The reunion between Nash and John Stier did not lead to a lasting
 reconciliation. "It just sort of petered out" John Stier
 recalled. His father was more interested in talking about his own
 problems than his son's. "When I asked him for advice, he'd
 answer with something about Nixon" he sddd41 Nash's confidences
 were unsettling. Nash had some idea that his son, having attained
 his majority, would play "an essential and significant personal
 role in my personal long-awaited `gay liberation! "44 He had
 waited a long time, as he said at the time, to "tell him about my
 life and problems and life history" Eleanor Stier recalled that
 he did SDD41

John David eventually stopped returning his father's calls. The
 two would not meet again for seventeen years. "I haven't always
 wanted to have contact with him" John David said. "Having a
 mentally ill father was rather disturbing."

More often than commonly realized, schizophrenia can be an
 episodic illness, especially in the years following its initial
 onset. Periods of acute psychosis may be interspersed with
 periods of

-----817

relative calm in which symptoms diminish dramatically either as a
 result of treatment or spontaneouslydd46 This was the pattern for
 Johnny.

In 1979, on the first day of the fall semester at Rider College
 in Lawrenceville, New Jersey, Kenneth Fields, the chairman of the

mathematics department, was asked to talk with a freshman who had made a pest of himself at the math orientation session, questioning everything and protesting that the presentation was not rigorous enough

.47

"I don't need to take calculus," the young man said when he arrived in Fields's office. "I'm going to major in math." Since Rider rarely attracted students with an interest or background in mathematics, Fields was intrigued. Quizzing the student as they walked around the campus, he quickly concluded that no mathematics course at Rider was advanced enough for this young

man and offered to tutor him personally. "By the way, A817
 what's your name""he finally asked. "John Nashea"the student
 replied. Seeing Fields's look of astonishment, he added, "You may
 have heard of my father. He solved the embedding theorem." For
 Fields, who had been an

-----818
 undergraduate at MIT in the 1960's and was familiar with the Nash
 legend, it was an amazing moment.

Fields proceeded to meet with Johnny weekly. Johnny took a while
 to buckle down, but he was soon plowing through difficult texts
 in linear algebra, advanced calculus, and differential geometry.

"It was obvious that he was a real mathemati-
 cianea"said Fields. He was also bright and friendly, a
 fundamentalist Christian who made friends with other religious,
 intellectually precocious students. He talked to Fields, who has
 several relatives who suffer from schizophrenia, about his mental
 illness. Occasionally he would do a riff on extraterrestrials,
 and on one occasion he threatened a history professor. By and
 large, said Fields, Johnny's symptoms seemed to be under control.
 He got straight A's and won an academic prize in his sopbomore
 year. Fields soon concluded that Johnny was wasting his time at
 Rider and belonged in a Ph.D. program. In 1981, despite his lack
 of a high school or college diploma, Johnny was accepted at
 Rutgers University with a full scholarship.

-----819
 Once there, he breezed through his qualifying examinations. From
 time to time he would threaten to drop out of school and Fields
 would get frantic calls from Alicia begging him to talk to
 Johnny. When Fields did, Johnny would answer, "Why do I have to
 do anything? My father doesn't have to do anything. My mother
 supports him. Why can't she support me""B he didn't drop out. He
 succeeded brilliantly.

Melvyn Nathanson, then a professor of mathematics at Rutgers,
 liked to assign what he called simple versions of unsolved
 classical problems in his graduate course on number theorydd41 "I
 gave one the first weekea"he recalled. "Johnny came back with the
 solution the following week. I gave another one that week and
 a

week later he bad that solution too. It was extraordinary."
 Johnny wrote a joint paper with Nathanson that became the first
 chapter of his dissertationdd49 He then wrote a second paper on
 his own, which Nathanson called "beautiful"and which also became
 part of the thesis." His third paper was an important

generalization of a theorem proved by Paul Erdős in the 1930's
for a special

-----820

case of so-called B sequences. "Neither Erdős nor anyone else had
succeeded in proving that the theorem held for other sequences,
and Johnny's successful attack on the problem would generate a
flurry of papers by other number theorists.

When Johnny got his Ph.D. from Rutgers in 1985, said Nathanson,
he seemed poised for a long and productive career as a first-rate
research mathematician. An offer of a one-year instructorship at
Marshall University in West Virginia seemed like the first of the

usual steps that eventually carry new mathematics Ph.D's A820 to tenured positions somewhere in academia. While Johnny was in graduate school, Alicia Larde returned to El Salvador for good and Alicia Nash moved to a job as a computer programmer at New Jersey Transit in Newarkdd"Things seemed rather hopeful.

PART FIVE

The Most Worthy

As you know, he has had his illness, but right now he fine, ft not attributable to One or several things. It just a question Oflivinga quiet life. ALSO-ICIA NA-SH,

-----821
1994

PETER

SARNAK,

a brash thirty-five-year-old number theorist whose primary interest is the Riemann Hypothesis, joined the Princeton faculty in the fall of 1990. He had just given a seminar. The tall, thin, white-haired man who had been sitting in the back asked for a copy of Sarnak's paper after the crowd had dispersed. Sarnak, who had been a student of Paul Cohen's at Stanford, knew Nash by reputation as well as by sight, naturally. Having been told many times Nash was completely mad, he wanted to be kind. He promised to send Nash the paper. A few days later, at teatime, Nash approached him again. He had a few questions, he said, avoiding looking Sarnak in the face. At first, Sarnak just listened politely. But within a few minutes, Sarnak found himself having to concentrate quite hard. Later, as he turned the conversation over in his mind, he felt rather astonished. Nash had spotted a real problem in one of Sarnak's arguments. What's more, he also suggested a way around it. "The way he views things is very different from other peopleea"Sarnak said

-----822
later. "He comes up with instant insights I don't know I'd ever get to. Very, very outstanding insights. Very unusual insightsdd"I

They talked from time to time. After each conversation, Nash would disappear for a few days and then return with a sheaf of computer printouts. Nash was obviously very, very good with the computer. He would think up some miniature problem, usually very ingeniously, and then play with it. If something worked on a small scale, in his head, Sarnak realized, Nash would go to the

computer to try to find out if it was "also true the next few hundred thousand times."

What really bowled Sarnak over, though, was that Nash seemed perfectly rational, a far cry from the supposedly demented man he had heard other mathematicians describe. Samak was more than a little outraged. Here was this giant and he had been all but forgotten by the mathematics profession. And the justification for the neglect was obviously no longer valid, if it had ever been.

That was 1990. In retrospect, it is impossible to say exactly when Nash's miraculous remission, which began to be noted by

mathematicians around Princeton roughly at the beginning of this decade, really began. But, in contrast to the onset

A822

-----823

of his illness, which became full-blown in a matter of months, the remission took place over a period of years. It was, by his own account, a slow evolution, "a gradual tapering off in the 1970's and 1980's."

Hale Trotter, who saw Nash nearly every day in the computer center during those years, confirms this: "My impression was of a very gradual sort of improvement. In the early stages he was making up numbers out of names and being worried by what he found. Gradually, that went away. Then it was more mathematical numerology. Playing with formulas and factoring. It wasn't coherent math research, but it had lost its bizarre quality.

Later it was real research

As early as 1983, Nash was beginning to come out of his shell and making friends with students. Marc Ducey, a graduate student in economics, sought Nash out in 1983. "I felt bold enough at the time to want to meet this legend. He discovered that he and Nash shared an interest in the stock market. "We'd be walking along Nassau Street and we'd be talking about the market." Ducey recalled. Nash struck Ducey as a "stock picker" and on occasion Ducey followed his advice (with less than stellar

-----824

results, it must be said). The following year, when Ducey was working on his thesis and was unable to solve the model he wanted to use, Nash helped to bail him out. "The calculation of an infinite product was involved," Ducey recalled. "I was unable to do it, so I showed it to Nash. He suggested I use Stirling's formula to compute the product and then he wrote down a few lines of equations to indicate how this should be done." All during this time, Nash struck Ducey as no odder than other mathematicians he had encountered.

By 1985, Daniel Feenberg, who had helped Nash factor a number derived from Rockefeller's name a decade earlier and was now a visiting professor at Princeton, had lunch with Nash. He was deeply struck by the change he saw in Nash. "He seemed so much better. He described his work in the theory of prime numbers. I'm not competent to judge it, but it seemed like real mathematics, like disreal research. That was very gratifying."

The changes were for the most part visible only to a few. Edward G. Nilges, a programmer who worked in Princeton University's computer center from 1987 to

1992, recalled that Nash "acted frightened and silent" at first.

In Nilges's last year or two in Princeton, however, Nash was asking him questions about the Internet and about programs he was working on. Nilges was impressed: "Nash's computer programs were startlingly elegant."

And in 1992, when Shapley visited Princeton, he and Nash had lunch and were able, for the first time in many, many years, to have quite an enjoyable conversation. "Nash was quite sharp then," Shapley recalled. "He was free of this distraction. He'd

learned how to use the computer. He was working on the Big Bang. I was very pleased."

That Nash, after so many years of severe illness, was now "within the normal range for the `mathematical personality` "raises a great many questions. Had Nash really recovered? How rare is such a recovery? Did the "recovery" indicate he had never really had schizophrenia, which, as everyone knows, is incurable? Were his psychotic episodes in the late 1950's through the 1970's really symptoms of bipolar illness, which is generally less debilitating and carries better odds of recovery?

-----826

Absent a re-diagnosis based on Nash's psychiatric records, no absolutely definitive answer is possible. Psychotic symptoms alone, psychiatrists now agree, "do not a schizophrenic make," and distinguishing between schizophrenia and bipolar illness when symptoms first appear remains difficult even with today's more precise diagnostic criteria. Nonetheless, there are strong reasons for believing that Nash's initial diagnosis was, in fact, correct and that he is one of a very small number of individuals who suffered a long and severe course of schizophrenia to experience a dramatic remission.

The fact that Nash's younger son has also been diagnosed with paranoid schizophrenia and schizoaffective disorder is strong evidence that Nash himself had schizophrenia. In contrast to the Freudian theories popular in the 1950's, when Nash was first diagnosed, schizophrenia is now thought to have a strong genetic component. 11

The duration and severity of Nash's symptoms combined with his inability to do work that was, prior to and since his illness, the principal passion of his life, and his withdrawal from most human contact is also powerful evidence. Moreover, Nash has described his

-----827

illness not in terms of highs and lows, bouts of mania followed by disabling depression, but rather in terms of a persistent dreamlike state and bizarre beliefs in terms not dissimilar to those used by other people with schizophrenia." He has spoken of being preoccupied by delusions, of being unable to work, and of withdrawing from the people around him. Mostly, however, he has defined it as an inability to reason." Indeed, he has told Harold Kuhn and others that he is still plagued by paranoid thoughts, even voices, although, in comparison to the past, the noise level has been turned way down. Nash has compared rationality to dieting, implying a constant, conscious struggle. It is a matter

of policing one's thoughts, he has said, trying to recognize paranoid ideas and rejecting them, just the way somebody who wants to lose weight has to decide consciously to avoid fats or sweets.

14

While psychiatry has made progress in defining disease, definitions of recovery remain controversial. The absence of obvious symptoms, as George Winokur and Min Tsuang wrote, "does not necessarily mean that [individuals] are well, since they still may be suffering from a

defect state that is stabilized and with which they have 828
 now learned to copedd"B such an assessment, possibly appropriate
 to Nash's state in the late 1970's and early 1980's, seems overly
 pessimistic now. Both the perceptions of those who know Nash and
 his own indicate a more expansive, farreaching change. "John has
 definitely recovered," said Kenneth Fields of Rider College, who
 has known Nash since the late 1970's and has had a great deal of
 firsthand experience with people who suffer from schizophrenia.
 It would be more accurate to describe Nash's recovery as a
 "remissiondd" And, it turns out, the remission, though miraculous,
 is not unique. Until a few years ago,
 nobody knew much about the life history of people with
 schizophrenia. The only studies dated to the 1970's and were done
 by psychiatrists who worked at state hospitals. Since the only
 older people who were still there to be studied were still sick
 enough to require constant hospitalization, schizophrenia was
 viewed as a degenerative disease. Its assault on the brain was
 thought to continue, more or less evenly, until death. Manfred
 Bleuler, a German psychiatrist, was the first researcher to
 systematically challenge this

-----829
 viewdd" In a twenty-year follow-up of more than two hundred
 patients, he found 20 percent "fully recovered." Moreover, he
 concluded that long-lasting recoveries did not result from
 treatment and hence appeared to be spontaneous. Then a German
 team at the University of Bonn did a long-term follow-up of
 patients who had been admitted to one of the city's psychiatric
 hospitals during the late 1940's and early 19 50's.

16
 Going back to the records, they reviewed the diagnosis of
 schizophrenia and chose only patients whose histories and
 symptoms were consistent with modern definitions of the disease.
 There were about five hundred. Then they located the people or
 their families and, through interviews with the patients and
 people who knew them, created detailed portraits of what had
 happened to them.

Many -- about a quarter -- had died, mostly suicides. Some were
 still institutionalized, apparently unresponsive to any drugs or
 to electroshock treatment, which was used far more extensively
 than in the United States. Another group was living with their
 families, but still had symptoms, especially the

-----830
 negative symptoms of lethargy, lack of drive, and lack of

interest and pleasure in life. But a surprisingly large group -- perhaps a quarter -- seemed to be symptom-free, living independently, with a circle of friends and jobs in the professions for which they had been trained or had held before they got sick. Most of these had not been under the care of a physician for years,

The researchers were extremely surprised. As news of the study results spread through the small global community of schizophrenia researchers, a team in the United States at the University of Vermont decided to undertake a similar long-term study. Despite their initial skepticism, their results were

remarkably similardd"Ten years after the disease struck, A830
 most patients were still extremely sick. Thirty years later,
 however, a significant minority were leading fairly normal lives.
 Only about

5 percent conformed completely to the backward image. Most of
 those who committed suicide, it turned out, did so in the first
 ten years of the disease. These appeared to be people who got
 well enough between acute episodes to appreciate the awfulness of
 what lay ahead of them and succumbed to despair. And most of the
 damage

-----831
 to thinking and emotion from the disease seemed to occur in those
 years as well. After that, symptoms seemed to level out.
 Subsequent research has somewhat tempered these optimistic
 conclusions.`., All long-term studies are plagued by
 uncertainties about diagnoses and by differences over what
 constitutes "recoverydd"A study by Winokur and Tsuang of 170
 patients, perhaps the most rigorous, found that thirty years
 after the onset of the illness, just 8 percent could be
 considered well. 19

Thus, while Nash's dramatic recovery is not unique, it is
 relatively rare.

While none of the studies was able to pinpoint factors that
 favored recovery, they suggest that someone with Nash's history
 prior to the onset of his illness-high social class, high IQ,
 high achievement, with no schizophrenic relatives, who gets the
 disease relatively late in the third decade, who experiences very
 acute symptoms early and gets sick at the time of some great life
 change comhas the best chance of remissiondd10 On the other hand,
 young men like Nash for whom the contrast between early
 achievement and the state to which they are reduced by the

-----832
 disease is greatest are also most likely to commit suicide. Since
 suicides are relatively rare for hospitalized patients, Martha
 may have saved Nash's life by insisting, during the 1960's, that
 he be hospitalized. Whether or not insulin shock and
 antipsychotic drugs, which apparently produced the temporary
 remissions Nash experienced in the first half of the 1960's,
 increased the odds of a remission later in life is unclear. Vv;le
 a larger number of patients who got sick during the 1950's, when
 antipsychotic drugs became available on a wide scale, were among
 those who were symptom free in late middle age, early treatment
 with drugs wasn't a particularly accurate indicator of what would

happen laterdd" At the same time, Nash's refusal to take the antipsychotic drugs after 1970, and indeed during most of the periods when he wasn't in the hospital during the 1960's, may have been fortunate. Taken regularly, such drugs, in a high percentage of cases, produce horrible, persistent symptoms like tardive dyskinesia comstiffening of head and neck muscles and involuntary movements, including of the tongue -- and a mental fog, all of which would have made his gentle

-----833

reentry into the world of mathematics a near impossibilitydd21
Nash's remission did not come about, as many people later

assumed, because of some new treatment. "I emerged from irrational thinking" he said in 1996, "ultimately, without medicine other than the natural hormonal changes of aging." He described the process as one that involved both a growing awareness of the sterility of his delusional state and a growing capacity for rejecting delusional thought. He wrote in 1995: Gradually I began to intellectually reject some of the delusionally influenced lines of thinking which had been characteristic of my orientation. This began, most recognizably, with the rejection of politically-oriented thinking as essentially a hopeless waste of intellectual effort.

14

He believes, rightly or wrongly, that he willed his own recovery: Actually, it can be analogous to the role of willpower in effectively dieting: if one makes an effort to "rationalize" one's thinking then one can simply recognize and reject the irrational hypotheses of delusional thinking."

-----834

"A key step was a resolution not to concern myself in politics relative to my secret world because it was ineffectual" he wrote in his Nobel autobiography. "This in turn led me to renounce anything relative to religious issues, or teaching or intending to teach.

"I began to study mathematical problems and to learn the computer as it existed at the time. I was helped (by mathematicians who got me computer time) By the late 1980's, Nash's name was appearing in the titles of dozens of articles in leading economics journals. Nash himself remained in obscurity. Many younger researchers, of course, simply assumed he was dead. Others thought that he was languishing in a mental hospital or had heard that he had a lobotomy. Even the best-informed saw him, for the most part, as a sort of ghost. In particular, with the exception of the 1978 von Neumann Prize, the result of Lloyd Shapley's efforts, the recognition and honors routinely accorded scholars of his stature simply failed to materialize. One particularly egregious episode in the academic year 1987-88 illustrated just how powerfully the perceptions of Nash's mental illness worked

-----835

to reinforce his marginalized status, even in the field, economics, that he had helped to revolutionize. Being elected a Fellow in the Econometric Society is, as one former president of the society put it, tantamount to getting

one's membership card in the club of bona-fide economic theorists." By 1987, there were some 350 living Fellows, including every past and future Nobel Laureate to date but Douglass North (presumably excluded because he is an economic historian, not a mathematical economist), as well as every leading contributor to game theory-Kuhn, Shapley, Shubik, Aumann, Harsanyi, Selten, and so forth comb not Nash. I I In late 1988, Ariel Rubinstein, a recently elected Fellow, was surprised to discover this "historic mistake" and promptly nominated Nash." The nomination came too late for the November 1989 election. Further, the society's bylaws required any candidate proposed by

a sole sponsor to pass muster with the society's A835
 five-member nominating committee-one of whose main tasks was, in
 any case, to "determine whether

-----836
 previous nominating committees had overlooked p"and to correct
 such oversights." As a result, the nomination was forwarded to
 the committee, which took it up in the spring of 1989. By then,
 Rubinstein, a game theorist who holds professorships at the
 University of Tel Aviv and Princeton University, was a member of
 the committee. The other members, all professors of economics,
 were Mervyn King at the London School of Economics (also a
 vice-chairman of the Bank of England), Beth Allen at the
 University of Minnesota, Gary Chamberlain at Harvard, and Truman
 Bewley at Yale14

ReRVSS-IO

The proposal to put Nash on the ballot sparked an intense
 controversy be-
 tween Rubinstein and the rest of the committee, one that dragged
 on for months. From the start, the issue was Nash's mental
 illness. Mervyn King said in 1996: "People felt in some vague
 sense this was relevant."" Other committee members pointed out
 that Nash had no recent publications, was not even a member of
 the society, and was unlikely to participate actively, if
 elected.

-----837
 16

At one point Truman Bewley, the committee's chairman, wrote to
 Rubinstein, "I doubt [Nash] would be elected, since he is well
 known to have been crazy for years," dismissing the nomination as
 "frivolous."

17

When Rubinstein refused to back down, Bewley asked him to find
 out more about "the current status of Nash's healthdd" Af
 Rubinstein objected that no other candidates were being similarly
 investigated, Bewley made his own inquiries, calling, among
 others, his colleague at Yale Martin Shubik, who had known Nash
 in graduate school and had received some of Nash's "mad" letters.
 Bewley reported back to the committee: "Regarding Nash, I
 inquired and learned that he is still crazy. Fellowship is an
 activity more than a reward for pastddwork. The fellows are the
 ultimate governing body of the Econometric Society.""
 In June, the committee voted four to one to keep Nash off the
 November

1989 ballot. Rubinstein was the sole dissenter. Beth Allen recalled, "People were asked to give a rank ordering. Nash didn't make it. Ariel had

-----838

a fit. He insisted Nash be put on the ballot anyway." Bewley made it clear that the matter was closed, a decision he later regretted. "It was the wrong decision;" he said in 1996.¹⁹ The episode is reminiscent of the Institute for Advanced Study's refusal, for many years, to grant a mathematics professorship to the world-renowned logician Kurt Gbdeidd⁴¹ But, in that case, there was considerably more justification, since the Institute's

tiny mathematics faculty feared that G6del's well-known A838
paranoia and terror of decision-making would hamstring its
ability to conduct business, which included the selection of each
year's visiting scholarSdd41

The crowning irony of this affair is that when Nash did get on
the ballot, in the election for 1990 (because Rubinstein
circumvented the nominating committee by submitting a joint
nomination with Kenneth Binmore, at the University of Michigan,
and Roger Myerson, at Northwestern Universityggea41 he received,
according to the Secretary of the society, Julie Gordon, "the
overwhelming majority of the votesdd041

You will have to wait to find out [the story of Nash prize] in
fifiyyears. We will never reveal it.

-----839

-

CARL-OL-OF JA-COBsoation,
secretary general, Royal Swedish Academy of Sciences, February
1997

IT

is

TuESDAY,

October 12, 1994. J6rgen Weibull, a personable young professor of
economics, looks at his watch for perhaps the fiftieth time.` He
is standing near the front of the massive Sessions Hall of the
Royal Swedish Academy of Sciences coma jewelbox of a room with a
heavily ornamented ceiling and portrait-lined walls comwh, at the
moment, is crowded with reporters and camera crews, jammed in
narrow aisles between the U-shaped tables. Near-pandemonium
reigns. Everybody is milling around, speculating in loud voices
about the delay. Weibull had been so elated when he left his
office at the University of Stockholm that midmorning that he
half walked, half ran through the highway underpass and up the
hill to the academy half a mile away. Assar Lindbeck, the
chairman of the prize committee, had asked him if he wouldn't
mind being on hand to answer questions at the

-----840

press conference -- quite an honor. But now Weibull's mouth feels
dry, his shoulders ache, and he can feel the first twinges of a
headache as he tries to imagine what has gone wrong.

The Nobel press conference had, as usual, been called for
eleven-thirty. These staid, heavily scripted events are always
held right after the final, ceremonial vote
and always

start on time. But it is one o'clock and there is no sign of any academy officials and no word either. All the reporters are saying that nothing like this has ever happened before. Suddenly, the enormous doors to his left swing open and a small knot of academy officials burst into the hall, all wearing slightly dazed expressions, like moviegoers stepping out of a theater into daylight. They hurry past the milling, shouting throng, ignoring the questions, brushing aside the demands for explanations. But Weibull, who is standing near the table with the microphones, manages to catch Lindbeck's eye for a fraction of a second. The relief is overwhelming. "Lindbeck didn't signal

or anything like that"be said later, "but I saw right away that everything had turned out all

A840

-----841
rightdd"I And the relief turns into something like joy when he listens to Carl-Olof Jacobson, the academy's handsome, silver-haired

secretary general, read the first few words of the press release: "John Forbes Nash, Jr., of Princeton, New jersey. . ."

The behind-the-scenes saga of John Nash's Nobel Prize is almost as extraordinary as the fact that the mathematician became a Laureate at all. For years after the idea of a prize for game theory was first considered, even Nash's most ardent admirers considered the likelihood of his winning impossibly remoteddble. But much later, when the prize was virtually his, after he had been told that he had won it, and within an hour of the official notification, the

ne plus ultra

of honors very nearly eluded him comwith far-reaching consequences for the future of the economics prize itself.

This previously untold story is one that the Royal Swedish Academy of Sciences and the Nobel Foundation comintend on preserving the Olympian aura that surrounds the prizes-have tried very hard to keep under wraps. The academy is one

-----842

of the most secretive of societies, and all details comthe nominations, inquiries, deliberations, and votes-of the lengthy selection process are among the most closely guarded secrets in the world. The very statutes of the prize demand it:

Proposals received for the award of a prize, and investigations and opinions concerning the award of a prize may not be divulged. Should divergent opinions have been expressed in connection with the decision of the prize-winning body concerning the award of the prize, these may not be included in the record or otherwise divulged. A prize-winning body may, however, after due consideration in each individual case, permit access to material which formed the basis for evaluation and decision concerning a prize, for purposes of historical research. Such permission may not be granted until at least 50 years have elapsed after the date on which the decision in question was taken.`

There have been breaches, of course. In the 1960's and 1970's, advance rumors

of the literature Laureates used to trickle out of the Academy of Arts and Letters with notorious regularity.` In 1994, a member of

the

-----843

Norewegian Nobel Committee quit over the impending peace prize to the Palestinian leader Yasir Arafat, and took his protest to the media. Michael Sohlman, the executive director of the Nobel Foundation, still sounds furious when he recounts the incidentdd7 But, few, if any, cracks have appeared, figuratively or otherwise, in the gray Beaux Arts walls of the Royal Swedish Academy of Sciences, guardian of the physics, chemistry, and economics prizes. If not for the mysterious one-and-a-halfhour delay on the day that the Nash prize was announced, the academy

might well have succeeded in protecting the secrecy of the A843 process. As it was, academy officials not only refused to explain the delay but denied that it was in any way significant. Indeed, they very quickly began to assert that it had never happened. Recently, Karl-Göran Mäler, a member of the economics prize committee in 1994 and privy to all of the events that transpired, said, "I do not recall any delaydd"I

The prize in economics is something of a

-----844

stepchildddd9 Alfred Nobel, the Swedish industrialist and inventor, did not have the dismal science in mind when he wrote his famous 1894 will creating Nobel Prizes in physics, chemistry, medicine, literature, and peace. The economics prize was not created until nearly seventy years later, the brainchild of the then head of the Swedish central bank. The prize is financed by the bank and administered by the Royal Swedish Academy of Sciences and the Nobel Foundation. It is not, in fact, a Nobel Prize, but rather "The Central Bank of Sweden Prize in Economic Science in Memory of Alfred Nobel." To the public, that is a distinction without much of a difference. The early winners of the economics prize -- among them Paul Samuelson, Kenneth Arrow, and Gunnar Myrdal- were generally acknowledged to be intellectual giants and lent their distinction to the prize. And, so far at least, it has become "the ultimate symbol of excellence for scientists and laymen alike"and does in fact make economics Nobelists "life peers in the world community of scholarsdd011

The criteria, rules, and procedures for the economics prize are patterned after those that apply

-----845

to the science prizesdd"Candidates must be living. No more than three can share a prize, which is less of a problem in economics than in physical science, where teamwork is more the norm. Though many people, even those who participate in the nominating process, have failed to appreciate it, the Nobel is not a prize for outstanding individuals nor is it a lifetime achievement award. The prize is awarded for specific achievements, inventions, and discoveries. These can be theories, analytical methods, or purely empirical results. As in physics, in which mathematics plays as big a role as in economics, there is a strong bias against prizes for only mathematics." (Nobel himself is said to have hated mathematicians, though some of the best

stories about why-revolving around sexual and professional jealousy -- turn out to have been apocryphal). I I

The prize selection process is also virtually identical to the cycles for the science prizes.

14

A five-member prize committee, composed of senior Swedish economists, gathers nominations and referees reports from elite academics around the world. The committee makes its choice every spring,

usually in April. The so-called Social Sciences Class-all 846
academy members in economics and other social sciences
comendorses the candidate or candidates in early fall, usually
late August or early September. And the academy votes on the
nominees in early October, on the day that the winner or winners
are announced.

On paper, at least, all the members of the prize committee are as
distinguished as the candidates, and the selection of winners is
a detached, disinterested, and, ultimately, democratic exercise
in scientific judgment comz divorced from personal likes and
dislikes, prejudices, or political and pecuniary considerations
as the business of determining the winners in a sports
tournament. There is some, even a
good deal, of truth in this idealized description of what
actually goes on, but it is not anything like the whole story.
Assar Lindbeck, who joined the prize committee in 1969 and became
its chairman in 1980, has dominated the economics selections for
the entire history of the Nobel Prize." Tall, red-haired,
powerfully built, he looks like the

-----847
boss of a machine too] shop or a mine. He is from the far north
of Sweden, a little crude, a little uptight, more than a little
brusque. He has opinions, strong ones, about nearly all topics
that engage his lively mind, and as a result is quite unpopular
in the academy. But he is not without a certain earthy charm. His
sense of humor is sly and dry. He is a Sunday painter comshowing
up at prize committee meetings with paint spatters on his
horn-rimmed glasses. A large -- and extremely graphic -- erotic
painting hangs in his office at the university.

Lindbeck is Sweden's most important economist. Top academic
economists in Sweden, where academia, government, and industry
have long been closely entwined, have traditionally wielded a
great deal more political power than their American counterparts.
16 Bertil Ohlin, the committee's first chairman, was for years
the leader of Sweden's opposition. Gunnar Myrdal, who won the
prize in 1974, was a minister in the Social Democratic
government. Lindbeck himself was a prot6ong6 of Prime Minister
Olof Palme, has held many political advisory posts, and has been
involved in most public policy

-----848
debates since the 1960's.
Unlike Ohlin and Myrdal, Lindbeck never abandoned his research
career to become a full-time politician. Indeed, he is generally

considered a likely contender for a Nobel himself. Even today, at age sixty-eight, there is a small assembly line on the shelves behind his desk at the University of Stockholm: impressively large piles of paper marked "Articles Under Preparation," "Articles Submitted," and "Articles Accepted." And he has used his political savvy and prestige to build up economics departments and research institutes. "He's kind of a mafia leader, a fixer," was said Karl-Gustaf Larsson, an adjunct member of the economics prize committee and a professor of resource economics at the University of Umea.

17

He adds: A848

I never did any resource economics, but I became a professor of resource economics. [Lindbeck] has good ideas about who to move here and there. He listens. He has his own opinions. I like him. He's a very sound guy. Very smart.

-----849

Lindbeck has a reputation for getting his way. His style is that of a central banker rather than a chief executive officer. As his longtime friend Wer put it, "Assar never controlled with commandsdd011 In an article Lindbeck wrote on the economic prize in the mid-1980's, he bragged: "So far the proposals of the prize committee to the Academy have been unanimous. A consensus has in fact developed quite 'automatically` within the committee, as if by some kind of invisible hand, after intensive discussionsdd019 The invisible hand, of course, was his own. "You could put it that wayea"said Wgren, laughing. "You can sdy

it's unanimous. ... But he's a dominating person. We don't vote officially. You agreedd010

Kerstin Fredga, the president of the Swedish Academy of Sciences, said at one point, "Very few people have ever dared say no to Assardd"I I Ironically, by December 1994, when Fredga made the remark, it was no longer true.

-----850

John Nash's name first appeared as a candidate for a Nobel in the mid-1980'sdd11 The Nobel selection process is like a giant funnel, At any given time, the economics prize committee has a dozen "investigations" running of fields and clusters of possible candidates. But, fairly quickly, the focus shifts to the hottest fields and candidates. By 1984, the "obvious" Nobels had been handed out to the likes of Samuelson, Arrow, and James Tobin. The committee was looking further afield among newer branches of economics, and nothing was newer or hotter at that particular moment than game theory." In 1984, the prize committee contacted a young researcher at Hebrew University in Jerusalem. A combat veteran and an activist in Israel's peace movement, Ariel Rubinstein took months to write a painstaking ten-page report on potential candidates for a prize in game theory. He placed Nash at the top of the Ji/Dd14

The 1982 paper that established Rubinstein as one of the leading

researchers in game theory was an extension of Nash's 1950 bargaining paper¹⁵ Rubinstein's sense of indebtedness to Nash and his

-----851

appreciation for Nash's original achievement were thus very vivid. Having encountered Nash on a visit to Princeton, Rubinstein also could not help but be struck by the stark contrast between Nash's past contributions and his current circumstances. His outrage was fueled partly by a firsthand encounter with the stigma of mental illness: his mother was once hospitalized for depression, and Rubinstein never forgot the lack

of basic human respect accorded her by doctors and relativesdd16 A851

The Nobel Prize committee did not take up the matter again until 1987, when it commissioned a second report, this time from Weibulldd17 After he submitted it, Lindbeck told him that the committee wanted to ask him some questions and asked him to attend a couple of committee meetings at the Royal Academy. Weibull was, of course, pledged to complete secrecy. When Weibull walked into the paneled room, introductions were hardly necessary. As a member of Sweden's small academic elite, Weibull already knew the five men, mostly academics, sitting around the enormous table. He was nonetheless slightly awed, realizing from the committee's questions that

-----852
he was being given the opportunity to participate at the earliest stage of a historic decision. "My impression ... [was] that it was the first time that the committee had met to consider thisdd018 Weibull presented a verbal summary of his report, telling the committee about the central ideas in game theory, their importance for economic research, and the key contributors. He, too, had placed Nash at the top of his list of half a dozen seminal thinkers.

The committee's questions were carefully phrased to hide the members' own opinions, and focused, in the first session, on whether game theory was just a fad or really an important tool for investigating a wide range of interesting economic problems. By the second meeting, however, Lindbeck, the committee chairman, zeroed in on Nash. Was what Nash did merely mathematics? Lindbeck asked. Did he simply formalize ideas that economists had formulated at least a hundred years earlier? Was it true that Nash had stopped doing research in game theory in the early 1950's? That question was the closest anyone came to mentioning the subject of Nash's mental illnessdd19

-----853
When Weibull left the meeting, he thought that there was a good chance that the committee would eventually agree to award a prize in game theory, but he had no reason, given Nash's illness and the decades that had passed since his early papers, to believe that Nash would make the cut.

Eric Fisher, a visitor at Stockholm University's Institute for International Economics that year, recalled being quizzed by Assar Lindbeck about Nash's mental state. Fisher had been an undergraduate at Princeton, where he used to see Nash hanging out

in the foyer of Firestone Library. Lindbeck wanted to know whether Nash was "competent enough to handle the publicity that winning [a Nobel] might entaildd010

It was two years later, the fall of 1989, that Weibull hurried across the Princeton University campus to meet Nash for the first time." After weeks of delicate negotiation, with the chairman of the mathematics department acting as a go-between, the elusive mathematician had finally agreed to have lunch. Weibull had a specific motive for the meeting. Lindbeck had pulled him aside shortly before his departure from Sweden and asked him to report back to him on Nash's mental

state. There was some talk, Lindbeck said, that Nash had 854
some sort of remission and was behaving quite reasonably. Was it
true? Weibull was about to find out.

Weibull knew instantly that the tall, white-haired, frail-looking
man standing in the driveway in front of Prospect House,
Princeton's Florentine faculty club, was Nash. He was standing
there rather awkwardly, smoking, looking down at the ground,
obviously dressed up for the occasion, wearing white tennis shoes
but also a long-sleeved dress shirt and long pants. As Weibull
drew nearer, he could see that Nash was deathly nervous. When
Weibull gave him his ready, friendly smile and extended his hand,
Nash was unable to meet his eye and, after the briefest of
handshakes, instantly put his hand back into his pocket.

They ate, not in the main, formal restaurant, but downstairs in a
small cafeteria. Weibull, a gentle, soft-spoken man, asked Nash
questions about his work. Sometimes the conversation took odd
turns. When Weibull asked Nash about refining the Nash
equilibrium concept by, perhaps, taking into account irrational
moves by players, Nash answered him

-----855
by talking, not about irrationality, but about immortality. But
on the whole, Nash struck Weibull as no more eccentric,
irrational, or paranoid than many other academics. Weibull
learned interesting details about Nash's game theory papers that
he hadn't known. Nash had gotten his idea for the bargaining
solution as an undergraduate at Carnegie Tech by thinking about
trade agreements between nations. While he had used both
Brouwer's and Kakutani's fixed-point theorems to prove his
equilibrium result, he still thought that the proof relying on
Brouwer was both more beautiful, and more apt. He said that von
Neumann had opposed his idea of equilibrium, but that Tucker had
supported him.

Afterward, though, what stood out for Weibull about the meeting,
and the thing that transformed him that day from a detached
observer and objective informant into an ardent advocate, was
something Nash said before they walked into the club. "Can I go
in""Nash had asked uncertainly. "I'm not facultydd"T this great,
great man did not feel that he had a right to eat in the faculty
club struck Weibull as an injustice that demanded remedy.
By the summer of 1993, rumors about a possible

-----856
prize in game theory were rampantdd"A very small, very select
symposium on game theory had taken place in mid-June, at what

used to be Alfred Nobel's old dynamite factory in Bjorkborn, a few hundred kilometers north of Stockholm. These symposia, sponsored by the prize committee, are invariably seen as Nobel beauty contests. This one was organized by Karl-Göran Marer with the help of Jörgen Weibull and a Cambridge economist, Partha Dasgupta. Lindbeck, who was spending the spring term in Cambridge, oversaw the preparations by telephone. The dozen or so invited speakers represented two generations of leading game-theory researchers, mostly theorists and experimentalists, among them John Harsanyi, Reinhard Selten, Robert Aumann, David Kreps, Ariel Rubinstein, Alvin Roth, Paul Milgrom, and Eric

Maskin. The topic? Rationality and Equilibrium in Strategic Interaction. A856

Most of the participants took it for granted that they were performing for the benefit of the prize committee and assumed that the three graybeards in the group, Harsanyi, Selten, and Aumann, were the likely Laureatesdd14 Aumann, the white-bearded -----857

Israeli dean of game theory, was strutting around "as if he had already wondd"Much was made of the choice of topic, which was theoretical and focused on noncooperative as opposed to cooperative games, and those who hadn't been invited comNash most obviously, of course.

As it turned out, the prize committee was far from committing itself to a candidatedd"Protestations that the main motivation for the symposium was to create an opportunity for the committee "to educate itselfea"z Torsten Persson of the prize committee put it later, were accurate. Only one other prize committee member besides MA-LER was even there-and that was Ingemar Stahl. His brother, Ingolf, was one of the speakers, and Ingemar intimated that he had come to hear him. But everyone assumed that he was there to act as a spy for the committeedd16

A few weeks later, Harold Kuhn, the professor of mathematics and economics at Princeton University, got an urgent fax from Stockholm. It was from Weibull, who wanted Kuhn to send a number of documents, among them Nash's Ph.D. thesis and a RAND memorandum-"no later than mid-August pleasedd03fulWeibull also asked Kuhn to get him a transcript of an -----858

interview with Nash conducted by Robert Leonard, the historian. Leonard, who had not taped the interview, wrote Kuhn a note in which he said that the request "sent my mind reeling in the Swedish direction."

31

In Stockholm, meanwhile, the prize committee was about to report to the so-called Ninth Class of the academy-all the academy members in the social sciences. 19 The bulk of the report, of course, was devoted to the proposed candidates for 1993, two economics historians, Robert Fogel of the University of Chicago and Douglass North of Washington University in St. Louis. But the committee also updated the class on two or three other proposals that constituted the top choices for subsequent prizes. One of them was a prize in game theory; Nash was on the short list of half a dozen candidatesdd40

Nearly the only point the prize committee had agreed on was that it wanted to go ahead with a prize in game theory in 1994, the fiftieth anniversary of John von Neumann and Oskar Morgenstern's great opus.

Lindbeck and the others were still toying with "every possible
-----859

configuration" of two and three winners

.41

The short list of the candidates that the committee had focused most of its attention on had scarcely changed since the prize was first conceived. 41 Apart from Nash it included Lloyd

Shapley, whom Nash had known as a graduate student at A859 Princeton. Shapley was the most direct intellectual descendant of von Neumann and Morgenstern and the clear leader of the field in the 1950's and 1960's when most of the work was in cooperative theory. Reinhard Selten and John Harsanyi, who had elaborated the theory of noncooperative games, were also on it. Harsanyi's breakthroughs permitted analysis of games of incomplete information while Selten developed a way to discriminate between reasonable and unreasonable outcomes in games. Aumann, who developed the role of common knowledge in games, was also on the list. And Thomas Schelling, who invented the notion of the strategic value of brinkmanship, was being considered because of his broad vision for the application of game theory to the social sciences.

The prize decision is made in stages

.41

-----860

Each year the committee starts meeting soon after the January 31 deadline for the two hundred or so nominations that the committee solicits from prominent economists around the world. By April, the committee decides on a particular candidate or candidates. In late August, it submits the proposal comalong with a document several inches thick that includes the referee reports, publications, and other supporting material comto the Ninth Class for endorsement. The academy then votes on the candidates in early October. But, as everyone involved was well aware, the power truly resides in the committee and, until recently, in one man, Assar Lindbeck. #6Fgren said, "The prize committee meets for a whole year. It's technically impossible for the higher body to make the decisiondd044 Debate in the committee was unusually contentious from the first meeting, attended by Lindbeck, M51er, Stahl, Persson and Lars Svensondd41 Lindbeck had come to the conclusion that the prize should be for contributions to noncooperative theory alone. These were the ideas that had proved fruitful for economics, "the most important so farea"z Lindbeck later said, adding "cooperative theory

-----861

has a few interesting applications in economics, but perhaps more in political sciencedd046 Although Maler sided with Lindbeck from the start, convincing the rest of the committee was harder than the latter anticipated. "It seemed self-evident afterward. But it

took a long time to come to this conclusion. And to convince othersdd041

Of

course, he later admitted, narrowing the prize down in this way would immediately knock out some of the obvious contenders, namely Shapley and Schellingdd41 And here was the real bone of contention: Focusing on noncooperative theory also meant that it would be difficult to deny Nash the prize. "Once we decided to limit the prize to noncooperative theory then it was very easy to decide who were the ... [key contributors). Then it was obvious that Nash is [part of the] Nobeldd049 Lindbeck proposed a

three-way prize for the definition of equilibria in A861
noncooperative games: Nash, Harsanyi, and Seltendd111

This was where the debate got nasty.

The person on the committee least intimidated by Lindbeck and
best equipped intellectually

-----862
to challenge him was Ingemar Stahl, a sixty-year-old professor at
Lund with a joint appointment in economics and law." Stahl is a
quick study and a brilliant debater, a man who delights in taking
contrarian, often extreme positions, in any debate. He had long
been one of the most active committee members and had written
many of the committee's prize proposals since the early 1980's.
Stahl is short, with a large head and a big belly. His detractors
call him Zwergel or "little dwarf"bbh his back. A onetime
wunderkind who never quite lived up to his early promise, Stahl
owes the prestigious chair at Lund, his academy membership, and
his longtime position on the prize committee more to his
political connections and his high-profile posture in public
policy debates than to his research output. Like Lindbeck, Stahl
began his upward climb early, while he was still in high school,
as a prot6ong6 of various Social Democratic politicians,
including Palme, but he had gone over to the conservative
opposition in the late 1960's. Stahl was deeply and adamantly
opposed to awarding the prize to Nash. From the start, he was
highly

-----863
skeptical of game theory comz indeed he is of all pure theory. He
is an institutionalist, likes intuitive rather than formal
reasoning, and is leery of mathematics and "techniciansdd"He was,
for example, a main mover behind the prizes for James Buchanan in
1986 and Ronald Coase in 1991 --
economists whose theories focus on the way governments and legal
structures affect the workings of

365
markets. He also prides himself on grasping Nobel politics. The
more he learned about Nash, the less he liked the idea of giving
Nash a prize. In particular, he considered giving the prize to
Nash the kind of ill-considered gesture that was likely to result
in embarrassment and, more important, make the committee look
bad.

"I knew he had been illea"he said later. "I didn't think many
people knew about it. I guess I heard Hbrmander's version."

51

Stahl had done quite a bit of digging. In the early fall, he had made a call to Lars H6rmander, Sweden's most eminent mathematician and winner of the

-----864

1962 Fields Medal." Hbrmander had just retired from the University of Lund. Stahl identified himself as a member of the Nobel Prize committee. He'd heard that Hbrmander had known Nash quite well in the 1950's and 1960's, he said. The committee was thinking of giving Nash a Nobel Prize. Could H6rmander give him the lowdown on Nash?

Hbrmander was surprised. Like most other pure mathematicians, he

didn't think much of Nash's work in game theory. And the last time Hbrmander had laid eyes on Nash was in the academic year 1977-78. Hbrmander had been in Princeton and he had seen Nash hanging around Fine Hall. Nash was "a ghost" Hbrmander didn't think Nash had recognized him or had even been aware of his presence. Hbrmander hadn't even tried to speak with him. To give such a man a prize seemed to him "absurd, risky."

14

Hbrmander was precise and frank. His memories of Nash were extremely distasteful. He recalled Nash's decision to give up his citizenship; his deportation, first from Switzerland, then from France; Nash's bizarre behavior at the 1962 conference in

-----865

Paris; the stream of anonymous cards, with their hints of envy and hostility, that came after Hbrmander won the Fields in 1962. Stahl had also made inquiries among several psychiatrists he knew who, he says, described the illness as unlike depression or mania, where the self remains intermittently at least recognizable. "I knew this type of illness" he said later. "I know some psychiatrists here. Some of the best head shrinkers. When I talked to them I found out that with this disease there is a complete change of personality. He is not the man who did the thing."

Lindbeck, relying on reports from Weibull and Kuhn, was telling committee members that Nash was much improved, that he had, in fact, recovered his sanity. 16 About this, too, Stahl was deeply skeptical. The psychiatrists he spoke to told him that schizophrenia is a chronic, unrelenting, degenerative disease. "It's a very tragic illness. It gets calmed down but actually recovering is another matter."

Stahl knew that there was great sympathy for Nash. And he could see that Lindbeck had made up his mind. So he didn't attack frontally, but simply

-----866

raised question after question. "He'd throw out an argument and somebody would shoot it down" said another member of the committee. "Then he'd shift to another argument. He tried to irritate and confuse us ... to raise doubts."

18

Stahl would say, "He's sick.... You can't have a person like that"

019

He asked what would happen at the ceremony, "Would he come? Could he handle it? It's a big show"

061

He quoted Hbrmander and others who had known Nash in the 1950's and 1960's. He read them what he considered a particularly damning quotation from a book by Martin Shubik, who had known Nash as a graduate student.

"The most damning thingea"Stahl repeated later, was something Martin Shubik wrote in one of his books: that "you can only understand the Nash equilibrium if you have met Nash. Ifs a game and it's played alonedd061

He brought up Nash's work for RAND: "These guys worked with the atom bomb during the cold war. It would be a shameful thing for

the prizedd061

A866

-----867

He brought up Nash's lack of interest in game theory after graduate school. As Lindbeck, Jacobson, the academy's secretary general, and others later hinted, Stahl was not the first member of a Nobel Prize committee who was motivated by deep animus toward a particular candidate or who embraced a wide range of intellectual objections in an effort to derail the candidatedd61

But as the spring wore on, Stahl made a great many midnight phone calls. He seemed, Weibull later recalled, to be trying out any and all arguments against Nash's candidacydd61

What was certainly the case throughout those months, a member of the Swedish academy said, was a growing feeling on Stahl's and others' part that "a few bad choices would sink the prize. Nash was of course a very weak prize. People were afraid that the thing would blow up. A big scandaldd061 And David Warsh, a syndicated columnist in whom Stahl evidently confided, subsequently wrote, "The whole intellectual world is watching to see what the Swedish Academy of Sciences is going to do about Nash. The Swedes are known to be worried about what Nash might saydd066 Christer Kiselman, head

-----868

of the mathematics class of the academy at the time and a member of the academy's governing council, remembers talking to Stahl. He recalls that Stahl told him that Nash's work was done too long ago and was too mathematical to warrant a prizedd61 Kiselman, whose son Ola has suffered from schizophrenia since age sixteen, had a different interpretation: "[Stahl) was afraid of schizophrenia. So he had some prejudices. So he thought other people would think the same way. He was afraid of some scandal that would reflect on the committee."

61

One by one Lindbeck knocked down Stahl's objectionsdd69 Lindbeck has a reputation for courage. He has never been afraid to take unpopular positions, even at the risk of alienating his political allies. In the late 1970's, for example, he had publicly opposed a favorite Social Democrat proposal to promote worker ownership of manufacturing concerns that had become trendydd70 Now Lindbeck took the position that Stahl's objections-that Nash was a mathematician, that Nash had stopped being interested in game theory forty years

-----869

earlier, that Nash was mentally ill comwere irrelevant. He too

was worried that Nash would do something peculiar at the ceremony, but he was sure that could be managed. In any case, it was no basis for denying the prize to someone who was, on intellectual grounds, obviously worthy. Besides, he found that his emotions were involveddd71 Most Laureates were already famous and much honored. The Nobel was only a crowning glory. But in Nash's case it was quite different. Lindbeck thought a great deal about the "misery of his life"and that Nash had been, for all intents and purposes, forgotten. Later, he was to say, "Nash was different. He had gotten no recognition and was living in real misery. We helped lift him

into daylight. We resurrected him in a way. It was A869
emotionally satisfying.0"The only other time Lindbeck had felt
similarly was when a Viennese libertarian and critic of Keynes,
Friedrich von Hayek, won. "Hayek was so hated, so despised....
He'd been in a very deep depression, he told me. It was terribly
satisfying to indicate his greatness.""

The committee listened to Stahl, but it soon became

-----870

clear that he wasn't going to win allies. The younger men,
Svenson and Persson, were keen on a game-theory prize, and the
older ones weren't inclined to pick a fight with Lindbeck.
The normal procedure when there are unresolved disagreements is
to append a formal reservation -- a minority opinion -- to the
committee reportdd14Such reservations, which are duly reported to
the full academy at the voting session, are not unheard of in
physics or chemistry." And, although they are not reported in the
announcements at the time of the decision, they become part of
the official record and may be made public after fifty years.
Things were different in the economics committee. Lindbeck was
extremely proud of its record and apparently regarded unanimity
as necessary in maintaining the prize's credibilitydd16
As the report to the Ninth Class was being readied, Stahl
threatened to register a formal reservationdd"In the end-whether
because of pressure from Lindbeck, advice from his old friend
Maler, or simply a reluctance to go down in history as first to
break the former pattern of unanimity-he did not. The Class,
which is used to going along with committee proposals, endorsed
the proposal.

-----871

To Lindbeck, this was the end of the matter. He had prevailed, as
he usually did. He felt, however, that extraordinary measures
were necessary to make sure that everything would go smoothly
once the media furor broke. He took an unprecedented step. He
telephoned Kuhn in Princeton and told him that "it's ninety-nine
percent certain now"t Nash would get the prize. "The votes were
unanimousea"he told Kuhn, not giving any hint of the
controversy." He gave Kuhn permission to inform the president of
Princeton University of the impending award so that the
university could make arrangements. As it turns out, Kuhn had to
wait until after Labor Day to pass along his exciting newsdd71
Harold Shapiro, president of Princeton, was away on vacation.
For once, Lindbeck, for all his political savvy, was wrong. It
was not just that Stahl, who was far angrier than Lindbeck

appreciated at the time, was a powder keg waiting to explode. Rather, Lindbeck's own long reign, and, indeed, the economics prize itself, were on shakier ground than he imagined. Powerful critics of both within the academy, including a former secretary general of the academy and a number of

-----872

prominent physicists, were itching to do something. This prize had become an issue for them. Few people outside Sweden, indeed, few outside the Royal Swedish Academy of Sciences, realize how controversial, even vulnerable, the economics prize has been

since its creation in 1968 and continues to be to the present. A872

The economics prize has never been especially popular within the academy, "Many people question the Nobel Prize [in economics] herea"said one longtime member." Oldtimers still thought it had been a grave mistake to add a new Nobel to the original prizes. They thought it cheapened the currency and had, after the "mistake" of accepting the economics prize, successfully fought off efforts to establish other prizes that used the Nobel name. Erik Dahmen, an economist who was a close adviser to one of the richest families in Sweden, the Wallenbergs, calls it "the so-called Nobel Prize in economics."He adds:

This is not really a Nobel Prize. It should never be spoken of together with the other prizes. The academy should never have accepted the prize in economics. I have been against

-----873
the prize since I became a member of the academy. One physicist said: "The economics prize was just a way of jumping on the Nobel bandwagon, piggybacking on the Nobel." Economics was not held in high regard by many of the natural scientists who dominated the academy. It is not, they said, a sufficiently scientific field to deserve equal footing with hard sciences like physics and chemistry. Ideas, they said, slipped in and out of fashion, but one could not point to scientific progress, a body of theories and empirical facts about which there was certainty and near-universal agreement. Anders Karlquist, a physicist, said, "It's not as solid and big an enterprise as chemistry and physics." Lars GA-RDING, a mathematician at the academy, for example, said later that Nash's prize was for "a very small thing."

14
Finally, there is a widespread feeling, particularly on the part of natural scientists and mathematicians, that the shallowness of the field was leading to a sharp and rapid decline in the quality of Laureates coma decline that would necessarily

-----874
worsen with time. Bengt Nagel, secretary of the physics Nobel Prize committee, jokingly quotes an economist who is supposed to have said in the early 1980's, "All the mighty firs have fallen. Now there are only bushes left." There are occasional calls to abolish the prize. After Myrdal won

the prize, he is supposed to have suggested abolishing the prize because there were no longer any prizeworthy candidatesdd16As recently as 1994, Kjell Olof Feldt, the former minister of finance and soon-to-be chairman of the board of the Bank of Sweden comwh finances the prize comsuggested in a lengthy article in a political monthly that the prize be done away with." But although many academy members regret that the prize was established in the first place, said Karlquist, they "realize that it's a fact of life.", By 1994, in fact, the critics' objective was to wrest control of the prize from the economists. Lindbeck was personally

unpopular. It was particularly galling that membership in the economics prize committee seemed to be a lifetime sinecure and that its members could choose winners without any real accountability to the

-----875
academy.

In February, an academy committee had "suggested" the economics prize committee be forced to operate by the same rules that apply to the physics and chemistry committees. The suggestion was not binding, but it was a warning note, the first concrete sign that critics of the prize were gaining momentum, and it carried with it the promise that the academy council would, when it got around to it, appoint another group specifically mandated to deal with the matter of the economics prize. The imposition, as for other standing committees, of term limits would, of course, have a drastic and immediate effect on the economics committee. It would eliminate Lindbeck, Miler, and Stahl, the three longtime members, and virtually end their reign. The other, and more drastic, suggestion was to widen the membership to include non-economists and, most radically, to transform the economics Nobel into, in effect, "the Nobel Prize in social sciences," a notion that appealed not only to natural scientists, but also to the psychologists, sociologists, and other non-economists in the academy's Ninth Class.

Thus the debate between Lindbeck and Stahl over

-----876
whether Nash was a suitable candidate for the prize, a debate

that really turned on whether the choice of Nash would embarrass the committee, took place in an unusually hostile atmosphere and under intense scrutiny. The future of the prize committee and the prize looked more vulnerable than they had in times past. All of these behind-the-scenes opinions and maneuvers explain why, between early September and early October, Stahl acquired a powerful set of allies who joined him for reasons quite apart from Nash's candidacy. The stage was set.

In the end, Nash and the two other candidates for the 1994 economics prize passed by a mere handful of votes, the first in the history to skirt so close to defeat. It is a peculiarity, indeed a major administrative and logistical headache, of the Nobel Prize process that no award can really be said to exist until the members of the fall body of the Royal Swedish Academy of Sciences have had their say. They have "the sole right to decide" a Nobel Foundation booklet puts it: "Even a unanimous

committee recommendation may be overruled091 Only when the plenary session has cast ballots and the votes are counted and the results

-----877

announced do the secretary general and members of the prize committee march off to telephone the winners. They then proceed to the Sessions Hall to announce the winners` names to the world press. Other prizes, like the Fields Medal for mathematics or the John Bates Clark medal for economics, by contrast, are settled months ahead of time, their winners notified after a leisurely interval and carefully instructed to sit on the secret until the

awarding institutions get around to issuing their press releases or

A877

holding their festivities. Presumably, the inconvenience of the last-minute Nobel vote is outweighed by the benefit of being able to avoid leaks before the official announcement.

The Nobel vote, moreover, is traditionally a mostly ceremonial affair, the final flourish after a lengthy selection procedure that is more or less completely dominated by the senior members of the prize committees. In the case of the economics prize, a few dozen random academicians come a fraction of the number who turn out for the physics or chemistry prizes, the other two Nobel awards administered by the academy- assemble in the second week of October largely for the pleasure of hearing

-----878

a distinguished lecture on the proposed candidates' contributions to scientific progress. As one academy member put it, "Members attend less for the vote itself than for a chance to hear the presentations."

14

In some recent years, the modest quorum of forty academy members has proved difficult to achieve⁹¹ According to the rules, academy members have three options. They may vote for the candidate or candidates proposed by the committee and endorsed by the Social Sciences Class. They may vote for an alternative candidate of their own choosing. Or they may vote not to give a prize that year. The winner or winners must obtain a simple majority of votes. Until 1994, no candidates proposed by the committee had ever failed to gain a wide majority of votes.

The academy meeting that began promptly at 10:00 A.M.

on Tuesday, October

12, in a rather small, poorly lit auditorium tucked in a far corner of the academy's ground floor⁹⁶ promised to be no more or less interesting than previous years' meetings. Fewer

-----879

than sixty members were scattered around the room, but, as the officials present noted with satisfaction, there was no question of not getting a quorum. (A couple of years earlier, thirty-nine members had sat in that room waiting for a fortieth -- who did finally show up⁹¹ Kerstin Fredga, the astrophysicist who was the academy's president, and Carl-Olof Jacobson were sitting side by side on the stage. The ballot box was perched at the end of the platform. The five members of the prize committee who belonged to the academy were sitting near the front of the room.

Lindbeck was at the podium in a few long strides. Wearing his thick blackrimmed glasses and usual frown of concentration, Lindbeck dove right into his subject, an overview of the entire process by which the committee had arrived at its recommendation for a prize in game theory, Always intense, Lindbeck stuttered with excitement, waved his long arms, and made a good many very dry jokesdd91 He was followed by Jacobsonealow-keyed by contrast, who gave the official endorsement of the Social Sciences Class. Both men claimed that the decisions by the committee as well as the Class were, as always,

unanimous. Lindbeck added that unanimity had come about "as 880
if by an Invisible Hand`was his standing joke. Finally, M51er
got up and launched the main presentation, a lecture on the
contributions of the three candidates.

The lecture was quite disappointing. M51er, never a brilliant
speaker, was more nervous and unsure of himself than usual⁹⁹ He
quickly became mired in technicalities and jargon. He read most
of it, His wife had left him a few weeks
earlier, he was agitated and depressed, and he had had a terrible
time preparing the talk.

All this took something like an hour. Had things proceeded as
usual there would have been a few rather perfunctory and mostly
polite questions from the floor, perhaps a standard monologue by
one of the oldtimers about the dubiousness of the economics prize
in the first place, before a general silence, a passing-out of
plain squares of white paper and number two pencils, quick
scribbles, folding, and the drifting down of academicians to the
stage to stuff their ballots in the box.

Instead, all hell broke loose. Later the president of the Nobel
Foundation remarked wryly that "Troy could only have been
destroyed by someone inside

-----881

the walls. And that's what happened here."""No one recalls
whether

Stahl launched

the first verbal grenade, but it was soon obvious to Lindbeck and
M51er that they were in the midst of an ambush. Stahl challenged
Maler to give a single major example showing that the theory had
any empirical validity whatsoever. Wer, who was in particularly
poor shape to answer questions, fumbled. Stahl did notcontrary to
a story six weeks later in

Dagens Nyheter,

one of Sweden's two dailies comd anything as crass, or risky, as
to urge the academy to withhold the prize to Nash because of the
mathematician's mental illness."" Instead, he argued, forcefully
and brilliantly, that a prize for non-cooperative game theory was
too narrow, too insubstantial, too technical. He reminded the
audience that Nash's contribution had been made nearly half a
century earlier and that it was more mathematics than economics.
He derided Harsanyi and Selten for being "boring,0"mere
techniciansdd"Other members of the audience soon chimed in.
Stahl did not make the mistake of merely

-----882

criticizing the committee's proposal, which, after all, he had signed. He had an alternative, he said.",` In light of the members' unhappiness, in light of unanswered questions, in light of Wer's clearly unsatisfactory report, might it not be more prudent to postpone the prize in game theory? Why not vote instead to give the prize to Robert Lucas, the University of Chicago professor whom the committee had virtually decided to propose for the following year."` Everybody, he reminded them, was enthusiastic about Lucas, who had invented a theory to explain why governments` efforts to manage the business cycle were doomed to failure com"rational expectations"- and was

clearly one of the most important economists of the century. It was an unassailable choice. A882

Lindbeck, who had at first seemed stunned by the audacity of Stahl's surprise attack, told the members in no uncertain terms what Stahl was implying. He reminded the members that Stahl had signed on to the game-theory prize and accused Stahl of wishing to scuffle the prize because of Nash's illness. He told the membership that it would be a grave injustice to withhold the prize. He did not

-----883

tell them that, in an absolute breach of the Nobel rules, he had already informed Princeton University's president, Alicia Nash, and Nash himself that he was getting the prize. But those facts were very much in his mind as he appealed to the members.

114

By the time Carl-Olof Jacobson called for the vote, the atmosphere in the room was tense and bitter. An unusually large number of academicians stayed to hear the vote count. Two members of the academy chosen by the president and Jacobson removed the ballots in front of the audience and tallied the votes. The paper was handed to Jacobson, and Jacobson read the votes one name at a time. For Lindbeck it was, as he later said, a moment of unbearable suspense. Mr. Nash ... Mr. Harsanyi ... Mr. Selten ... Mr. Lucas ... no prize....

A few moments later, Fredga, Jacobson, Lindbeck, and Wer, very much shaken, were the only ones left in the room. Their candidates had gotten all that they needed: a slim majority of the votes. Later, in public, these individuals would all

-----884

deny that anything extraordinary had happened. They would pretend that Wer's report had been unusually long, that there had been a great many questions, that the Laureates had been difficult to reach, or simply state baldly that the delay had never occurred.

But behind closed doors, within the academy, there would be shock, consternation, and fingerpointing. "It was a unique event. It had never happened before" said one member of the academy. "It's not good for the academy to have close votes" said Kiselman. "The very next day the council hastily appointed an ad hoc committee "to study the future of the economics prize."

1116

Afterward, a committee member friendly to Stahl would say that Stahl had been "used by the physicists" Stahl's double-cross had backfired. Instead of being regarded as the man who saved the

prize committee from an embarrassing mistake, he had set into motion the very consequences he feared. Like players in So Long Sucker, the game that Nash and his friends at Princeton had invented forty years earlier, Lindbeck and MA-ER formed a temporary coalition with the critics of the economics prize. They threw themselves behind the rules changes. They were

-----885

determined to punish Stahl and get him off the committee -- even if the new rules meant that they had to step aside as well. One prize committee member called their strategy "elegantdd0101 Had Nash known about it, he would have appreciated it as a textbook

execution of McCarthy's Revenge Rule, especially because A885
Lindbeck could reasonably expect to get elected to the committee again after a three-year interlude, but Stahl, who had provoked the scandal and compounded his sin by talking to a reporter, was out for good.

The consequences did not end there. According to several members of the academy, the ad hoc committee went on record to recommend changing the very nature of the economics prize. In its report, issued a few months later, in February

1995, the committee issued an instruction that essentially redefined the economics prize as a prize in social sciences, open to great contributions in fields like political science, psychology, and sociologydd109 It also ordered the committee membership to be opened to two non-economists. No public announcement of these far-reaching changes was made. But within a year, Lindbeck, Wer, and Stahl were gone; two social

-----886

scientists who weren't economists-a statistician and a sociologist- were

members of the prize committee; and among the top candidates for the prize was Amos Tversky, an Israeli psychologist who works on irrationality in decision making."`

In the auditorium on October 12, the three men rushed over to a small committee room."` Jacobson was armed with a page of telephone numbers for the Laureates. It was he who would inform the Laureates of the honor that was about to grace them.

They tried to reach Selten first since Selten was in Germany and, unlike Nash or Harsanyi, would not necessarily be asleep. It was early in the morning for Nash in New Jersey and the middle of the night for Harsanyi in California. As it turns out, Selten was out grocery shopping. Jacobson then tried Harsanyi and, when he got him, quickly put Wer, who knew Harsanyi well, on the line to quickly assure him, with much joviality, that Jacobson was not some student or, worse, reporter playing a trick on him."`

Nash was the last to be called. Jacobson waited expectantly as the telephone rang. Unbeknownst to most of Jacobson's colleagues at the

-----887

academy, he had a brother who, like Nash, had been diagnosed with schizophrenia as a young man in the 1950's and had been institutionalized ever since."` It was a moment of incredible poignancy for Jacobson, "the greatest momentea"he later said, of his twenty-year tenure at the academy.

"He was unusually calmed"he said afterward. "That was my thought.

'He is taking this very calmly.`"

114

Washington, D.C., December 1994

ON

THE AFTERNOON-OF

December 5, 1994, John Nash was riding in a taxi headed to Newark Airport on his way to Stockholm, where he would, in a few days' time, receive from the King of Sweden the gold medal engraved with the portrait of Alfred Nobel.` At around the same time, a few hundred miles to the south, in downtown Washington, DddC,,

Vice-President Also Gore was announcing with great fanfare A887
the opening of "the greatest auction ever."

There was, as
The New York Times
would later report, no fast-talking auctioneer, no

-----888
banging gavel, no Old Masters. On the auction block was thin
airwaves that could be used for the new wireless gadgets like
telephones, pagers, faxes -- worth billions and billions of
dollars, enough licenses for every major American city to have
three competing cellular phone services. In the secret war rooms
and bidding booths were CEO's of the world's biggest
communications conglomerates and an unlikely group of blue-sky
economic theoreticians who were advising them. When the auction
finally closed the following March, the winning bids totaled more
than \$7 billion, making it the biggest sale in American history
of public assets and one of the most successful (and lucrative)
applications of economic theory to public policy ever. Michael
Rothschild, dean of Princeton's Woodrow Wilson School, later
called it "a demonstration that people thinking hard about a
problem can make the world work better ... a triumph of pure
thought."

The juxtaposition of Core and Nash, the high-tech auction and the
medieval pomp of the Nobel ceremony, was hardly an accident. The
FCC auction was designed by young economists who were using
-----889

tools created by John Nash, John Harsanyi, and Reinhard Selten.
Their ideas were specifically designed for analyzing rivalry and
cooperation among a small number of rational players with a mix
of conflicting and similar interests: people, governments, and
corporations and even animal species.

The prize itself was a long-overdue acknowledgment by the Nobel
committee that a sea change in economics, one that had been under
way for more than a decade, had taken place. As a discipline,
economics had long been dominated by Adam Smith's brilliant
metaphor of the Invisible Hand. Smith's concept of perfect
competition envisions so many buyers and sellers that no single
buyer or seller has to worry about the reactions of others. It is
a powerful idea, one that predicted how free-market economies
would evolve and gave policymakers a guide for encouraging

growth and dividing the economic pie fairly. But in the world of megamergers, big government, massive foreign direct investment, and wholesale privatization, where the game is played by a handful of players, each taking into account the others' actions, each pursuing his own best

-----890

strategies, game theory has come to the fore.`

After decades of resistance comPaul Samuelson used to joke about "the swamp of n-person game theory"ful-a younger generation of theorists began using game theory in areas from trade to industrial organization to public finance in the late

1970's and early 1980's Game theory opened up "terrain A890 for systematic thinking that was previously closed." Indeed, as game theory and information economics have become increasingly entwined, markets traditionally seen as fitting the purely competitive mold have increasingly been studied using game-theory assumptions. The latest generation of texts used in top graduate schools today all recast the basic theories of the firm and the consumer, the foundation of economics, in terms of strategic games."

"Concepts, terminology and models from game theory have come to dominate many areas of economicsea" said Avinash Dixit, an economist at Princeton who uses game theory in work on international trade and is the author of

Thinking Strategically,

"At last we are seeing the realization of the true

-----891

potential of the revolution launched by von Neumann and Morgenstern.0" And because most economic applications of game theory use the Nash equilibrium concept, "Nash is the point of departuredd011

The revolution has gone far beyond research journals, experimental laboratories at Caltech and the University of Pittsburgh, and classrooms of elite business schools and universities. The current generation of economic policyrnakers comincluding Lawrence Summers, undersecretary of the treasury, Joseph Stiglitz, chairman of the Council of Economic Advisers, and Vice-President A] Gore-are steeped in the stuff, which, they say, is useful for thinking about everything from budget proposals to Federal Reserve policy to pollution cleanups. The most dramatic use of game theory is by governments from Australia to Mexico to sell scarce public resources to buyers best able to develop them. The radio spectrum, T-bills, oil leases, timber, and pollution rights are now sold in auctions designed by game theorists comwith far greater success than that of earlier policies."

-----892

Economists like Nobel Laureate Ronald Coase have advocated the use of auctions by government since the 1950's. 14Auctions have long been used in markets where sellers of unusual items -- from vintage wines to movie rights -- have no idea what bidders are willing to pay. Their basic purpose is to make bidders reveal how much they value the item. But the arguments of Coase and others were stated in abstract, entirely theoretical terms, and little

thought was given to how such auctions would actually be conducted. Congress remained skeptical.

Before 1994, Washington simply gave away licenses for free. Until 1982, it had been up to regulators to decide which companies deserved the licenses. Needless to say, the process was dominated by political pressures, outrageously expensive paperwork, and long delays. The pace of licensing lagged hopelessly behind market shifts and new technologies. After 1982, Washington awarded licenses using lotteries, with the winners free to resell licenses. Although the reform did speed up the granting of licenses, the process was still hugely inefficient-and unfair.

Bidders with no intention of operating an actual telephone business A892

-----893

spent millions to get into the game for the purpose of reaping a windfall. Further, although telephone companies were forced to pay the costs of obtaining licenses, Washington (and taxpayers) did not get the benefit of any revenues. There had to be a better way.

A young generation of game theorists, including Paul Milgrom, John Roberts, and Robert Wilson at the Stanford B-school, came up with that better waydd" Their chief contribution consisted of recognizing, as Milgrom said, that "the mere design of some

auction wasn't enough.... (Getting the auction design right was also critically important"

16

In particular, they concluded that the most obvious auction designs -- auctioning licenses one by one in sequence using simultaneous sealed bids comwas the way least likely to succeed in getting licenses into the hands of corporations that could use them best comWashington's stated objective.

Game theorists treat an auction like a game with rules and try to evaluate how a given set of rules, taken together, is apt to affect the bidders'

-----894

behavior. They take stock of the options the rules allow, the payoffs to the bidders associated with the options, and bidders' expectations about their competitors' likely choices.

Why did these economists conclude that traditional auction formats would not work? Mainly because the value of each individual license to a user depends

- as is the case with a Rembrandt or a Picasso -- on what other licenses the user is able to obtain. Some licenses are perfect substitutes for one another. That would be the case for similar spectrum bands to provide a given service. But others are complements. That would be the case for licenses to provide paging services in different parts of the country.

"To permit the efficient license assignment, an auction must allow bidders to consider various packages of licenses, combining complements and switching among substitutes during the course of the auction. Designing an auction to allow this is quite difficult," writes Paul Milgrom, one of the economists who designed the FCC auction of which Gore was speaking."

A second source of complexity, Milgrom says, is that the purpose of the licenses is

-----895

to create businesses for new services with unknown technology and unknown consumer demand. Since bidders' opinions are bound to be wildly divergent, it is possible that license assignment would depend more on bidders' opti-

mism than on their ability to create a desired service."`

Ideally, an auction design can minimize that problem.

As Congress and the FCC inched closer to the notion of auctioning off spectrum rights, Australia and New Zealand both conducted

spectrum auctionsdd19 That they proved to be costly flops A895
and political disasters illustrated that the devil really was in
the details. In New Zealand, the government ran a so-called
second price auction, and newspapers were full of stories about
winners who paid far below their bids, In one case, the high bid
was NZDD7 million, the second bid NZDD5,000, and the winner paid
the lower price. In another, an Otago University student bid NZ\$I
for a television license in a small city. Nobody else bid, so he
got it for one dollar. The government expected the cellular
licenses to fetch NZDD240 million. The actual revenue was NZDD36
million, one-seventh of the advance

-----896
estimate. In Australia, a botched auction, in which parvenu
bidders pulled the wool over the government's eyes, delayed the
introduction of pay television by almost a year.

The FCC's chief economist was an advocate of auctions, but no
game theorists were involved in the first stage of the FCC
auction design. The theorists` phones started ringing only by
accident after the FCC issued a tentative proposal for an auction
format with dozens of footnotes to the theoretical literature on
auctionsdd10 That was how Milgrom and his colleague Robert
Wilson, leading auction theorists, got into the game.
Milgrom and Wilson proposed that the FCC adopt a simultaneous,
multipleround auctiondd"In a simultaneous auction, a bunch of
licenses are sold at the same time. Multiple rounds mean that,
after the first round of bidding, prices are announced, and
bidders have a chance to withdraw or raise one another's bids.
This is repeated round after round until the auction is over. The
chief advantage of this format is that it allows bidders to take
account of interdependencies among licenses. just as sequential,
closed-bid auctions let sellers discover what bidders are willing
to pay for

-----897
individual items, the simultaneous, ascending-bid auction lets
them discover the market value of different groupings of items.
This early proposal-which the FCC eventually adopted-did not
cover seemingly small but critical detailsdd"Should there be
deposits? Minimum bid increments? Time limits? Should the bidding
system be wholly computerized or executed by hand? and so forth.
Milgrom, Roberts, and another game theorist, Preston McAfee, an
adviser to AirTbuch, provided proposals on these issues. The FCC
hired another game theorist, John McMillan, of the University of
California at San Diego, to help evaluate the effect of every

proposed rule. According to Milgrom, "Game theory played a central role in the analysis of the rules. Ideas of Nash equilibrium, rationalizability, backward induction, and incomplete information, though rarely named explicitly, were the real basis of daily decisions about the details of the auction process." By late spring 1995, Washington had raised more than \$10 billion from spectrum auctions. The press and the politicians were ecstatic. Corporate bidders were largely able

to protect themselves from predatory bidding and were able 898
to assemble an economically sensible set of licenses. It was, as
John McMillan said, disa triumph for game theorydd"14

50 Reawakening

Princeton, 1995-97

Mathema6cs is a young man game. Yet it is not bearable to
contemplate a brief distinction and burgeoning ofactivity...

followed by a lifetime of boredom.

comNoRBERT WIENER

ON

THE AFTERNOON

of the Nobel announcement, after the press conference, a small
champagne party was in progress in Fine Hall. Nash made a short
speech.` He was not inclined to give speeches, he said, but he
had three things to say. First, he hoped that getting the Nobel
would improve his credit rating because he really wanted a credit
card. Second, he said that one is supposed to say that one is
really glad he is sharing the prize, but he wished he had won the
whole thing because he really needed the money badly. Third, Nash
said that he had won for game theory and that he felt that game
theory was like string theory, a subject

-----899

of great intrinsic intellectual interest that the world wishes to
imagine can be of some utility. He said it with enough skepticism
in his voice to make it funny.

All the Swedes` fears -- not to mention Harold Kuhn's own private
worries -- about how Nash would cope with the pomp in Stockholm
proved groundless. Everything went swimmingly. The receptions.
The press briefings. The Nobel award ceremony itself. The lecture
in Uppsala afterward. Indeed, in the weeks between the
announcement of the prize and the ceremony, Nash did and felt
things that had lain beyond his grasp for decades. When he first
arrived in Stockholm, J6rgen Weibull recalled, he behaved pretty
much as Weibull had remembered from Princeton a few years before:
"He didn't look you in the eye. He mumbled. Socially he was very
tentative, very uncertain. But his mood went up from day to day.
He got less and less unhappy."

Harold Kuhn, who was to lead a Nobel seminar honoring Nash's
work, and his wife Estelle accompanied Nash and Alicia to
Stockholm.` It was exhilarating. The nicest moment of the week,
so full of grand scenes and ceremonies, came when

-----900

Nash had his much-dreaded private audience with the King. By

tradition, the King spends a couple of minutes alone with each Laureate. When Nash's turn came, he grimaced and frowned so much that Harold was afraid he might refuse to go into the King's chambers at the last minute, but finally he followed the aide inside. Five minutes passed, then seven. Finally, after a full ten minutes, Nash emerged, looking relaxed, even amused. "What did you talk about" everybody asked at once. Quite a bit, it turned out. In 1958, John told Harold and Estelle, he and Alicia had taken a grand tour of Europe and had driven up into the south of Sweden in their new Mercedes 180. The King had been a student in

Uppsala then, addicted to fast sports cars. Around that A900 time, the Swedes were shifting from driving on the left to driving on the right. Nash and the King had spent ten minutes chatting about the pitfalls of driving fast on the lefthand side of the road.

At dusk, Nash and Weibull were riding in a limousine through the countryside north of Stockholm. The farmhouses were lighting up one at a time, the sky was beginning to glimmer. Nash reached over to Weibull and said, "Look, Jargen. It's so beautifuldd0bled

-----901

They were on their way back from Uppsala where Nash had given a talk comhis

first in three decades. Nash hadn't been asked to give the customary hour-long Nobel lecture in Stockholm. The lecture at the University of Uppsala was arranged by Christer Kiselmandd6Nash's chosen topic was a problem that had interested him before his illness and that he had taken up again since his remission: developing a mathematically correct theory of a non-expanding universe that is consistent with known physical observations. The conventional view, of course, is that the universe is expanding, and attempting to overturn the consensus is exactly the kind of contrarian intellectual bet that Nash has always enjoyed. Nash's talk on "the possibility that the universe isn't expanding"bbgan with tensor calculus and general relativity comstuff so difficult that Einstein used to say he understood it only in moments of exceptional mental clarity. Though he later confessed to nervousness, he spoke without notes, clearly and convincingly, according to Weibull, who has a doctorate in physics. Physicists and mathematicians in the audience said afterward that Nash's

-----902

ideas were interesting, made sense, and were expressed with the appropriate degree of skepticism.

It is a quiet life, despite the fairytale of Stockholm and the lofty status of Laureate. The Nashes still live in the Insulbrick house with the hydrangeas out front, next to the alley and across from the Princeton train station. There is a new boiler, a new roof, a few new items of furniture, but that's about it. (Nash was also able to pay down his half of the mortgage.) The few friends they see regularly, among them Jim Manganaro, Felix and Eva Browder, and of course Armand and Gaby Borel, are pretty much the people they have been seeing for some years. Their daily routines have changed less than one might think, dominated as

they are by the twin needs of earning a living and caring for Johnny. Alicia takes the train to Newark every day. Nash, who no longer drives, rides the "Dinky" in town, eats lunch at the Institute, and spends the afternoons in the library or, on rare occasions, in his new office. Very often, when Johnny is not in the hospital or on the road, he takes Johnny with him.

It is a life resumed, but time did not stand still

-----903

while Nash was dreaming. Like Rip Van Winkle, Odysseus, and countless fictional space travelers, he wakes to find that the

world he left behind has moved on in his absence. The brilliant young men that were are retiring or dying. The children are middle-aged. The slender beauty, his wife, is now a mature woman in her sixties. And there is his own seventieth birthday fast approaching.

There are days when he feels that he has escaped the ravages of time, when he believes he can pick up where he left off, when he feels "like a person who wants to do the research he might have done in his 30's and 40's at the delayed time of his 60's and 70's" In his Nobel autobiography, he writes:

Statistically, it would seem improbable that any mathematician or scientist, at the age of 66, would be able through continued research efforts to add to his or her previous achievements.

However, I am still making the effort, and it is conceivable that with the gap period of 25 years of partially deluded thinking providing a sort of vacation, my situation may be atypical. Thus I have hopes of being able to achieve something of value through my current studies or with any new ideas that come in the future.

-----904

But many days he is not able to work. As Nash once told Harold Kuhn, "The Phantom was not in until very late, after 6:00 Pddm. because even a Phantom can have ordinary human problems and need to go to a doctor." And there are other days when he discovers an error in his calculations or learns that a promising idea has already been mined by someone else, or when he hears of new experimental data that seem to make certain speculations of his seem less interesting.

On such days, he is full of regrets. The Nobel cannot restore what has been lost. For Nash, the primary pleasure in life had always come from creative work rather than from emotional closeness to other people. Thus, recognition for his past achievements, while a balm, has also cast a harsh light on the vexing issue of what he is capable of doing now. As Nash put it in 1995, getting a Nobel after a long period of mental illness was not impressive; what would be impressive is persons who AFTER a time of mental illness achieve a high level of mental functioning (and not just a high level of social respectability.)"

Nash gave the starkest assessment of his own situation in front of an audience of psychiatrists to whom

-----905

he had been introduced as "a symbol of hopedd" In answer to a

question at the end of his 1996 Madrid lecture, he said, "To recover rationality after being irrational, to recover a normal life, is a great thingff" B then he paused, stepped back, and said in a far stronger, more assertive voice: "But maybe it is not such a great thing. Suppose you have an artist. He's rational, But suppose he cannot paint. He can function normally. Is it really a cure? Is it really a salvation? ... I feel I am not a good example of a person who recovered unless I can do some good workea" adding in a wistful, barely audible whisper, "although I am rather olddd" I I

These thoughts were much in Nash's mind when he turned down an

offer of thirty thousand dollars from the Princeton University Press in 1995 to publish his collected works. A905

"Psychologically I have a problem since I have been, unfortunately, a long time without any publicationsea"he said to Harold Kuhn. He was saying, in short, that he doesn't want to close the door on future work by acknowledging that his lifetime oeuvre is complete. As Nash says, "I did not want to publish a collected works simply because I wanted to think of

-----906
myself as, and assume the posture of, a mathematician, still actively engaged in research and not just resting on his laurels (as they say). And of course I knew that if a collected works was not published at this time, then it could be published later when, hopefully, I would have nice new things to add to it." In these feelings, however, he is not so different from his brilliant contemporaries. They, too, are having to face, or have already faced, the prospect that they are likely never to match their past achievements. Some have remained more active than others. But aging is a fact of life, and an especially stringent one for a mathematician. It is, for most of them, a young man's game.

It takes extraordinary courage to return to research after a hiatus of nearly thirty years. But this is exactly what Nash did. As he told the Madrid audience, "I am again engaged in scientific study. I am avoiding routine problems and instead I am 'dabbling.' his

Nash had been thinking about a mathematical theory of the universe since before his meeting with Einstein. Since the lecture in Uppsala, he has suffered various setbacks. In August 1995, he said, "I got results that indicated I had made a

-----907
fundamental error a long time ago and that I must reformulate ... [the] theorydd"Apparently "there was stuff being lost in a singular integration and when I considered distributed matter instead of a point particle, I found the lost stuff which had been erroneously ignored"- adding, with characteristic objectivity, that "this is good since I have avoided publishing a version based on errors." He went on to describe the specific error: There was a discrepancy in the field ... which spoiled things. Recalculation revealed ... there had been errors in the calculation. Now I must finish up the calculation for a distributed mass of gravitating matter, at least to the first order level of approximation. This level itself could bring an

interesting (distinctive result)."

Reawakening

383

This evaluation of the difficulties encountered in his research gives a good

idea that the problems Nash is working on are ambitious, that he has lost none of his taste for making high-risk bets (whether on ideas or stocks!), and that his thinking is still sharp. And even if his chances of achieving a new breakthrough are

statistically small, as he says, the pleasures of thinking 908
about problems are once again his.

The truth, however, is that the research has not been the main thing in his present life. The important theme has been reconnecting to family, friends, and community. This has become the urgent undertaking. The old fear that he depended on others and that they depended on him has faded. The wish to reconcile, to care for those who need him, is uppermost. He and his sister Martha, estranged for nearly twenty-five years, now talk on the telephone once a week. Johnny, of course, is the main thing, the constant.

It was Nash who had told the women to call the policedd14 Johnny had been living at home. He had been all right for a while, but then he began to wear a paper crown. One afternoon, he wanted some money. Because he believed he was a sovereign, he thought that he should be able to get money from Sovereign Bank. But the ATM in front of the bank would not spit out any cash. In fact, it would not return his bank card. Agitated and unhappy, Johnny called his mother, who has an account at Sovereign, and demanded she meet him at the ATM and get his

-----909
card out of the machine. Alicia told John, who insisted on going with her. The couple tried, vainly, to extract Johnny's card. They also tried, unsuccessfully, to soothe Johnny. At that point, their son became enraged, picked up a big stick, and started to poke first his mother, then his father. Some bystanders across the street stopped when they saw the young man threatening the two elderly people. Nash shouted for one of them to call the police. A squad car pulled up. The police took Johnny, whom they knew well, back to Trenton State. Johnny was in the hospital when his parents got the news from Stockholm informing them of Nash's Nobel. Nash and Micia called him first. He thought that they were pulling his leg, that it was a joke, and hung up on them. Later he saw his father's face on CNN."

The subject of Johnny's future is extremely painful. Nash had spoken matter-of-factly about it. Alicia, looking miserable, said nothing and instead sank deep into her seat and closed her eyes. She finally interjected, "He just wants to get on with his lifedd011

The hopeful path that Johnny seemed to be on in his early twenties had long ago petered out. Whether

-----910
because of the stress of teaching, the social isolation, or

because the remission had simply run its course, the year at Marshall University was a disaster. He had come home and has not worked since. "Of course I've been a bad example," Nash admits. "Johnny wanted to get a job, Nash said, but he seemed to think he would be able to get one in a college mathematics department. He had been writing letters introducing himself as the son of a Nobel Laureate and asking for a position. Now Nash was telling the Kuhns that Johnny would not take his medicine when he was not in the hospital. Alicia adds, "He goes to the hospital, he gets better, but when he gets home he doesn't like to take his medication." Then he would get sick again, hearing voices and

having delusions, He would be hospitalized again and get A910 better. Then it would start all over again. Watching over Johnny is now Nash's main task in life. Except when Johnny is "on the road" wandering around the country on Greyhound buses, Nash is his caretaker. Nash takes it for granted that his son is his responsibility. As Nash said on one occasion, "My time of delusional thinking is, presumably,

-----911

in the past, but my son's time of it is right now.0" They get up in the morning together after Alicia has gone to work. They eat breakfast together. Nash takes him to the library, to the institute, to Fine Hall. On Monday evenings they all attend family therapy together. Nash has tried to get his son interested in the computer and plays computer chess with him. He has said: `Ultimately computers could be a good sort of occupational therapy (as perhaps I was benefited in an OT [occupational therapy] fashion by [Hale] Trotter's help in letting me get familiar with computer use.) 19

Johnny is thirty-eight years old. He is tall and handsome like his father, and he and his father share an interest in mathematics and chess. But Johnny's illness has dragged on for more than half his life, a quarter of a century. He has been treated with the newest generation of drugs, including Clozaril, Risperadol, and, most recently, Zyprexa. These drugs, which have enabled him, for the most part, to stay out of the hospital, have not given him a life. Time hardly passes for him. He no longer competes in chess tournaments comonce his greatest joy. He no longer reads, saying that he has not been able to for a

-----912

long time. He is often angry and occasionally violentdd10 Life with Johnny is a tremendous strain on Nash and Alicia. Nash calls it being "perturbed,0" tyrannizedea" and he is often preoccupied with the "drift and danger of degradation."" It is a constant disruption even when, as is often the case, Johnny is roaming around the country on Greyhound buses. For instance, Alicia and John go to the Olive Garden to celebrate Nash's birthday, and Johnny calls to say that he has lost his ATM card and has no money. The evening is spent wiring him funds. "We're at our wits` end" Alicia said recently. "You work so hard ... and then he's out of it. The Nobel hasn't helped Johnny at all."" Johnny draws Nash and Alicia together and tears them apart. There are deep conflicts. They blame each other for Johnny's misbehavior comwhen he destroys things in the house, attacks

them, acts inappropriately in public. Nash feels that Alicia expects him to be the bad cop, a role he's not happy with, while she is the soft one. But they rely on each other. They agree every day on

-----913

what one or the other should do. They also agree when it is time to hospitalize him. Nash is more judgmental and apt to hold Johnny responsible for his illness. He's sometimes quite cruel, telling Harold Kuhn and others at times that people like Johnny ought to be jailed or that he has chosen to be as he is: "I don't think of my son ...

as entirely a sufferer. In part, he is simply choosing

A913

to escape from `the world! "11

Despite such moments of insensitivity, the truth is that Nash expresses hope and pleasure when there is the prospect of a new medication, a new therapy, or when he gets an idea -- like teaching Johnny how to play chess on the computer that he thinks will help him. When his friend Avinash Dixit invites him for dinner, he immediately asks if he might bring Johnny alongdd14 At Dixifs, Johnny takes out a chess set, and father and son sit down to play. Nash is "less than mediocredd"At one point, he says he wants to take back a bad move. Johnny lets him. Then Nash wants to take back another.

-----914

"Dad, if you keep doing that, you'll winea"says Johnny.

"But when I play against the computer, I'm allowed to take back movesea"Nash says.

"But, Dadea"protests Johnny, "I'm not a computer! I'm a human heing!"

Men it is time to go to the pharmacy for Johnny's "meds," Nash accompanies Aliciadd21 When it is time to attend an open house at the outpatient program where Johnny is sometimes enrolled, Nash is there and on timedd16 Alicia sees this and feels supported by him. She feels that she couldn't do without him.

Marriage is easily the most mysterious of human relationships. Attachments that seem superficial can become surprisingly deep and lasting. Such is the bond between Nash and Alicia. In retrospect, one feels that this is not an accidental pairing, that these two people needed each other. Strong-minded, pragmatic, and independent as she is, Alicia's girlish infatuation has survived the disillusionments, hardships, and disappointments. She takes Nash clothes shopping. She frets, when he travels, that he'll be kidnaped by terrorists or killed in a

-----915

plane crash or merely worn out. When his ankle swells from a sprain, she leaves a dinner party and sits with him for four hours in the emergency room. More telling, she looks at an old photograph of him in bathing trunks at a poolside in California and says with a giggle, "Aren't his legs beautiful?"

17

He, meanwhile, sets his clock by her. Stubborn, reserved, self-centered, and jealous of his time (and money) as he is, Nash does nothing without consulting Alicia first, defers to her

wishes, and tries to help her, whether it is by washing the dishes, straightening out a problem at the bank, or going with her to family therapy every Monday night. She is the one to whom he faithfully reports the day's events, whom he ran into, what the lecture was about, what he ate for lunch. They argue about money, the housework, Johnny, social engagements, but he has committed himself to making her life easier and more joyful. Nash is trying to be more sensitive and accommodating. He said, self-critically, "I know I have my social faults and I make Alicia very angry when she is saying

something that I can anticipate before she's finished and 916
 then I start saying something as if what she's saying is not of
 an importance."" He accepts, with some humor, that his genius
 does not make him the authority on all matters. When it comes to
 refinancing their mortgage or choosing between gas and oil heat,
 he complains humorously that Alicia does not take him seriously
 as an "economics sage ... notwithstanding the Nobeldd019
 He does, of course, often wound her. But he catches himself, too,
 and makes amends. A typical exchange: at Gaby and Armand Borel's
 dinner partyea10 Alicia announces to the assembled company that
 their son has received a tentative offer to teach mathematics at
 a small college in Mexico. Nash engages in an act of cruelty.
 "Yesea"he says, "my son is in a mental hospital in Arkansas but
 he got a job offer!" He is laughing at the absurdity of this
 juxtaposition. This is too much for Alicia. "You have to be fair
 to Johnny," she returns. Nash says nothing. But later in the
 evening he goes to some lengths to make amends. He brings an
 offering, maps of Mexico, that he found in books on the

-----917

Borels` shelves, to Alicia. He takes the opportunity comduring a
 conversation about Andrew Wiles's successful proof of Fermat's
 Last Theorem -- to point out that Johnny had done some
 "classical"number theory in graduate school. Johnny had published
 "one correct result, one incorrect, but the correct one was a
 breakthrough of sortsea"he tells the other guests. Alicia
 responds by paying attention, by taking in what he means.
 Much of the renewal of their marriage has taken place since the
 Nobel. There is now a sense of reciprocity. It is as if regaining
 the respect of his peers has made Nash feel that he has more to
 offer the people in his life, and has made those close to him,
 especially Alicia, feel that he has more to give. This has become
 self-reinforcing. At one time, before the Nobel, Alicia referred
 to Nash as her "boarder"and they lived essentially like two
 distantly related individuals under the same roof. Now there is
 even some discussion of remarrying, although in what was perhaps
 an assertion of Nash's old insistence on "rationalityea"they gave
 the idea up as impractical, as so many older couples have in
 light of the attendant tax and Social Security

-----918

penalties. However, a certificate is not of real importance. They
 are a real couple again. John Stier took the first step in ending
 his twenty-year estrangement from his father, mailing him a copy
 of the June 1993

Boston Glohe

column that speculated on Nash's chances of winning a Nobel." He sent the clipping anonymously, but Nash immediately guessed its source. He was unsure whether to interpret John Stier's gesture as a taunt or a friendly overture. He told Harold Kuhn that something in the way the letter was addressed to him hinted at mockery. But the following February, two months after his triumph in Stockholm, Nash boarded a shuttle bound for Boston to spend a weekend getting reacquainted with his older son.

Such an encounter, inspired by hopes of putting their sad history behind them, was bound to be bittersweet, an occasion that

revived as many painful memories, disappointments, and misunderstandings as it unlocked happier feelings. When the two men finally met face to face, John Stier was no longer the nineteen-year-old Amherst College history major Nash remembered from their last encounter, but a man of forty-four comnearly as old as Nash had been in 1972, when they had last seen each other. Physically, he resembled his father to a striking degree. The impressive stature, broad shoulders, luminous eyes, English complexion, and finely modeled nose were all Nash's. But in his life's choices comand in his ability to derive great satisfaction from helping others-he was his mother's son. John Stier had stayed in Boston, remaining single and pursuing a career as a registered nurse. At the time, he was thinking of returning to graduate school to obtain an advanced degree in nursing.

In the two days they spent in each other's company comthe most time they had ever been together at one stretch -- they touched on personal topics only occasionally. Indeed, they were mostly with other people; it was important for Nash to have others confirm the reconciliation. They sat looking at old photographs with Eleanor, had a meal with Arthur Mattuck, the closest friend of Nash's "first family," and visited Marvin Minsky in his artificial intelligence laboratory at MIT. At one point, Nash telephoned Martha from

John Stier's apartment and put his son on the phone." When father and son did venture into personal territory, Nash was, as usual, full of the best intentions. He wished to show his son how vitally important he was to him, he wanted to share with him some of his own recent good fortune, he wanted to give him the benefit of paternal advice. He was motivated by love and by a sense of responsibility. He told John that he would divide his estate equally between him and his brother and he invited him to accompany him to a conference in Berlin. All this was to the good. But, as in so many other relationships in his life, Nash's intentions weren't always matched by the emotional means to carry them out satisfactorily. Even as he tried to draw his son closer, he said and did things that could only be called insensitive and alienatingdd14He did not try to hide his own feelings of disappointment. He criticized his son's appearance, calling him fat (which he is not). He criticized his son's choice of profession, suggesting that nursing was beneath a son of his and

John Stier's apartment and put his son on the phone." When father and son did venture into personal territory, Nash was, as usual, full of the best intentions. He wished to show his son how vitally important he was to him, he wanted to share with him some of his own recent good fortune, he wanted to give him the benefit of paternal advice. He was motivated by love and by a sense of responsibility. He told John that he would divide his estate equally between him and his brother and he invited him to accompany him to a conference in Berlin. All this was to the good. But, as in so many other relationships in his life, Nash's intentions weren't always matched by the emotional means to carry them out satisfactorily. Even as he tried to draw his son closer, he said and did things that could only be called insensitive and alienatingdd14He did not try to hide his own feelings of disappointment. He criticized his son's appearance, calling him fat (which he is not). He criticized his son's choice of profession, suggesting that nursing was beneath a son of his and

urging him to go to medical school instead of pursuing a master's in nursing. He hinted strongly that he hoped John would help care for his younger

-----921

brother, but then angered him by saying it would do Johnny good to be around a "less intelligent older brother." Finally, he said he wanted John to change his name to Nash, a suggestion meant to be magnanimous, but which actually proved hurtful since it implied that he meant for John to renounce all that he was and had been. Eleanor, of course, felt injured. A few months later, Nash did take John Stier to Berlin with him.

The tensions of their first reunion surfaced agdd16Nash A921 remorselessly needled his son about trifles, making him turn out the light when he wanted to read, not letting him order dessert, telling him not to cat butter or bread. Yet even so, John Stier felt great pride when Nash gave his lecturesdd17;And Nash was able to write to Harold Kuhn, "Berlin was a great experience ... my son enjoyed the trip.""

A Nobel award has a finality about it. Yet despite the unique honor, life continues beyond the fairytale celebration in Stockholm. More so than for other Laureates, Nash's immediate future is uncertain. Nobody knows whether his remission is permanent. People have relapsed after many years of being symptom-free. The present is precious.

-----922

Unlike a game of Hex, outcomes in real life aren't predetermined by the first or even the fiftieth move. The extraordinary journey of this American genius, this man who surprises people, continues. The self-deprecating humor suggests greater self-awareness. The straight-from-the-heart talk with friends about sadness, pleasure, and attachment suggests a wider range of emotional experiences. The daily effort to give others their due, and to recognize their right to ask this of him, bespeaks a very different man from the often cold and arrogant youth. And the disjunction of thought and emotion that characterized Nash's personality, not just when he was ill, but even before are much less evident today. In deed, if not always in word, Nash has come to a life in which thought and emotion are more closely entwined, where getting and giving are central, and relationships are more symmetrical. He may be less than he was intellectually, he may never achieve another breakthrough, but he has become a great deal more than he ever was -- "a very fine person" as Alicia put it once.

As we leave him now he is perhaps just hurrying under the Eisenhart gate on his way to Fine Hall ... or sitting next to Alicia on the living-room sofa watching Dr. Mo on the big television ...

-----923

or losing a game of chess to Johnny ... or spending 105 minutes on the telephone comforting Lloyd Shapley after his wife's death ... or giving Harold Kuhn a look like a naughty boy's when Harold asks whether the lecture notes for Pisa are ready ... or sitting at the institute math table with his lunch tray, nodding while Enrico Bombieri, who has just read the love

letters of Carrington, bemoans the lost art of letter writing ...
or, after listening to an astronomy lecture, gazing through a
telescope at some distant star glimmering in the night sky....

THE FESTIVE SCENE

at the turn-of-the-century frame house opposite the train station
might have been that of a golden wedding anniversary: the
handsome older couple posing for pictures with family and
friends, the basket of pale yellow roses, the 1950's photo of the
bride and groom on display for the occasion.

In fact, John and Alicia Nash were about to say "I d"forthe
second time, after a nearly forty-year gap in their marriage, For

them it was yet another stepda big step, "according to A923
John-in piecing together lives cruelly shattered by
schizophrenia. "The

-----924
divorce shouldn't have happenedea"he told me. "We saw this as a
kind of retraction of thatdd"Alicia said simply, "We thought it
would be a good idea. After all, we've been together most of our
lives."

After Mayor Carole Carson pronounced them man and wife, John was
asked to kiss his bride again for the camera. "A second take""he
quipped. "Just like a movie."

A few moments before the ceremony Alicia's cousin spoke to me
about "the amazing metamorphosis"he had witnessed in John's life
since the Nobel. It's not just the many other honors and speaking
invitations from around the world that have followed, or the much
wider audience that now appreciates the full range of exciting
intellectual contributions made during his brief but brilliant
career, or even the glamour of having his remarkable story told
by Hollywood. At seventy-three, John looks and sounds wonderfully
well. He feels increasingly certain that he won't suffer a
relapse. "It's like a continous process rather than just waking
up from a dreamea"he told a

New York Times
reporter recently. "When I dream ... it

-----925
sometimes happens that I go back to the system of delusions
that's typical of how I was ... and then I wake and then I'm
rational again." Growing self-confidence may be one reason that
he is less embarrassed by talking about his past, and now speaks
to groups that see his experience as "something that helps to
reduce the stigma against people with mental illness." For the
first time since resigning from MIT in 1959, he now enjoys a
modicum of personal security for himself and his family. Little
things that the rest of us take for granted -- having a driver's
license again, or getting a credit card -- mean a lot. "I feel I
can go into a coffee place and spend a few dollarsea"Nash told me
last year when I was working on a story about how economics
Laureates spend their prize checks. "Lots of other academics do
thatea"he said. "If I was really poor, I couldn't do that. I was
like that."

Once threatened by homelessness, John values his home and
personal belongings as few of us can. Back at the house after the
ceremony, he was looking at a 1950 Parker Brothers version of

Hex, the game he'd invented as a Princeton graduate student. He once owned a copy, he said. "I lost so many of my possessions due to my mental illness."

-----926

He has been able to return to mathematics. "I am workingea"he told the

Times

reporter. He no longer dreams of picking up where he left off, but is glad to be able to do serious work and make a contribution. John is once more a fixture at the math table at the Institute for Advanced Study and at tea in the Fine Hall

common room. He now has a grant from the National Science Foundation. The other day he gave a seminar at the Institute about his new research on the theory of bargaining. "It actually wouldn't have been possible in those earlier days because I'm using computational facilities that didn't exist in the '50's and '60's," he said. "I'm ready to do a publication now." Even more important, his remission and the Nobel have enabled him to renew broken ties. He has reconnected with old acquaintances from Bluefield, Carnegie, Princeton, and MIT. After today's ceremony, he gossiped happily with a mathematician and an engineer he first met in his twenties. He and Alicia were going to spend their second honeymoon among friends in Switzerland, where John will be giving a talk at a

A926

-----927

memorial celebration for Jargen Moser, who died last year. John has been able to share his good fortune with those closest to him. He's been in touch with John David, the older son who was once lost to him. He spends much of his time with his younger son, John Charles. On his wedding day, he proudly described a mathematical result that Johnny has lately been trying to publish. He and his sister, Martha, still talk on the phone every week. And, as today's scene suggests, he has come to acknowledge Alicia's central role in his life.

As for his biographer, John's attitude has changed dramatically. While this book was being written, he said to a New York Times

reporter, "I adopted a position of Swiss neutrality." Since its publication, however, "A lot of my friends, family, and relations persuaded me it was a good thing." Besides, there is so much in the book that he had forgotten or never even knew. At this point in life, he made it clear, retrieving some of the past has been something of a solace.

When John met Russell Crowe, who plays

-----928

him in the movie inspired by his life, he told me that his first words to the Australian actor were, "You're going to have to go through all these transformations!" Even in the three years since the publication of this book, the transformations in Nash's life have been as remarkable as any that will be portrayed on screen. Princeton junction, New Jersey, June 1, 2001

Prologue

1. George W. Mackey, professor of mathematics, Harvard University, interview, Cambridge, Mass.,

12.14.95.

2. See, for example, David Halberstam, *The Fifties*

(New York: Fawcett Columbine, 1993). 3. Mikhail Gromov, professor of mathematics, Institut des Hautes-Études, Bures-sur-Yvette, France, and Courant Institute, interview, 12.16.97.

war era is based on judgment of fellow 1 _A opinion among mathematicians when he wrote: "To some, this brief paper, written at a e 21

for which he has won a Nobel prize in economics, may seem 929
like the least of his achievementsdd"ln"Acellratin of John F.

Nash, Jr.ea"a special volume,

Duke Mathernaticallournal,

vol. 81, no. I (Durham, N.C.: Duke University Press, 1995), the
game theorist Harold W. Kuhn calls Nash "one of the most original
mathematical minds of this century."

4. Paul R. Halmos, "The Legend of John von Neumann;"`

American Mathematical Monthly, vol.

80 (1973), pp. 382-94.

5. Donald J. Newman, professor of mathematics, Temple University,
interview, Philadelphia, 3.2.96.

6. Harold W. Kuhn, professor of mathematics, Princeton
University, interview, 7.26.95.

7. John Forbes Nash, Jr., remarks at the American Economics
Association Nobel luncheon, San Francisco, 1.5.96; plenary
lecture, World Congress of Psychiatry, Madrid, 8.26.96.

8. John Nash, "Parallel Control;"` RAND

-----930

Memorandum no. 1361, 8.7.54; plenary lecture, Madrid,
8.26.96, op. cit.

9. Interviews with Newman, 3.2.96; Eleanor Stier, 3.13.96.

10ddJohn Nash, plenary lecture, Madrid, 8.26.96, op. cit.

11. Jurgen Moser, professor of mathematics, ETH, Zurich,
interview, New York City, 3.21.96,

12. Interviews with Paul Zweifel, professor of physics, Virginia
Polytechnic Institute, 10.94; Solomon Leader, professor of
mathematics, Rutgers University, 7.9.95; David Gale, professor of
mathematics, University of California at Berkeley, 9.20.95;
Martin Shubik, professor of economics, Yale University, 9.27.95;
Felix Browder, president, American Mathematical Society, 11.2.95;
Melvin Hausner, professor of mathematics, Courant Institute,
1.26.96; Hartley Rogers, professor of mathematics, MIT,
Cambridge, 2.16.96; Martin Davis, professor of mathematics,
Courant

-----931

Institute, 2.20.96; Eugenio Calabi, 3.2.96.

13. Atle Selberg, professor of mathematics, Institute of Advanced
Study, interview, Princeton, 8.16.95.

14. George W. Boehm, "The New Uses of the Abstract;"`
Fortune

(July 1958), people. 127: "Just turned thirty, Nash has already
made a reputation as a brilliant mathematician who is eager to

tackle the most difficult problemsdd"Boehm goes on to say that Nash is working on quantum theory and that he invests in the stock market as a hobby.

15. John von Neumann, "Zur Theorie der Gesellschaftsspiele," Math. Ann.,

vol. 100 (1928), pp, 295-

320. See also Robert J. Leonard, "From Parlor Games to Social Science: Von Neumann, Morgenstern and the Creation of Game Theory,

1928-19442'JoLimal ofEconomic Literature (1995).

16. See, for example, Harold Kuhn, ed., *Classics in Game Theory* (Princeton: Princeton University Press, 1997); John Eatwell, Murray Milgate, and Peter Newman, *The New Palgrave: Game Theory* (New York: Norton, 1987); Avinash K. Dixit and Barry J. Nalebuff, *Thinking Strategically* (New York: Norton, 1991).

17. Robert J. Leonard, "Reading Cournot, Reading Nash: The Creation and Stabilization of the Nash Equilibrium," *The Econometric Journal* 42 (1994), pp. 492-511; Martin Shubik, "Antoine Augustin Cournot," in Eatwell, Milgate, and Newman, op. cit., pp. 117-28.

18. Joseph Baratta, historian, interview, 6.12.97.

19. John Nash, "Non-Cooperative Games" Ph.D. thesis, Princeton University Press (May 1950). Nash's

-----933
thesis results were first published as "Equilibrium Points in N-Person Games,"

Proceedings of the National Academy of Sciences, USA (1950), pp. 48-49, and later as "Non-Cooperative Games," *Annals of Mathematics*

(1951), pp. 286-95. See also "Nobel Seminar: The Work of John Nash in Game Theory," in

Les Prix Nobel

1994 (Stockholm: Norstedts Tryckeri, 1995). For a reader-friendly exposition of the Nash equilibrium, see Avinash Dixit and Susan Skeath,

Games of Strategy, (New York: Norton, 1997).

20. See, for example, Anthony Storr, *Solitude: A Return to the Self*

(New York: Ballantine Books, 1988); Robert Heilbroner, *The Worldly Philosophers* (New York: Simon and Schuster, 1992); E. T. Bell,

-----934
Men of Mathematics

(New York: Simon and Schuster, 1986); Stuart Hollingdale, *Makers of Mathematics*

(New York: Penguin, 1989); Ray Monk, *Ludwig Wittgenstein: The Duty of Genius* (New York: Penguin, 1990); John Dawson,

Logical Dilemmas.- The Life and Work of Kurt Gddel
(Wellesley, Mass.: A. K. Peters, 1997); Roger Highfield and Paul
Carter, The Private Lives ofAlhert Einstein
(New York: St. Martin's Press, 1994); Andrew Hodges,
Alan Turing: 7-85 Enigma
(New York: Simon and Schuster, 1983).

2 1. Anthony Storr,
The Dynamics of Creation
(New York: Atheneum, 1972).

22. Ibid.

23. John G. Gunderson, "Personality Disorders,"

The New Harvard Guide to Psychiatry (Cambridge: The Belknap Press of Harvard

A934

-----935

University, 1988), pp. 343-44. 24. Ibid.

25. Ibid.

26. Havelock Ellis, A

Study of British Genius

(Boston: Houghton Mifflin, 1926).

27. Rogers, interview, 2.16.96.

28. Zipporah Levinson, interview, Cambridge, 9.11.95.

29. Irving 1.

Gottesman, Schizophrenia Genesj.- The Origins of Madness

(New York: W. H. Freeman,

1991). For a contrary view, which states that cases of

schizophrenia have been documented as long as 3,400 years ago,

see Ming T. Tsuang, Stephen V. Faraone, and Max Day,

"Schizophrenic Disorders,"

New Harvard Guide to Psychiatry,

op. cit.

30. Tsuang, Faraone, and Day, op. cit., people. 259.

31. Gottesman, op. cit.; Tsuang, Faraone, and Day, op. cit.;

Richard S. E. Keefe and Philip D. Harvey,

-----936

Understanding Schizophrenia: A Guide to the New Research on

Causes and Treatment

(New York: Free Press, 1994); E. Fuller Torrey,

Surviving Schizophrenia: A Family Manual

(New York: Harper and Row, 1988).

32. Gottesman, op. cit.

33. For an excellent summary see Michael R. Trimble,

Biological Psychiatry

(New York: John Wiley and Sons, 1996), people. 224.

34. Eugen Bleuler, quoted in Louis A. Sass,

Madness and Modernism

(New York: Basic Books, 1992), people. 14.

35. Emil Kraepelin, quoted in ibid., pp. 13-14.

36. Torrey, op. cit.

37. Gottesman, op. cit.

38. Ibid.

39. See, for example, Tsuang, Faraone, and Day, op. cit.

-----937

40. See, for example, Gottesman, op. cit.

41. Ibid.

42. See, for example, Storr,
Solitude,
op. cit.; Cale Christianson,
In the Presence of the Creator (New
York: Free Press, 1984); Richard S. Westfaill,
The Life ofisaac Newton
(Cambridge, UX: Cambridge University Press, 1993).
(Wa 43. George Winokur and Ming Tsuang, The Natural HW-ORV of
Manii, Depression and Schiecpfhrenia
shington, D.C.: American Psychiatric Press, 1996), pp. 253-68;
Manfred Bleuler,

The Schizophrenia Disorders: Long-Tenn Patient and Family A937 Studies

(New Haven: Yale University Press, 1978).

44, M. Bleuler, op. cit., quoted in Sass, op. cit., people. 14.

45, Storr,

-----938

The Dynamics of Creation,

op. cit.

46. See, for example, Gottesman, op. cit. For discussions of
differences between manic depressive illness and schizophrenia,

see Torrey, op. cit.; Kay Redfield Jamison,

Touched with Fire: Manic-Depressive Illness and the Artistic

Temperament

(New York: Free Press, 1993).

47. Sass, op. cit., prologue.

48. Emil Kraepelin,

Dementia Traecox and faraphrenia

(Huntington, Nddally: R. E. Krieger, 1971), quoted in Sass, op.

cit., pp. 13-14.

49. Sass, op. cit., people. 4.

50. Letter from John Nash to Emil Artin, written in Geneva,
undated (1959).

51. Letter from John Nash to Alex Mood, 11,94.

52. R. Nash, interview, 1.7.96.

53. Confidential source.

54. See, for example, Mikhail Gromov, Partial Differential

Relations

-----939

(New York: Springer-Verlag, 1986); Heisuke Hironaka, "On Nash

Blowing Up,"

Arithmeticand Geomeby

IIGGBoston: Birkauser, 1983), pp. 103-

11; P. Ordehook,

Game Theory and Political Theory: An Introduction

(Cambridge, UX: Cambridge University Press, 1986); Richard

Dawkins,

The Seh7nessh Gene

(Oxford: Oxford University Press, 1976); John Maynard Smith,

Did Darwin Get It Right?

(New York: Chapman and Hall, 1989); as well as

Math Reviews and Socill Science Citation Index,

various dates.

55. Eatwell, Milgate, Newman, op. cit., people. xii.

56. Ariel Rubinstein, professor of economics, Princeton University and University of Tel Aviv, interview,

-----940

10.18.95.

57. Eatwell, Milgate, Newman, op. cit.

58. Member, School of Historical Studies, Institute for Advanced Study, interview, 1995.

59. Freeman Dyson, professor of physics, Institute for Advanced Study, interview, Princeton, 12.5.96.

60. Enrico Bombieri, professor of mathematics, Institute for Advanced Study, interview, 12.6.96.

61. See, for example, Winokur and Tsuang, op cit., people. A940
268.

Part One: A BEAUTIFUL MIND

1: Bluefield

1. John Forbes Nash, Jr., autobiographical essay,
Les Prix Nobel 1994,
op. cit.

2. "Nash-Martin,"
Appalachian Power and Light Searchlight,
vol. 3, no. 9 (September 1924), people. 14.

3. Ibid.

-----941

4. Martha Nash Le R ke, 7.31.95. tv, interv'ew, oanc,
5. The history of Nashes is based on en al gical materials,
regional histories, and newspaper clippings supplied by Martha
Legg and Richard 4ashe including
The Hlsfty Of GMYSOD County, Texas, vol.
2 (Grayson County Frontier Viluge, 1981) and Graham Landrum and
Allan Smith, Grayson County: An Illustrated History (Fort Worth,
Tex.: Historical Publishers). The facts of John Forbes Nash,
Srdd`s early life are based on interviews with Martha Nash Legg
as well as his obituary.

6. Obituaries of Martha Nash,
Baptist Standard
(1944); M. Legg, interview, 8. 1,95; R. Nash, interview, San
Francisco, 1.7.97.

7. M. Legg, interview, 7.31.95.

8. The history of the Martins and the facts of Virginia Martin's
early life are based on interviews with Martha Legg as well as
obituaries of Emma Martin and Virginia Martin

-----942

in the

Bluefield Daily Telegraph-

9. Letter from John Forbes Nash, Jr., to Martha Legg, undated
(1969).

10, For a short history of the marriage bar, see Claudia Goldin,
"Career and Family: College Women Look to the Pastea"Working
Paper No. 5188 (Cambridge, Mass.: National Bureau of Economic
Research, July 1995).

11. C. Stuart McGehee,
The City of Bluefield. Centennial History 1889-1989
(Bluefield Historical Society).

12. Ibid.; John E. Williams, professor of psychology, Wake Forest

University, interview, 8.95.

13. John Nash,

Les Prix Nobel 1994,

op. cit.

14. Williams, interview, 10.24.95; William Lewis, McKinsey and Partners, interview, 10.94.

15. John Nash,

Les Prix Nobel 1994,

-----943

op. cit.

16. M. Legg, interview, 8.3.95.

17. Ibid. A943
18. John G. Gunderson, 'Personality Disordersea"op. cit., pp. 343-44; also Nikki Erlenmeyer-Kimling, professor of genetics and development, Columbia University, interview, 1. 17.98.
19. ` . Le
20. Gerg in William Archer, Bluefield Daily Telegraph, 10.94. 21. Report 1supplied by Martha Legg.
22. John Nash, Les Pir Nobel 1994, op. cit.
23. M. Legg, interview, 8.1.95.
24. Eddie Steele, quoted in William Archer, Bluebeld Daily Telegmph, 10. 13.94.
25. Donald V. Reynolds, interview, 6.29.97.
- 26 Ibid,
27. Ibid.
28. M. Legg, interview, 8.2.95.

-----944

29. Ibid.
30. E. T. Bell, Men ofMathematics, op. cit.; Betty Umberger, quoted in William Archer, Bluefield Daily Telegraph, 10. 13.94.
31. Janice Thresher Frazier, personal communication, 9.97.
32. The origin of this quotation is unknown.
33. M. Legg, interview, 10.94.
34. Kuhn, interview, 3.97.
35. John Nash, Les Prix Nobel 1994, op. cit.
36. Bell, op. cit.
37. Ibid.
- 38, Ibid.
39. Denis Brian, Einstein: A Life (New York: John Wiley and Sons, 1996).
40. Bell, op. cit.; also Kuhn, interview, 10.21.97.
41. Bell, op. cit.

-----945

42. M. Legg, interview, 8.1.95. 43. Williams, interview.
44. Donald V. Reynolds, interview. 45. Interviews with Peggy

Wharton, 12.96; Robert Holland, 6.9.97; John Louthan, 6.21.97;
John Williams; Reynolds. 46. Reynolds, interview.
47. [bid.
48. Felix Browder, president, American Mathematics Society,
interview, 11.2.95. 49. M. Legg, interview, 11.94.
50. Nelson Walker, quoted in William Archer,
Bluefield Daily Telegraph, 10.94. 51. Edwin Elliot, quoted in
William Archer,
Bluefield Daily Telegraph, 11. 14.94.
53. Reynolds, interview; see also William Archer, "Boys Will Be
Boys,"

Bluefield Daily Telegraph,
11.14.94.

A945

54. Julia Robinson, in Donald Albers, Gerald L. Alexanderson, and
Constance Reid,
More Mathematical People

-----946

(New York: Harcourt Brace Jovanovich, 1990), people. 27 1.

55. Anthony Storr,
The Dynamics of Creativity,
op. cit.

56. M. Legg, interview, 11.94.

57. Vernon Dunn, quoted in William Archer,
Bluefield Daily Telegraph, 11.94. 58. Beaver High School
Yearbook, 1945. 59. Interviews with Williams and Louthan. 60. M.
Legg, interview, 8.1.95.

61. John Nash,
Les Prix Nobel 1994,
op. cit.

62. John F. Nash and John F. Nash, Jr., "Sag and Tension
Calculations for Cable and Wire Spans Using Catenary Formulas,"
Electrical Engineering,
1945.

63. Uncle App News, 7.45.

2: Carnegie Institute of Technology

1. Nash's interest in number theory, topology, and other branches
of pure mathematics was recalled by Robert Siegel, professor of
physics,

-----947

College of William and Mary, interview, 10.30.97; Hans F.
Weinberger, professor of mathematics, University of Minnesota,
interviews, 9.6.95, 10.28.95, and 10.29.95; Paul F. Zweifel,
professor of mathematics, Virginia Polytechnic Institute,
interviews, 10.94 and 9.6.95; Richard J. Duffin (deceased),
emeritus professor of mathematics, Carnegie-Mellon University,
interviews, 10.94, 8.95, and 10.26.96.

2. See, for example, Stephan Lorant, Pittsburgh: 7-85 Story of an
American City
(Lenox, Mass.: author's edition, 1980) and interviews with Nash's
contemporaries.

3. Richard Cyert, former president, Carnegie-Mellon University,
interview, 10.26.95. Also Herbert Simon, Nobel Laureate,
Carnegie-Mellon University, interview, 10.26.95.

4. Duffin, interview, 10.26.96; Robert E. Gleeson, professor of

history, Carnegie-Mellon University, interview, 10.27.95; Glen U. Cleeton,

-----948

The Story of Carnegie Tech, IT The Doherty Administration, 1936-1950 (Pittsburgh: Carnegie Press, 1965); Robert E. Gleeson and Steven Schlossman, George Leland Bach and the Rebirth of Graduate Management Education in the United States, 1945-1975 (Graduate Management Admission Council, Spring 1995); Robert E. Gleeson and Steven Schlossman, The Many Faces of the New Look: The University of Virginia ` ` Came

diseTech

and the Reform of American Management Education rglnl'?` His
in the Postwar Era

(Graduate Management Mission Council, Spring 1992).

5. Interviews with Weinberger, 10.28.95; Zweifel, 10.94; George
W. Hinman, professor of physics, Washington State University,
10.30.97; David R. Lide, editor,
CRC Handbook of Chemistry and Physics, 10.

-----949

30.97; Edward Kaplan, professor of statistics, Oregon State
University, 5.2 1.97.

6. Interviews with Martha Nash Legg, 8.2.95; Weinberger,
10.28.95; Zweifel, 10.94.

7. Interviews with Siegel, 10.30.97; Hinman, 10.30.97.
cit.

Les Prix Nobel 1994,

8. John Nash, autobiographical
op. essay,

9. Lide, interview, 10.30.97. 10.30.97.

10. Hinman, interview,

11. Lide, interview, 10.30.97.

12. John Nash,

Les Prix Nobel 1994,

op. cit.

13. Interviews with Raoul Bott, professor of mathematics, Harvard
University, 11.5.95; Hinman,
10.30.97; Cathleen S. Morawetz, professor of mathematics, Courant
Institute, and daughter of J. Synge,

-----950

2.29.96.

14. Duffin, interview, 10.26.95.

15. Duffin, interview, 10.94.

16. Morawetz, interview.

17. Ibid.

18. Interviews with Lide, 10.30.97, and Duffin, 10.26.95.

19. Weinberger, interview, 9.6.95.

20. Siegel, interview, 10.30.97. Siegel may have been mistaken;
Bluefield had both a symphony and concert series before the war.

21. Bott, interview, 11.5.95.

22. Patsy Winter, Williamsburg, Virginia, interview, 10. 30.97.

23. Weinberger, interview, 10.28.96.

24. Lide, interview, 10.30.97.

25. Interviews with Zweifel, 10.94, and Lide, 10.30.97.
26. Weinbergerbbvintervioew, 10.28.95.
27. Siegel, inte ew 1 .30.97.
28. Hinman, interview, 10.30.97.
29. Zweifel, interview, 10.94.
30. Zweifel, interview, 1.21.98.
31. Ibid.; also interviews with Hinman, 10.30.97, and Siegel, 10.30.97.

-----951

32. Siegel, interview, 10.30.97.
33. Weinberger, interview, 10.28.95.

34. Zweifel, interview, 10.94. A951
35. Fletcher Osterle, professor of mechanical engineering, Carnegie-Mellon University, interview, 5.21.97.
36. Mathematical Monthly (September 1947), people. 400.
37. Leonard F. Klosinski, director, the William Lowell Putnam Mathematical Competition, interview, 10.96; Gerald L. Alexanderson, associate director, the William Lowell Putnam Mathematical Competition, interview, 10.96; Garrett Birkhoff, "The William Lowell Putnam Mathematical Competition: Early History" and L. E. Bush, "The William Lowell Putnam Mathematical Competition: Later History and Summary of Results," reprinted from American Mathematical Monthly, vol. 72 (1965), pp. 469-83.
38. Hinman, interview.
39. Harold Kuhn, interview, 7.97.

-----952

40. John Nash,
Les Prix Nobel 1994,
op. cit.
41. This scene is based on recollections of Duffin, interview, 10.94 and 10.26.95; Bott, interview, 10.94; and Weinberger, interviews, 9.6.95 and 10.28.95.
42. Duffin, interview, 10.94.
43. Bott, interview, 10.94.
44. Martin Burrow, professor of mathematics, Courant Institute, interview, 2.4.96.
45. Duffin, interviews, 10.94 and 10.26.95.
46. Duffin, interview, 10.94.
47. Bott, interview, 11.5.95.
48. Weinberger, interview, 10.28.95.
49. Siegel, interview, 10.30.97.
50. Weinberger, interview,
51. John Nash,
Les Prix Nobel 1994,
op. cit.
52. See Chapter 9.
53.
The Carnegie Tartan,

-----953

- 4.20.48.

- 54. Interviews with Kuhn, 10.97, and M. Legg, 8.3.95.
- 55. John Nash,
Les Prix Nobel 1994,
op. cit.
- 56. The perception of Harvard's relative decline and Princeton's
ascendancy by the late 1940's was widespread among Nash's
contemporaries.
- 57. Duffin, interview, 10.26.95.
- 58. Letter from Solomon Lefschetz to Nash, 4.8.48.
- 59. Details about the JSK Fellowship, named after John S.
Kennedy, a Princeton alumnus, are based on a memorandum from

- Sandra Mawhinney to Harold Kuhn, 10.27.97. A953
60. Graduate Catalog, Princeton University, various years; Report to the Dean of Faculty, Princeton University, various years.
61. John Nash,
Les Triv Nobel 1994,
op. cit.
62. Letter from S. Lefschetz to J. Nash.
- 954
63. Letter from John Nash to Solomon Lefschetz, undated, mid-April 1948. 64. Clifford Ambrose Truesdell, interview, 8.14.96.
65. Letter from J. Nash to S. Lefschetz. For the events transpiring then, see
Chronicle of the Twentieth Century
(Mount Kisco, N.Y.: Chronicle Publications, 1987).
66. Interviews with Charlotte Truesdell, 8.14.96, and Kaplan, 5.21.97.
67. Letter from J. Nash to S. Lefschetz, 4.26.48.
68. Clifford Truesdell, interview, 8.14.96.
69. Charlotte Truesdell, interview, 8.14.96.
- 3: The Center of the Universe
1. Martha Nash Legg, interview, 8.3.95. 2. See, for example, Rebecca Goldstein, *The Mind-Body Problem* (New York: Penguin, 1993); Ed Regis, "o Got Einstein Office? (Reading, Mass.: Addison Wesley, 1987); and recollections of Nash's
- 955
- contemporaries, including interviews with Harold Kuhn and Harley Rogers and letter from George Mowbry, 4.5.95.
3. F Scott Fitzgerald,
This Side of P (New York: Scribner, 1920).
4. Albert Einstein, quoted in Goldstein, op. cit.
5. As recalled by her niece Gillian Richardson, interview, 12.14.95.
6. Donald Spencer, professor of mathematics, Princeton University, interview, Durango, Colorado, 11.18.95.
7. Leopold Infeld,
Quest (New York: Chelsea Publishing Company, 1980).
8. Virginia Chaplin, "Princeton and Mathematics,"

Princeton Alumni Weekly

(May 9, 1958).

9. John D. Davies, "The Curious History of Physics at Princeton,"

-----956

Princeton Alumni Weekly (October

2, 1973).

10, Harold W. Kuhn, interview, 1.97. 11. Eugene Wigner,

Recollections of Eugene Paul Wigner as Told to Andrew Szanton

(New York: Plenum Press, 1992).

12. Regis, op. cit.

14. Chaplin, op. cit.; William Aspray, "The Emergence of

Princeton as a World Center for Mathematical Research, A956
1896-1939ea" in A Century of Mathematics in America, Part 11
(Providence, R.I.: American Mathematical Society, 1989);
Gian-Carlo Rota, "Fine Hall in Its Golden Ageea" in Indiscrete
Thoughts
(Washington, D.C.: Mathematical Association of America, 1996),
pp. 3-20.
15. Davies, op. cit.
16. Solomon Lefschetz, "A Self Portrait;" typewritten, 1.54,
Princeton University Archives.
17. Davies, op. cit.
18. Ibid.

-----957

19. Ibid.
20. Robert I. Leonard, "From Parlor Games to Social Scienceea" op.
cit.
21. Davies, op. cit.
22. Woodrow Wilson, quoted in ibid.
23. George Gray, Confidential Monthly Trustees Report,
Rockefeller Foundation Archives (November
1945).
2 plus Wigner, op. cit.
25. The account of the Institute's history is based on Regis, op,
cit.; Bernice M. Stern, A
History of the Institute for Advanced Study 1930-1950,
unpublished two-volume manuscript (1964). 26. Garrett Birkhoff,
"Mathematics at Harvard 1836-1944ea" in
A Century of Mathematics in America, Part 11
op. cit., pp. 3-58; William Aspray, "The Emergence Of Princeton
as a World Center for Mathematical Research, 1896-1939ea" in A
Century of Mathematics in America, Pqrt If

-----958

op. cit., pp. 195.216; Gian-Cado Rota, "Fine Hall in Its Golden
Ageea" in A
Century of Mathematics in America, Part II,
op. cit., pp. 223-36.
27. Robin E. Rider, "Alarm and Opportunity: Emigration of
Mathematicians and Physicists to Britain and the United States,
1933-1945,"
Historical Studies in the Physical and Biological Sciences,
yet. 15, no. 1 (1984), pp. 108-71. 28. Paul Samuelson, "Some
Memories of Norbert Wienerea" provided by author, undated. 29.
William James, "Great Men, Great Thoughts and Environment,"

Atlantic Monthly,
vol. 46 (1880), pp. 441-59, quoted in Silvano Arieti,
Creativity. The Magic Synthesis
(New York: Basic Books, 1976), people. 299.
30. See, for example, Davies, op. cit.; Chaplin, op. cit.; Nathan
Rheingold,

-----959

"Refugee Mathematicians in
the United States of America, 1933-1941: Reception and Reaction,"
Annals of Science,
vol. 38 (1981), pp. 313-38; Rider, op. cit.; Lipman Bers, "The

European Mathematician's Migration to America," A959
in A Century of Mathematics in America, Part I (Providence, R.I.:
American Mathematical Society, 1988).

and World War Ilea" in

A Centur

31. See, for example, Mina Rees, "The Mathematical Sciences
v of Mathematics in America, Part I-

op. cit., Peter Lax, "The Flowering of Applied Mathematics in
Americaea" in

A Century of Mathematics in America, Pqrt If

op, cit., pp. 4 5 5 com66; Fred Kaplan, 7-h

e Wizards of Armageddon

(New York: Simon and Schuster, 198 3). 32. Chaplin, op. cit.

33. Andrew Hodges,

-----960

Alan Turing: The Enigma

(New York: Simon and Schuster, 1983). 34. Chaplin, op. cit.

35. Ibid.

36. See Kaplan, op. cit.; William Poundstone,

Prisoner Dilemma

(New York: Doubleday, 1992); David Halberstam,

The Fifiies,

op. cit.

37. Rees, "The Mathematical Sciences and World War IIEA" OP. cit.;

Lax, "The Flowering of Applied Mathematics in Americaea" op. cit.,

pp. 455-66.

38. Herman H. Coldstine, A Brief History of the Computerea" in A

Century of Mathematics in America, Part I op. cit., pp. 311-22;

Poundstone, op. cit., pp. 76-78, on von Neumann's role in the

development of the computer; Halberstam, op. cit., pp. 93-97, on

von Neumann and the computer.

39. Hartley Rogers, professor of mathematics, MIT, interview,

1.26.96.

-----961

4:

School of Genius

1,

Solomon Leader, professor of mathematics, Rutgers University,

interview, 6.9.95

2, The portrait of Solomon Lefschetz is based on interviews with

Harold W. Kuhn, 11.97; William Baumol, 1.95; Donald Spencer,

11.18.95; Eugenio Calabi, 3.2-96; Martin Davis, 2.20.96; Melvin

Hausner,

2.6.96; Solomon Leader, 6.9.95; and other contemporaries of Nash's at Princeton. Also consulted were several memoirs, including Solomon Lefschetz, "Reminiscences of a Mathematical Immigrant in the United States," American Mathematical Monthly, vol. 77 (1970); A. W. Tucker, Solomon Lefschetz.- A Reminiscence; Sir William H d e Solomon Leischetz, 1884-1972; Phillip Griffiths, Donald Spencer, and George Whitehead, Solomon L, tional Academy of Sciences, 1992);

GianmXltz:

962

Biographical Memoirs

(Washington, D.C.: Na

Carlo Rota,

Indiscrete Thoughts,

op. cit.

3. Lefschetz's obituary in

The New York Times

(October 7 `1972) credits him for "develop[ing] [the

Annals of Mathematics]

into one of the world's foremost mathematical journals." 4. "It

should be noted that although Lefschetz was Jewish, he was not

above engaging in a mild form of anti-semitism. He told Henry

Wallman that he was the last Jewish graduate student that would

be admitted to Princeton because Jews could not get a job anyway

and so why bother "Ralph Phillips, "Reminiscences of the

1930's,"

The Mathematical Intelligencer,

vol. 16, no. 3 (1994). Lefschetz's attitude toward Jewish students

was well known. Phillips's impressions were confirmed by Leader,

interview, 6.9.95; Kuhn, interview,

-----963

11.97; Davis, interview, 2.20.96; and Hausner, interview, 2.6.96.

397

5. Baumol, interview, 1.95.

6. See, for example, Gian-Carlo Rota, "Fine Hall in Its Golden

Age" op. cit. DOD personnel security application, 3.10.56,

Princeton University Archives. 7. Solomon Lefschetz, "A Self

Portrait: typewritten, 1.54, Princeton University Archives.

8. Ibid. ...

9. Don24 Sluininencer, interviews, 11.28.95; 11.29.95; 11.30.95.

10. Rota, op. cit.

11. Ibid.

12. Ibid.

13. Leader, interview, 6.9.95.

14. Davis, interview, 2.6.96.

15. Hausner, interview, 2.6.96.

16. Leader, interview, 6.9.95.

17. Spencer, interviews.

18. Virginia Chaplin, "Princeton and Mathematicsea" op. cit.;

Davis, interview, 2.20.96; Hartley Rogers, interview,

-----964

1.26.96.

19. Ibid.
20. Hausner, interview.
21. Ibid.
22. Ibid.
23. Joseph Kohn, interview, 7.25.96. 24. Robert Kanigel,
The Man "o Knew Infinity
(New York: Pocket Books, 1991); G. H. Hardy, "The Indian
Mathematician Ramanuianea"lecture delivered at the Harvard
Tercentenary Conference of Arts and Sciences, August 31, 1936,
reprinted in A
Century ofMathematics

(Washington, D.C.: Mathematical Association of America, A964 1994), people. 110.

25. Hardy, op. cit.

26. J. Davies, op. cit.; Gerard Washnitzer, professor of mathematics, Princeton University, interview, 9.25.96.

27. Graduate Catalog, Princeton University, various years; Report to the President, Princeton University, various years.

-----965

28. Letter from John Nash Forbes, Jr., to Solomon Lefschetz referring to request for private room, 4.46; Calabi, interview,

29. Interviews with Kuhn, 11.97; Washnitzer, 9.25.96; Felix Browder, 11.2.96; Calabi, 3.12.96; John Tukey, professor of mathematics, Princeton University, 9.30.97; John Isbell, professor of mathematics, State University of New York at Buffalo, 8.97; Leader, 6.9.95; Davis, 2.6.96.

30. Kuhn, interview.

31. Davis, interview.

32. Interviews with Washnitzer and Kuhn.

33. Washnitzer, interview.

34. Tukey, interview.

35. Kuhn, interview.

36. Calabi, interview.

37. Martin Shubik, "Came Theory at Princeton: A Personal Reminiscence" Cowles Foundation Preliminary Paper 901019, undated.

38. Interviews with Hausner; Davis; Kuhn; Spencer; Leader; Rogers; Calabi; and John McCarthy, professor of computer science,

-----966

Stanford University, 2.4.96.

39. Hausner, interview, 2.6.96.

40. Interviews with Davis, Leader, Spencer; Rota, op. cit.

41. Rota, op. cit.

42. Isbell, interview.

43. Tukey, interview.

44. David Yarmush, interview, 2.6.96. 45. Princeton Alumni Directory 1997. 46. John W. Milnor, professor of mathematics and director, Institute for Mathematical Sciences, State University of New York at Stony Brook, interviews, 10.28.94 and 7.95.

47. Interviews with Kuhn, Hausner, John McCarthy.

48. Interviews with Hausner and Davis.

5: Genius

1. Kai Lai Chung, professor of mathematics, Stanford University,

interview, 1.96; letter, 2.6.96.

2. Abraham Pais,

Subtle Is the Lord: The Science and Life of Albert Einstein

(New York: Oxford University Press,

-----967

1982).

3. Interviews with Charlotte Truesdell, 8.14.96; Martin Davis,

2.20.96; Hartley Rogers, 2.16.96; and John McCarthy, 2.4.96; John

Forbes Nash, Jr., Personnel Security Questionnaire, 5.26.50,

Princeton University Archives. 4. "Trivialea"Melvin Hausner,

interview; "burblingea"Patrick Billingsley, professor of

statistics, University of Chicago, interview, 8.12.97; A967
"hackerea"Hausner, interview.
5. Rogers, interview.
6. Davis, interview.
7. Peggy Murray, former secretary, department of mathematics,
Princeton University, interview, 8.25.97.
8. Davis, interview.
9. John Milnor, interview, 9.26.95. 10. John Nash,
autobiographical essay, Les Prix Nohel 1994,
op. cit.
11. Mentioned by many of his contemporaries, this was confirmed
by Nash in a conversation with Harold Kuhn. 12. Harold Kuhn,
personal communication,

-----968

8.96.
13. E enio Calabi, interview,
14. 1 ui T
15. Interviews with Solomon Leader and Calabi.
16. Letter from John Nash to Solomon Lefschetz, 4.48.
17. Calabi, interview.
18. John Milnor, "A Nobel Prize for John Nash,"
The Mathematical Inteffigencer,
vol. 17, no. 3 (199 5), people. 5.
19. Leader, interview, 6.9.96.
20. Ibid.
21. David Gale, interview, 9.20.95. 22. Davis, interview.
23. Kuhn, interview, 9.96.
24. Hausner, interview.
25. Milner, interview, 9.26.95.
26. Norman Steenrod, letter, 1950, quoted by Harold Kuhn,
introduction, "A Celebration of John F. Nash, Jr.;"`
Duke Mathematical journal,
vol. 8 1, no. 2 (1996).
27. E. T. Bell,

-----969

Men ofMathematics,
op. cit.
28. Steenrod, letter, 2.5.53.
29. For this assessment, I relied on Hale Trotter and Harold
Kuhn.
30. Milnor, interview.
31. Kuhn, interview, 8.97.
32. Ed Regis,

Who Got Einstein OlWce?

op. cit.; Denis Brian,

Einstein: A LITC,

op. cit.

33. John Forbes Nash, Jr., plenary lecture, World Congress of Psychiatry, Madrid, 8.26.96, op. cit.

34. Ibid.

35. Regis, op. cit.

36. Ibid.; also Brian, op. cit.

37. Brian, op. cit.

38. Ibid.

39. Nash, as told to Harold Kuhn; see also Brian, op. cit., for description of Kemeny's assistantship under Einstein in 1948-49.
40. Brian, op. cit.
41. John Nash, as told to Kuhn, November
-----970
- 1997.
42. Ibid.
43. Ibid.
44. Ibid.
45. Calabi, interview,
46. William Browder, professor of mathematics, Princeton University, interview, 12.6.96.
47. Steenrod, letter, 2.5.53.
48. Milnor, interview, 9.26.95.
49. Interviews with Leader and Kuhn.
50. Princeton University Archives.
51. Ibid.
- 51 Melvin Peisakoff, interview, 6.3.97. 53. RAO ers, interview.
54. Calabi, interview.
55. Hausner, interview.
56. Rogers, interview.
57. Hausner, interview.
58. Felix Browder, interview, 11.2.95. 59. Leader, interview.
60. Harold Kuhn witnessed the scene, and Mel Peisakoff confirmed that it took place.
61. Donald Spencer, interview.
62. Letter from A] Tucker to Alfred Koerner,
-----971
- 10.8.56.
63. The portrait of Artin is based on Gian-Carlo Rota, Indiscrete Thoughts, op. cit., as well as recollection of John Tate; Spencer, interview, 11.18.96; Hauser, interview; and materials from the Princeton University Archives.
64. Spencer, interview.
- 6: Games
1. Albert W. Tucker, as told to Harold Kuhn, interview.
2. Interviews with Marvin Minsky, professor of science, MIT, 2.13.96; John Tukey, 9.30.97; David Gale, 9.20.96; Melvin Hausner, 1.26.96 and 2.20.96; and John Conway, professor of mathematics, Princeton University, 10.94; John Isbell, e-mails, 1.25.96, 1.26.97, 1.27.97. 3. Isbell, e-mails.

4. Letter from John Nash to Martin Shubik, undated (1950 or 1951); Hausner, interviews and e-mails.

5. William Poundstone,
Pdsoneea6 Dilemma,

-----972

op. cit.; John Williams,
The Compleat Strategyst (New
York: McGraw Hill, 1954).

6. Poundstone '0 Cit.

7. Solomon Leale,, interview, 6.9.95. 8. Martha Nash Legg,
interview, 8.1.95. 9. Isbell, e-mails.

10. Hartley Rogers, interview, 1.26.96. 11. Ibid. A972
12. Ibid.
13. Nash may have had the idea while he was at Carnegie. This, in any case, is Hans Weinberger's recollection, interview, 10.28.95.
14. Martin Gardner,
Mathematical Puzzles and Diversions
(New York: Simon and Schuster, 1959), pp. 65-70.
15. Gardner's comment, in 1959, was that Hex "may well become one of the most widely played and thoughtfully analyzed new mathematical games of the century."
16. Gale, interview, 9.20.95.
17. Dinner at which John Nash, David Gale, and the author were present, January 5,

-----973

- 1996, San Francisco.
Iand Gale, interview.
19. Ibid.
20. Phillip Wolfe, mathematician, IBM, interview, 9.9.96.
21. John
MILDO-RATHER,
"A Nobel Prize for John Nash;" op. cit.
22. Ibid.; Gardner, op. cit.
23. Gale, interview.
24. Ibid.
25. Ibid.
26. Kuhn, interview.
27. Ibid.
28. Milnor, interview, 9.26.95.

7: John von Neumann

1. See, for example, Stanislaw Ulam, "John von Neumann, 1903-1957," Bulletin of the American Mathematical Society, vol. 64, no. 3, part 2 (May 1958); Stanislaw Ulam, Adventures of a Mathematician (New York: Scribner's, 1983); Paul

-----974

- R. Halmosea"The Legend of John von Neumann," American Mathematical Monthly, vol. 80 (1973); William Poundstone, Prisoner Dilemma, op. cit.; Ed Regis, Who Got Einstein 01>ei op. cit.

John von Neumann

A974

-----975

(New York: Pantheon Books, 1992), pp. 3 50-56.

8. John von Neumann,

The Computer and the Brain

(New Haven: Yale University Press, 1959).

9. See, for example, G. H. Hardy, A Mathematician

Apology (Cambridge, U.K.: Cambridge University Press, 1967), with
a foreword by C. P. Snow.

10. Ulam, "John von Neumann;" op. cit.

11. Poundstone, op. cit.,

12. Poundstone,

Prisoner Dilemma,

people. 190.

13. Clay Blair, Jr., "Passing of a Great Mind;" Life (February
1957), pp. 89-90, as quoted by Poundstone, op. cit., people. 143.

14. Poundstone, op. cit.

15. Ulam, "John von Neumannea"op. cit.

16. Harold Kuhn, interview, 3.97.

-----976

17. Paul R. Halmos, "The Legend of John von Neumann;" op. cit.

18. Ibid.

19. Poundstone, op. cit.

20. Halmos, op. cit.

22. Poundstone, op. cit.

23. Ulam,

Adventures of a Mathematician,

op. cit.

2 plus Ulan), "John von Neumannea"op. cit.

25, Ibid.

26. Ibid., people. 10; Robert J. Leonard, "From Parlor Games to
Social Scienceea"op, cit.

27. Richard Duffin, interview, 10.94.

28. Halmos, op. cit.

29. Ulam, "John von Neumann;" op. cit., pp. 35-39.

30. Interviews with Donald Spencer, 11.18.95; David Gale,
9.20.95; and Harold Kuhn, 9.23.95.

31. Poundstone, op. cit.

32. Herman H. Goldstine, "A Brief History of the Computerea"A

-----977

Century of Mathematics in America, Part I

op. cit.

33. John von Neumann, as quoted in ibid. 8: The Theory of Games

1. John von Neumann and Oskar Morgenstern,
The Theory of Games and Economic Behavior (Princeton: Princeton
University Press, 1944, 1947, 1953).
2. Both von Neumann and Morgenstern came to the seminar. Albert
W. Tucker, interview, 10.94. See also Martin Shubik, "Game Theory
and Princeton, 1940-1955: A Personal Reminiscence" Cowles
Foundation Preliminary Paper, undated, people. 3; David Gale,
interview, 9.20.95; and Harold Kuhn, interview, 9.20.95.
3. A. W. Tucker, "Combinatorial Problems Related to Mathematical
Aspects of Logistics: Final Summary Report" U.S. Department of
the Navy, Office of Naval Research, Logistics Branch, February

28, 1957), people. 1. A977

4. Melvin Hausner, interview, 2.6.96.

-----978

5. Interviews with David Yarmush, 2.6.96, and John Mayberry, 4.15.96.

6. David Gale, interview.

7. Kuhn, interview.

and Ibid.; Hausner, interview.

9. Robert J. Leonard, "From Parlor Games to Social Sciencea"op. cit.

10. See, for example, H. W. Kuhn and A. W. Tucker, "John von Neumann's Work in the Theory of Games and Mathematical Economics,"

Bulletin of the American Mathematical Society

(May 1958).

11. Leonard, "From Parlor Games to Social Sciencea"op. cit.

12. Ibid.

13. Ibid.

14. Dorothy Morgenstern Thomas, interview, 1.25.96. Morgenstern kept a portrait of the kaiser hanging in his home.

15. Letter from George Mowbry to author, 4.5.95.

16. Leonard, "From Parlor Games to Social Sciencea"op. cit.

-----979

17. As quoted in ibid.

18. Ibid.

19. Ibid.

20. Ibid.

21. Ibid.

22. Ibid.

23. Ibid.

24. Ibid.

25. A. W. Tucker, who knew both men well, said, "If he hadn't been forced to write a book, it wouldn't have gotten writtenea"interview, 10.94. Von Neumann was interested in economics before he met Morgenstern.

26. Leonard, "From Parlor Games to Social Sciencea"op. cit.

27. Ibid.

28. Von Neumann and Morgenstern, op. cit., people. 6.

29. Leonid Hurwicz, "The Theory of Economic Behavior,"

The American Economic Review

(1945), pp. 909-25.

30. Von Neumann and Morgenstern, op. cit., people. 7.

31. Ibid., people. 3.

- 32. Ibid.
- 33. Ibid., people. 4.
- 34. Ibid., people. 7,
- 35. Ibid., people. 1
- 36. Ibid.
- 37. fbiand, people. 6.
- 38.
- New York Times,
- 3.46.
- 39. See, for example, Herbert Simon,

The American journal of Sociology, A980
no. 50 (1945), pp. 58-60. Hurwicz, op. cit.; Jacob Marschak,
"Neumann's and Morgenstern's New Approach to Static Economics,"
Journal of Political Economy,
no. 54 (1946), pp. 97-115; John McDonald, "A Theory of Strategy,"
Fortune
(June 1949), pp. 100- 110.

40. Leonard, "From Parlor Games to Social Science" op. cit.

42. Ibid.

43. Shubik, "Game Theory and Princeton:" op. cit., people. 2.

-----981

44. Von Neumann and Morgenstern, op. cit. See also Falwell,
Milgate, and Newman, op. cit.

45. Von Neumann and Morgenstern, op. cit. 46. Ibid.

47. See, for example, John C. Harsanyi, "Nobel Seminar" in
Les Prix Nobel 1994.

48. Von Neumann and Morgenstern, op. cit. 49. Ibid.

50. Ibid.

51. Harsanyi, op. cit.

9: The Bargaining Problem

1. John Forbes Nash, Jr., "The Bargaining Problem,"

Econometrica,

vol. 18 (1950), pp. 155-62.

2. Nash's bargaining solution was "virtually] unanticipated in
the literature" according to Roger B. Myerson, "John Nash's
Contribution to Economics,"

Games and Economic Behavior,

no. 14 (1996), people. 291. See also Ariel Rubinstein, "John
Nash: The Master of Economic Modeling,"

-----982

The Scandinavian Journal of Economics,

vol. 97, no. 1 (1995), pp. 11 --

12; John C. Harsanyi, "Bargaining," in Eatwell, Milgate, and
Newman, op. cit., pp. 56-60; Andrew Schotter, interview,

10.25.96; Ariel Rubinstein, interview, 11.25.96; James W.

Friedman, professor of economics, University of North Carolina,
interview, 10.2.96.

3. "This is the classical problem of exchange and, more
specifically, of bilateral monopoly as treated by Cournot,
Bowley, Tinbergen, Fellner and others" Nash, "The Bargaining
Problem" p. 155. As Harold Kuhn points out, Nash's delineation
of the history of the problem was undoubtedly supplied by Oskar
Morgenstern, "It is now clear that Nash had not read those

writersea"Harold Kuhn, "Nobel Seminar," Les Prix Nobel 1994.

For a delightful short history of exchange, including the
references to pharaohs and kings, see Robert L. Heilbroner,
The
Worldly

-----983

Philosophers,

6th edition (New York: Touchstone, 1992), people. 27.

4. John C. Harsanyi, "Approaches to the Bargaining Problem Before
and After the Theory of Games: A Critical Discussion of
Zeuthen's, Hick's and Nash's Theories," Econometrica,

vol. 24 (1956), pp. 144-57.

A983

5. In his now-classic reformulation of the Nash bargaining model, Ariel Rubinstein traces the bargainin problem to Edgeworth, "Mathematical Psychics: An Essay on the Application of Mathematics to the Mora Sciences" (London: C. Kegan Paul, 188 1), reprinted in *Mathematical Psychics and Other Essays* (Mountain Center, Calif.: James and Gordon, 1995). Martin Shubik writes, "Even as a graduate student I was struck by the contrast between cooperative game theory, the seeds of which I regarded as already present in Edgeworth and noncooperative theory which was present in Cournot;" Martin Shubik, *Collected Works*, forthcoming, people. 6. For lively accounts of

-----984

Edgeworth's life and contributions, see Heilbroner, op. cit., pp. 174-76, and John Maynard Ke s "Obituar of Francis Isidro Edgeworth, March 26, 1926ea"reprinted in Edgeworth, op. cit.

6. HeiMer, cip. city people. 17 3.

7. Ibiddeap. 174.

8. Ed worth, op. cit.

9. Ibif

10. Ibid.

11. Harsanyi, op. cit.

12. John von Neumann and Oskar Morgenstern,

The Theory of Games and Economic Behavior, op.

cit., people. 9. "It may also be regarded as a nonzero-sum

two-person gameea"Nash, "The Bargaining Problemea"op. cit.,

people. 155; "even though von Neumann and Morgenstern's theory of

games was an essential step toward a strong bargaining theory,

their own analysis of two-person bargaining games did not go

significantly beyond the weak bargaining theory of neoclassical

economicsea"Harsanyi, "Bargainingea"op. cit., pp. 56-57.

-----985

13. See, for example, Robert J. Leonard, "From Parlor Games to

Social Scienceea"op. cit., for a history of the axiomatic

approach, and a superb interpretive discussion of "axiomatics" in

Robert J. Aumann, "Game Theory," in John Eatwell, Murray Milgate,

and Peter Newman,

The New Falgrave,

op. cit., pp. 26-28.

14. Von Neumann and Morgenstern used the axiomatic method to

derive their theory of expected or von utilities in the second,

1947, edition of

Theory of Games and Economic Behavior. Individual Value
problem in social sciences, I believe, was Kenneth J. Arrow's
Ph.D. thesis
Social Choice and Individual Values
(New York: John Wiley and Sons, 1951). Lloyd S. Shapley's "A
Value of N-Person
Games" Contributions to the Theory of Games II
(Princeton: Princeton University Press, 1953), pp. 307-17, is
another stellar

exa le. 986

sh Tphe

15. John Na , T Bargaining Problemea"op, cit., people. 15 5.

16. John Nash,

Les Prix Nobel 1994,

op. cit., pp. 276-77.

17. The sketch of Bart Hoselitz is based on an interview with his friend Sherman Robinson, professor of economics, University of Chicago, 7.95, and questionnaires, letters, and a curriculum vitae from CarnegieMellon University archives.

18. This bit of history about international trade theory after World War 11 was supplied by Kenneth Rogoff, professor of economics, Princeton University, interview.

19. John Nash,

Les Prix Nobel 1994,

op. cit., pp. 176-77.

20. Nash told Myerson that he was inspired by a problem posed by Hoselitz. Roger Myerson, professor of economics, Northwestern University, interview, 8.7.97.

2 1. Myerson, e-mail, 8.11.97.

-----987

22. Letter from John Nash to Martin Shubik, undated (written in 1950 or 1951).

23. Harold Kuhn was for many years convinced that Nash had mailed a copy of his first draft to Von Neumann while he was still at Carnegie. Also interviews with David Gale, 9.20.95, and William Browder, 12.6.96.

24. After historian Robert Leonard published the established version of the origins of the paper in "Reading Cournot, Reading Nash: The Creation and Stabilisation of the Nash Equilibrium," The Economic journal, no. 164 (May 1994), people. 497, Nash corrected the record at a lunch with Harold Kuhn and Roger Myerson, 5.96, Kuhn, personal communication, 5.96.

25. John Nash, "The Bargaining Problemea"op. cit., people. 155.

26. John Nash,

Les Prix Nobel 1994,

op. cit., people. 277.

10: Nash's Rival Idea

1. Harold Kuhn, interview, 4.14.97.

-----988

2. Albert William Tucker, interview, 10.94.

3. The beer party scene was reconstructed from the recollections of Melvin Hausner, 2.6.96, Martin Davis, 2.20.96, and Hartley Rogers, 1. 16.96, who attended several such parties in the course of their graduate school careers.
4. Davis, interview.
5. Ibid. Amazingly, Davis was able, forty years later, to recall the entire song, a few lines of which are given here, interview.
6. Kuhn, interview, 4.16.97.
7. Ibid.
8. Henri Poincart, quoted in E. T. Bell,
Men of Mathematics,

- op. cit., people. 551. A988
9. John Nash to Robert Leonard, e-mail, 2.20.93. Further details supplied by Harold Kuhn, interview, 4.17.97.
- 10, "All the graduate students were afraid of him" as to Donald Spencer, interview, 11.8.95.
- 989
11. Von Neumann's dress and manner are described by George Mowbray in a letter, 4.5.95. Harold Kuhn, interview, 5.2.97.
12. See, for example, Norman McRae, John von Neumann, op. cit., pp. 350-56
13. As told to Harold Kuhn, 4.17.97. 14. John Nash, Les Prix Nobel 1994, op. cit.
15. Silvano Arieti, Creativity, op. cit., people. 294.
16. J. Nash to R. Leonard, e-mail. 17. Ibid.
18. The conversation between Nash and Gale was recounted by Gale in an interview, 9.20.95. Gale also suggested that Nash use Kakutani's fixed point theorem instead of Brouwer's to simplify the proof, a suggestion that Nash followed in the note in the National Academy of Sciences Proceedings.
19. John F. Nash, Jr., "Equilibrium Points in N-Person Games," communicated
- 990
- by S. Lefschetz, 11.16.49, pp. 48-49.
20. Gale, interview.
21. Tucker, interview, 10.94.
22. Gian-Carlo Rota, interview, 12.12.95.
23. Tucker's account of Minsky's thesis on computers and the brain, "Neural Networks and the Brain Problem" is given in an interview with Stephen B. Maurer published in the Two Year College Mathematics journal, vol. 14, no. 3 (June 1983).
24. Tucker, interview.
25. Harold Kuhn, "Nobel Seminar," Les Prix Nobel 1994, op. cit., people. 283.
26. Tucker, interview, 10.94.
27. Ibid.
28. Ibid.
29. John Nash,

Les Prix Nobel 1994,

op. cit.

30. Tucker, interview.

31. Letter from Albert W. Tucker to Solomon Lefschetz, 5.10.50.

-----991

32. Ibid.

33. See, for example, introduction, John Eatwell, Murray Milgate,
and Peter Newman,

The New P-41 ongrave,

op. cit.

34. "It so happens that the concept of the two-person zero-sum

games has

A991

very few

real life applicationsea"John C. Harsanyi, "Nobel Seminar,"

Les Prix Nobel 1994,

op. cit., people. 285.

35. Ibid.

36. Nobel citation.

37. Avinash Dixit and Barry Nalebuff, Thinking Strategically,

op. cit.

38. Ibid.

39. "Nowadays it almost seems to be obvious that the correct application of Darwinism to problems of social interaction among animals requires the use of non-cooperative game theory:`

according to Reinhard Selten, "Nobel Seminar,"

Les Prix Nobel 1994,

-----992

op. cit., people. 288.

40. "Came Theoryea"in Eatwell, Milgate, and Newman, op. cit.,

people. xiii. 41. Michael Intriligator, personal communication,

6.27.95.

43. Von Neumann, as Nash always acknowledged, nonetheless helped to gain attention for Nash's ideas. For example, the preface to the third edition (1953) of

TheoTy of Games and Economic Behavior directs readers to Nash's work on noncooperative games, people. vii.

11: Lloyd

1. T. S. Ferguson, "Biographical Note on Lloyd Shapley;` in Stochastic Games and Related Topics in Honor of Professor L. S. Shapley, edited by T. E. S. Raghavan, T. S. Ferguson, T. Parthasarathy, and O. J. Vrieze (Boston: Kluwer Academic Publishers, 1989).

2. See, for example, Carl Sagan,

Broca Brain

(New York: Random House, 1979).

3. David Halberstam,

-----993

The Fifties,

op. cit.

4. The description of Shapley's experiences during the war, at Princeton, and at RAND draw on the recollections of Harold Kuhn,

11.18.96; Norman Shapiro, 2.9.96; Martin Shubik, 9.27.95 and

12.13.96; Melvin Hausner, 2.6.96; Eugenio Calabi, 3.2.96; John

Danskin, 10.19.96; William Lucas, 6.27.95; Hartley Rogers,

- 1.26.96; John McCarthy, 2.4.96; Marvin Minsky, 2.13.96; Robert Wilson, 3.7.96; Michael Intriligator, 6.27.95.
5. Letter from John von Neumann, 1.54.
6. Solomon Leader, interview, 6.9.95. 7. Rogers, interview, 1.26.96.
8. "It was like ESP. Shapley seemed to know where all of the pieces were all of the time" Minsky, interview.
9. Hausner, interview, 2.6.96.
10. Danskin, interview, 10.19.95.
11. Letter from Lloyd Shapley to Solomon Lefschetz, 4.4.49.

12. Interviews with Nancy Nimitz, 5.21.96, and Kuhn, 4.4.96. 994
13. Shapiro, interview, 12.13.96.
14. Intr`linin ator, interview, 6.27.95. 15. Shubi , interview, 12.13.96.
16. Lloyd S. Shapley, interview, 10.94.
17. Ibid.
18. Shubik, interview, 12.13.96.
19. Interviews with Shapley, Shubik, McCarthy, Calabi.
20. Calabi, interview.
21. Ibid.
22. Ibid.
23. Shubik, interview, 9.27.95.
24. Shubik, interview, 9.27.95.
25. Letter from Nash to Martin Shubik, undated (1950 or 1951).
26. McCarthy, interview.
27. McCarthy, interview.
28. Hausner, interview, 2.6.96; M. Hausner, J. Nash, L. Shapley, and M. Shubik, "So Long Sucker-A Four-Person Gameea"mimeo provided by Hausner.
29. Interviews with Shubik and McCarthy.

-----995

30. John Nash and Lloyd Shapley, "A Simple Three-Person Poker Game;` Annals of Mathematics, no. 24 (1950).
31. "To some extent there was a competition between Nash, Shapley, and meea"Shubik, interview, 12.13.96,
32. Shapley, interview.
33. Shapley, Additive andNon-Additive SetFunctions, Ph.D. thesis, Princeton University, 1953. Shapley published his famous result-the so-called Shapley value coma value for n-person games, in 1953.
34. Martin Shubik, "Came Theory at Princeton, op. cit., people. 6: "We all believed that a problem of importance was the characterization of the concept of threat in a twoperson game and the incorporation of the use of threat in determining the influence of the employment of threat in a bargaining situation. [Nash, Shapley, and 11 worked on this problem, but Nash managed to formulate a good model of the two person bargain utilizing threat moves to start withdd"Shubik is referring here to Nash's "Two-Person Cooperative Games;`

-----996

published in

Econometrics

in 1953 but actually written in August 1950 during Nash's first summer at RAND.

35. Letter from Albert W. Tucker, 1953.

36 Ibiand

37 Letter from Frederick Bohnenblust, spring 1953.

38. Letter from John von Neumann, 1.54. 39. Kuhn, interview, 11.18.96.

12: The War of Wits

1. John McDonald, "The War of Wits," Fortune (March 1951).

2. William Poundstone, A996
Prisoner Dilemma,
op. cit.; Fred Kaplan,
The Wizards of Armageddon, op.
cit.;
The RAND Corporation: The First Fifteen Years (Santa Monica,
Calif.: RAND, November 1963) and
40th Year Anniversary
(Santa Monica: RAND, 1963); John D. Williams, An Address,
6.21.50; Bruce

-----997
L. R. Smith,
The RAND Corporation
(Cambridge: Harvard University Press, 1966); Bruno W. Augenstein,
A
Brief History of RAND Mathematics Department and Some of Its
Accomplishments
(Santa Monica, Calif.: RAND, March 1993); Alexander M. Mood,
"Miscellaneous Reminiscences,"
Statistical Science,
vol. 5, no. 1 (1990), pp. 40-41.

3. Herman Kahn,
On Thermonuclear War
(Princeton: Princeton University Press, 1960), as quoted in
Poundstone, op. cit., people. 90.

4. Isaac Asimov,
Foundation
(New York: Bantam Books, 1991).

5. Poundstone, op. cit.

6. Kaplan, op. cit., people. 52.

7. Ibid., people. 10.

8. Oskar Morgenstern,
The Question of National Defense
(New York: Random House, 1959), as

-----998
quoted in Poundstone, op. cit., pp. 84-85.
9. McDonald, "The War of Witsea" op. cit.
10. The account of RAND's beginnings is based on Poundstone, op.
cit.
11. Ibid., people. 93.
12. See, for example, Stanislaw Ulam, Adventures of a
Mathematician, op.
cit.; Richard Rhodes,

The Making of the Atomic Bomb

(New York: Simon and Schuster, 1986); Hodges,

Abu Turing: The Enigma,

op. cit.

13. Mina Rees, "The Mathematical Sciences and World War IIEA"OP.
cit.

14. The sketch of RAND's mathematics, economics, and computer
groups is based largely on interviews with RAND staff and
consultants from the early Cold War period, including Kenneth
Arrow, 6.26.95; Bruno Augenstein, 6.13.96; Richard Best, 5.22.96;
Bernice Brown, 5.22.96; John Danskin, 10.19.95; Martha Dresher,

5.21.96; Theodore Harris, 5.24.96; Mario Juncosa, 5.21.96 999
and 5.24.96; William Karush, 5.96; William F. Lucas, 6.26.95;
John W. Milnor, 9.95; John McCarthy, 2.4.96; Alexander M. Mood,
5.23.96; Evar Nering, 6.18.96; Nancy Nimitz, 5.21.96; Melvin
Peisakoff, 6.3.96; Harold N. Shapiro, 2.20.96; Norman Shapiro,
2.29.96; Lloyd S. Shapley, 11.94; Herbert Simon, 10.16.95; Robert
Specht, 2.96; Albert W. Tucker, 12.94; Willis H. Ware, 5 .24.96;
Robert W. Wilson, 8.96; Charles Wolf, Jr., 5.22.96.

15. Augenstein, interview, 6.13.96.

16. R. Duncan Luce, interview, 1996. 17. The descriptions of
Arrow's contributions are taken from Mark Blaug,
Great Economists Since Keynes
(Totowa, N.J.: Barnes and Noble, 1985), pp. 6-9.

18. Kenneth Arrow, professor of economics, Stanford University,
interview, 6.26.95. 19. McDonald, interview.

-----1000

20. Richard Best, former manager of security, RAND Corporation,
interview, 5.22.96.

21. Interviews with Alexander M. Mood, professor of mathematics,
University of California at Irvine, former deputy director,
mathematics department, RAND Corporation, 5.23.96, and Mario L.
Juncosa, mathematician, RAND, 5.21.96 and 5.24.96.

22. Kaplan, op. cit., people. 5 1.

23. Bernice Brown, retired statistician, RAND, interview,
5.22.96.

24. Augenstein, interview.

25. Arrow, interview.

26.

Chronicle of the Twentieth Century,
op. cit., people. 667.

27. David Halberstam,
The Fifties,
op. cit.

28. Ibid.

29. Ibid., people. 46.

30. Kaplan, op. cit.

31. Martha Dresher, interview.

-----1001

32. Best, interview.

33. Halberstam,
The Fifties,

op. cit., people. 45;

Chronicle of the Twentieth Century,

op. cit., people. 677.

34. Halberstam, op. cit., people. 49.

35.

Chronicle of the Twentieth Century,

op. cit., people. 750.

36. Best, interview.

37. Ibid.

38. Letter from Col. Walter Hardie, U.S. Air Force, to RAND,
10.25.50.

39. As told to Harold Kuhn, interview, 8.97.

40. Letter from John Nash to John and Virginia Nash, 11.10.5 1.

41. Best, interview. A1001
42. The Eisenhower guidelines refer to DOD directive 52206, 1953 and Executive Order 10450, 1953.
43. Danskin, interview.
44. Robert Specht, interview, 10.96. 45. John Williams,
-----1002
- The Compleat Strategyst,
op. cit.
46. The account of mathematicians` work habits is based on interviews with Brown, Mood, juncosa, Danskin, and Shapiro.
47. Interviews with Mood and Juncosa. 48'Juncosa, interview. d-
49. Mood, interview. Mood, and juncosa; Poun
50. The description of Williams is based on interviews with Best, Brown,
stone op. cit.; and Kaplan, op. cit. I. Mood, interview.
52. As quoted in Poundstone, op. cit., people. 95.
53. Mood, interview.
54. Danskin, interview.
55. Arrow, interview.
56. Mood, interview.
57. Best, interview.
58. Harold Shapiro, interview.
59. Mood, interview.
60. Danskin, interview.
61. Ibid.
62. Best, interview.

-----1003

13: Game Theory at RAND

1. Kenneth Arrow interview, 6.26-95.
R
..
arch in the Mathematical Theory Of Games
2. M. Dresher aQ L. S. Shapley Summary OfRAND
(RM-293)
(Santa Monica, Calif.: jU, 7.13.49).
3. Arrow, interview.
fArmageddon,
op. cit.
4. Fred Kaplan
The Wizards 0 teaeaV, of Conflict (Cambridge: Harvard University Press, 1960).
5. Thomas C. chelling,
The Stra

6. Ibid. Lucas, "The
7. Arrow, interview.
exa le Martin Shubik "Game Theory and Princeton,` op. cit.;
William
8. See, for m
Behavior,
-----1004
v01. 8. (199 (, pp. 264-68; Carl Kaysen, Fiftieth Anniversary
oFTUBI"
Games and Economic
interview, 2.15.96.

9. John McDonald, "The War of Witsea"op- cit. probability A1004 theory see John Williams,
10ddFora humorous account of Prussian military's romance with The Compleat Strategyst, op. cit.
11. McDonald, op. cit.
12. Bernice Brown, interview, 5.22.96. 13. Rosters RAND Department of Mathematics. iption of game theoretic analyses of duels, see Dixit
14. Dreshe'r and Shapley, op. cit. For a lucid descr and Skeath, op. cit. bruary 1957),
- 15, Dresher and Shapley, op. cit. r "Passing of a Great Mind, Life (Fe
16. For von Neumann's views` see Clay Blair,
-----1005

J

- ., . , people. 143. pp. 88-90, as quoted in William Poundstone, Prisoner's Dilemma,
OP' cit'
17. Arrow interview.
18. See undstone, op. cit.; Joseph Baratta, interview, 8.12.97.
19. Arrow interview.
- I Economics
(Princeton: Princeton
20. John knowledge. Kagel and Alvin E_ Roth, The Handbook OfExPerm`comta
University Press, 1995), pp. 8-9.
- 2 1, Albert W. Tucker, interview 12.94.
- ilebuff, Thinking Strategically,
OP- cit-
22. See, for example, Avinash 6ixit and Barry M ` Murray Milgate, and
23. See, for example, Anatole Rappaport, "Prisoners Dilemmaea"in John Eatwell,
Peter Newman
The New Palgrave,
-----1006
- op. cit., pp. 199-204.
- 24, Dixit nd Nalebuff, op. cit.
25. Harold Kuhn, interview, 7.96.
26. Poundstone, op. cit.; also Kagel and Roth, op. cit.
27. John F. Nash, Jr., as quoted in Kagel and Roth, op. cit.
Personal Reminiscenceea"in

Toward a

28. Mar "Game Theory at Princeton 1949-1955: A
John von Neumann and Oskar Morgenstern, 1944 (Princeton, NJ: Princeton University Press 1992).

History of Game Theory,

edited by E. Roy Weintraub. One of the threats in bargaining was
published as a RAND

29. The first version of Nash's analysis of the 31.50). A final
in John von Neumann and Oskar Morgenstern, 1944 (Santa Monica, Calif.: RAND,
8

Journal of Mathematical Economics (January 1953), pp. 28-40. Also "Rational
Non-Linear version appeared under the same title in

Econometric8

A1006

Utilityea"RAND Memorandum, D-0793,

-----1007

8.8.50.

30. Kaplan, op. cit.

31. Ibid.

32. ibid.

33. Ibid ., pp. 91-92.

34. Ibid.

35. Bruno Augenstein, interview- (ted in Poundstone, op. cit., P. 168.

36" R, Duncan Luce and Howard Raiffa as quo 1960).

37. Thomas Schelling, The

Strategy of Conflict

(Cambridge, Mass.: Harvard University Press,

14: The Draft

1. Department of Mathematics, Princeton University.

2. Recommendations of 5.11.50 by Solomon Lefschetz, chairman, mathematics department, to president, Princeton University, that John Forbes Nash, Jr., be appointed research assistant, three-quarters time, on A. W Tucker's ONR Contract A-727.

3. See, for example, David Halberstam, The Fifties,

-----1008

op. cit.

4. Proceedings of the International Congress of Mathematicians, August 30-September 6, 1950, vol. 1, people. 516.

5. Letter from John Nash to Albert W. Tucker, 9.10.50. Letter from John Nash to Solomon Lefichetz, undated (probably written between April 10 and April 26, 1948), gives the clearest statement of why Nash wanted to avoid the draft: "Should there come a war involving the U.S. I think I should be more useful, and better off, working on some research project than foing, sayeaeainffthe infantry."

6. Letter from Fred D. Rigby, Office of Nava Research Washington, D.C., to Albert W. Tucker, 9.15.50.

7. Letter from J. Nash to A. W Tucker, 9.10.50.

8. Letters from A. W. Tucker to Local Board No. 12, 9.13.50;

Raymond 1. Woodrow to Local Board No.

12, 9.15.50 and 9.18.50; Raymond J. Woodrow, Committee on Project

Research and Inventions, Princeton University, to Local Board No.

12, Bluefield, WddVa., re

-----1009

occupational deferment for John F. Nash, Jr. (with reference to

RAND consultancy). 9. Letter from F. D. Rigby to A. W. Tucker, 9.10.50.
10. Ibid.
11. Halberstam, op. cit.
12. Hans Weinberger, interview, 10.28.95. 13. Harold Kuhn, interview, 9.6.96. 14. Gottesman, Schizophrenia Genesis, op. cit., pp. 152-55; also Bruce Dohrenwind, professor of social psychology, Columbia University, interview, 1.16.98. 15. H. Steinberg and J. Durrel, "A Stressful Situation as a Precipitant of Schizophrenic Symptoms,"

British journal of Psychiatry, vol. A1009
III (1968), pp. 1097-1106, as quoted in Gottesman,
Schizophrenia Genesis,
op. cit.

16. Notes of telephone call from Alice Henry, secretary,
department of mathematics, Princeton University, re I-A
classification of John Nash and request that Dean

-----1010

Douglas Brown write a letter to ONR to be forwarded to the
Bluefield draft board, 9.15.50.

17. "Information Needed in National Emergency" form filled out
9.50 by John F. Nash, Jr., refers to I-A status, pending
application for II-A, ONR and RAND research roles.

18. Letter from Raymond J. Woodrow, Committee on Project Research
and Inventions, Princeton University, to commanding officer,
Office of Naval Research, New York Branch, re deferment for John
F. Nash, Jr., 9.18.50. 19. Letter from W. S. Keller, Office of
Naval Research, New York Branch, to Selective Service Board No.
12, Bluefield, WV-A., re deferment for John F. Nash, Jr.,
9.28.50.

20. Richard Best, interview, 5.96.

21. Melvin Peisakoff, interview, 5.96. 22. Best, interview.

23. Letter from Raymond J. Woodrow to John Nash, 10.6.50.

24. Ibid.; letter from L. L. Vivian, ONR, New York Branch, to
commanding officer, ONR, New York Branch Office, re

-----1011

notification of Nash by draft board that active service postponed
until June 30, 1951, and continued I-A status, 11.22.50. 15: A
Beautiful Theorem

1. Richard J. Duffin, interview, 10.26.95.

2. "He can hold his own in pure mathematics, but his real
strength seems to lie on the frontier between mathematics and the
biological and social sciences" letter from Albert W. Tucker to
Marshall Stone, 12.14.51.

3. John Nash, "Algebraic Approximations of Manifolds,"
Proceedings of the International Congress of Mathematicians, vol.
1 (1950), people. 516, and "Real Algebraic Manifolds,"
Annals of Mathematics,

vol. 56, no. 3 (November 1952; received October 8, 1951). For
expositions of Nash's result, see John Milnor, "A Nobel Prize for
John Nash" op. cit., pp. 14-15, and Harold W Kuhn, introduction,
"A Celebration of John F. Nash, Jr.,"

-----1012

Duke Mathematical Journal

vol. 81, no. 1 (1995), people. iii.

4. Harold Kuhn, interview, 11.30.97. 5. See, for example, June Barrow-Green, *Roaming and the Three-Body Problem* (Providence, R.I.: American Mathematical Society, 1977); also Kuhn, interview.

6. George Hinman, interview, 10.30.97. 7. John F. Nash, Jr., *Les Prix Nobel* 1994,

op. cit. "Wiener's Life" in

8. See, for example, E. T. Bell, *Men of Mathematics*,

op. cit., and Norman Levinson

- "Norbert Wiener 1894-1964," A1012
Bulletin of the American Mathematical Society,
vol. 72, no. 1 part 11, people. 8.
9. Martin Davis, interview, 2.6.96.
10. Norman Steenrod, letter of recommendation, 2.51, as quoted by
Kuhn, introduction, "A Celebration of John F. Nash, Jr." op.
cit.
11. John Nash, "Algebraic Approximations of Manifolds" op. cit.,
people.
-----1013
516.
12. Solomon Lefschetz, President's Report, Princeton University
Archives, 7.18.80.
13. Solomon Lefschetz, memorandum, 3.9.49, on Spencer's
appointment as visiting professor at Princeton in academic year
1948-49; Donald Spencer, interviews, 11.28.95 and 11.29.95.
14. Lefschetz, memorandum, 3.9.49.
15. Donald Clayton Spencer, Biography, 10.61, Princeton
University Archives.
16. See, for example, "Analysis, Complex,"
Encyclopaedia Britannica (1962).
17. Kodaira won the Fields in 1954; David C. Spencer, "Kodaira
(1915-1997),"
American Mathematical Monthly,
2.98.
18. Spencer won the Fields in 1947, Biography, op. cit.
19. Lefschetz, memorandum, 3.9.49.
20. Joseph Kohn, professor of
-----1014
mathematics, Princeton University, interview, 7.19.95.
21. Ibid. Also Phillip Griffiths, director, Institute for
Advanced Study, interview, 5.26.95.
22. In his recommendation for Spencer's appointment as visiting
professor in 1949, Lefschetz remarks on
on his "warm and sympathetic personality. Spencer had an unusual
willingness to reach out to colleagues in trouble. He became
deeply involved in helping Max Shiffman, a bright young
mathematician at Stanford who was diagnosed with schizophrenia;
John Moore, a mathematician who suffered a severe depression; and
John Nash after Nash returned to Princeton in the early 1960's.
See Spencer, op. cit.
23. Spencer, op. cit.
24. As slightly restated by Milnor, "A Nobel Prize for John

Nashea"op. cit., people. 14.

25. Intersectional Nomination: Class Five; 1996 Election, John F. Nash, Jr.

26. Michael Artin, professor of mathematics, MIT, interview, 12.2.97.

-----1015

27. See, for example, Michael Artin and Barry Mazur, "On Periodic Points,"

Annals of Mathematics, no.

81 (1965), pp. 82-99. Milnor calls this an "important" application.

28. Barry Mazur, professor of mathematics, Harvard University, interview, 12.3.97. A1015

29. Nash cites, for example, H. Seifert, "Algebraische Approximation von Mannigfaltigkeiten," Math. Zeit., vol. 41 (1936), pp. 1-17.

30. Ibid.

31. Steenrod, letter, 2.5.1, as quoted by Kuhn, introduction, "A Celebration of John F. Nash, Jr." op. cit.

32. Spencer, op. cit.

33. Nash, as told to Harold Kuhn, private communication, 12.2.97. The subsequent Nash-Moser theorem has even more profound implications for celestial mechanics. See Chapter 30.

34. Albert W. Tucker, interview, 11.94.

-----1016

Nash still dabbled in game theory, perhaps partly to maintain his RAND connection. For example, he wrote "N-Person Games: An Example and a Proof," RAND Memorandum, RM-615, June 4, 1951, as well as, with graduate students Martin Shubik and John Mayberry, "A Comparison of Treatments of a Duopoly Situation," RAND Memorandum P-222, July 10, 1951.

35. Kuhn, interview.

36. Letter from Albert W. Tucker to Hassler Whitney, 4.5.55.

37. Arlin supervised the honors calculus pro I high, according to John Tate (interview, 6.29.97), he took very seriously. Later documents refer to Nash's having been a poor teacher; the comments undoubtedly stem from his experiences in 1950-51.

38. "There is no doubt that the department should look towards keeping Milner permanently as a member of our faculty," Solomon Lefschetz, President's Report, Princeton University Archives, 9.5.1.

39. Letter from A. W. Tucker to H. Whitney, op. cit.

-----1017

40. William Ted Martin, professor of mathematics, MIT, interview, 9.7.95.

41. Letter from Albert W. Tucker to Marshall Stone, 2.26.51.

42. Nash told Kuhn that his desire to live in Boston played a role in his accepting the MIT position, Kuhn, personal communication, 7.97. 16: MIT

I

Lindsay Russell, interview, 1.14.96. 2. Patrick Corcoran, retired captain, Cambridge City Police, interview, 8.12.97.

3. Felix Browder, interview, 11.14.95. 4. Gian-Carlo Rota,

professor of mathematics, MIT, interview, 10.29.94. 5. Paul A. Samuelson, professor of economics, MIT, interview, 11.94. 6. Harvey Burstein, former FBI agent who set up the campus police at MIT, interview, 7.3.97. 7. Samuelson, interview. 8. William Ted Martin, professor of mathematics, MIT, interview, 9.7.95.

-----1018

9. Samuelson, interview. 10. Department of Physics, MIT, communication, 1.98. 11. Course catalog, MIT, various years. 12. Samuelson, interview.

13. Ibid. A1018
14. Arthur Mattuck, professor of mathematics, MIT, e-mail, 6.23.97.
15. Joseph Kohn, professor of mathematics, Princeton University, interview, 7.25.95.
16. Samuelson, interview. See also Report to the President, MIT, various years.
17. Jerome Lettvin, professor of electrical engineering and bioengineering, MIT, interview, 7.25.97; Emma Duchane, interview, 6.26.97.
18. Samuelson, interview.
19. Gian-Carlo Rota, interview.
20. Hearing before Committee on Un-American Activities (HUAC), House of Representatives, Eightythird Congress, First Session, Washington, D.C., April 22 and 23, 1953.
- 1019
21. Samuelson, interview.
22. Martin, interview.
23. Ibid.
24. See, for example, Wiener's obituary, New York Times, 3.19.64; Paul Samuelson, "Some Memories of Norbert Wiener" 1964, Xerox provided by Samuelson; and Norbert Wiener, Ex-Prodip, (New York: Simon and Schuster, 1953) and IA-RN a Mathematician (New York: Simon and Schuster, 1956).
25. Samuelson, "Some Memories of Norbert Wiener" op. cit.
26. Ibid.
27. Zipporah Levinson, interview, 9.11.95.
28. Samuelson, "Some Memories of Norbert Wiener" op. cit.
29. Z. Levinson, interview.
30. Ibid.
31. Ibid.
32. Ibid.
33. Note from John Nash to N. Wiener, 11.17.52.
- 1020
34. Letter from John Nash to Albert W. Tucker, 10.58.
35. Jerome Neuwirth, professor of mathematics, University of Connecticut at Storrs, interview, 5.21.97.
36. The sketch of Levinson is based on recollections of his widow, Zipporah Levinson; Arthur Mattuck; F. Browder, 11.2.95; Gian-Carlo Rota, 11.94; and many others. Also Kenneth Hoffman, Memorandum to President J. B. Wiesner, 3.14.74; William Tcd Martin et al., obituary of Norman Levinson, 12.17.75.
37. HUAC, op. cit. See also Chapter 19.
38. Arthur Mattuck, "Norman Levinson and the Distribution of

Primesea"address to MIT shareholders,
10.6.78.

17: Bad Boys

1. Donald J. Newman, professor of mathematics, Temple University,
interview, 12.28.95; Leopold Flatto, Bell Laboratories,
interview, 4.25.96,

2. Sigurdur Helgason, professor of

-----1021
mathematics, MIT, interview, 2.13.96.

3. Course catalog, MIT, various years. 4. Arthur Mattuck,
interview, 11.7.95. 5. Robert Aumann, professor of mathematics,

Hebrew University, interview, 6.25.95. A1021

6. Joseph Kohn, interview, 7.19.95. 7. Ibid.

8. Auniann, interview.

9. Seymour Haber, professor of mathematics, Temple University, interviews, 3.14.95 and 3.19.95.

10. George Whitehead, professor of mathematics, MIT, interview, 12.12.95. 11. Eva Browder, interview, 9.6.97.

12. Barry Mazur, interview, 12.3.97. 13. Harold Kuhn quotes Nash taking credit for introducing the tea hour at MIT in his introduction to the special volume in honor of Nash, "A Celebration of John F. Nash, Jr." op. cit.

14. Isadore M. Singer, professor of mathematics, MIT, interview, 12.13.95. 15. Kohn, interview.

-----1022

16. Singer, interview.

17. Jerome Neuwirth, interview, 5.21.97. 18. Mattuck, interview, 2.13.96.

19. Descriptions of this legendary crowd are based on interviews with Kohn; Felix Browder, 11.2.95, 11.10.95, 9.6.97; Aumann; Neuwirth; Newman; H. F. Mattson, 10.29.97 and 11.18.97; Larry Wallen, 5.16.97 and 5.20.97; Mattuck; Paul Cohen, 1.5.96; Jacob Bricker, 5.22.97; and others.

20. F. Browder, interview, 9.6.97.

21. Haber, interview.

22. Ibid.

23. Martha Nash Legg, interview, 3.29.96.

24. Neuwirth, interview.

25. Ibid.

26. Mattuck, interview, 2.13.96.

27. Interviews with Neuwirth and F. Browder, 11.2.95.

28. Jurgen Moser, professor of mathematics, Eidgenbssische Technische Hochschule, Zurich, interview,

-----1023

3.23.96.

29. Marvin Minsky, professor of science, MIT, interview, 2.13.96.

30. Herta Newman, interview, 3.2.96. 31. Andrew Browder, professor of mathematics, Brown University, interview, 6.18.97.

32. Haber, interview.

34. D. Newman, interview, 2.4.96.

35. Zipporah Levinson, interview, 9.11.95.

36. Neuwirth, interview.

37. D. Newman, interview.

38. Ibid.
39. Lawrence Wallen, professor of mathematics, University of Hawaii, interviews, 5.20.97 and 6.4.97.
40. Kohn, interview.
41. H. F. Mattson, professor of computer science, Syracuse University, interview, 5.16.97; also Wallen, interview.
42. 1. C. Lagarias, "The Leo Collection: Anecdote and Stories" AT&T Bell Laboratories, 4.29.95 (Xerox).
43. Mattuck, interview, 5.21.95, and

Neuwirth, interview. 1024

44. Neuwirth, interview.

45. The sketch of Donald J. Newman is based on an interview with him and on interviews with Flatto, Kohn, Mattuck, Singer, and Harold S. Shapiro, professor of mathematics, Royal Institute of Technology, Stockholm, Sweden, e-mail, 5.21.97.

46. Singer, interview, 12.13.95.

47. Mattuck, interview, 11.7.95.

48. D. Newman, interview, 3.2.96.

49. Helgason, interview, 12.3.94; also interviews with Mattuck and Singer.

50. Flatto, interview.

51. Ibid.

52. Ibid.

53. Singer, interview.

54. Haber, interview.

55. Ibid.

56. Flatto, interview.

57. Ibid.

58. Ibid.

59. Neuwirth, interview.

60. Ibid.

61. D. Newman, interview, 3.2.96.

-----1025

62. Ibid.

63. H. Newman, interview.

64. Fred Brauer, professor of mathematics, University of Wisconsin, interview, 5.22.97.

18: Experiments

1. Harold N. Shapiro, professor of mathematics, Courant Institute, interview, 2.20.96.

2. John Milnor, interview, 9.26.95. 3. The account of the cross-country trip is based largely on recollections of Martha Nash Legg, interviews, 8.29.95 and 3.29.96, and Ruth Hincks Morgenson, interview, 6.22.97.

4. John Nash to Harold Kuhn, personal communication, 6.24.97; also Morgenson, interview.

5. M. Legg, interview.

6. Ibid.

7. Ibid.

8. Ibid.; Milnor, interview.

9. John M. Danskin, interview, 10.29.95.

10. M. Legg, interview.

-----1026

11. Ibid .

12. John Milnor, "Games Against Nature" in

Decision Processes,

edited by R. M. Thrall, C. H. Coombs, and R. L. Davis (New York:

John Wiley and Sons, 1954).

13. "Some Games and Machines for Playing Them" RAND Memorandum,

D-I 164, 2.2.52.

14. John Nash and R. M. Thrall, "Some War Games" RAND

Memorandum, D-1379, 9.10.52.

15. G. Kalisch, J. Milnor, J. Nash, and E. Nering, "Some A1026
Experimental N-Person Games" RAND Memorandum, RM-948, 8.2 5.5 2.

16. M. Legg, interview.

17. The description of the experiment is based on, apart from the
original paper, Evar Nering, professor of mathematics, University
of Minnesota, interview, 6.18.96; R. Duncan Luce and Howard
Raiffa,

Games and Decisions

(New York: John Wiley and Sons,

-----1027

1957), pp. 259-69; John H. Kagel and Alvin E. Roth, The
handbook of Experimental Economics,
op. cit., pp. 10-11.

18. Kagel and Roth, op. cit.

19. Milnor, interview, 10.28.94.

20. John Milnor, "A Nobel Prize for John Nash" op. cit.

21. See, for example, Kagel and Roth, op. cit.

22. Milnor, interview, 1.27.98.

23. Letter from John Nash to John Milnor, 12.27.64.

19: Reds

1. Zipporah Levinson, interview, 9.11-95

2. Hearing before Committee on Un-American Activities, House of
Representatives, Washington, D.C.,

4.22.5 3 and 4.23.5 3. Unless otherwise noted, all references to
the hearing are based on this transcript.

3. David Halberstam,

The Fifties,

op. cit.

-----1028

4. Letter from Harold W. Dodds, president, Princeton University,
to Colonel S. R. Gerard, Screening Division, Western Industrial
Personnel Security Board, 10. 14.54, Princeton University
Archives.

5. See, for example, F. David Peat, Infinite Potential. The Life
and Times of David Bohm

(Reading, Mass.: Addison Wesley, 1997). 6. Z. Levinson,
interview.

7. Ibid. See also Felix Browder, interview, 11.10.95.

8. Z. Levinson, interview.

9. Ibid.

10.

The Tech,

spring 19 5 3, various issues.

11. Z. Levinson, interview.

12. Ibid.

13. William Ted Martin, interview.

14. Z. Levinson, interview.

15. Fred Brauer, e-mail, 6.23.97; Arthur H. Copeland, professor of mathematics, University of New Hampshire, e-mail, 6.24.97; Arthur Mattuck,

-----1029

e-mail, 6.25.97.

16. John Nash, plenary lecture, World Congress of Psychiatry, Madrid, 8.26.96, op. cit.

20: Geometry

A1029

1. Letter from Warren Ambrose to Paul Halmos, undated (written spring 1953).
2. The portrait of Ambrose is based on the recollections of Isadore Singer, 2.13.95; Lawrence Wallen, 6.4.97; Felix Browder, 11.2.95; Zipporah Levinson, 9.11.95; William Ted Martin, 9.7.95; H. F. Mattson, 10. 29.97, 11 18.97, 11.28.97; Gian-Carlo Rota, 10.94; George Mackey, 12.14.9 5.
3. See, for example, 1. M. Singer and H. Wn, "A Tribute to Warren Ambrose," Notices of the AMS (April 1996).
4. Robert Aumann, interview, 6.28.95. 5. Gabriel Stolzenberg, professor of mathematics, Northeastern University, interview, 4.2.96.

-----1030

6. Leopold Flatto, interview, 4.15.96. See also "The Leo Collection: Anecdotes and Stories" ATANDT Bell Laboratories, 4.29.94.
7. Ibid.
8. George Mackey, interview, 12.14.95. 9. Felix Browder, interview, 11.2.95. 10. Flatto, interview.
11. Despite its apocryphal ring, the story appears to be true and has been confirmed by Nash. Harold Kuhn, personal communication, 8.97. 12. Armand Borel, professor of mathematics, Institute for Advanced Study, interview, 3.1.96.
13. F. Browder, interview.
14. Ibid.
15. Joseph Kohn, interview, 7.19.95. Phrasing the question precisely, Ambrose would have used the adverb "isometrically" - mea distion t preserve distances" - after "embedding."
16. Shlomo Sternberg, professor of mathematics, Harvard University, interview, 3.5.96.
17. Mikhail Gromov, interview, 12.16.97.

-----1031

18. John Forbes Nash, Jr., Les Prix Nobel 1994, op. cit.
19. Gromov, interview.
20. John Conway, professor of mathematics, Princeton University, interview, 10.94. 21. JiIrgen Moser, e-mail, 12.24.97. 22, Richard Palais, professor of mathematics, Brandeis University, interview, 11.6.95.
23. Moser, interview.

- 24, Donald J, Newman, interview, 3.2.96.
25. JtIrgen Moser, "A R idly Convergent Iteration Method and Non-linear Partial Differential Eq"ations, 1, IVA-NNALIDELLA Scullf, Normale Superiore andPisa, vol. 20 (1966), pp. 265-315,499-535. 26. See, for example, Kyosi [to, ed,, Encyclop candc Dictionary ofMathernatics (Mathematical Society of Japan; Cambridge: MIT Press, 1987), people. 1076, Lars Hbrmander, "The Boundary Problems of Physical Geodesy," -----1032
- Archive for Rational Mechanics andAnaIysis, vol. 62, no. 1 (1976), pp. 1-52; and S. Klainerman,

Communications in Pure and Applied Mathematics, vol. 33 A1032

(1980), pp. 43-101 -

27. John Nash, "C' Isometric Imbeddings,"

Annals of Mathematics,

vol. 60, no. 3 (November 1954), pp. 383-96.

28. Kohn, interview.

29. John Forbes Nash, Jr.,

Les Prix Nobel 1994,

op. cit.

30. Rota, interview, 11.14.95.

31. Flatto, interview.

32. Jacob Schwartz, professor of computer science, Courant

Institute, interview, 1.29.96.

33. Isadore Singer, interview, 12.14.95. 34. Paul J. Cohen,

professor of mathematics, Stanford University, interview, 1.6.96.

35. Moser, interview, 3.23.96.

-----1033

36. The Nash-Federer correspondence wasn't saved, and Federer declined to be interviewed (personal communication, 6.25.96). The account is based on the recollections of several individuals, including Wendell Fleming (interview, 6.97), a longtime collaborator and friend of Federer.

37. Fleming, interview.

38. John Nash, "The Imbedding Problem for Riemannian Manifolds,"

Annals of Mathematics,

vol. 63, no. I (January 1956, received October 29, 1954, revised August 20, 1955).

39. Borel, interview.

40 Letter from John Forbes Nash, Jr., to Virginia and John Nash,

Sr., 4.54. 41. Rota, interview.

42. Stolzenberg, interview, 4.2.96.

43. Ibid.

44. Schwartz, interview.

45. Moser, interview.

46. Ibid.

47. Ibid.

48. Rota, interview, 10.94.

-----1034

49. George Whitehead, professor of mathematics, MIT, interview,

12.12.95. 50. Flatto, interview.

51. Lawrence Wallen, interview, 6.4.97. Part T%vo: SEPARATE LWES

21: Singularity

1. Postcard from John Nash to Arthur Mattuck, 1968. B stood for

Jacob Bricker, T for Ervin D. Thorson, F for Herbert Amasa Forrester, and R for Donald V. Reynolds.

22: A Special Friendship

I. Letter from John Forbes Nash, Jr., to Martha Nash Legg, 11.4.65.

2. Ibid.

3. Herta Newman, interview, 3.2.96.

4. D. Newman, interview.

5. Joseph Kohn, interview, 2.15.96. 6. H. Newman, interview.

7. D. Newman, interview.

8. In his 11.4.65 letter, Nash describes Thorson as one of three

"special friendshipsdd"Thorson was working in Santa A1034
Monica, California, at Douglas Aircraft.

9. The references to Tin Nash's letters continued

-----1035

until at least 1968, usually in conjunction with references to B
(for Bricker) and F 10. M. Legg, interview, 3.30.96.

11. Douglas Aircraft could supply no biographical or professional
information on Thorson (Donald Hanson, personal communication,
6.17.97). Nash did not recall Thorson when asked about him by
Harold Kuhn (6.97). What details are known of Thorson are based
solely on an obituary in the

Hernet News

and a brief conversation with his surviving sister, Nelda
Troutman, 5.28.97.

12. Hanson, interview.

13. Ibid.

14. Troutman, interview, 5.28.97.

15. Ibid,

16. Ibid.

17. Under the Eisenhower guidelines, homosexuals were not
permitted to have security clearances.

23ccEleanor

1. The description of Nash's stay at Mrs. Grant's house is based
on interviews with Lindsay Russell,

-----1036

1.14.96, 4.23.96, and 7.97.

2. Postcard from John Nash, Jr., to Virginia and John Nash, Sr.,
9.52.

3. Martha Nash Legg, interview, 9.3.95. 4. Eleanor Stier,
interview, 2.14.96.

5. Ibid., 3.15.96.

6. Ibid., 2.14.96 and 3.18.96.

7. Arthur Mattock, interview, 11.7.95. 8. Eleanor's history was
taken from interviews with her, 3.15.95, and John David Stier,
9.20.97.

9. E. Stier, interview, 2.14.96.

10. ibid., 3.15.96.

11. That Nash was interested in, and experimented with, various
drugs was recalled by Donald Newman, interview, 3.2.96. Eleanor
Stier confirmed this, interview, 3.18.96, although neither
witnessed Nash's expetiments, if indeed they ever took place.
Their possible significance is twofold. First, it suggests Nash's
concern with enhancing his mental powers but also his concerns

about his own "manliness,"

12. E. Stier, interview, 3.13.96.

13. Ibid.

14. M. Legg, interview.

15. E. Stier, interview, 3.15.96,

-----1037

Confirmed by Jacob Bricker, interview, 5.22.97, and Arthur
Mattuck, interview.

16. Bricker, interview.

17. E. Stier, interview, 7.95.

18. Ibid.

19. Bricker, interview. A1037
20. E. Stier, interview, 3.15.96.
21. John David Stier, interview, 6.29.96.
22. E Stier, interview, 3.15.96.
23. J. D. Stier, interview, 9.20.97. 24. E. Stier, interview, 3.15.96.
25. Ibid.
26. Ibid, 3.18.96.
27. Ibid., 3.18.96, and J. D. Stier, interview, 9.20.97.
28. 1. D. Stier, interview, 9.20.97. 29. A. Mattuck, interview.
30. E. Stier, interview, 3.18.96.
31. Bricker, interview; Mattuck, interview.
32. E. Stier, interview, 3.18.96.
33. Mattuck, interview.
34. E. Stier, interview, 3.18.96.

-----1038

35. Ibid., 3.15.96.
36. Mattuck, interview,
- 3T Best, interview, 5.22.96.
- 38, Mattuck, interview, 5.21.97.
39. Bricker, interview.
40. E. Stier, interview.
41. Ibid., 3.18.96.
42. Ibid.
43. 1. D. Stier, interview, 9.20.97. 44. Ibid.
- 24: Jack
1. Donald J. Newman, interview, 3.12.96.
2. Arthur Mattuck, interview, 5.21.97. 3 The portrait of Bricker is based on interviews with Mattuck; Newman; Herb Kamowitz; Jerome Neuwirth, 5 .23,97 and 6.5.97; Leopold Flatto, 4.25.96; Lawrence Wallen, 5.20.97.
4. Jacob Bricker, interview, 5.22.97. 5. Jack Kotick, interview, 1.21.98. 6. D. Newman, interview, 3.12.96.
7. Ibid., 1.25.98.
8. Eleanor Stier, interview.
9. Letter from John Nash to Martha Nash Legg,

-----1039

- 11.4.65.
10. Herta Newman, interview, 3.2.96. 11. Sheldon M. Novick, Henryjames: The Young Master (New York: Random House, 1996).
12. Letter from J. Nash to M. Legg.
13. Alfred C. Kinsey et at.,

Sexual Behavior of the Human Male (Philadelphia: Saunders, 1948).

14. Letter from J. Nash to M. Legg.

15. Bricker, interview, 5.22.97.

16. Neuwirth, interviews.

17. Mattuck, interviews, 5.20.97 and 5.28.97.

18. Bricker, interview, 5.22.97.

19. Postcard from John Nash to Jacob Bricker, 8.3.67.

20. Letter from John Nash to Arthur Mattuck, 7.10.68,

"Mattuckine" seems to be a reference to the Mattachine Society, the first American advocacy group for homosexuals, founded in 1951 (source: Neil Miller, Out

of the Past: Gay and Lesbian History from 1869 to the Present A1039

[New York: Vintage Books, 1995],

-----1040

pp. 334-38).

21. Bricker, interview.

22. Bricker, interview, 1.26.98.

25: The Arrest

lininNash mostly pursued his growing interest in computers and wrote a paper in which he proposed the idea of parallel control.

"Higher Dimensional Core Arrays for Machine Memoriesea"RAND

Memorandum, D-2495, 7.22.54; "Parallel Control," RAND Memorandum,

RM-1 361, 827.54. He wrote two other papers as well, including

"Continuous Iteration Method for Solution of Differential

Gamesea"RAND Memorandum, RM-1326, 8.18.54.

2.

The Evening Outlook

(Santa Monica, California), summer 1954, various dates.

3. Ibid.

4. Melvin P. Peisakoff, interview, 6.3.97.

5. Richard Best, interview, 5.22.96. All direct quotations

attributed to Best throughout chapter 25 come from the 5.22.96

interview.

-----1041

6. Letter from John Nash toArthur Mattuck, 1.15.73. In a reference to his 1954 arrest, Nash named the arresting officer.

7. Best, interview.

8. Ibid.

9. DOD Directive 52206, 1953; Executive Order 10450, 1953;

Greene very. McElroy,

360 US 474, 1959.

10. Best, interview.

11. "The C Law: An Empirical Study of Enforcement and Administration in Los I vol. 13 (1966), pp. 643, 691.

"Solicitation"and "police deco S"- Thomas E. Lodge, "there May Be Harm in Asking: Homosexual Solicitations and the Fighting Wo'l

"Doctrineea"in

Homosexuality, Crimmoloby and the Law,

edited by Wayne R. Dynes and Steven Donaldson (New York: Garland

Publishing, 1992), pp. 461-93. "In 1961 every state in the United

States had sodomy lawsea"f Lesbians, Gay Men and the Law,

edited by William B. Rubenstein (New York: The New Press, 1993),

people. xvi.

12. See, for example, Jerel McCrary and Lewis Gutierrez, "The Homosexual Person in the Military and in National Security Employment," *Journal of Homosexuality*, vol. 5, nos. 1 and 2 (Fall 1979-Winter 1980); Ellen Schrecker, *The Age of McCarthyism: A Brief History with Documents* (New York: St. Martin's Press, 1994).

13. McCrary and Gutierrez, *op. cit.*

14. Nancy Nimitz, retired economist, RAND Corporation, interview,

5.21.96. A1042

15. Best, interview.

16. Ibid.

17. Ibid.

18. McCrary and Gutierrez, op. cit.

19. Best, interview.

20. Ibid.; "The Consenting Adult Homosexual and the Law" op. cit.

21. Best, interview.

22. Ibid.

23. Ibid.

24. Ibid.

-----1043

25. Postcard from John Nash to Virginia and John Nash, Sr., 9.54.

26. Alexander M. Mood, interview, 5.22.96.

27. RAND mathematics department roster, 1954, RAND Archives.

28. Letter from I. Nash to A. Mattuck, 1. 15.73.

29. John W. Milnor, interview, 1.27.98.

30. Lloyd Shapley retold the story of Nash's arrest at a Thanksgiving dinner in 1994. Norman Shapiro, former RAND employee, interview, 2.29.96.

31. Felix Browder, interview, 9.6.97. Browder's recollection was that "Norman Levinson had to take care of it" and that Levinson later regarded the affair as a sign of "approaching schizophrenia."

32. As quoted by N. Shapiro, interview. "Likely it was John."

33. Irving I. Gottesman, professor of psychology, University of Virginia, interview, 1. 16.98.

34. Nikki Erlenmeyer-Kimling, professor of

-----1044

genetics and development, Columbia University, interview, 1.17.98.

35. "J. C. C. McKinsey (obituary), Proceedings and Addresses of the American Philosophical Association, vol. 27 (1954).

36. Andrew

Hodges and Alan Turing. The Enigma, op. cit.

26: Alicia

1. Alicia Nash, interviews, 10.94 and 4.18.97.

2. Peter Munstead, chief librarian, music library, MIT, interview, 9.19.97; also Lawrence Wallen, interview, 6.4.97.

3. The portrait of Alicia at age twenty-one is based largely on interviews with two women who knew her as an undergraduate at MIT: Joyce Davis, 5.17.97 and 6.30.97, and e-mails, various dates; and Emma Duchane, 4.30.96 and 6.26.97. It also draws on interviews with Wallen, 6.5.97; Arthur Mattuck, 11.7.97; Herta Newman, 3.2.96; Jacob Bricker, 5.22.97.

-----1045

5. Ibid.

6. J. Davis, interview.

7. Ibid.

8. The Larde family history is based on interviews with Alicia

Nash, Odette Larde, Enrique L. Larde, and the senior A1045
Enrique Larde's self-published history,
The Crown Prince Rudolf- His Mysterious Life After Mayerling
(Pittsburgh: Dorrance Publishing, 1994). 9. E. Larde,
The Crown Prince Rudolf
op. cit.

10. A. Nash, interview, 5.14.97.

11. O. Larde, interview, 1.7.97.

12. See, for example, Patricia Parkman, Nonviolent Insurrection
in El Salvador (Tucson: University of Arizona Press, 1988).

13. O. Larde, interview.

14. Tinker Cassell, Veterans Administration, Biloxi, Mississippi,
interview, 8.97.

15. The sketch of Marymount is based on interviews with A. Nash,
4.18.97; Elizabeth

-----1046

Keegen,
4.18.97; Sister Kathleen Fagan, Marymount High School, 5.22.97;
Sister Raymond, Marymount High School,
5.22.97.

16. Sister Raymond, interview.

17. Fagan, interview.

18. A. Nash, interview.

19. Duchane, interview.

20. A. Nash, interview.

21. O. Larde, interview.

22. J. Davis, interview.

23. Sister Raymond, interview.

24. A. Nash, interview.

25. Sister Raymond, interview.

26.

The Tech,

9.5 1.

27. A. Nash, interview, 8.22.95.

28. J. Davis, interview.

29. Ibid.

30. Duchane, interview.

31. J. Davis, interview.

32. Letters from Joyce Davis to her parents, 1951-53.

-----1047

33. J. Davis, interview.

34. Letter from Alicia Nash to Joyce Davis, June or July 1952.

35. J. Davis, interview.

- 36. Ibid.
 - 37. H. Newman, interview, 3.2.96.
 - 38. Duchane, interview.
 - 39. A. Nash, interview, 11.94.
 - 40. J. Davis, interview.
 - 41. Letter from J. Davis to her parents, 4.24.54.
 - 42. Letter from A. Nash to J. Davis, June or July 1954.
 - 43. A. Nash, interview, 7.18.96.
 - 44. John Moore, professor of mathematics, Princeton University, interview, 10.6.95.
- 27: The Courtship

1. Arthur Mattuck, interview, 11.7.95. 2. Letter from A1047
Alicia Nash to Joyce Davis, 7.55.

3. Ibid.

4. Emma Duchane, interview, 4.30.96. 5. Jacob Bricker, interview,
5.22.97. 6. Duchane, interview, 6.26.97.

-----1048

7. Ibid.

8. Ibid., 4.30.96.

9. Ibid., 6.26.97.

10. Mattuck, interview.

11. Eleanor Stier, interview, 2.14.96. 12. Duchane, interview,
4.30.96.

13. "Grant in Aid, Support for Dr. John F. Nash, Jr., as Alfred
F. Sloan Research Fellow in Mathematics," 5.15.56; also, Report
for 195 5-56, Alfred F. Sloan Foundation, New York, New York.

14. "The application is quasi-tentative ... the draft blem a
complicationdd"Letter from John Nash to Albert W. Tucker, undated
(probably written in early faW01955).

15. Letter from John Nash to Hassler Whitney, 10.55; John Forbes
Nash, Jr., membership application, Institute for Advanced Study,
5.23.55. Nash's application was formally approved in January
(source: letter from Robert Oppenheimer to John Nash, 1. 17.56).

16. Letter from A. Nash to J. Davis, 2.56. 17. Nesmith Ankeny,
who joined the MIT faculty in the fall of 1955, witnessed the

-----1049

incident and related

the anecdote to Harold and Estelle Kuhn not long after it
occurred (source: Harold Kuhn, e-mail, 5.21.97, and interview,
5.22.97). 18. J. Davis, interview, 5.19.97.

28: Seattle

1. The Institute on Differential Geometry took place from
mid-June to the end of July 1956 at the University of Washington
in Seattle. Dates and participants given in a memorandum from
Carl B. Allendoerfer, chairman, department of mathematics,
University of Washington, Seattle, 5.23.56.

2. John Milner, e-mail, 8.97,

3. Eugenio Calabi, interview, 3.2.96; John Isbell, professor of
mathematics, State University of New York at Buffalo, interview,
6.14.97; Raoul Bott, professor of mathematics, Harvard
University, interview, 11.5.95.

4. E-mail from John Nash to Harold Kuhn, 4.16.96.

5. Letter from John Nash to Martha Nash Legg, 11.4.65.

6. The description of Forrester is based on:

Arthur Mattuck, interview, 5.21.97, e-mail, 6.13.97; Isbell, interview, 6.14.97; Calabi, interview, 3.2.96; Albert Nijenhuis, interview, 6.17.97, e-mails, 6.13.97; Victor Klee, e-mails, 6.13.97, 6.14.97, 6.16.97; Kuhn, e-mails, 4.16.96, 4.17.96, 4.18.96; Joseph Kohn, interview, 4.17.96; John Walter, interview, 6.13.97; Robert L. Vaught, interview, 6.13.97; Ramesh Gangolli, interview, 6.16.97. Mary Sheetz provided the dates of Forrester's employment at the University of Washington, e-mail, 6.16.97.

7. Nijenhuis, interview.

8. Mattuck, interview.

9. Isbell, interview. A1050

10. Vaught, interview.

11. Nijenhuis, interview.

12. Vaught, interview.

13. Ibid.

14. Walter, interview.

15. Nash was in Seattle in February of 1967, apparently for a month. Letter from John Nash to Virginia Nash, 2.67.

-----1051

16. Klee, interview.

17. This scene is reconstructed on the basis of recollections from Martha Nash Legg, interview, 9.2.95.

18. Postcard from John Nash to Virginia and John Nash, Sr., 7.12.56.

19, Jerome Neuwirth, interview, 5.21.97. 20. Jacob Bricker, interview, 5.22.97. 29: Death and Marriage

1. Postcard from John Nash to Virginia and John Nash, Sr., 8.1 1.56

2. Ibid., 9.18.56.

3. Elizabeth Hardwick, "Boston: A Lost Ideal," Harper's,

December 1959, quoted in Paul Mariani, *Lost Puritan; A Life of Robert Lowell* (New York: Norton, 1994), people. 27 1. 4.

Postcards from John Nash to Virginia and John Nash, Sr., 8.5 3, 9.5 3, 12.2.5 3, 1.2.5 5.

5. Martha Nash Legg, interview, 3.29.96. 6. Harold Kuhn, interview, 8.97.

7. M. Legg, interview.

8. Letter from John Nash to Martha Nash Legg,

-----1052

from Paris, 9.28.59.

9. M. Legg, interview.

10. Letter from J. Nash to H. Kuhn, 8.97. 11. Death certificate of John Nash, Sr., 9.12.56.

12. M. Legg, interview.

13. Eleanor Stier, interview, 3.15.96. 14. Natasha Brunswick, interview, 9.25.95.

15. Leo Goodman, as told to Harold Kuhn, 1.95.

16. Alicia Nash, interview, 5.14.97. 17. Letter from Alicia Nash to Joyce Davis, 10.26.56.

18. Ibid.

19. Sylvia Plath,

The Belljar

(New York: Harper and Row, 197 1).

20. M. Legg, interview.

21. John Nash, dinner party at Gaby and Armand Borel's, 3.22.96,

22. M. Legg, interview.

23. A. Nash, interview, 10. 11.97; also M. Legg, interview.

24. Postcard from J. Nash to V. Nash,

-----1053

2.57.

25. Enrique Larde, interview, 12.21.95. Part Three: A SLOW FIRE
BURNING

30: Olden Lane and Washington Square

1. Institute for Advanced Study, Directory, 1956-57, A1053
Institute for Advanced Study Archive, Princeton, New Jersey. 2.
Regis,
Who Got Einstein Office?,
op. cit., people. S.
3. John Danskin, interview, 10.19.95. 4. Paul S. Cohen, professor
of mathematics, Stanford University, interview, 1.6.96.
5. Peter Lax, professor of mathematics, Courant Institute,
interview, 2.29.96.
6. Cathleen Morawetz, professor of mathematics, Courant
Institute, interview, 2.29.96.
7. George Boehn, "The New Uses of the Abstract,"
Fortune,
July 1958.
8. Constance Reid,
Courant in Gottingen and New York: The Story
-----1054
of an Improbable Mathematician (New York: Springer Verlag, 1976).
9. Ibid.
10. Ibid.
11. Lax, interview.
12. Boehm, "The New Uses of the Abstractea"op. cit.
13. Nash told Harold Kuhn that he kept a car in New York City
that year and that parking it caused him innumerable headaches,
personal communication, 7.97.
14. Postcard from John Nash to Virginia and John Nash, Sr.,
8.11.56.
15. Natasha Brunswick, interview, 9.25.95.
16. Tilla Weinstein, professor of mathematics, Rutgers
University, interview, 8.25.97.
17. Morawetz, interview.
18. Lars Hbrmander, professor of mathematics, University of Lund,
interview, 2.13.97.
19. Lax, interview.
20. Hbrmander, interview.
21. John Isbell, e-mail, 3.28.95.
-----1055
22. Boehm, "The New Uses of the Abstractea"op. cit.
the American Mathematical Societ
23. Stanislaw Ulam, "John von Neumann, 1903-57,"
Bulletin of
vol. 64, no. 3, part ii (May 1958). 24. John Nash, "Continuity of
Solutions of Parabolic and Elliptic Equations,"

American Journal of Mathematics,
vol. 80 (1958), pp. 931-54.

25. See Chapters 2 and 16.

26. John Nash, "Continuity of Solutions of Parabolic and Elliptic Equations," op. cit. 27. Louis Nirenberg, professor of mathematics, Courant Institute, interview, 10.94. See also Lax, interview.

28. Ibid.

29 Ibid.

30. Lax, interview.

31. Ibid.

32. Nirenberg, interview. A1055

33. H6rmander, interview.

34. Ibid.

35. Lax, interview.

-----1056

36. Nirenberg, interview.

37. Armand Borel, professor of mathematics, Institute for Advanced Study, interview, 3.1.96.

38. Lax, interview.

39. Morawetz, interview; Gian-CaTlo Rota, interview, 10.94.

40. Paul R. Garabedian, professor of mathematics, Courant Institute, interview, 2.20.96.

41. "Ennio De Giorgi, 1928-1996" and "Interview with Ennio De Giorgi,"

Notices of the American Mathematical Society, 10.97.

42. John Nash, Jr.,

Les Prix Nobel 1994,

op. cit.

43. Rota, interview.

44. Lax, interview.

45. Letter from John Nash to Robert Oppenheimer, 7.10.57.

46. Ibid.

47. John Nash, plenary lecture, World Congress of Psychiatry, Madrid, 8.26.96, op. cit.

-----1057

48. Institute for Advanced Study, directories, various years.

49. Letter from J. Nash to R. Oppenheimer. 50. John Nash, plenary lecture, op. cit, 31: The Bomb Factory

1. Richard Emery, attorney, interview, 4.4.96.

2. Ibid.

3. Postcard from John Nash to Virginia Nash, 9.57.

4. Emma Duchane, interview, 6,26.96. 5. Alicia Nash, interview, 7.1.97.

6, Duchane, interview.

7. Hartley Rogers, interview, 2.16.96. 8. Zipporah Levinson, interview, 9.11.95.

9. A. Nash, interview, 10.94.

10. Nash's chief result was initially published in a note comsubmitted by Marston Morse of the Institute for Advanced Studies on 6.10.57 comin the

Proceedings of the National Academy of Sciences, no. 43 (19 57), pp. 754-58. The full paper was submitted to the

American Journal of Mathematics

nearly a year later, on

5.26.58, and published in vol. 80 (1958), pp. 931-58.

11. Elias Stein, professor of mathematics, Princeton University, interview, 12.2.95. 12. Lennart Carleson, professor of mathematics, University of Stockholm, interview, 10.3.95.

13. Ibid.

14, Stein, interview.

15. Ibid.

16. Ibid.

17. Paul R. Garabedian, interview, 2.20.96.

18. George Boehm, "The New Mathematics," two-part series, A1058 Fortune (June and July 1958).
19. Martha recalled Nash's telling her that he was considering accepting a post at Caltech in order to raise the likelihood of an offer from Harvard, possibly because Harvard and MIT had an informal nonraiding policy. Martha Nash Legg, interview, 3.30.96.
20. Letter from John Nash to Albert W.
-----1059
Tucker, 10.58.
21. At that time, tenure was normally not awarded until the candidate's seventh year. At MIT, unlike some other institutions, tenure was paired with promotion to full, not associate, professor. 22. Gian-Carlo Rota, interview, 10.94. 23. John Forbes Nash, Jr., Les Prix Nobel 1994, op. cit.
24. Awards, Honors and Prizes, 8th edition, vol. 11 (Detroit: Gale Research, 1989), people. 129.
25. Lars H6rmander, interview, 2.13.97. 26. Confidential source. 27. Proceedings, International Congress of Mathematicians, 1958 (Providence, R.I.: American Mathematical Society, 1960).
28. Jtirgen Moser, interview, 3.71.96. 29. Proceedings, International Congress of Mathematicians, op. Cit.
-----1060
30. Confidential source.
31. Confidential source.
32. Moser, e-mail, 12.24.97.
33. Peter Lax, interview, 2.6.96.
34. Moser, interview, 3.21.96.
35. Ibid.
36. For the history of the B6cher Prize, see the Web site for the American Mathematical Society.
37. Letter from Lars H6tionnander to author, 1.3.96; H6rmander, interview, 2.13.97. 38. H6rmander, e-mail, 12.16.97.
39. Ibid.
- 32: Secrets
1. John Forbes Nash, Jr., plenary lecture, World Congress of Psychiatry, Madrid, 8.26.96, op. cit.
2. G . H. Hardy,

The Mathematician Apolo (Cambridge, UK: Cambridge University Press, 1967), with a foreword by C. P. Snow. 3. Paul S. Cohen, interview, 1.5.96. 4. Stanislaw Ulam, "John von Neumann, 1903-1957" op. cit., people. 5. 5. Hardy, op. cit.

-----1061

6. Felix Browder, interview, 11. 10.95.

7. Harold Kuhn, interview, 7.95.

8. Ibid.

9. John Nash, plenary lecture, op. cit. 10. Elias Stein, interview, 12.28.95. 11. Cohen, interview.

12. E. T. Bell,

Men of Mathematics,

A1061

op. cit.

13. Enrico Bombieri, interview, 12.6.95. 14. Bell, op. cit.

15. Andrew Wiles, professor of mathematics, Princeton University, personal communication, 6.97.

16, Lars H6rmander, interview, 2.13.97. 17. F. Browder, interview.

18. John Forbes Nash, Jr.,

Les Prix Nobel 1994,

op. cit.

19. Bell, op. cit.

20. Ibid.

21. Ibid.

22. Jacob Schwartz, professor of computer science, Courant Institute, interview,

-----1062

1.29.96.

23. Jerome Neuwirth, interview, 5.27.97. 24. Stein, interview.

25. Ibid.

26. Richard Palais, professor of mathematics, Brandeis University, interview, 11.6.95.

27. Bell, op. cit.

28. Atle Selberg, interview.

29. Eugenio Calabi, interview, 3.2.96. 30. Letter from John Nash to Martha Nash Legg, 11.4.65.

31. Stein, interview.

32. Hbrmander, interview.

33. Harold Kuhn, e-mail, 7.97.

34. Paul A. Samuelson, interview.

35. William Ted Martin, interview, 9.7.95.

36. Robert Solow, professor of economics, MIT, interview, 1.95.

37. Martin, interview.

38. Cathleen Morawetz, interview, 2.29.96.

39. Alicia Nash, interview, 1.3.97. 40. Ibid.

-----1063

41. John Nash, personal communication, 3.22.96.

42. Eva Browder, interview, 9.6.97.

43. Ibid.

44. A. Nash, interview

45. F. Browder, interview.

46. John Moore, professor of mathematics, Princeton University, interview, 10.5.95.

33: Schemes

1. Alicia Nash, interview, 7.1.97.
2. Ibid.
3. Letter from John Nash to Albert W. Tucker, early October 1958.
4. George Mackey, interview, 1.21.96. 5. Letter from C. Ralph Buncher, professor of biostatistics and epidemiology, University of Cincinnati Medical Center, to author, 5.20.96.
6. A. Nash, interview.
7. John Nash, letter to A. Tucker, 10. 5 8.
8. Ibid.
9. Martha Nash Legg, interview, 3.29.96. 10. Paul A. Samuelson, interview,

3.13.96. 1064

11. Saunders McLane, former chairman, department of mathematics, University of Chicago, interview,

3.4.96.

12. Shlomo Sternberg, interview, 3.5.96. 13. Ibid. Also

membership application, Institute for Advanced Studies, fall

1958. 14. Letter from Albert W. Tucker to John Nash, 10.8.58.

15. Letter from Albert W. Tucker to Sloan Foundation, 10.8.58.

16. Letter from Albert W. Tucker to Guggenheim Foundation, 11.26.58.

17. Gian-Carlo Rota, interview, 11.14.95.

18. Robert Solow, emeritus professor of economics, MIT, interview, 1.95.

19. Letter from John Nash to Virginia Nash, 10. 15.5 8.

20.

New York Times, 11.

14.6 3.

21. Paul S. Cohen won the Fields in 1966 and the 136cher in 1964.

The sketch of

-----1065

Paul Cohen is based on interviews with Raoul Bott, 11.95 and

11.5.96; Lennart Carleson, 10.18.95; Elias Stein, 12.28.95; Felix

Browder, 11.2.95; Adriano Garsia, professor of mathematics,

University of California at San Diego, 12.31.95; Lars H6rmander,

2.13.97; Jargen Moser, 3.21.96; Jerome Neuwirth, 5.27.97.

22. Cohen, interview, 1.5.96.

23. Stein, interview, 12.28.95.

24. Ibid.

25. Garsia, interview, 12.31.95.

26. Cohen, interview.

27. Garsia, interview; Neuwirth, interview, 5.27.97.

28. F. Browder, interview, 11.10.95. 29. Ibid., 11.2.95.

34: The Emperor of Antarctica

1. Richard Emery, interview, 4.4.96. The party scene described by Emery is also based on the recollections of Jurgen and Gertrude Moser, John and Karen Tate, Adriano Garsia, Gian-Carlo Rota, and Alicia Nash.

2. Alicia Nash, interview, 2.7.96.

-----1066

3. Paul S. Cohen, interview, 1.5.96.

4. Al Vasquez, professor of mathematics, City University of New York, interview, 6.17.97.

5. Raoul Bott, interview, 11.5.95.

6. Emma Duchane, interview, 6.26.97. 7. Letter from C. Ralph Buncher to author, 5.20.96; also letter from Henry Y. Wan, professor of economics, Cornell University, to author, 6.5.96. Tony Phillips, professor of mathematics, State University of New York at Stony Brook, interview, 8.26.97, recalled Nash's question to the class.
8. Ramesh Gangolli, professor of mathematics, University of Washington, interview, 6.12.95. Also, Alberto R. Galmarino, professor of mathematics, Northeastern University, interview, 6.95. 9. Atle Selberg, interviews, 8.16.95 and 1.23.96.
10. Gian-Carlo Rota, interview, 10.29.94; Gangolli, interview;

Galmarino, interview. Martha Nash Le put this episode A1066

-----1067

later, but Gangolli and Galmarino recall that Nash didn't meet his classes for the last couple of weeks of the term which ended 1.21.59 and Rota recalled that Nash stopped by his apartment before "driving south."

II. Jerome Neuwirth, interview, 6.4.97; also Carsia, interview, 12.31.95.

12. Hartley Rogers, interview, 2.16.96. 13. Ducharie, interview, 4.30.96.

14. Confidential source.

15. Vasquez, interview.

16. Kate Tate, interview, 8.11.97. 17. John Nash, plenary lecture, op. cit. 18. A. Nash, interview.

19. Cohen, interview.

20. Vasquez, interview.

21. Harold Kuhn, interview, 8.94.

22. Cohen, interview.

23. Neuwirth, interview.

24. Moser, interview, 3.23.96.

25. William Ted Martin, interview, 9.7.95.

26. Felix Browder, interview, 11.2.95; Paul A. Samuelson, interview, 10.94. 27. John Danskin, interview, 10.19.96.

-----1068

28. The account of this incident is based on interviews with the following sources: Sigurdur Helgason, 2.13.96; F. Browder; Samuelson, 10.94 and 3.15.96; Harold Kuhn, interview, 1.95. Browder, who later became chairman of the Chicago department, recalled seeing the letter in the files. Efforts by the current chair-man to locate it proved fruitless.

29. Vasquez, interview.

30. E nio Calabi, interview, 3.2.96. Iu

31. 1 . y

32. Selberg, interview.

33. Program, 5 54th Meeting, Columbia University, New York, February 28, 1959,

Bulletin of the American Mathematical Society, vol. 65 (1959), people. 149.

34. Harold N. Shapiro, interview, 2.29.96.

3 5. Peter Lax, interview, 2.6.96. 36. Donald J. Newman, interview, 3.2.96.

-----1069

37. Cathleen Morawetz, interview, 2.29.96.

38. F. Browder, interview.

35: In the Eye of the Storm

I. Alicia Nash, interview, 7.1.97.

2. Emma Duchane, interview, 6.26.97. 3. A. Nash, interview.

4. Donald V. Reynolds, interview, 6.29.97.

5. A. Nash, interview.

6. Duchane, interview.

7. Martha Nash Legg, interview, 3.29.96. 8. Duchane, interview.

9. A. Nash, interview.

10. Duchane, interview.

11. A. Nash, interview.

12. Duchane, interview. A1069
13. Ibid.
14. William Ted Martin, interview, 9.7.95.
15. Cian-CaTlo Rota, interview, 10.29.94.
16. Letter from John Nash to Virginia Nash, 3.12.59.
17. Letter from John Nash to Martha Nash Legg,
-----1070

3.12.59.
18. A. Nash, interview, 7.1.97.
19. A] Vasquez, interview, 6.17.97. 20. Duchane, interview,
21. Ibiand
22. Paul S. Cohen, interview, 1.5.96, 23. Gertrude Moser,
interview, 8.25.95. 24. Kay Whitehead, professor of mathematics,
Tufts University interview, 12.12.95.
36: Day Breaks in Bowditch Hall
1. Paul S. Cohen, interview, 1.5.96. 2. Adriano Garsia,
interview, 12.31.95, 3. Cohen, interview.
4. My description of how MIT's psychiatric service likely handled
Nash's commitment is based on interviews with Benson Rowell
Snyder, who was hired by P
7.24.97; Wade Rockwood, interview, 7.26.97; Mert)
Burststein, former FBI agent who was brought in by Stratton to
expand MIT's campus olice, interview, 7.3.97.
5. The description of how Nash was taken to McLean against his
will is baselon a

-----1071
contemporaneous account by a former dean of Tufts Medical School,
A. Warren Stearns, who in rvievved Nash s ortly after his te shc
commitment (letter fron Stearns to Bernard Bradley, 4.14.59), and
a further elaboration by Nash (E-mail,
5.15.98).
6. Snyder, interview.
7. For a portrait of McLean as it was in the 1950's, I relied on
an official history by S. B. Sutton, A
History ofMcLean Hospital
(Washington, D.C.: American Psychiatric Press, 1986); annual
reports; firsthand accounts by Sylvia Plath, Robert Lowell, and
Ray Charles, as well as Suzanna Kayseri's more r nt reationt,
Girl
'ece`
Interrupted-
and interviews with individuals associated with McLean in that
era, including Pau Howard, former associate psychiatrist in chief

and director of the clinical service, 2.15.95; Kahne; Joseph
Brenner,

-----1072

7.23.97; Arthur Cain, psychiatrist, 8.20.97; Alfred Pope, senior
neuropathologist, McLean Hospital, and professor of
neuropathology, Harvard Medical School, 12.13.95 and 2,16.96. 8.
Robert Garber, former president, American Psychiatric
Association, interview, 5.6.96. 9. Sylvia Plath,
The Belljar,
op. cit.; Ray Charles,
Brother Ray

(New York: Da Capo, 1978, 1992). 10. Letter from A. W. A1072
Steams to B. Bradley, 5.1 plus 5 3.

11. Zipporah Levinson, interview, 9.11.95.

12. Emma Duchane, interview, 6.26.97. 13. Robert Lowell was
hospitalized at McLean at the end of April 1959. Lowell was
confined to Bowditch, as he had been two years earlier when he
wrote "Day Breaks at Bowditch Hallea"one of the poems in
To the Union Dead

Several of Nash's visitors, including Gian-Carlo Rota, Isadore
Singer, and

-----1073

Arthur Mattuck, recall encounters with Lowell, and therefore it
seems that Nash, too, was confined to Bowditch. Since we have no
firsthand reports from Nash, I have made use of Lowell's
irripressi"ns from 1957 and 1959, augmented by the impressions of
some of Lowell's visitors, including his wife, writer Elizabeth
Hardwick, letter, 8.8.97; poet Stanley Kunitz, interview, 8.2.97;
and Lowell's executor, Frank Bidart, interview, 7.27.97. See also
Ian

Hamilton,

Robert Lowcll: A Biography

(New York: Random House, 1982); Paul Mariam,

The Lost

Puritan,

op. cit., and interview, 7.28.97; Peter Davison,

The Fading Smile: Poets in Boston, 1955-1960, from Robert Frost
to Robert Lowell to Sylvi Plath

(New York: Knopf, 1994), and interview, 8.11.97.

-----1074

14. "I've been conditioning here for about a monthea"letter from
Robert Lowell to Edmund Wilson,

5.19.59, from Bowditch House; "in the hospital I spent a mad
month or more rewriting everything in my three booksea"letter
from Robert Lowell to Elizabeth Bishop, 7.24.59.

15. Elizabeth Hardwick, personal communication, 9.8.97.

16. Arthur Mattuck, e-mail, 8,8.97. 17. "The house I was in was
divided between ex-paranoid boys and senile old menea"letter from
Robert Lowell to Peter Taylor, 3.15.58, 18. Letter from R. Lowell
to E. Bishop, 3.15.58.

19. Ibid.; also "Waking in the Blueea"Robert Lowell,

Life Studies and For the Union Dead

(New York: Farrar, Straus and Giroux, 1992). Quotes in this and
the following paragraphs are taken from "Waking"unless otherwise

noted.

20. From "Waking in the Blue"; also Duchane, interview.

21. Letter from R. Lowell to E. Bishop; also "Waking in the Blue."

-----1075

22. Seymour Krim, "The Insanity Bitea" in
View of a Nearsighted Cannoneer
(New York: E. P. Dutton,
1968).

23. Al Vasquez, interview, 6,17.97. 24. Z. Levinson, interview,
25. Vasquez, interview.

26. Carsia, interview. A1075
27. Jiirgen Moser, interview, 3.23.96. 28. Duchane, interview.
29. George Mackey, interview, 12.14.95.
30. Herta Newman, interview, 3.2.96. 31. Felix Browder,
interview, 1.2.95. 32. Gian-Carlo Rota, interview, 10.29.94.
34. This is Jerome Lettvin's term, Jerome Lettvin, professor of
electrical engineering, MIT, interview,
7.25.97.
35, John McCarthy, interview, 2.4.96. 36. Arthur Mattuck,
interview, 11.7.95. 37. I am assuming that Nash's treatment was
similar to that of other patients and have based my account

-----1076
on the recollections of Paul Howard, clinical director of McLean
at the time, as well as other McLean staffers, including Joseph
Brenner, psychiatrist, interview, 7.25.97; Cain, interview;
Kahne, interview.
38. Letter from A. W. Stearns to B. Bradley, 5.20.59.
39. Kahne, interview.
40. Brenner, interview, 7.23.97.
41. Z. Levinson, interview.
42. Cohen, interview; F. Browder, interview.
43. Francine M. Benes, psychiatrist, McLean Hospital, interview,
2.13.96. 44. See, for example, MaTiani, op. cit., and Hamilton,
op. cit.
45. Kahne, interview; also Howard, interview. 46. Kahne,
interview.
47. Howard, interview.
48. Brenner, interview.
49. Z. Levinson, interview.
50. Isadore Singer, interview, 12.13.95. 51. Letter from A. W.
Stearns to B. Bradley, 5.20.59.
52. Duchane, interview.

-----1077
53. Letter from A. W. Stearns to B. Bradley, 5.20.59.
54. Taffy Griffiths, physician, Princeton, 5.20.59, and
interview, 7.95. 55, Notes of a telephone conversation between A.
Warren Stearns and Bernard E. Bradley, attorney,
5.13.59. In an interview (8.19.97), Bradley said that he handled
many similar cases, but did not recall Nash.
56. The sketch of A. Warren Stearns is based on a biographical
essay provided by the Tufts University
archives; an interview with his son Charles Stearns, 3.14.96; and
an interview with Paul Samuelson, who knew Stearns, 3.15.96. 57.

A. W. Steams and B. Bradley phone conversation, 5.14.59.

58. Letter from A. W. Stearns to B. Bradley, 5.20.59.

59. Ibid.

60. Letter from Robert A. Crimes, attorney, Hardy, Hall and Grimes, to A. Warren Steams, 6.18.59.

61. Letter from A. W. Steams to B. Bradley,

-----1078

5.20.59.

62. Ibid.

37: Mad Hatter's Tea

1. Emma Duchane, interview, 6.26.97. The sketch of Alicia Nash

and the final months of her pregnancy are based on this. A1078

2. Confidential source.

3. Confidential source.

4. Michael Artin, interview, 12.12.95. 5. Confidential source.

6. Zipporah Levinson, interview, 9.11.95.

7. A] V s uez, interview, 6.17.97. a 7r,

8. Letter orn John Nash to Lars 1-16rmander, undated (arrived around 6.1.59).

9. Gab Borel, interview, 9.94.

1 jo

0. n Nash, flenary lecture, World Congress of Psychiatry, Madrid,

8.26.96, op. cit. Il. Paul Samueson, interview, 3.16,97.

12. Z. Levinson, interview.

13. William Ted Martin, interview, 9.7.95.

-----1079

14. A. Warren Stearns, note for file, 6.15.59.

15. Samuelson, interview.

16. Letter from Henry Y. Wan, Jr., to author, 6.5.96.

17. Enrique Larde, interview, 12.21.95. 18. John Danskin,

interview, 10.19.95. 19. Alicia Nash, interview, 7.1.97.

Part Four: THE LOST YEARS

38: Citoyen du Monde

1. Postcard from John Nash to Virginia Nash, 7.18.59.

2. Ibid., 7.20.59.

3. Janet Flanner,

Paris Journal 1944-1965

(New York: Atheneum, 1965).

4. John Moore, interview, 10.6.97.

5. Alicia Nash, interview, 8.15.97.

6. Odette Larde, interview, 12.8.95. 7. International Herald Tribune,

7.10.59, 7.11.59, 7.12.59, 8.7.59. 8. Interviews with Joseph Baratta, historian, 8.12.97; Francis Bourne, 8.12.97; David Gallup, attorney, 8.12.97.

-----1080

9. New York Times,

5.27.48; Garry Davis, World Citizen Foundation, interview,

8.13.97. See also Art Buchwald,

I'll Always Have Paris

(New York: C. P. Putnam and Sons, 1996), and Garry Davis,

My County Is the World: The Adventures of a World Citizen

(New York: C. P. Putnam and Sons, 1961).

10.

New York Times,

9.18.48.

11.

International Herald Tribune,

6.16.49.

12. Buchwald, op. cit.

13.

International Herald Tribune, 6.16.49. 14. Louis Sass,

Madness and Modernism,

op. cit., pp. 324-25.

15. Postcard from J. Nash to V. Nash, 7.29.59.

16. Section 1481 of the 1941 Immigration and Naturalization Act. 1081
17. Edward A. Betancourt, Overseas Citizens Services, Immigration and Naturalization Service, interview, 8.26.97. 18. 1941 Immigration and Naturalization Act.
19. John Nash, plenary lecture, World Congress of Psychiatry, Madrid, 8.26.96, op. cit.
20. Martha Nash Legg, interview, 3.29.96.
21. Armand Borel, interview, 3.1.96.
22. Postcard from J. Nash to V. Nash, 7.31.59.
23. Ibid.
24. Denis Brian, Einstein: A Life, op. cit.
25. International Herald Tribune, various issues, August 1959.
26. John Nash, plenary lecture, op. cit. 27. See, for example, Paul Hofmann, Switzerland

- 1082
- (New York: Henry Holt and Co., 1994).
28. Mary Wollstonecraft Shelley, *Frankenstein or the Modern Prometheus* (New York: Penguin, 1985).
29. Postcard from J. Nash to V. Nash, 8.12.59.
30. As quoted by Sass, op. cit.
31. Letter from John Nash to Lars Hbrmander, 2.10.60.
32. Zurbuchen, Le Directeur, Contrble de l'HABITANT, Geneva, 9.29.59, provided by Schweizerisches Bundesarchiv.
- 3 3. Franz Kafka, *The Castle* (New York: Scholastic Books, 1992), with an introduction by Irving Howe.
34. Ibid.
35. Ibid.
36. Postcard from J. Nash to V. Nash, 9.28.59.
37. Convention Relating to the Status of Refugees of July 28, 1951, United Nations High Commissioner for Refugees, Geneva.

- 1083
38. Zurbuchen, op. cit.
39. Ibid.
40. Direktion der Eidg. Militarverwaltung, Berne to Contr6fule de

L'HABITANT, Geneva, 11.21.59.

41. John Nash, plenary lecture, op. cit. 42. Ibid.

43. Harold Kuhn, interview, 1.95.

44. John Haslam, as quoted by Sass, op. cit.

45. Sass, op. cit.

46. Postcard from J. Nash to V. Nash, 9.28.59.

47. Letter from M. Legg to John Nash, 9.59. 48. A. Nash, interview.

49. Telegram from Amory Houghton, U.S. ambassador to France, to Secretary of State Christian A. Herter, 12.15.59.

50. Letter from J. Nash to L. H6rmander, from Paris, 1. 18.60.

5 1. Postcard from J. Nash to V. Nash, 10. 11. 59. A1083
52. After returning to the U.S., Nash claimed to be a resident of
Liechtenstein, which levied no income tax, and refused to sign
U.S. tax forms

-----1084

(source: H. Kuhn, interview, 8.92).

53. O. Larde, interview, 12.8.96.

54. Letter from John Nash to Virginia Nash, 11. 10. 59.

55. The anecdote concerns Paul Erdos and was told by Donald
Spencer, interview, 11.28.95.

56. O. Larde, interview, 12.8.95.

57. M. Legg, interview, 3.29.96.

58. Sass, op. cit.

59. Letter from John Nash to Norbert Wiener, 12.9.95.

60. Letter from J. Nash to V. Nash, 12.13.59.

61. Franz Kafka,

The Metamorphosis

(New York: Schocken Books, 1995). 62. Irving Howe introduction,
Kafka,

The Castle, op.

Cit.

63. James M. Glass,

Delusion

(Chicago: University of Chicago Press, 1985).

-----1085

64. Telegram from A. Houghton to C. A. Herter.

65. Telegram from Henry S. Villard, U.S. consul to Switzerland,
to Secretary of State Christian A. Herter, 12.16.59. 66. Ibiand

67. Theodore Friend, obituary of Edward Hill Cox, 8.4.75,
Swarthmore College Archive.

68. A. Nash, interview.

69. Telegram from A. Houghton to C. A. Herter.

70. Telegram from H. S. Villard to C. A. Herter.

71. Letter from J. Nash to V. Nash, 12.26.59; O. Larde,
interview, 12.8.95. 72. O. Larde, interview, 12.8.95,

73. Shiing-shen Chem, professor of mathematics, University of
California at Berkeley, interview, 6.17.97.

74. A. Nash, interview.

75. "Alexandre Grothendieckea"History of Mathematics Archive,
School of Mathematical and Computational Sciences, University of
St. Andrews, Scotland; see also interviews with Nick

-----1086

Katz, professor of mathematics, Princeton University, 8.26.97;

Arthur Mattock, 9.19.97; Paulo Ribenboim, professor of mathematics, Queens University, Kingston, Ontario, Canada, 9.28.97; Tony Phillips, 8.26.97.

76. O. Larde, interview, 12.8.85.

77. A. Nash, interview.

78. Felix Browder, interview, 9.6.97. See also Larkin Farinholt's obituary, New York Times, 7.17.90, for details of his career.

79. Letter from J. Nash to L. Hbrmander, 2.10.60.

80. John Nash, plenary lecture, op. cit. 81. Letter from Lars

Hörmänder to John Nash, 2.12.60, A1086

82. Postcard from J. Nash to V. Nash, 3.2.60.

83. John Nash, conversation with author, 6.25.95.

84. F. Browder, interview.

85. Ibid.

86. Letter from J. Nash to V. Nash, 3.60. 87. Michael Artin, interview, 12.12.95.

-----1087

88. Al Vasquez, interview, 6.17.97.

89. Cathleen Morawetz, interview, 2.29.96.

90. John Danskin, interview, 10.19.95. 91. M. Legg, interview.

92. Eleanor Stier, interview, 3.18.96. 93. Letter from J. Nash to V. Nash, 4.9.60. 94. Ibid.

95. Telegram from AJ-LYN C. Donaldson, Department of State, to Virginia Nash, 4.21.60.

96. Emma Duchane, interview, 4.30.95. 97. Vasquez, interview.

98. A. Nash, interview.

99. G. Davis, interview.

39: Absolute Zero

1. Alicia Nash, interview, 8.15.97.

2. Martha Nash Legg, interview, 8.1.95. 3. Interviews with John Danskin, 10.19.95, and Joyce Davis, 5.30.97. 4. Handwritten note from Alicia Nash to Joyce Davis, summer 1960.

5. Odette Larde, interview, 12.7.95. 6. A. Nash, interview.

-----1088

7. Jean-Pierre Cauvin, professor of French, University of Texas at Austin, interview, 8.25.97; also Agnes Sherman, interview, 8.26.96.

8. O. Larde, interview.

9. Cauvin, interview.

10. Danskin, interview.

11. Ibid.

12. Elvira Leader, interview, 6.9.95. 13. Solomon Leader, interview, 6.9.95. 14. Danskin, interview.

15. Samuel C. Howell, memorandum to file, 11.10.60.

16. Notes of conversations between Oskar Morgenstern and Douglas Brown, Princeton University Archives, 11.2.50.

17. Letter from Raymond J. Woodrow to John F. Nash, Jr., 10.21.60.

18. Letter from Donald Spencer to Jean Leray, 10.31.60.

19. Ibid.

20. Burton Randol, professor of mathematics, City University of New York, interview, 8.26.97.

21. Ibid.

-----1089

23. Ibid.

24. Confidential source.

25. Confidential source.

26. Randol, interview.

27. Danskin, interview.

28. Martin Shubik, interview, 10.94.

29. Paul Zweifel, interview, 9.6.95. 30. Edmond Nelson, professor of mathematics, Princeton University, interview, 8.17.95.

31. Armand Borel, interview, 3.1.96.

32. Danskin, interview. Robert Coheen, president of Princeton University, was unable to confirm these events, which would have been handled by someone on the campus security detail in any case, interview, 9.10.97.

33. A. Nash, interview.

34. O. Larde, interview.

35. Confidential source.

40: Tower of Silence

1. Martha Nash Legg, interview, 8.2.95. 2. Ibid.

I University Press, 1994), and "Abuse in AmerIntemationaljournaloflawandPsychistry, vol. 3 (1980), pp. 295-3 10. Also

-----1090

interview with Grob, professor of history, Rutgers University, 8.4.97.

4. See biographies of Dorothea Dix, including Rachel Basker, Angel of Mercy.- The Story of Dorothea Dix (New York: Messner, 195 5); also Penny Colman, Breaking the Chains: The Crusade of Dorothea Lynde Dix (White Hall, Va.: Shoetree Press, 1992).

5. Descriptions of Trenton State are based on interviews with psychiatrists who were affiliated with the hospital, including Robert Garber, former president, American Psychiatric Association, 5.6.96; Peter Baurnecker, 5.1.96, 5.2.96, 5.9.96; Arthur A. Sugarman, 8.2 5.97.

6. Baurnecker, interview.

7. Ibid.

8. Ariel Rubinstein, e-mail, 2.3.97. 9. Baurnecker, interview. Bprobably refers to Jacob Bricker (see Chapter 44). 10. John Danskin, interview, 10. 19.96. For an account of the hijacking, see

-----1091

Time

magazine, 2.3.61.

11. M. Legg, interview.

12. Danskin, interview.

13. Robert Winters, interview, 8.9.95. 14. Letter from Robert Winters to Joseph Tobin, 2.2.61.

15. Letter from Robert Winters to Harold Magee, 2.2.59. Also interview with Tobin, 6.10.97. 16. Seymour Krim, "The Insanity Bitea"op. cit.

17. Baurnecker, interview.

18. Phillip Ehrlich, psychiatrist, Princeton Hospital, interview,

- 8.24.97. 19. Baumecker, interview.
20. M. Legg, interview.
21. Interviews with Garber and Baumecker.
22. Baumecker, interview.
23. Danskin, interview.
24. Garber, interview.
25. Baumecker, interview.
26. Ibid.
27. Burton Randol, interview, 8.25.97. 28. Lenore McCall,
BetWeen Us and the Dark

(Philadelphia: J. B. Lippincott, 1947). 1092

29. Baumecker, interview.

30. Garber, interview.

31. Jerome Lettvin, interview, 7.25.97. 32. Grob,

The Mad Among Us,

op. cit., people. 18 5.

33. Garber, interview.

34. Letter from John Nash to Alexander Mood, 12.17.94, one of many references Nash has made to his insulin treatments and memory loss.

35. Richard Nash, interview, 1.6.96.

36. Interviews with Grob and Lettvin.

37. Baumecker, interview.

38. Ibid.

39. Ibid.

40. Postcard from John Nash to Virginia Nash, 7.14.61. Nash says he's due to be released the following day.

41. Baurnecker, interview.

42. Postcard from J. Nash to V. Nash, 7.14.61.

41: An Interlude of Enforced Rationality

1. John Forbes Nash, Jr.,

-----1093

Les Prix Nobel 1994,

op. cit.

2. Louis Sass,

Madness and Modernism,

op. cit.

3. A decline in measured intelligence within a short time of the onset of schizophrenia has been documented in a series of studies. Jed Wyatt, personal communication, 6.97.

4. Letter from John Nash to Donald Spencer, undated, spring 1961.

5. Interviews with Armand Borel, 3.1.96, and Atle Selberg, 1.23.96.

6. Letter from Atle Selberg to John Nash, 9.25.61; letter from Robert Oppenheimer to John Nash, 10.3.61.

7. John Nash, membership application, 7.17.61, Institute for Advanced Study Archive.

8. Letter from J. Nash to D. Spencer.

9. Shlomo Sternberg, interview, 3.5.96. Also postcards from John Nash to Virginia Nash, 8.1.61 and 8.3.61.

-----1094

10. Alicia Nash, interview, 8.15.96.
11. Interviews with John Danskin, 10.19.95, and Odette Larde, 12.7.95.
12. O. Larde, interview.
13. "Recent Advances in Game Theory" Princeton, October 4-6, 1961.
14. Reinhard Selten, professor of economics, University of Bonn, interview, 6.27.95.
15. John Harsanyi, interview, 6.27.95.
16. Harold Kuhn, personal communication, 8.97.
17. John Nash, "Le Problème de Cauchy Pour Les Equations Differentielles; d'une Fluide Géométrique," Bulletin de la Société Mathématique de France,

vol. 90 (1962), pp. 487-97. Submitted 1.19.62. A1094

18. John Nash,

Les Prix Nobel 1994,

dismant

19. According to the

Encyclopedia oAL-THEMATICS,

-----1095

"Mathematical study of [the Cauchy problem for the general Navier-Stokes equation) has become active since J. Nash and N. Itaya proved the existence of unique regular solutions local in time."

20. Selberg, interview.

21. Gillian Richardson, interview, 12.14.97.

22. Karl Uitti, professor of French, Princeton University, interview, 8.22.97, 23. Confidential source.

24. Uitti, interview.

25. Jean-Pierre Cauvin, interview, 8,25.97.

26. Hubert Goldschmidt, Columbia University, interview, 3.20.97.

27. Letter from Robert Oppenheimer to Leon Motchane, Institut des Hautes etudes, 4.26.62.

28. Memorandum from Robert Oppenheimer to Atle Selberg, 4.26.62.

29. Stefan A. Burr, professor of computer science, City College of New York, interview, 5.95.

30. A. Borel, interview.

-----1096

31. Ibid.

32. Gaby Borel, interview, 10.94.

33. A] Vasquez, interview, 6.17.97. 34. Lloyd S. Shapley, interview, 10.94.

35. Ibid.

36. Postcard from J. Nash to V. Nash, 7.62.

37. Ed Nelson, professor of mathematics, Princeton University, interview, 8.17.95. 38.-Lars Mirmander, interview, 2.13.97. 39.

John Nash, personal communication with Harold Kuhn, 8.97.

40. H6rmander, interview.

41. Ibid.

42. Death certificate of Carlos Larde, State Department of Health, New Jersey, 7.2.62.

43. Postcard from John Nash to Martha Nash Legg, 7.24.63.

44. John Danskin, interview, 10.19.95. 45. Confidential source.

46. Proceedings, International Congress of Mathematicians, Stockholm, 1962.

47. Letter from John Nash to Martha Nash Legg,

9.20.62.

48. Unsigned postcard to mathematics department, Princeton University, 9.1.62.

49. Uitti, interview.

50. Letter from John Nash to M. Legg, 11.19.62.

51. Ibid., 1.26.63.

52. M. Legg, interview, 3.30.96.

53.

Alicia L Nash vs. John Forbes Nash, Complaint, Superior Court of New Jersey, Mercer County,

12.27.62; Frank L. Scott, attorney, interview, 8.12.97. A1097

54. M. Legg, interview, 8.2.95.

5 5. A.

Nash vs. J. Nash,

op. cit.

56. judgment Nisi,

Alicia Nash vs. John Forbes Nash, Superior Court of New Jersey,
Mercer County,

5.1.63.

57. Final Judgment (Divorce), Alicia L. Nash and John Forbes
Nash, 8.2.63.

-----1098

58. Robert Winters, interview, 8.9.95.

59. Letter from James G. Miller to Albert E. Meder, Jr.,
treasurer, American Mathematical Society,
4.2.63.

60. Harold Kuhn, interview, 8.95.

61. Letter from William Ted Martin to Albert W. Tucker, 4.1.63.

62. Ibid.

63. Letter from Albert E. Meder to William Ted Martin, 3.28.63.

64. Confidential source.

65. Donald Spencer, interview, 11.28.95. 66. Winters, interview.

67. Letter from Martha Nash Legg to Donald Spencer, 4.24.63.

42: The "Blowing Up" Problem

1. Robert Garber, interview, 5.6.96.

2. Ken Kesey,

One Flew Over the Cuckoo Nest

(New York: Viking, 1962); Joanne Greenberg,

I Never Promised You a Rose Garden

(New York: Signet, 1964); Thomas S.

-----1099

Szasz,

The Myth of Mental Illness (New
York: Hoeber-Harper, 1961).

3. William Otis, psychiatrist, interview, 5.3.96.

4. Garber, interview.

5. Alicia Nash, interview, 8.15.97.

6. Otis, interview.

7. A. Nash, interview.

8. Martha Nash Legg, interview, 3.30.96. 9. Garber, interview.

10. Ibid.

11. Frank L. Scott, interview, 11. 12.97.

12. Garber, interview.

13. Letter from John Nash to Norbert Wiener, 5.1.63.
14. Interviews with A. Nash; Donald Spencer, 11.28.95; Gaby Bore], 3.14.96.
15. Howard Mele declined to be interviewed, 4.9.96.
16. New Jersey Board of Medicine.
17. Interviews with Garber and Otis.
18. Belle Parmet, social worker, interview,
-----1100
8.24.97.
19. Letter from J. Nash to NddWiener.
20. Garber, interview.

21. Letter from John Nash to Virginia Nash, 8.10.63. A1100

22. Ibid., 8.22.63.

23. Ibid., 8.29.63.

24. Richard S. E. Keefe and Phillip D. Harvey,

Understanding Schizophrenia

(New York: Free Press,

1994), people. 48.

25. Louisa Cauvin, interview, 8.25.97. 26. Armand Borel,

interview, 3.1.96.

27. Ibid.

28. Memorandum from Robert Oppenheimer to Atle Selberg, 9.30.63.

29. Letter from David Gale to Deane Montgomery, 1.3.64.

30. Letter from J. Nash to V. Nash, 10.31.63.

31. Ibid., 3.14.64.

32. Ibid., 10.31.64 and 12.13.64.

33 John Nash, plenary lecture, World Congress of Psychiatry,

Madrid, 8.26.96,

-----1101

op. cit.

34. Heisuke Hironaka, "On Nash Blowing Upea" in

Arithmetic and Geometry If

(Boston: Birkhauser,

1983).

35 William Browder, interview.

36. Memorandum from John Milnor to Dean of Faculty J. Douglas

Brown, 4.8.64. 37. Ibid.

38. Letter from Howard S. Mele to John Milnor, 3.30.64.

39. Garber, interview.

40. Letter from H. S. Mele to J. Milnor. 41. Memorandum from J.

Douglas Brown to Robert F. Goheen, 4.6.64.

42. Letter from Ernest J. Johnson to John Nash, 5,1.64.

43. Letter from J. Nash to V. Nash, 2.18.64. 44. Ibid., 3.14.64.

45. Ibid., 3.64.

46. During the spring, Nash wrote to a colleague in Europe saying

that he hoped to accept a visiting position at the Institut des

Hautes 9mentudes near Paris, arranged by Alexandre

-----1102

Grothendieck.

47. M. Legg, interview, 3.29.96.

48. Ibid.

49. Letter from John Nash to Martha NaEh Legg, 4.64.

50. Karl Uifti, interview, 8.22.97.

5 1. Letter from J. Nash to V. Nash, 2.18.64.

52. Letter from John Nash to a colleague, 5.64 or 6.64.
53. Letter from John Nash to Robert Oppenheimer, 5.24.64.
54. The 1964 Summer Research Institute on Algebraic Geometry, American Mathematical Society, Notices, October 1963; also John Tate, professor of mathematics, University of Texas, interview, 6,20.97.
55. Letter from J. Nash to V. Nash, 8.31.64. 56. Ibid.
57. John Nash, plenary lecture, op. cit. 58. Ibid.
59. Ibid.
60. Letter from John Nash to Arthur Mattuck, 11.13.71.

61. Harold Kuhn, e-mail, 5.96. 1103
62. Letter from J. Nash to V. Nash, 8.31.64. 63. Postcard from John Nash to Virginia Nash, 9.2.64.
64. jean Pierre Serre, e-mail, 2.15.96.
65. Postcard from J. Nash to V. Nash, 9.7.64.
66. Memorandum from A. W. Tucker to J. D. Brown, 9.18.64.
67. Postcard from 1. Nash to V. Nash, 9.64.
68. Atle Selberg, interview, 1.23.96. 69. Letter from John Nash to John Milnor, 12.27.64.
70. Interviews with John Danskin, 10.9.96; also with William Lucas, professor of mathematics, Claremont Graduate School, 6.27.95, and Herbert Scarf, professor of mathematics, Yale University, 8.97.
71. Danskin, interview.
72. Kuhn, interview.

- 1104
73. Richard C. Palais, professor of mathematics, Brandeis University, interview, 11.6.95.
 74. A. Borel, interview.
 - 75 Palais, interview.

- 76, Letter from 1. Nash to V. Nash, 7.29.65. 43: Solitude
1. Letter from John Nash to Martha Nash Legg, 1.16.66.
2. Martha Nash Legg, interview, 3.29.96. 3. Letter from J. Nash to M. Legg, 7.27.65. 4. Ibid., 8.2.65.
5. John David Stier, interviews, 6.29.96 and 9.20.97.
6. Letter from J. Nash to M. Legg, 10.31.65.
7. Ibid., 5.1.66.
8. Ibid.
9. J. D. Stier, interviews, 6.29.96 and 9.20.97. Except where noted, the facts of John David Stier's childhood are drawn from these interviews.
10. Eleanor Stier, interview, 3.25.96. 11. 1. D. Stier, interview, 9.20.97. 12. Letter from 1. Nash to M. Legg, 1.

- 1105
- 16.66.
 13. Ibid., 2.22.66.
 14. Ibid., 2.27.66.
 15. Ibid., 4.24.66.
 16. Ibid., 5.8.66.
 17. Letter from John Nash to Virginia Nash, 10.31.65.
 18. Ibid.
 19. Letter from J. Nash to M, Legg, 11.14.65.

20. Letters from J. Nash to V. Nash, 10.31.65 and 1.16.65.
21. Letter from J. Nash to M. Legg, 11.28.65.
22. Ibid.
23. Ibid., 1.9.66.
24. Letters from J. Nash to V. Nash, 1.16.65, and to M. Legg, 2.22.66; also Joan Berkowitz, interview, 8.28.97.
25. Palais, interview.
26. Al Vasquez, interview, 6.17.97. 27. "Analyticity of Solutions of Implicit Function Problems with Analytic Data," *Annals of Mathematics*,

- vol. 84 (1966), pp. 345-55. 28, Harold Kuhn, interview, 1106
7.17.97. 29. Letter from J. Nash to M. Legg, 9.19.66.
30. Egbert Brieskorn, professor of mathematics, University of
Bonn, interview, 1.27.98.
31. Letters from J. Nash to M. Legg, 12.5.65 and 5.1.66.
32. Letter from J. Nash to M. Legg, 2.27.66. 33. Letter from J. Nash
to V. NT, 1.9.66. 34. Kuhn, interview, 5.9.66 and The paper was not
rejected, according to Nash, but the editors asked for revisions
that he never made.
35. Mikhail
GTOMOV,
interview, 12.15.97.
36. This point was raised by Francine M. Benes, psychiatrist,
McLean Hospital, interview, 2.13.96.
37. John Nash visited Gian-Carlo Rota in New York City sometime
during his first year in Boston, Rota recalled that at lunch Nash
traced patterns on his plate and complained that shock treatments
had caused him "to forget all my
-----1107
mathematics," interview, 10.29.94. 38. Richard Wyatt, personal
communication, 6.97.
39. This was Max Shiffman at Stanford University. Donald Spencer,
interview, 11.29.95.
40. Letter from J. Nash to M. Legg, 6.26.96.
41. Zipporah Levinson, interview, 11. 15.96.
42. Letter from J. Nash to M. Legg, 5.22.66.
43. Letter from John Nash to Harold Kuhn, 5.17.66.
44. Palais, interview.
45. Vasquez, interview.
46. Letter from J. Nash to M. Legg, 9.1.66. 47. Martha Legg
quoting her letter of 9.28.66 to Pattison Esmiol.
48. M. Legg, interview.
49. Letter from Pattison Esmiol to Martha Nash Legg, 10.7.66.
50. Letter from J. Nash to M. Legg, 10.8.66.
51. M. Legg, interview.
-----1108
52. Letter from J. Nash to M. Legg, 11.66.
53. Ibid., 11.28.66.
54. Vasquez, interview.
55. Joseph Kohn, interview, 1.16.96. 56. Z. Levinson, interview,
11. 15.96. 57. Richard Nash, interview, San Francisco, 1.6.96.
58. Letter from J. Nash to M. Legg, 2.67, saying that he had been
in Seattle since February,

59. Postcard from John Nash to Martha Nash Legg, 3.11.67, saying that he had been in Santa Monica for about ten days and would be returning to Roanoke by March 22.
60. Jacob Bricker, interview, 5.22.97. 61. Letter from P. Esmiol to M. Legg, 4.19.67.
62. Gilbert Strand, professor of mathematics, MIT, e-mail, 6.5.97.
63. Letter from Armand BOT-EL to Norman Levinson, 5.17.67.
64. Greeting card from John Nash to Arthur Mattuck, 1. 15,73.
65. Palais, interview.

66. Letter from John Nash to Itirgen Moser, 5.23.67, 1109
67. Z. Levinson, interview, 11. 15.96. 6and Letter from J. Nash to M. Legg, 6.26.67. 69. Z. Levinson, interview.
70. Anna Rosa Kohn, interview, 1. 16,96.
71. Letter from Norman Levinson to Martha Nash Legg, 630.67.
- 44: A Man All Alone in a Strange World 1. Letter from John Nash to Arthur Mattuck, 8.5.68.
2. Ibid.
3. Letter from John Nash to a colleague, 1967. 4. Martha Nash Legg, interview, 3.2.96. 5. James Glass, Delusion (Chicago: University of Chicago Press, 1985).
- 6, M. Legg, interview, 10.94.
7. Ibid., 8.31.95.
8. Letter from J. Nash to A. Mattuck, 8.8.67.
9. See, for example, Diagnosticand Statistical Manual ofMental
-----1110
Disordm
(Washington, D.C.: American Psychiatric Press, 1987). Ming T. Tsuang, Stephen V. Faraone, and Max Day, "Schizophrenic Disordersea"op. cit.
10. E. Fuller Torrey, Surviving Schizophrenia (New York: Harper and Row, 1988).
11. ` . . . symptoms of clouded consciousness and disorientation in schizophrenia are relatively rateea"Richard S. E. Keefe and Phillip D. Harvey, Undmtanandng Schizophrenia, op. cit.
12. Letter from J. Nash to A. Mattuck, 3.18.68.
13. See, for example, Torrey, op. cit. Also Glass, op, cit., and James Glass, professor of government and politics, University of Maryland, research affiliate of the Sheppard and Enoch Pratt Hospital, interview, 10.94.
14. Letter from J. Nash to A. Mattuck, 7.24.67.
15. Ibid., 8ddand67.
-----1111
16. Ibid., 9.9.67.
17. Ibid., 10.7.67.
18. Ibid., 9.9.67.
20. References to the story of Jacob and Esau appear in numerous letters and postcards written by Nash between 1967 and 1969,

including 8.8.67, 9.25.67, 10.7.67, 11.8.67, 12.24.67, and 6.16.69.

21. Letter from J. Nash to A. Mattuck, 1.20.68.

22. Ibid., 2.22.68.

23. Ibid., 3.10.68.

24. Ibid., 6.16.69.

25. Letter from John Nash to Eleanor Stier, 8.20.68.

26. Letter from J. Nash to A. Mattuck, 8.11.67.

27. Ibid., 11.8.67.

28. Letter from J. Nash to A. Mattuck, 3.18.68.

29. Ibid., 2.27.68.

30. Ibid., 4.24.69. A1111
31. See, for example, Keefe and Harvey, op. cit., people. 110.
32. Letter from J. Nash to A. Mattuck, 11.

-----1112

- 11.69.
33. See, for example, Keefe and Harvey, op. cit., pp. 6-7.
34. Peter Newman, interview, 12.12.95. 35. Letter from J. Nash to
V. Nash, 8.8.68. 36. The example given combines phrases from two
letters to Arthur Mattuck, 9.9.67 and 3.18.68. Nash ended
virtually every letter in this period with a variation on this
paragraph.
37. M, Legg, interview, 3.2.96. The account of the remainder of
Nash's interlude in Roanoke comes from this interview.

45: Phantom of Fine Hall

1. Joseph Kohn, interview, 7.25.95. 2. David Raoul Derbes,
University of Chicago, e-mail, 3.27.95; Daniel Rohrlich,
University of Tel Aviv, e-mail, 9.3.97.
3. Derbes, e-mail.
4. Sylvain Cappell, professor of mathematics, Courant Institute,
2.29.96. 5. Lee Mosher, protessor of mathematics, Rutgers
University at Newark, interview, 9.20.97.
6. Derbes, e-mail.

-----1113

7. Mark Reboul, interview, 8.30.97.
8. Steven Epstein, e-mail, 3.28.95.
9. Sara Beek, University of Tel Aviv, e-mail, 5.31.95.
10. Ibid.
11. Ibid,
12. Ibiand
13, Frank Wilczek, zrofessor of physics, Institute for Advanced
Study, interview, 9.11.97.
14. Letter from May B. Schneider, professor of physics, Grinnell
College, to author, 9.20.95.
15. Letter from David A. Cox, professor of mathematics, Amherst
College, to author, 3.27.95.
16. Letter from M. Schneider to author, 9.28.95.
17. Marc D. Rayman, chief mission engineer, New Millennium
Program, NASA, e-mail, 11.24.95.
18. Letter from M. Schneider to author.
19. Wilezek, interview.
20. Ibid.

-----1114

21. Harold Kuhn, interview, 8.30.97.

22. Margaret Wertheim, "When I Plus I Makes Neither 2 Nor I
Iea"New York Times,
1997.
23. Hale Trotter, fessor of mathematics, Princeton University,
interview, 11.29.95. 0`
24. Peter CziffTa, Yirbrarian, Fine Hall, interview, 8.26.97.
25. William Browder, interview, 12.6.95. 26. James Class,
interview, 10.94. 27. Ibid.
28. Roger Lewin, professor of psychiatry, University of Maryland,
interview, 10.94. 29. Steven Bottone, e-mail, 9.2.97. 30. Daniel
Feenberg, research associate, National Bureau of Economic

Research, interview, 10.94. A1114

31. Trotter, interview, 9.11.97.

32. Reboul, interview.

33. Feenberg, interview.

34. Trotter, interview, 9.30.96,

35. Marc Fisher, reporter,

-----1115

Washington Post,

e-mail, 3.29.95.

36. Charles Gillespie, professor of history, Princeton University, interview, 7.26.95.

37. Amir H. Assadi, professor of mathematics, University of Wisconsin, interview, 12.13.95.

38. Kohn, interview.

39. Claudia Goldin, professor of economics, Harvard University, interview, 8.30.95.

40. Feenberg, interview.

41. Alicia Nash, interview, 12.6.97. 42. Interviews with Alan Hoffinan, 10.94; Lloyd Shapley, 10.94; George Nernhauser, 8.29.97; Albert W Tucker, 10.94.

43. Shapley, interview.

44. [bid,

45. Nernhauser, interview.

46. Hoffman, interview.

47. [bid.

46: A Quiet Life

1. Letter from Alicia Nash to Martha Nash Legg

-----1116

and Virginia Nash, 11.8.68.

2. [bid.

3. Gillian Richardson, interview, 12.14.95.

4. John Coleman Moore, professor of mathematics, Princeton University, interview, 10.6.95.

5. George Whitehead, interview, 12.12.95,

6. Interviews with Moore, also with Gaby Borel, 10.94 and 3.14.96.

7. Herb Cork, RCA, interview, 4.23.96.

8. Alicia Nash, private communication, 12.6.97.

9. Martha Nash Legg, interview, 3.30.96; confirmed by Alicia Nash in private communication. 10. Interview with Moore, and with G. Borel, 10.6.95.

11. A. Nash, private communication, and interview, 12.28.95,

12. A. Nash, interview, 12.28.95.

13. Ibid., 1.10.95.

14. Ibid.

15. Odette Larde, interview, 12.8.95.

-----1117

16. Moore, interview, 10.94. 17. Richard Keefe, interview, 5.95.

18. Richard S. E. Keefe and Phillip D. Harvey,

Understanding Schizophrenia,

op. cit., people. 9.

19. A. Nash, interview, 1.10.95.

20. A. Nash, private communication, 12.6.97.

21. Joyce Davis, interview, 5.30.96. 22. Anna Bailey, interview,

- 5.29.97. 23. A. Nash, interview, 1.10.95. In addition, A1117 interviews with John Charles Martin Nash, Harold Kuhn, Gaby Borel, and others.
24. David Salowitz, "It's Not a Matter of Degrees: John Nash, Shy High School or College Degree, Seeks Ph.D.," The Princeton Packet, 7.1.81.
25. A. Nash, interview, 1.10.95.
26. Amir Assadi, interview, 2.4.96. 27. Solomon Leader, interview.
28. A. Nash, interview, 5.16.95.
29. Salowitz, op. cit.
30. Ibid.

-----1118

31. A. Nash, interview, 5.16.95. Also letter from John Nash to Richard Keefe, 1.14.95.
32. Salowitz, op. cit.
33. Bailey, interview.
34. A. Nash, interview, 5.16.95.
35. Armand Borel, interview, 3.1.96.
36. Moore, interview, 10.5.94.
37. G. Borel, interview, 10.94.
38. John David Stier, interview, 9.20.97.
39. Letter from Alicia Nash to Arthur Mattuck, 1117.71.
40. 1, D. Stier, interview,
41. Norton Starr, professor of mathematics, Amherst College, interviews, 7.95 and 1.20.98.
42. Eleanor Stier, interview, 3.18.96. 43. John Stier, interview, 1.21.98.
- 44, Letter from John Nash to Arthur Mattuck, 1. 15.73.
45. E. Stier, interview, 3.18.96.
46. Irving 1. Gottesman, professor of psychology, University of Virginia, interview, 1.16.98.

-----1119

47. Kenneth L. Fields, professor of mathematics, Rider University (formerly Rider College), interview, 1,30.98.
48. Melvyn B. Nathanson, professor of mathematics, Graduate Center of the City University of New York, interview, 1.31.98.
49. John C. M. Nash (with Melvyn B. Nathanson), "Cofinite Subsets of Asymptotic Bases for the Positive Integers," journal of Number Theory, vol. 20, no. 3 (1985), pp. 363-72; John C. M. Nash, "Results in Bases in Additive Number Theory"Ph.D. thesis, Rutgers University, 1985.

50. John C. M. Nash, "Some Applications of a Theorem of M. Kneser," *Journal of Number Theory*, vol.

44, no. 1 (1993), pp. 1-8.

51. John C. M. Nash, "On

Bounded

Sequences,"

Canadian Mathematical Bulletin,

-----1120

vol. 32, no. 4 (1989), pp. 446-49.

52. Alicia Nash, interview, 9.97.

Part Five: THE MOST WORTHY

47: Remission

A1120

I

disPeter Sarnak, professor of mathematics, Princeton University,
interview, 8.25.95. 2. E-mail from John Nash to Harold Kuhn,
6.20.96.

3. Hale Trotter, interviews, 11.29.95 and 9.10.97.

4. Mark Dudey, professor of economics, Rice University,
interviews, 10.94 and 6.24.95.

5. Daniel Feenberg, interview, 10.94. 6. Letter from Edward G.
Nilges to author, 8.19.95.

7. Lloyd S. Shapley, interview, 10.94. 8. George Winokur and Ming
T. Tsuang, *The Natural History of Manic Depression and
Schizophrenia*

(Washington, D.C.: American Psychiatric Press, 1996), people. 28.

9. Letter from John Nash to Richard Keefe,

-----1121

1.14.95. Nash gives Johnny's diagnosis as "paranoid
schizophrenia" and "schizo-affective disorder."

10. See, for example, Irving I. Gottesman,
Schizophrenia Genesis,

op. cit., people. 18; Michael R. Trimble, *Biographical Psychiatry*
(New York: John Wiley and Sons, 1996), pp. 184-85.

11. John Forbes Nash, Jr.,
Les Prix Nobel 1994,

op. cit.

12. John Nash, plenary lecture, World Congress of Psychiatry,
Madrid, 8.26.96, op. cit.

13. Harold Kuhn, interview, 9.95.

14. Letter from John Nash to Richard Keefe, 1.14.95. Nash has
made the same point to many people.

15. Winokur and Tsuang, op. cit., people. 30; also Manfred
Bleuler,

*The Schizophrenic Disorders: Long-Term Patient and Family
Studies*

(New Haven: Yale University Press,

-----1122

1978).

16. Gerd Huber, Gisela Gross, Reinhold Schuttler, and Maria Linz,
"Longitudinal Studies of Schizophrenic Patients,"

Schizophrenia Bulletin,
vol. 6, no. 4 (1980)

17. C. M. Harding, G. W. Brooks, T. Ashikaga, J. S. Strauss, and
A. Brier, "The Vermont Longitudinal Study of Persons with Severe

Mental Illness, I and II," American journal of Psychiatry,
vol. 144 (1987), pp. 718-26, 727-35. E. Johnstone, D. Owens, A.
Gold et al., "Schizophrenic Patients Discharged from Hospital: A
Follow-Up Study,"
British journal of Psychiatry,
no. 145 (1984), pp. 586-90, found that 1 percent of the 120 in
the study had no significant symptoms and were functioning
satisfactorily; 50 percent were still psychotic; and the
remainder were somewhere in between. Only two subjects, both of
whom had been hospitalized only once, were considered truly well.
18. Richard Wyatt, head of neuropsychiatry,

National Institute of Mental Health, personal communication, 12.97. See also Winokur and Tsuang, op. cit. pp. 199-217.

19. Winokur and Tsuang, op. cit., pp. 267-6.

20. Huber et al., op. cit.

21. Richard Wyatt, interview, 5.5.96. 22. E. Fuller Torrey, *Surviving Schizophrenia*, op. cit.

23. E-mail from J. Nash to H. Kuhn, 6.1.95.

24. John Forbes Nash, Jr., *Les Prix Nobel 1994*, op. cit.

25. Letter from J. Nash to R. Keefe.

26. John Forbes Nash, Jr., *Les Prix Nobel 1994*, op. cit.

27. Social Science Citation Index, various dates.

28. John Conway, professor of mathematics, Princeton University, interview, 10.94. 29. Nash's work on Riemannian embeddings and

-----1124

partial differential equations would likely have made him a strong candidate for a Fields in the 1960's and his contributions to game theory might easily have been honored with a Nobel as early as 1983, when Gerard Debreu won for his work on general 'tininbrium theory. He would certainly have garnered lesser honors such as membership in the National equals y of Sciences and the American Academy of Arts and Sciences.

30. Amartya Sen, professor of economics, Harvard University, interview, 12.92.

31. Fellows of the Econometric Society as of January 1988, *Econometrica*, vol. 56, not. 3 (May 1988).

32. Ariel Rubinstein, professor of economics, University of Tel Aviv and Princeton University, interviews, 1.96 and 2.96.

33. Mervyn King, professor of economics, London School of Economics, and vice-chairman, Bank of England, interview, 2.28.96.

34. Letter from Julie Gordon, executive director, The Econometric Society,

-----1125

to author, 2.2.96.

35. King, interview.

36. Interviews with Gary Chamberlain, professor of economics, Harvard University, 2.28.96; Beth E. Allen, professor of economics, University of Minnesota, 2.26.96.
37. Letter from Truman Bewley, professor of economics, Yale University, to Ariel Rubinstein, undated (spring 1989).
38. Ibid., 6.4.89.
39. Truman Bewley, interview, 2.20.96. 40. John Dawson, Logical Dilemmas.- The Life and Work of Kurt Gddel, op. cit.
41. Ibid.
42. Ken Binmore, Roger Myerson, Ariel Rubinstein, "Nornination of

Candidates as a Fellowea01990. A1125

43. Letter from J. Gordon to author, 1.31.96. 48: The Prize

1. 16rgen W. Weibull, Stockholm School of Economics and member
economics prize committee, interview, 11.14.96.

-----1126

2. Ibid.

3. Carl-Olof Jacobson, secretary-general of the Royal Swedish
Academy of Sciences, interview, 2.12.97.

4. Kenneth Bimur, game theorist at the London School of
Economics, for example, recently wrote to Harold Kuhn (e-mail,
1.7.98) that he had nominated Nash for the Nobel once in the
1980's. "I didn't persist in nominating him because nobody seemed
to take the idea seriously."

5. Statutes of the Nobel Foundation, 4.27.95 -

6. Michael Sohlman, executive director, Nobel Foundation,
interview, 2.11 97.

7. Ibid.

8. Karl-Göran Wer, executive director, Beijer Institute of the
Royal Swedish Academy of Sciences, interview, 2.12.97. 9. Assar
Lindbeck, "The Prize in Economic Science in Memory of Alfred
Nobel,"

journal of Economic Literature,
vol. 23 (March 1985), pp. 37-56.

-----1127

10. Harriet Zuckerman, *Scientific Elite: Nobel Laureates in the
United States*
(London: Free Press,
1977).

11. Lindbeck, op. cit.

12. See, for example, John E. Morrill, "A Nobel Prize in
Mathematics,"

The American Mathematical Monthly,
vol. 102, no. 10 (December 1995). 13. Lars Gårding and Lars
Hörmander, "Why Is There No Nobel Prize in Mathematics?" *The
Mathematical Intelligencer*
(July 1985), pp. 73-74.

14. Jacobson, interview.

15. The sketch of Lindbeck is based on the author's interview
with him in Stockholm on 2.12.97, two autobiographical essays,
and the impressions of members of the prize committee and the
Academy of Sciences, including Carl-Olof Jacobson, 2.12.97,-
Karl-Gustaf Wgren, professor of economics, University of Umeå,
2.12.97; Karl-Göran Mler, 2.12.97; Jörgen Weibull and Torsten

Persson, visiting professor, Harvard University, 10.4.94 and

3.7.97. 16. Persson, interview, 3.7.97.

17. Ldf ren, interview.

18. M5 er, interview.

19. Lindbeck, "The Prize in Economic Science" op. cit.

20. Lo-fgren, interview.

21. Kerstin Fredga, as told to Harold Kuhn at the 12.94 Nobel ceremony in Stockholm, 1.95.

22. By the late 1980's, Harold Kuhn and other game theorists were nominating Nash. Others, however, saw no point in doing so. "I did

not nominate him." Shubik later recalled. "He was better than several of the other people I nominated. It seemed that they'd throw him out because he's nuts. The other reason was that I thought the bargaining work was better than the stuff on noncooperative equilibria." interview, 12.13.96.

23. Lindbeck, interview, 2.12.97.

24. Ariel Rubinstein, interview, 6.26.95. 25. Ariel Rubinstein, "Perfect Equilibrium in a Bargaining Model,"

-----1129

Econometrica,

no. 50 (1982), pp. 97-109.

26. Rubinstein, interview, 6.95.

27. Weibull, interview, 1.14.96.

28. Ibid.

M Ibid.

30. E-mail from Eric Fisher, assistant professor of economics, Ohio State University, to author, 7.25.95.

31. Weibull, interview, 11.6.96.

32. Gene Grossman, professor of economics, Princeton University, interview, 9.93. Grossman was the first to point out to the author, a reporter at

The New York Times,

that Nash might share a Nobel.

33. Nobel Symposium on Game Theory: Rationality and Equilibrium in Strategic Interaction, Bjorkbom, Sweden, June 18-20, 1993.

34. Confidential source who attended the conference, 35. Persson, interview.

36. Confidential source who attended the conference. 37. Fax from 16wen Weibull to Harold Kuhn, 7.14.93.

-----1130

38. Letter from Robert J. Leonard to Harold Kuhn, 7.27.93.

39. Jacobson, interview.

40. Lindbeck, interview.

41. Ibid.

42. Confidential source.

43. Jacobson, interview.

44. Wgren, interview.

45. Lindbeck, interview.

46. Ibid.

47. Ibid.

48. Shapley's most important work is in cooperative game theory while Schelling's work is in applications of game theory.

49. Lindbeck, interview.

50. Ibid.

51. The sketch of Stahl is based on interviews with his brother Ingolf Stahl, 2.12.97; Wer; Lindbeck; Wgren; Weibull; David Warsh, columnist, Boston Globe, 2.5.97; and others.

52. Ingemar Stahl, professor of law, Lund University, interview, 2.4.97.

53. Letter from Lars Hbrmander to Ingemar Stahl,

- 9.10.93, with Nash bibliography. 54. Ibid. 1131
55. Ingemar Stahl, interview.
- 5and Ibid.
57. Ibid.
58. Confidential source present at the discussion.
59. Ibid.
60. Ingemar Stahl, interview.
61. Confidential source.
62. Ibid.
63. Interviews with Lindbeck and Jacobson. 64. Weibull, interview.
65. Confidential source.
66. David Warsh, "Game Theory Plays Strategic Role in Economics' Most Interesting Problemsea"Chicago Tribune, 7,24,94.
67. Christer Kiselman, professor of mathematics, University of Uppsala, interview, 3.5.97.
68. Ibid.
69. Confidential source.
70. Weibull, interview, 11.6.96.
- 1132
71. Lindbeck, interview.
72. Ibid.
73. Ibid.
74. Jacobson, interview.
75. Confidential source.
76. Lindbeck, interview.
77. Ibid.; also confidential source.
78. As quoted by Harold Kuhn, interview, 1.95.
79. E-mail from Harold Kuhn to Harold Shapiro, president, Princeton University, 9.1.94.
80. Confidential source.
81. Erik Dahmen, professor of economics, Stockholm Institute of Economics, and member, Royal Swedish Academy of Sciences, interview, 2.12.97.
82. Confidential source.
83. Anders Karlquist, interview, 3.17.97. 84. Lars CA-RDING, professor of mathematics, Lund University, personal communication, 2.10.97.
85. Bengt Nagel, personal communication, 2.10.97.
86. Confidential source.
- 1133

87. Kiell Olof Feldt, 1 Nationalekonomns Atervandsgrand," Moderna Tider (March 1994).
88. Karlquist, interview.
89. Confidential source.
90. Lindbeck, interview.
91. Confidential source.
92. Ibid.
93. Statutes of the Nobel Foundation.
94. Confidential source.
95. Ibid.

96. Jacobson, interview. A1133

97. Confidential source.

98. Jacobson, interview.

99. Ingemar Stahl, interview.

100. SohIman, interview.

101. Johann Schuck, reporter, article in Dagens Nyheter,

12.10.94. Schuck broke the story of the behind-the-scenes fight between Stahl and Lindbeek that delayed the announcement of the prize. A translation was provided by Hans Carlsson, professor of economics, Lund University, 12.4.95. 102. Confidential source.

-----1134

103. Ibid.

104. Harold Kuhn informed Alicia Nash on Friday, October 7, and Nash himself on October 10, the day before the official announcement.

105. Kiselman, interview.

106. Confidential source with access to the report.

107. Confidential source.

108. Ibid.

109. Confidential source with access to the report.

110. Confidential source.

112. Miler, interview.

113. Jacobson, interview.

114, [bid.

49: The Greatest Auction Ever

1. Harold Kuhn, interview, 1.95.

2. William Safire, "The Greatest Auction Ever,"

New York Times, 3.16.95,

as quoted by Paul Milgrom,

Auction Theory for Privatization

(New York: Cambridge University Press, forthcoming).

-----1135

3. Edmund Andrews, "Wireless Bidders Jostle for Positionea"New York Times,

12.5.94.

4. Milgrom,

Auction Theory for Privatiation,

op. cit.

5. Michael Rothschild, dean of the Woodrow Wilson School, remarks

at conference, "Market Design: Spectrum Auctions and Beyond:"

Princeton University, 11.9.95.

6. Peter C. Cramton, "Dealing with Rivals? Allocating Scarce

Resources? You Need Game Theory0ggXerox, 1994). Nash provided the

fundamental theory used to analyze and predict behavior in simple games in which rational players have complete knowledge of each other's preferences and abilities. Harsanyi, in papers published in 1967 and 1968, analyzed games in which some parties had private information. Selten, in 1976, extended the theory to dynamic games, games that take place over time. Cramton gives the offers and counteroffers during a merger negotiation as an example of a dynamic game. 7. Peter PasselT, "Game Theory

Captures a 1136

Nobelea"New York Times, 10.

12.94.

8. Paul Samuelson as quoted by Vincent P. Crawford, "Theory and Experiment in the Anal` f tr. rlyeais o Strategic Interaction," Symposium on Experimental Economics, Econome lence Nociety, Seventh Wo Congress, August 1995 (draft: September 1994).

9. See, for example, Robert Gibbons, "An Introduction to Applicable Game Theory," Journal of Economic Perspectives, vol. 11, no. I (Winter 1997), pp. 127-49. 10. Avinash Dixit, interview, 7.97.

11. Avinash Dixit, as quoted by Passell, op. cit.

12. Ibid.

13. John McMillan, Games, Strategies and Managers (New York: Oxford University Press, 1992).

14. R. H. Cease, "The Federal Communications Commission," Journal of Law and Economics

-----1137

(October 1959), pp. 1-40, quoted by John McMillan, "Selling Spectrum Rights," Journal of Economic Perspectives, vol. 8, no. 3 (Summer 1994).

15. Peter C. Cramton, "The PCS Spectrum Auction: An Early Assessment," The Economist (August 25, 1995).

16. Milgrom, Auction Theory for Privatization, op. cit.

17. Ibid. See also McMillan, "Selling Spectrum Rights," op. cit., pp. 153-55. 18. Ibid.

19. See, for example, McMillan, "Selling Spectrum Rights," op. cit.; Paul Milgrom, "Game Theory and Its Use in the PCS Spectrum Auction," Games '95, conference, Jerusalem, 9.29.95,

20. Milgrom, Auction Theory for Privatization, op. cit.

-----1138

21. Ibid.

22. Ibid.

23. Ibid.

24. McMillan, "Selling Spectrum Rightsea" op. cit.

50: Reawakening

1. Sylvain Cappell, interview, 2.29.96. 2. 16rgen Weibull, interview, 11.14.96.

3. Harold and Estelle Kuhn, interviews, 1.95.

4. Weibull, interview.

5. Lena Koster, "For the First Time in 30 Years: Economy Prize Winner Lectured in Uppsala" Uppsala

Nya Tidning,

12.94.

6. Christer Kiselman, interview, 3.4.97. 7. Weibull, interview.

8. John Forbes Nash, Jr., A1138
Les Prix Nobel 1994,
op. cit.
 9. As quoted by Harold Kuhn, interview, 7.24.96.
 10. E-mail from John Nash to Harold
-----1139
Kuhn, 3.26.96.
 11. John Nash, plenary lecture, World Congress of Psychiatry,
Madrid, 8.26.96, op. cit.
 12. E-mail from J. Nash to H. Kuhn, 11.94.
 13. Ibid., 8.6.95 and 8.26.95.
 14. Harold Kuhn, interview, 1.95.
 15. Armand Borel, interview, 3.1.96.
 16. This conversation took place in a taxi on the way to Newark
Airport on 12.5.94 and was recounted by Harold Kuhn, interview,
1.95. 17. As quoted by H. Kuhn, interview, 1.95.
 18. E-mail from John Nash to Herbert Meltzer, 7.8.97.
 19. E-mail from 1. Nash to H. Kuhn, 7.16.95.
 20. Confidential source.
 21. E-mail from 1. Nash to H. Kuhn, 5.12.95.
 22. Alicia Nash, interview, 5.16.95. 23. H. Kuhn, interview,
7.26.95.
 24. Avinash Dixit, personal communication, 1.31.96.
-----1140
 25. E-mail from
J.
Nash to H. Kuhn, 8.6.95.
 26. Ibid.
 27. Alicia Nash, personal communication, 11.29.97.
 28. E-mail from J. Nash to H. Kuhn, 6.6.96.
 29. Ibid., 9.94.
 30. John Nash, personal communication, 3.22.96.
 31. H. Kuhn, interview, 8.95.
 32. Interviews with John David Stier, 9.20.97; Eleanor Stier,
7.95; Arthur Mattuck, 11.7.95.
 33. Martha Nash Legg, interview, 3.1.96. 34. J. D. Stier,
interview.
 35. Ibid.
 36. E. Stier, interview.
 37. J. D. Stier, interview.
 38. E-mail from J. Nash to H. Kuhn, 9.26.95.
- Bell, E. T.
Men ofMathematics.

New York: Simon and Schuster, 1986.

-----1141

Blaug, Mark.

Great Economists Since Keynes.

Totowa, N.J.: Barnes and Noble Books, 1985.

Bleuler, Manfred.

The Schizophrenic Disorders: Long-Term Patient and Family Studies.

New Haven: Yale University Press, 1978.

Boehm, George W. "The New Uses of the Abstract."

Fortune

(July 1958). Brian, Denis.

Einstein: A Life. A1141
New York: John Wiley and Sons, 1996. Buchwald, Art.
IIIA-LWAYS Have Paris.
New York: G. P. Putnam and Sons, 1996.
A Century of Mathematics in America. Providence, R.I.: American
Mathematical Society, 1988. Chaplin, Virginia. "Princeton and
Mathematics."
Princeton Alumni Weekly
(May 9, 1958).

-----1142
Chronicle of the Twentieth Century, Mt. Kisco, N.Y.: Chronicle
Publications, 1987.
Community of Scholars Institute for-Advanced Study Faculty and
Members, 1930-1980, A. Princeton: Institute for Advanced Study,
1980.
Davies, John D . The Curious History of Physics at Princeton."
Princeton Alumni Weekly
(October 2,
1973).
Davison, Peter.
The Fading Smile: Poets in Boston from Robert Frost to Robert
Lowell to Sylvia Plath,
1955-1960.
New York: Knopf, 1994.
Diagnostic and Statistical Manual for Mental Disorders,
3rd ed. Washington, D.C., American Psychiatric Association, 1987.
Dixit, Avinash K., and Barry J. Nalebuff. Thinking Strategically.
New York: W. W. Norton, 199 1.

-----1143
Dixit, Avinash, and Susan Skeath. Games of Strategy.
New York: W W. Norton, 1997. Eatwell, John, Murray Milgate, and
Peter Newman, eds.
The New falgrave. Game Theory.
New York: W. W. Norton, 1989. Ewing, John H., ed. A
Century of Mathematics.
Washington, D.C.: The Mathematical Association of America, 1994.
Gardner, Howard.
Creating Minds.
New York: Basic Books, 1993. Gardner, Martin.
Mathematical Puzzles and Diversions.
New York: Simon and Schuster, 1959. Glass, James M.
Delusion.
Chicago: University of Chicago Press, 1985.

Goldstein, Rebecca.
The Mind-Body Problem.
New York: Penguin, 1993.
Gottesman, Irving

-----1144

1. Schizophrenia Genesis: The Origins of Madness.
New York: W. H. Freeman and Co., 1991.
Grob, Gerald N.
The Mad Among U.
Cambridge: Harvard University Press, 1994. Halberstam, David.
The Fifties.

New York: Fawcett Columbine, 1993. Hale, Nathan G., Jr. A1144

The Rise and Crisis of Psychoanalysis in the United States.

New York: Oxford University Press, 1995.

Halmos, Paul R. "The Legend of John von Neumann."

American Mathematical Monthly,

vol. 80 (1973), pp. 382-94.

Hardy, C. H. A

Mathematician ApoloV,

with foreword by C. P. Snow. Cambridge, UX: Cambridge University

Press, 1967. Heilbroner, Robert.

The Worldly Philosophers.

-----1145

New York: Simon and Schuster, 1992.

Hironaka, Heisuke. "On Nash Blowing Up,"

Arithmetic and Geometry H.

Boston: Birkhauser, 1983. Hollingdale, Stuart.

Makers of Mathematics.

New York: Penguin, 1989.

Ito, Kyosi, ed.

Encyclopedic Dictionary of Mathematics, vols. 1, 11, and 111, 3rd

ed. Mathematical Society of Japan; Cambridge: MIT Press, 1987.

Jamison, Kay Redfield.

Touched with Fire: Manic-Depressive Illness and the Artistic

Temperament

New York: The Free Press, 1993. "John von Neumann 1903-1957

. Bulletin of the American Mathematical Society

(May 19 5 8).

Kafka, Franz.

The Castle,

with introduction by Irving Howe. New York:

-----1146

Scholastic Books, 1992.

. The Metamorphosis.

New York: Shocken Books, 1995. Kagel, John H., and Alvin E. Roth.

The #1 andbook of Experimental Economics. Princeton: Princeton

University Press, 1995.

Kanigel, Robert.

The Man Mo Knew Infinity A Life of the Genius Ramanuian.

New York: Pocket Books, 1992. Kaplan, Fred.

The Wizards of Armageddon.

Stanford: Stanford University Press, 1983. Keefe, Richard S. E.,

and Philip D. Harvey.

Understanding Schizophrenia: A Guide to the New Research on

Causes and Treatment

New York: The Free Press, 1994. Kuhn, Harold W. Introduction, "A Celebration of John F. Nash, Jr.,"

Duke Mathematlcal Journal vol.

81, no. 1 (1995), pp. i-very.

. "Nobel Seminar: The Work of John Nash in Game Theory, December 8, 1994;"

-----1147

Les Prix Nobel 1994. Stockholm: Norstedts Tryckeri, 1995. Larde, Enrique.

The Crown Prince Rudolf- His Mysterious Life After Mayerling.

Pittsburgh: Dorrance, A1147
1994.

Leonard, Robert J. "From Parlor Games to Social Science: Von Neumann, Morgenstern and the Creation of Game Theory, 1928-1944." Journal of Economic Literature (1995).

. "Reading Cournot, Reading Nash: The Creation and Stabilization of the Nash Equilibrium." The Economic Journal (May 1994), pp. 492-511.

Lindbeck, Assar. "The Prize in Economic Science in Memory of Alfred Nobel." journal of Economic Literature, vol. 23 (March 1985), pp. 37-56. Lowell, Robert. "Waking in the Blue."

Life Studies and For the Union Dead
New York: Farrar Straus and Giroux, 1992.

-----1148

Luce, R. Duncan, and Howard Raiffa.
Games and Decisions.

New York: John Wiley and Sons, 1957. McDonald, John. "The War of Wits." Fortune (March 1951)

Milnor, John. "A Nobel Prize for John Nash."

The Mathematical Intelligencer, vol. 17, no. 3 (1995), pp. 14-15. Nash, John Forbes, Jr. "Sag and Tension Calculations for Cable and Wire Spans Using Catenary Formulas" with John F. Nash, Sr.). Electrical Engineering (1945).

. "Equilibrium Points in N-Person Games." Proceedings of the National Academy of Sciences, USA, vol. 36 (1950), pp. 48-49. Non-Cooperative Games, Ph.D. thesis, Princeton University, May 1950. "A Simple Three-Person Poker Game" with

-----1149

Lloyd S. Shapley).
Annals of Mathematics Study, vol. 24 (1950).

"The Bargaining Problem." Econometrica, vol. 18 (1950), pp 155-62. "Non-Cooperative Games." Annals of Mathematics, vol. 54 (1951), pp. 286-95. "Real Algebraic Manifolds."

Annals of Mathematics,
vol. 56, no. 3 (November 1952), pp. 405-21.
. "Some Experimental N-Person Games" with G. Kalisch, I. W.
Milnor, and E. D. Nering).
Decision Processes,
ed. R. M. Thrall, C. H. Coombs, and R. L. Davis. New York: John
Wiley and Sons, 1954.
"Two-Person Cooperative Games." *Econometrica*,
vol. 21 (1953), pp. 405-21.
"A Comparison of Treatments of a Duopoly Situation" with I. P.
Mayberry and M.

Shubik). 1150

Econometrica, vol.

2 1 (195 3), pp. 141- 54.

. "Higher Dimensional Core Arrays for Machine Memoriesdd"RAND
Memorandum, D-2495, 7.22.54.

"LODARDD"RAND Memorandum, D-2349, 7.23.54.

"Continuous Iteration Method for Solution of Differential

Gamesdd"RAND Memorandum, RM-1326,8.18.54,

"Parallel Controldd"RAND Memorandum, RM-1361,8.27.54.

"C` Isometric Imbeddings."

Annals of Mathematics,

vol. 60, no. 3 (November 1954), pp. 382-96.

. "Results on Continuation and Uniqueness of Fluid Flow."

Bulletin of the American Mathematical Society,

vol. 60 (1954), pp. 165-66.

. "A Path Space and the Stiefel-Whitney Classes."

Proceedings of the National Academy of

-----1151

320-2 1.

vol. 41 (195 5),

Sciences USA,

pp. The Imbedding Problem for Riemannian Manifolds."

Annals ofMathematics,

vol. 63, no. I (January 1956), pp. 20-63.

_. "Parabolic Equations."

Proceedings of the National Academy ol'Sciences USA,

vol. 43 (1957), pp 754-58.

Select Bibliogqphy

439

"Continuity of Solutions of Parabolic and Elliptic Equations."

American journal of Mathematics,

vol. 80 (1958), pp. 931-58.

com. "Le probleme de Cauchy pour les equations differentielles
d'un fluide general."

Bull. Soc. Math., France,

vol. 90 (1962), pp. 487-97.

com. "Analyticity of Solutions of Implicit Function Problems with
Analytic Data." Annals of Mathematics,

-----1152

vol. 84 (1966), pp. 345-55. "Arc Structure of Singularitics."

Duke Mathematicaljournal,

vol. 81, no. 1 (1996), pp. 31-38. Autobiographical essay,

Les Prix Nohel 1994.

Stockholm: Norstedts Tryckeri, 1995. Plenary lecture, World Congress of Psychiatry, Madrid, 8.26.96 (unpublished).

Nicholi, Armand M., Jr.

The New Harvard Guide to Tsychiahy Cambridge: The Belknap Press of Harvard University, 1988.

"Norbert Wiener 1894-1964."

Bulletin of the American Mathematical Sociqv vol. 72, no. 1, part ii (1964). Poundstone, William.

l'risoners'Dilernma.

New York: Doubleday, 1992. Regis, Ed. Mo Got Einstein

Offee? Reading, Mass.: Addison-Wesley, 1987.

Reid, Constance. A1152
Courant in GN-TINGFN and New York.
-----1153
New York; Springer Verlag, 1976. Rota, Gian-Carlo.
Indiscrete Thoughts.
Boston: Birkhauser, 1997.
Sass, Louis A.
Madness and Modernism.
New York: Basic Books, 1992. Schelling, Thomas C.
The Strategy of Conflict.
Cambridge: Harvard University Press, 1960. Storr, Anthony.
Solitude: A Return to the Self
New York: Ballantine Books, 1988.
com. The Dynamics of Creation.
New York: Atheneum, 1972.
Torrey, E. Fuller.
Surviving Schizophrenia: A Family Manual.
New York: Harper and Row, 1988. Trimble, Michael R.
Biological Psychiatry.
New York: John Wiley and Sons, 1996. Ulam, Stanislaw.
Adventures of a Mathematician.
New York: Scribner, 1983.
-----1154
U.S. House of Representatives. Hearings.
Committee on Un-American Activities, April 22 and 23, 1953. von
Neumann, John, and Oskar Morgenstern.
Theory of Games and Economic Behavior. Princeton: Princeton
University Press, 1944, 1947, 1953.
Williams, John.
The Compleat Strategist.
New York: McGraw Hill, 1954. Winokur, George, and Ming Tsuang.
The Natural History of Mania, Depression and Schizophrenia.
Washington, D.C.: American Psychiatric Press, 1996.
Zuckerman, Harriet.
Scientific Elite: Nobel Laureates in the United States.
London: The Free Press,
MANY PEOPLE
contributed to this book, two above all: my friend of twenty-five
years, Ellen Tremper, who cheered me on and rendered invaluable
assistance every step of the way, and Harold W. Kuhn, whose
enthusiasm for the
-----1155
enterprise and intimate knowledge of John Nash and the

mathematics community was a constant source of guidance and inspiration. No one could have done more. I am deeply indebted to Alicia Larde Nash and Martha Nash Legg, without whose support I could not have embarked on this biography, much less completed it. I am also grateful to John David Stier, Eleanor Stier, and John Charles Martin Nash for their cooperation, and appreciate John Nash's benign "attitude of Swiss neutrality" toward the undertaking.

No author was ever in better hands than those of Alice Mayhew, my editor, and Kathy Robbins, my agent -- not to mention those of Simon and Schuster's terrific publishing team, especially Robert

Labrie, Victoria Meyer, Elizabeth Hayes, and Nira Weisel. A1155
I am thankful to Amartya Sen and Phillip Griffiths for enabling
me to spend a vital year as a Director's Visitor at the Institute
for Advanced Study in Princeton; Gian-Carlo Rota for a shorter
but equally critical interlude at the MIT mathematics department;
and Vivien Arterberry for a productive week at the RAND
Corporation.

-----1156
Joseph Lelyveld, Soma Golden Behr, and Glenn Kramon of
The New York Times
granted me a generous leave of absence and enthusiastic support.
My colleagues Doug Frantz at
The New York Times
and Rob Norton at
Fortune
gave much-appreciated advice and encouragement at every stage.
Avinash Dixit, Harold Kuhn, Roger Myerson, Ariel Rubinstein, and
Robert Wilson patiently shared their insights about game theory
and served as valuable sounding boards.
Donald Spencer, Harold Kuhn, Lars H6rmander, Michael Artin,
Joseph Kohn, John Milnor, Louis Nirenberg, and Jargen Moser
worked hard to help me convey the originality of Nash's
contributions to pure mathematics clearly and accurately.
Superb histories by John McDonald, William Poundstone, Fred
Kaplan, and David Halberstam provided much of the context for
Nash's tenure at RAND. Ed Regis's lively history

-----1157
of the Institute for Advanced Study and Rebecca Goldstein's
delightful novel
The Mind-Body Problem
were also invaluable.
Richard Jed Wyatt guided me through the vast and fascinating
literature on schizophrenia. The extraordinary work of Louis
Sass, Anthony Storr, John Gunderson, Kenneth Kendler, Irving
Gottesman, Richard Keefe, James Glass, Kay Redfield Jamison, and
E, Fuller Torrey provided inspiration as well as important
information. Special thanks to Connie and Steve Lieber, the
founders of the National Alliance for Research on Schizophrenia
and Depression, for their interest in this project.
Psychiatrists Paul Howard, Joseph Brenner, Robert Garber, and
Peter Baurnecker provided firsthand descriptions of the
institutions where Nash was treated and glimpses into the
mysteries of clinical psychiatry.

Jbrgen Weibull and other members of the economics prize committee and the Swedish Academy of Sciences were wonderfully hospitable during my visit to Stockholm and helped me decipher the seemingly inscrutable process by which the

-----1158

ne plus

ultra

of honors is bestowed. Sociologist Harriet Zuckerman's landmark study of Nobel Laureates served as an excellent road map. Lloyd Shapley's loving and lovely phrase "a beautiful mind"bbcame, at Kathy Robbins's suggestion, the title of the book.

I am infinitely grateful to the hundreds of individuals A1158
 -- mathematicians, economists, psychiatrists, and others who knew
 John Nash comwho supplied the memories from which I've woven
 together his remarkable story. Every fragment, however tiny,
 added to the vividness of the whole, and each was gratefully
 received and treasured. In addition to those already cited, I am
 particularly indebted to Paul Samuelson, Arthur Mattuck, Paul
 Cohen, Odette Larde, Dorothy Thomas, Peter Lax, Cathleen
 Morawetz, Donald Newman, Also Vasquez, Richard Best, John Moore,
 Armand and Gaby Borel, Zipporah Levinson, Jerome Neuwirth, Felix
 and Eva Browder, Leopold Flatto, John Danskin, Emma Duchane, and
 Joyce Davis.

-----1159

Archivists and librarians at Carnegie Mellon University,
 Princeton University, MIT, Harvard University, the Institute for
 Advanced Study, the Rockefeller Archive Center, McLean Hospital,
 the Swiss National Archives, and the National Archive provided
 important material and expert guidance. Special thanks to Arlen
 Hastings, Momota Ganguli, and Elise Hansen at the Institute for
 Advanced Study for making my year at the institute so productive,
 and to Richard Wolfe for sharing his knowledge of the Cambridge
 intellectual community.

Ellen Tremper, Geoffrey O'Brien, Harold Kuhn, Avinash Dixit, Lars
 Hbrmander, Jtirgen Moser, Michael Artin, Donald Spencer, Richard
 Wyatt, and Rob Norton read and commented on various drafts. Their
 painstaking efforts eliminated mistakes, improved expositions,
 and added important new insights. All errors that remain are, of
 course, mine.

My husband, Darryl McLeod, and children, Clara, Lily, and Jack,
 not only lived with this book and its harried author for three
 years, but pitched in comon the computer, in the library, around
 the house comwhen

-----1160

deadlines were looming and the sky seemed about to fall. For
 their love and patience I am most indebted.

Abbat, John, 282 ABC conjecture, 21 Aberdeen Proving Ground, 56
 Acta Mathematica, 226

Adler, Alfred, 94

AEC (Atomic Energy Commission), 74, 80, 107, 110, 122, 134, 216

Aeschylus, 94 Afriat, Napthali, 284

Air Force, U.S., 105, 107, 110, 121, 134,
 135, 187

Albert, Adrian, 236, 244 Alchian, Armen, 119 John Alden Society,

33 algebra, 56, 65, 74

Gauss's proof of the fundamental theorem of, 67 von Neumann and,

81 algebraic geometry, 96

algebraic manifolds, 123-24, 128-32 algebraic topology, 59, 68

algebraic varieties, 131, 309 Allen, Beth, 354, 355 Amadur, Izzy,

153 Amadur, Ted, 153

Ambrose, Warren, 143, 155-56, 159,

-----1161

162,

163,203,282

American journal of Mathematics, 226-27 American Mathematical

Society (AMS), 38,226,245-46,303 A1161
 Amherst College, 344, 387 analysis: complex, 130 at Princeton, 64
 "Analyticity of Solutions of Implicit Function Problems with
 Analytic Data0ggNash), 317-18
 Ankeny; Barbara, 202
 Ankeny, Nesmith, 202
 Annals ofMathematics,
 58, 72, 131, 161,
 318
 antipsychotics, 329, 353 anti-Semitism, 58, 135, 136, M, 146,
 216
 Anti-Submarine Warfare Operations Evaluation Group (ASWOEG), 116
 Appalachian Power Company, 27, 33 Arafat, Yasir, 357 Archimedes,
 94 Aristophanes, 94 Aristotle, 94, 275 Army, U.S., 134
 Arnold, Henry "Hapea0106 Arrow, Kenneth:
 -----1162
 Nobel awarded to, 107, 358, 360
 at RAND, 107-8, 109, 113, 115, 117, 118
 artificial intelligence, 102
 Artin, Emil, 19, 64, 73, 159, 210, 229, 239,
 281
 Nash opposed by, 73-74, 132 Artin, Karin (Tate), 73, 239, 242
 Artin, Michael, 129, 131, 281 Artin, Natasha, 210
 Art of the Fugue, The
 (Bach), 113 Asimov, Isaac, 105 Assadi, Amir, 337-38, 343 ASWOEG
 (Anti-Submarine Warfare Operations Evaluation Group), 116
 Atomic Energy Commission (AEC), 74, 80, 107,110,122,134,216
 auctions, 374-78 Augenstein, Bruno, 107 Aumann, Robert, 140, 156,
 354
 in Nobel deliberations, 362, 363 Australia, 377
 Bach, Johann Sebastian, 113 Bailey, Anna, 343
 Balzac, Honor6 de, 325 Barnberger
 -----1163
 family, 54 Bank of Sweden, 358, 368
 Baptist Standard, 26
 bargaining, 88-91, 129, 149-51 "Bargaining Problem, The0ggNash),
 88,
 120,360
 BASIC, 71
 Baumecker, Peter, 289-90, 292, 294 Baumol, William, 102
 Baylor College, 26 Beckenback, Alice, 299
 Bell, E. T., 34, 35, 229, 230-31, 232
 Bellfar, The

(Plath), 211

Bellman, Richard, 110, 185 Berge, Claude, 243

Bers, Lipman, 246

Best, Richard, 184, 185-86, 189 Bewley, Truman, 3 54, 3 5 5

Binmore, Kenneth, 355

bipolar disorder (manic depressive illness), 18,258,318-19

Birkhoff, G. D., 53, 55, 103, 136 Blackwell, David, 117

-----1164

Blake, William, 13 Bletchley Park, 56, 107 Bleuler, Eugen, 17

Bleuler, Manfred, 352

Bluefield, West Va., description of, 28 Bluefield College, 35, 39

Blueea6enceld Daily Telegraph, A1164
 3 3, 3 8 Bluefield Supply, 33 B6cher Prize, 138, 226-27, 237, 243
 Bochner, Salomon, 64, 71, 128, 132 Boeing, 342-43
 Bohnenblust, H. Frederic, 103, 117 Bohr, Harald, 49, 50
 Bohr, Niels, 50, 56, 70
 Bombieri, Enrico, 20-21, 229, 230, 388 Borel, Armand, 264, 272,
 301, 313
 as Annals of Mathematics
 editor, 318 Carrier Clinic visits of, 307 IAS appointments
 arranged by, 296,
 308
 Nashes' socializing with, 299, 3 80, 3 86 Nash recommended by,
 321
 on Nash's embedding theorem, 161-62 Nash's nonsensical calls to,
 286
 Borel, Emile, 81
 -----1165
 Borel, Gaby, 264, 299, 344, 380, 386 Borsuk, Karol, 72
 Borsuk conjecture, 72
 Bott, Raoul, 40, 41, 203, 240 Boy Scouts, 33
 Bradley, Bernard E., 261 Brandeis University, 314-22 Brauer,
 Fred, 146 Brenner, Joseph, 239, 258 Brezhnev, Leonid, 332
 Bricker, Jacob Leon, 144, 223, 321 Alicia Larde and, 200-201
 Eleanor Stier and, 177, 178, 181, 182, 206-7
 Nash's delusions about, 326
 Nash's relationship with, 180-83, 204,
 206-7
 bridge, 142 Brieskorn, Egbert, 318 Brod, Max, 278 Brode, Wallace,
 279 Bronx High School, 142
 Brouwer's fixed point theorem, 45, 128, 362 Browder, Earl, 153
 Browder, Eva, 233-34, 380
 Browder, Felix, 73, 142, 154, 157, 229, 244,
 246-47
 -----1166
 Nashes' British trip and, 233-34 Nashes' socializing with, 3 80,
 386 on Nash's defection effort, 281
 Nash's McLean commitment and, 257 Browder, William, 309, 335
 Brown, Douglas, 126, 310, 312 Brownian motion, 55 Buchanan,
 James, 364 Buchwald, Art, 271
 Bulletin de Ja Sociand6 Math6matique de France,
 298
 Bunker Hill Community College, 344 Burr, Stefan, 299
 Bush, Vannevar, 137

Calabi, Eugenio, 64, 68, 72, 232, 244-45 Calabi, Giuliana, 245
calculus, tensor, 380
California Institute of Technology, 375 Camus, Albert, 271
Cappell, Sylvain, 99
Carl XVI Gustav, king of Sweden, 379-80 Carleson, Lennart,
223-24, 226, 227 Carnegie Institute of Technology, 35, 39-
45, 129, 362

-----1167

description of, 40
Carrier Clinic, 304, 305-8, 312-13, 343, 344
Cartan, Elie-Joseph, 157 Cartwright, Mary, 57 Casals, Pablo, 193

Castle, The A1167
 (Kafka), 273, 278 Cauchy problem, 297-98 Cauvin, Jean-Pierre, 284, 298, 308
 Cauvin, Louisa, 308
 Central Bank of Sweden Prize in Economic Science in Memory of Alfred Nobel, see
 Nobel Prize in economics
 Central Intelligence Agency (CIA), 134 Centre de la Recherches Nationale Scientifiques, 298
 Chamberlain, Gary, 354 Charles, Ray, 255 Chern, Shiing-shen, 72, 236, 279
 Chiang Kai-shek, 153
 Chicago, University of, 45, 132, 236, 237, 244
 China, 153
 Choate, Hall and Steward, 153 Chung, Kai Lai, 66
 -----1168
 Church, Alonzo, 63, 64, 93 CIA (Central Intelligence Agency), 134
 City College, 142, 144, 180
 John Bates Clark medal for economics, 369
 Clark University, 59
 C. L. E. Moore instructorships, 132, 135, 139, 142, 157, 160, 162
 Clozapine, 329 Clozaril, 384
 Coase, Ronald, 364, 375-76 Cocteau, Jean, 310-11
 Cohen, Paul J., 155, 160, 215-16, 230, 236-38, 240, 241, 259, 349
 Nash's McLean commitment and, 2 5 3, 257
 and onset of Nash's schizophrenia, 242-243, 250, 251
 College de France, 236, 265, 285 1962 conference at, 300-301
 Communist Party (Great Britain), I 10 Communist Party (U.S.), 135, 152-54
 competitive equilibrium, 108
 Compleat Strategpt, The
 -----1169
 (Williams), 83 complex analysis, 130
 complex variables, theory of, 67 Compton, Karl, 153
 Compton Pictured Encyclopedia, 3
 2 computer theory, 56, 65, 82
 Con Edison, 343, 344 continuity theorem, 219-20, 225 continuous geometry, 81
 Conway, John, 158
 Courant, Richard, 210, 216, 219 Courant Institute of Mathematical Sciences, 216-17, 223, 224
 Cournot, Antoine-Augustin, 14 Cox, Edward, 278
 creativity, schizophrenia and, 15-16 cryptography, 55-56

cybernetics, 55, 135 Cyert, Richard, 40 Cziffra, Peter, 334

Dagens Nyheter,

3 71 Dahmen, Erik, 368 Dalkey, N., 117

Danskin, John, 280, 282, 284, 296, 301,

303

Eleanor Stier's complaints to, 296 at

-----1170

game-theory conference, 313 Nash's behavior described by, 286-87

Nash's job search and, 283, 284

Nash's Trenton State hospitalization and, 290-91,292

Danskin, Odette Larde, 212, 284, 287, 296,

303,342

A1170

Danskin's marriage to, 283

Nashes' European stay and, 270, 273, 276,277,279,280 Dasgupta,

Partha, 362 Davies, John D., 51, 56 Davis, Garry, 271, 282

Davis, Joyce, 195, 196, 197, 198, 199, 200,

202,211,283,343 Davis, Martin, 67-68 Davis, Meyer, 271

De Giorgi, Ennio, 219-20, 224, 225 Dejarnette State Sanitorium,

331 Delusion

(Class), 335

de Rham, Georges, 101 Descartes, Ren6, 15, 35, 51 Dewey, Thomas

E., 49, 62 Dickason, H. L., 124 Dickinson, Emily, 323

-----1171

Dictionary of Scientific Biography (Gillespie, ed.), 337

DiMaggio, Joe, 192

Diophantine equations, 45, 334 Dirichlet, Peter Gustave Lejeune,

141 Dix, Dorothea, 289

Dixit, Avinash, 97, 375, 385 Doherty, Robert, 40-41 Dostoevsky,

Fyodor, 18 Douglas Aircraft, 106, 111, 113 Dresher, Melvin, 115,

119, 150

Dr. Strangelove,

80, 105

Duchane, Emma, 190, 196, 200-201, 202,

223

Alicia Nash's apartment with, 262 Nash's interest in, 317

Nash's McLean commitment and, 255,

256,257

and onset of Nash's schizophrenia, 240, 242,250,251

Dudey, Marc, 350 duels, theory of, 121 Duffin, Richard, 41,

44-45, 46

Duke journal ofMathematics, 318 Dynamics of Creation, The

-----1172

(Storr), 15 Dyson, Freeman, 20, 21, 221

Econometrica,

91, 120 Econometric Society, 20 Nash's fellowship in, 354-55

economics: bargaining and, 88-91, 120, 129,149-

151,360

see also

game theory; Nobel Prize in economics Edgeworth, Francis Ysidro,

88, 89 Ehrlich, Phillip, 287

Eilenberg, Samuel, 68

Einstein, Albert, 12, 13, 15, 19, 41, 46, 50,

63,79,84,87,118,216,271,308,380 adolescence of, 35

Davis supported by, 271

and general theory of relativity, 52, 70, 86, 231, 380
on God, 66
go played by, 75
Heisenberg's uncertainty principle critiqued by, 221
on intellectual isolation, 59 on Kaluza's

-----1173
theory, 94 liberal views of, 14 Nash's meeting with, 70-71, 94,
382 nuclear warning of, 56
on Princeton, 49, 50-51 recruited to IAS, 54- 5 5 relativity
papers of, 52, 70, 86
and special theory of relativity, 51-52, 70, 86

Swiss citizenship of, 272 Eisenhart, Luthor, 53, 388 A1173
 Eisenhower, Dwight D., 110, 111, 140,
 185,217 elections of 1948, 49, 62 elections of 1952, 140
 electroshock, 293 Eliot, T. S., 98 El Salvador, 191 embedding, of
 Riemannian manifolds, 155-63,203,204,218,219,345 Emery, Richard,
 222, 239-40
 Encyclopedic Dictionary of Mathematics,
 297
 entropy, 224
 Epstein, Samuel, 254-55 Erd6's, Paul, 346
 ergodic theorem, 81 Erlenmeyer-Kimling, Nikki, 188 Esau, 327
 Esmiol, Pattison, 314-15, 319, 321
 -----1174
 Estermann, Immanuel, 41 Euclid, 35, 230 Euler, Leonhard, 230
 Euripides, 94
 exotic spheres, 203
 Farinholt, Larkin, 280 Faulkner, James, 265
 Federal Bureau of Investigation (FBI), 153, 154,249,281
 Federal Communications Commission (FCC), 374, 376-78
 Federer, Herbert, 161 Feenberg, Daniel, 336, 350 Feldt, Kiell
 Olof, 368 Feller, William, 129, 285 Fellows, Benjamin Pierce, 135
 Fermat, Pierre de, 35, 51 Fermat's Last Theorem, 203, 386
 Fermat's Theorem, 35
 fiber bundles, 64
 Fields, Kenneth, 345, 346, 351 Fields Medal, 20, 224, 236, 333,
 369 description of, 225-26
 1958,234
 1962,232,365
 1966,279 selection process for, 225
 Fine, Henry Burchard, 52-53 first strike, 121
 -----1175
 Fisher, Eric, 361 Fitzgerald, F. Scott, 49
 Flatto, Leopold "Poldy" 144, 159, 163 Flexner, Abraham, 54
 Flood, Merrill, 119, 121-22, 150, 303 Floyd Ward dancing school,
 33
 fluid dynamics, 294, 297 Fogel, Robert, 363
 Forrester, Amasa, 203-6, 321
 Fortune,
 104, 106, 108, 115, 116, 216, 217,
 224
 Found7mentions of Economic Theory (Samuelson), 86
 Fox, Ralph, 64, 72, 75
 Fr-Inkenstem or The Modern Prometheus (Shelley), 273

Fredga, Kerstin, 360, 370, 372 Freud, Sigmund, 59, 94
Freudian theory, 188, 250, 259-60, 351 Friedrichs, Kurt, 225, 226
Fuchs, Klaus, I 10 Fuchsian functions, 93 Fuck Your Buddy, 102
Fukuda, Hiroshi, 75 Fulbright program, 236

-----1176

Galbraith, John Kenneth, 116 Gale, David, 62, 64, 77, 78, 83,
100, 308-9 Nash equilibrium and, 95 Gallagher, Chicky, 193

Galmarino, Alberto, 240-41

games: non-zero-sum, 87

two-person zero-sum, 14, 87, 95, 96, 115,
116, 119

"Games Against Nature0ggMilnor), 149 Gamesand Decisions A1176
(Luce and Raiffa), 122 game theory, 56, 84-91, 101, 286
application of, 374-78 Econometric Society and, 354 MIT seminar
on, 319 Nash's course in, 240-41, 265
and Nash's graduate studies, 65, 68, 77, 86-87, 90-91, 96, 100,
132
Nash's introduction to, 45 in
New Palgrave, 20
1961 conference on, 296-97
1964 conference on, 313
in Nobel deliberations, 357, 360-73 origins of, 13-14
RAND and, 104-5, 108, 111, 115-22,

-----1177

149-51
Tucker and, 64-65, 77, 83, 90, 91, 100,
118,119,362
von Neumann's role in, 13-14, 81, 83-
87, 88, 90, 91, 92, 93-94, 95, 96-97,
98, 100, 111, 115, 116, 117-18, 119,
128,149,150,362,363
see also
bargaining; min-max theorem; Nash equilibrium Gangolli, Ramesh,
240-41 Garabedian, Paul, 219-20
Garber, Robert, 292, 293, 294, 305, 307,
310
Girding, Lars, 219, 368 Garsia, Adriano, 237, 257, 258 Garson,
Greer, 36
Gauss, Carl Friedrich, 35, 69, 128, 141, 23,0 Gauss's proof of
the fundamental theorem of algebra, 67
Gauthier, Jacqueline, 260, 261 General

-----1178

Electric, 27
general theory of relativity, 52, 70, 86, 2 3 1,
380
geniuses: clusters of, 94 schizophrenia and, 19 geometry:
algebraic, 96 continuous, 81 differential, 203
geometry:
continued
and Nash's graduate studies, 68 non-Euclidean, 231
see also
Riemannian manifolds Germany, East, 281 Germany, Nazi, 84,115
Gibbon, Edward, 58 Gibbs, Willard, 51 Gide, Andr , 3 10-11
Gillespie, Charles, 337 Girschick, Abraham, 117 Glass, James,

278, 335 Gleason, Andrew, 146 Gleason, Jackie, 193
gea75,76,100,142,326,343 G6del, Kurt, 50, 54, 59, 70, 84, 216,
236,
355
Goodwin, Ruth, 243-44 Goheen, Robert,
-----1179
287, 3 10 Goldin, Claudia, 338 Goldman, Oscar, 252 Goldschmidt,
Hubert, 298 Goldstine, Hermann, 82 Gonshor, Harry, 144, 343
Goodman, Leo, 210 Gordon, Julie, 3 5 5 Gore, Also, 374, 375
Gottesman, Irving 1., 17, 188 Grant, Mrs. Austin, 172 Gromov,
Mikhail, 12, 158, 318 Grothendieck, Alexandre, 279, 298, 311,

312,334 A1179
 Guggenheim Foundation, 236 Gunderson, John G., 16
 Haber, Seymour, 146 Hahn, Otto, 56 Halmos, Paul, 12, 80, 155, 159
 Hardwick, Elizabeth, 256, 259 Hardy, G. H., 61, 79, 130, 137,
 228, 230
 Harish-Chandra, 286
 Harsanyi, John C., 98, 354, 362, 374 at 1961 conference, 297
 Nobel deliberations on, 363, 364, 371, 373
 Harvard University, 45, 46, 51, 55, 60, 134-
 135,136,137,144,146,235 Haslam, John,

-----1180

275
 Hausner, Melvin, 63, 69, 73 Hayek, Friedrich von, 367 Heifetz,
 Jascha, 246
 Heilbroner, Robert, 89 Hein, Piet, 76, 78 Heisenberg, Werner, 70,
 221 Heisenberg's uncertainty principle,
 221
 Henkin, Leon, 62, 64 Henry, Agnes, 126, 285 Herter, Christian A.,
 278, 279
 Hexea76,78,299
 see also
 "Nash"Hicks, John, 89, 108
 Hilbert, David, 52, 53, 81, 157 Hilbert's Fifth Problem, 81, 146
 Hilbert spaces, 44
 Hincks, Ruth, 147-48, 174 Hinman, George, 42, 44 Hironaka,
 Heisuke, 309, 333 Hiroshima bombing (1945), 195 Hitch, Charles,
 122
 Hitler, Adolf, 84 Hoffman, Abbie, 271 Hoffman, Alan, 339 Holder
 estimates, 219, 225 homology theory, 68, 69 homotopy chains, 69
 Hopf, Heinz, 162,

-----1181

22 5
 Hbrmander, Lars, 216, 217, 219, 226-27,
 232,264,280,300,301 Nobel deliberations and, 365, 366
 Hoselitz, Bert, 90-91 Houghton, Amory, 279
 House Un-American Activities Committee (HUAC), 152, 187
 Howard, Paul, 222 Hurwicz, Leo, 85 hydrogen bomb, 81, 93, 109,
 110 hyperbolic equations, see nonlinear partial differential
 equations
 IA-MORE a Genius
 (Wiener), 136
 IA-MORE a Mathematician
 (Wiener), 136 IAS,

see

Institute for Advanced Study IBM, 82 ICBM's (intercontinental ballistic missiles),

106,110

If

449

IHES (Institut des Hautes 9mentudes

-----1182

Scientifiques), 279, 280, 298, 311

lle de France,

2 3 3

Immigration Act (1941), 271-72 implicit-function theorems, 160, 222, 243 impossibility theorem, 108 Ingham, Albert E., 229, 232, 238 "Insanity Bit, TheOggKrim), 291 Institut des Hautes 9mentudes Scientifiques (IHES), 279, 280, 298, 311 Institute for Advanced Study jAS): activities at, 63 creation of, 54-55 description of, 50, 215-16 Godel's professorship at, 355 Lefschetz on, 59 Nash at, 202, 208, 215-16, 220-21, 236 Nash at, after illness, 296-97, 303, 308-309, 311 insulin coma therapy, 291-94, 299, 306, 329, 353 intercontinental ballistic missiles (ICBM's), 106, 110

-----1183

International Congress of Mathematicians:

1950, 129

1958, 233

1962, 300, 301

International Mathematical Union, 162

see also

Fields Medal

Isbell, John, 205

Jacob, 327

Jacobson, Carl-Olof, 356-57, 370, 371-72, 373

"Jeep"problem, 145-46 Jeffries, Steve, 186

`John"gg"Nash"), 75, 76-78 John XXIII, Pope, 276 John Alden

Society, 33

John Bates Clark medal for economics, 369

Johnniac, 109

John von Neumann Theory Prize, 338-39, 354

Jung, Carl, 94

-----1184

Kafka, Franz, 269, 273, 278, 327 Kahn, Herman, 10 5, 109, 111

Kahne, Merton J., 2 54, 2 58, 2 59 Kaiser Friedrich Institute, 56

Kakutani, Shizuo, 362

Kaluza, Theodor F. E., 94 Kant, Immanuel, 15 Kaplan, Fred, 105,

121 Karlin, Sam, 117 Karlquist, Anders, 368, 369 Kaysen, Carl, 116

Keefe, Richard, 342 Kemeny, John, 71, 270-71 Kennedy, John F.,

280 Keynes, John Maynard, 14 Keynesian economics, 85 Khrushchev,

Nikita, 278, 280, 332 King, Mervyn, 354, 355

Kinsey, Alfred, 181 Kirchner, Herman, 37 Kiselman, Christer, 366,
372

Nash's lecture arranged by, 380 Kiselman, Ola, 366

Klein bottles, 157-58

K6chel, Ludwig Alois Ferdinand von, 281 Kodaira, Kunihiko, 101,
130 Kohn, Anna Rosa, 322

Kohn, Joseph, 134, 140, 157, 313, 314, 319,

-----1185

320, 322

Nash as concern of, 338 Korean War, 123-27, 132, 229 Kraepelin,
Emil, 18 Kreisel, Georg, 284 Kreps, David, 362

Kriegspiel, 75-76, 100, 101, 112, 285 Krim, Seymour, 291 A1185
 Kubrick, Stanley, 80
 Kuhn, Estelle, 275, 379, 380, 384 Kuhn, Harold, 64, 243, 339,
 351, 381, 385,
 386, 388
 Carrier Clinic visit of, 313 description of, 21
 in Econometric Society, 354 game theory and, 77, 8 3, 100
 honeymoon of, 62
 on invention of Hex, 78 in Korean War, 125 Nash's letters to,
 312, 387
 on Nash's need for recognition, 44 on Nash's thesis, 95-96
 Nash told of Nobel by, 21-22
 at Nobel ceremonies, 275, 379, 380 Index
 Kuhn, Harold,
 continued

-----1186
 Nobel committee's request to, 363 Nobel deliberations and, 365,
 367 sherry sessions of, 62, 72
 on von Neumann, 79 Kunzig, Robert L., 152 Kuranishi, Masatake,
 162 Ladyshenskaya, Olga, 234 Lang, Serge, 64, 73 Larde, Eloi
 Martin, 191 Larde, Enrique, 191, 192, 212 Larde, Florentin, 191
 Larde, Jorge, 191 Larde, Muyu, 282 Larde (Danskin), Odette,
 see
 Danskin, Odette Larde
 Larde, Rolando, 191
 Larde Arthes, Carlos (father-in-law), 191 -
 192, 193, 194, 201
 illness and death of, 192, 296, 301 Larde Harrison, Alicia
 (mother-in-law), see Lopez-Harrison de Larde, Alicia Lasker, 180
 Lax, Anneli, 216
 Lax, Peter, 216, 217, 218, 226, 246 Leader, Elvira, 284
 Leader, Sol, 284, 343 League of Nations, 191, 270

-----1187
 Lefschetz, Solomon, 46, 47, 51, 58, 63, 64,
 69,71,93,95,96,130,329 anti-Semitism and, 58
 background of, 58-59 at IAS parties, 215 McCarthyism and, 153
 Nash defended by, 73, 74 Nash's job search and, 129, 132 new
 students welcomed by, 58-59
 Legendre, Adrien Marie, 230
 Legg, Charlie (brother-in-law), 209, 212,
 302,323,331
 Legg, Martha Nash (sister), 39, 170, 209,
 283,387

Alicia Nash's letter to, 340 Esmiol contacted by, 321 on John
Nash, Sr., 26 Levinson's letter to, 322 Mele contacted by, 3 10
Nash committed to Delarnette by, 331
Nash's 1962 European trip and, 301 on Nash's childhood, 32-33
and Nash's commitment to Carrier, 304,
306, 307-8
on Nash's desire to leave MIT, 235
-----1188
Nash's divorce and, 302
Nash's letters to, 169, 181, 279, 282, 301,
310, 314, 316-17, 318, 319-20 Nash's 1959-60 European stay and,

272, 279,282 A1188
Nash's present relationship with, 383 Nash's Roanoke years and,
323, 330 Nash's Trenton State hospitalization and,
287,288,290,291 at Nash's wedding, 212
and onset of Nash's schizophrenia, 249,
251
sanctuary search revealed to, 302 on trip to California, 147-48
World War 11 and, 35-36 Lemke, Carl, 339
Leonard, Robert, 52, 84, 86, 94, 363 Leray, Jean, 236, 285, 298,
300 Lettvin, Jerome, 134, 250
Levinson, Norman, 135, 143, 153, 155,
200,320
background of, 137-38 McCarthyism and, 153-54, 187
Nash's Brandeis post supported by, 313, 314
-----1189
Nash's McLean commitment and, 254, 257
on Nash's parsimony, 233
Nash's professorship and, 162-63 Nash's resignation and, 265
and onset of Nash's schizophrenia, 243,
244
Riemann Hypothesis and, 230 Riemannian manifolds and, 158, 160,
161,163
Levinson, Zipporah "Fagiea0136, 137, 144,
172,264,265,322 on Alicia Nash, 223 Alicia Nash aided by, 262
John Charles Nash's birth and, 263-64 Nash monitored by, 320
Nash's belongings moved by, 322 Nash's McLean commitment and,
255,
259,260
Lewin, Roger, 335 Lewis, John L., 28 Lewy, Hans, 221 Lide, David,
41
Life,
32, 244
Life, game of, 158 Lincoln Laboratory,
-----1190
133 Lindbeck, Assar, 356, 359-73 Littlewood, J. E., 130 Locke,
John, 94
Lbfgren, Karl-Gustaf, 359-60, 364 logic, 65
Lopez-Harrison de Larde, Alicia (mother-in-law), 191, 192, 194,
20 1, 342
European trip of, 276-77, 279, 280 John Charles Nash in care of,
277, 283, 287,296,309,341
John Charles Nash's mental problems andea343,344
United States left by, 346 Louthan, John, 38-39

Lowell, Robert, 253, 255, 256-57, 259,
260

Lucas, Robert, 371

Luce, R. Duncan, 107, 122

McAfee, Preston, 377 McCarthy, John, 102, 146, 258 McCarthy,
Joseph, 100, 110, 135, 184 McCarthyism, 100, 110, 135, 137,
152-54,
185, 187

-----1191

McCormick, Mrs., 195 McDonald, John, 116 Mackey, George, 11, 155,
257

McKinsey, J. C. C., 117, 185, 188, 189 McLean Hospital, A1191
253-61 description of, 255 optimism at, 259 treatment philosophy
of, 259 McMillan, John, 377, 378 Mad Hatter's Tea, 264
Magee, Harold, 291
Maler, Karl-Gbran, 358, 362, 364, 367, 369,
370-71,372
Malgrange, Bernard, 300 Manganaro, Jim, 380
Manhattan Project, 56, 81, 107, 110, 15 3,
193
MANIAC, 82
manic depressive illness (bipolar disorder), 18,258,318-19
manifolds, algebraic, 123-24, 128-32 manifolds, Riemannian,
embedding of, 155-63,203,204,218,219,345 Mao Tse-Tung, 332
-----1192
Marshall, Alfred, 89 Marshall University, 346, 384 Martha
Washington College, 27 Martin, Emma (grandmother), 27, 29 Martin,
James Everett (grandfather), 27 Martin, Lucy, 243
Martin, Margaret Virginia (mother),
see
Nash, Margaret Virginia Martin Martin, William Ted, 132, 135,
137, 153, 154,233
Michigan position arranged by, 303 Nash's McLean commitment and,
254
and Nash's professorship, 155 Nash's resignation and, 265
Nash's tenure and, 224, 244, 249, 250 and onset of Nash's
schizophrenia, 243, 244,250
senior seminar arranged by, 319 Martinez, Maximiliano Hernandez,
191 Marx, Karl, 88
Marymount School, 192-94
Mary Nash College for Women, 26 Maskin, Eric, 362
Massachusetts Institute of Technology
-----1193
(MIT), 55, 132-46, 152-63 Alicia Larde accepted to, 194
description of, 133
game theory seminar at, 319 McCarthyism at, 153 Nash's
resignation from, 265
Nash's tenure hopes at, 224, 244, 249, 250
Nash's unhappiness at, 235 Nash's visiting position at, 309
Matewan, 28
Ma this ema fical In teffigen cer, This e,
7 7, 7 8
Mathematician Apolqv, The
(Hardy),

228

mathematics: competition in, 228-29 Hilbert program in, 52

Mathematische Grundlagen der Quantenmechanik (von Neumann),
45,81

Mattson, John Otto, 184

Mattuck, Arthur, 167-68, 177, 178, 180,

182,199,201,223,263,316,317,387 on Forrester, 204

-----1194

John Stier and, 344 Nash's illness and, 262

Nash's McLean commitment and, 256,

258

Mazur, Barry, 131, 141 Meder, Albert E., Jr., 303 A1194
 Meitner, Lise, 56 Mele, Howard S., 307-8, 310, 312-13 Men
 ofMathematics
 (Bell), 34-35, 230-31 disddMetamorphosis, The"ggKafka), 278
 meteorology, 81
 Michigan, University of, 45, 149, 303-4 Milgrom, Paul, 362,
 376-77
 Miller, James, 303, 304
 Milnor, John, 101, 132, 170, 234, 296,
 308-9,312,313 Alicia Nash's driving lessons from, 284 at
 International Mathematical Congress,
 301
 knotted curves paper of, 72 on Nash's 1960's work, 309 Nash's
 board game and, 77, 78
 on Nash's speculative questions, 68-69 one-year Princeton post
 arranged by,
 -----1195
 309-10,311
 on Princeton student life, 64 at RAND, 117, 149-51
 on trip to California, 147-48 min-max theorem, 83, 86, 95, 96
 Minsky, Gloria, 316
 Minsky, Marvin L., 95, 143, 145, 200, 208,
 223,316,387
 MIT, see Massachusetts Institute of Technology
 M6bius strip, 66
 Montgomery, Deane, 296, 308-9 Mood, Alexander, 112, 113-14, 187
 Moore, John Coleman, 198, 269, 341-42, 344
 C. L. E. Moore instructorships, 132, 135,
 139,142,157,160,162 Morawetz, Cathleen Synge, 216, 217, 246,
 281-82
 Morgenstern, Oskar, 81, 83, 85, 87, 88, 90,
 91,94,97,102,105,149,284,308-9,
 363
 -----1196
 background of, 84
 game-theory conference organized by,
 296-97
 Nash's potential job with, 284-85, 286 Morse, Marston, 55, 56,
 296
 Moser, Gertrude, 222, 239, 251, 257, 262 Moser, Jorgen, 216, 223,
 224, 243, 257,
 321-22
 on Fields deliberations, 226 funds raised by, 303

Nash paper refereed by, 318 Nash's respect for, 222
New Year's Eve party of, 239-40 Riemannian manifolds and, 158,
159, 161, 162
Moskowitz, David, 44 Motchane, Leon, 298
Mozart, Wolfgang Amadeus, 281 Mueller, Egbert, 260, 261 Muse,
Leonard, 331
Myerson, Roger, 91, 355 Myrdal, Gunnar, 3 58, 3 59, 368
Nagel, Bengt, 368 Nalebuff, Barry, 97 "Nashea075, 76-78
-----1197
Nash, Alexander Quincy (grandfather), 26 Nash, Alicia Larde
(wife), 190-202, 298,

299,301,314,322,388 A1197
accepted at MIT, 194
assessments of Nash's relationship with, 223 attracted to Nash,
196-98
background and childhood of, 191-94 breakdown of marriage of, 296
Carrier commitment and, 304, 306 Cohen and, 237
death of father of, 192, 301 early married life of, 222-23
Eleanor Stier's meeting with, 201-2
electroshock eschewed by, 306 employment problems of, 341-43
European trip of, 233-34 informed of Nash's Nobel, 371 Italy trip
of, 276
John Charles Nash's graduate studies encouraged by, 346
John Charles Nash's mental problems and, 343, 344
Moore's relationship with, 341
Nash committed to McLean by, 253-61 Nash divorced by, 302-3, 306
-----1198
Nash offered housing by, 340
Nash's 1962 European trip and, 298,
301
in Nash's class, 196-97
Nash's contemplation of marriage with,
210-12
Nash's courtship with, 199-202 Nash's divorce threat against, 262
Nash's Geneva stay and, 273, 278, 279 on Nash's remission, 349
Nash's Trenton State hospitalization and, 287, 288, 290, 291, 294
Nash's wedding to, 212
at New Jersey Transit, 346 at New Year's party, 240
1959-60 European stay of, 265-82 at Nobel ceremonies, 379, 380
Nobel Prize and, 383
and onset of Nash's schizophrenia, 242, 245, 248-52
potential reconciliation with, 308, 309, 310, 313, 316, 319
pregnancy of, 235, 248, 251, 263-64 renewal of marriage of,
385-86
on return from Europe, 283, 284, 287
-----1199
sex discrimination suit filed by, 342-43 son of,
see
Nash, John Charles Martin Virginia Nash introduced to, 211
von Neumann prize and, 339 wedding of, 212 Nash, Jesse (uncle),
26
Nash, John Charles Martin (son), 255, 261,
263-64, 266, 283, 301, 322, 326, 342 Alicia Lopez-Harrison's care of,
277, 283, 287, 296, 309, 341

birth of, 255, 262-64 Boston visited by, 345
brought to Europe, 276-77, 279, 280 computer seen as therapeutic
for, 384,
385
custody of, 303 fundamentalism of, 343 John Stier's first meeting
with, 344 math studies of, 345-46 medication refused by, 344, 384
mental problems of, 343-44, 351, 383-
385
Nash's relationship with, 380, 383-85,
388
Nash's separations from, 308, 314, 316

Nobel Prize and, 383 1200
 at Trenton State Hospital, 383 von Neumann prize and, 339 Nash,
 John F., Jr.
 alien races and, 13, 241-42, 243, 275 assessment of schizophrenia
 diagnosis for, 351-53
 assessment of work of, 11-12 authority disdained by, 12
 autobiographical essay of, 32, 34, 44, 46,
 91, 129, 157, 159, 224-25, 295, 354 birth of, 30
 blackboard messages left by, 332-34 bombmaking by, 37
 at Brandeis, 314-22
 at Carnegie Tech, 39-45, 129
 at Carrier Clinic, 304, 305-8, 312-13 chemistry studied by, 41
 childhood of, 15, 29-39
 citizenship renunciation attempted by,
 271-72
 classes avoided by, 68 computers admired by, 12
 computer work of, 336-37, 349, 350, 384 delusions of, 325-28, 353
 -----1201
 diagnosed with paranoid schizophrenia, 258-59
 dismissed from RAND, 184-89 divorce considered by, 257, 262 draft
 avoided by, 123-27 draft feared by, 47, 202, 229 drug treatments
 of, 16-17 earliest memories of, 25 early education of, 31, 34,
 38-39 early mathematical talent of, 34 East Germany stay of, 281
 engineering studied by, 39, 40, 41 faculty position sought by, 12
 3 fellow students questioned by, 72 French studies of, 297-98
 games invented by, 75, 76-78, 102 generals passed by, 92-93
 Geneva stay of, 273, 274-79 graduate studies of, 45-47, 49, 58-98
 handedness of, 31
 Nash, John F., Jr.,
 continued
 hospitalization feared by, 325, 330, 340 indecent exposure charge
 against, 184-
 189,210
 initial recovery of, 295
 insulin coma therapy of, 291-94, 299, 306,329,353
 -----1202
 intellectual independence sought by, 68,
 71
 as introverted child, 30-31 investments of, 233, 236 job sought
 for, 284-85, 286 at McLean Hospital, 253-61 marriage of,
 see
 Nash, Alicia Larde mathematics chosen by, 42
 1959-60 European stay of, 265-82

1962 European trip of, 298
1964 European trip of, 311-12
1967 West Coast trip of, 320-22 Nobel prize announced to, 22
onset of schizophrenia in, 11, 16, 19-19,
221,238,240-52
passport destroyed or discarded by, 276 physical description of,
67, 113
pranks played by, 37, 101, 102, 114, 156 professorship gained by,
15 5, 156, 162-
163
psychotherapy of, 259 Putnam award and, 43-44 racial views of,

67-68, 217 reading A1202
-----1203

avoided by, 68
refugee status sought by, 273, 274-80, 302
remission of, 20, 349-55, 381-82 Roanoke years of, 323-31 science
experiments of, 32 science fiction as interest of, 12 security
clearance of, I 10 Shapley's friendship with, 99-103 shock
treatments and, 16-17, 232, 250,
304
single economics course of, 90-91 sociability encouraged in, 33
sons of,
see
Nash, John Charles Martin; Stier, John David
stock market as interest of, 233, 236,
350
summer jobs of, 33
teaching by, 139-41, 163, 235, 240-41 teasing of, 36, 42
thesis of, 95-96, 128
at Trenton State Hospital, 287, 288-94,
302,306,344

-----1204

vegetarianism of, 307 violence of, 73
von Neumann prize awarded to, 338-39, 354
whistling of, 66, 69, 113, 114, 141-42, 163
Nash, John F., Sr. (father), 25-34, 123 background and childhood
of, 26 death of, 209 health problems of, 208-9 Japanese invasion
feared by, 35-36 John Stier and, 206, 208, 2 10
New
York trip of,
208-9 West Point suggested by, 39
Nash, Margaret Virginia Martin (mother), 25-34,123,251,264 Alicia
Larde introduced to, 211
Carrier commitment and, 304, 306, 307-
308
death of, 27, 330-31
John Nash, Sr4's death and, 209-10 John Stier and, 206, 208, 209,
210 Nash's divorce and, 302
Nash's education fostered by, 31, 38 Nash's investments for, 233,
236

-----1205

Nash's letters to, 272, 276, 279, 301, 310,
312,314,319-20
Nash's McLean commitment and, 2 5 5,

260

Nash's 1959-60 European stay and, 272, 276,279

Nash's 1962 European trip and, 301 Nash's 1964 European trip and,
312 Nash's stay with, 323-30

Nash's Trenton State hospitalization and, 287,288,290,291 nervous
breakdown of, 27, 272

New York trip of, 208

and onset of Nash's schizophrenia, 249,
251

and potential Michigan position, 303 sociability encouraged by,
33

Nash, Martha (sister), see Legg, Martha Nash A1205
 Nash, Martha Smith (grandmother), 26 Nash, Richard (cousin), 293,
 320-21 Mary Nash College for Women, 26
 Nash equilibrium, 115, 118, 119, 329, 339,
 -----1206
 361-62, 375
 assessment of, 96-98
 dominant vs. dominated strategies in, 97 elaboration of, 93-96
 see also
 Nobel Prize
 in
 economics of
 1994
 Nash-Moser theorem, 159 Nathanson, Melvyn, 346
 National Academy of Sciences, 95, 115, 131
 National Science Foundation (NSF), 107, 236,296,313,314
 Navier-Stokes equations, 297
 Navy, U.S., 82, 83, 125, 126, 134,135 negotiation, in game
 theory, 120 Nehru, Jawaharlal, 278
 Nelson, Ed, 284, 286, 296, 300 Nerval, Gerard de, 228 Neuwirth,
 Jerome, 144, 182, 2 31 New Jersey Transit, 346
 Newman, Donald "D.J.ea012, 139,143,
 144-45,146,169,180,200,237,240 on
 -----1207
 Bricker and Nash, 180
 on Nash, 159
 Nash's McLean commitment and, 257-
 258
 and onset of Nash's schizophrenia, 243,
 246
 Newman, Herta, 143, 181, 196, 200 Newman, Peter, 329
 Ne w Palgm ve, 7-h e, 2
 0, 9 8
 Newton, Isaac, 12, 15, 17, 35, 51, 52, 56,
 85,94
 New York Times,
 70, 86, 100, 2 36, 241-42,
 374
 New York University,
 see
 Courant Institute of Mathematical Sciences New Zealand, 377
 Nietzsche, Friedrich, 12, 139, 235 Nijenhuis, Albert, 205, 206
 Nilges, Edward G., 350

Nimitz, Nancy, 185

Nirenberg, Louis, 203, 216, 218-19,

-----1208

243,

301

Nobel, Alfred, 358, 362 Nobel Foundation, 357, 358 Nobel Prize in
economics, 55, 107

ad hoc committee on future of, 372-73 criteria for, 358

establishment of, 3 58, 368

1972, 108

1986, 364

1991,364 A1208

1993, 363

proposed abolition of, 368 reform of, 369 selection process for,
358-60 unpopularity of, 368

Nobel Prize in economics of 1994, 150, 224,275,297

ceremonies for, 374, 379-80

delayed press conference about, 356-57 deliberations on, 357,
360-73

dinner in celebration of, 77 Nash informed of, 22, 371, 373

voting for, 370-72

Nobel Prize in literature, 357 Nobel Prize in peace, 357 Nobel

Prize in physics:

-----1209

1943,41

1963,53 nonexpanding universe, 380, 382 nonlinear partial
differential equations,

217-20, 223-24, 226, 231, 234, 243,

247,300,3J8

non-zero-sum games, 87

Norfolk and Western Railroad, 28, 104, 323 North, Douglass, 354,
363

North Carolina, University of, 148

NSF (National Science Foundation), 107, 236,296,313,314 nuclear
weapons, 56-57 game theory and, 119

hydrogen bomb, 81, 93, 109, 110 Manhattan Project and, 56, 81,
107, 110,

153,193

RAND and, 104- 5, 106, 109, 119, 121 number theory, 21, 35, 45,
56, 346

see also

Riemann Hypothesis numerology, 334-35, 350

Office of Naval Research (ONR), 123, 124,

125,126,219,313,314

-----1210

Office of the Chief of Ordnance, 56 Ohlin, Bertil, 359

ONR (Office of Naval Research), 123, 124,

125,126,219,313,314 Operation Match, 319 Index

operations research, 56

Oppenheimer, Robert, 19, 50, 53, 79, 193 hydrogen bomb and, 81,
93, 109

on IAS, 215

McCarthyism and, 110, 153 Nash's argument with, 220-21

Nash's IAS appointments and, 296, 308, 311

on Nash's sanity, 294

Oskar II, king of Sweden and Norway, 129 Ostrowski, Alexander, 303

Otis, William, 305

Pais, Abraham, 221

Palais, Richard, 231-32, 313, 317, 319, 321 Palme, Olof, 3 59,

364 parabolic equations, see nonlinear partial differential equations

Parker, Charlie, 156 Parker Brothers, 76, 78 Parmet, Belle, 307

partial differential equations, 137-38 nonlinear, 217-20, 1211
 223-24, 226, 231, 234,243,247,300,318
 Partial Differential Relations
 (Gromov),
 158
 Patri, Angelo, 33 Peisakoff, Melvin, 72, 126
 Personalit
 1v
 of Criminals, The
 (Stearns), 261 Persson, Torsten, 362, 364, 367
 Pitts, Walter, 134 Plath, Sylvia, 211, 255 Plato, 94
 Poincar6, Jules Henri, 12, 45, 93, 129 Polya, George, 230
 Portugal, 290 Post, Emil, 180 Poundstone, William, 76, 106, 119
 "Preliminary Design of an Experimental World-Circling
 Spaceship0106 Princeton, N.J.
 history of, 49
 as mathematics capital, 50-51 Princeton University, 45
 description of, 50
 -----1212
 dinner at, 61-62
 graduate housing at, 61-62 history of, 51 student life at, 61-62
 Princeton University mathematics department games played at,
 75-78 girls absent from, 62 grades as fiction at, 60
 Nash offered one-year post at, 309-10,
 311, 312
 Nash's fellowship to, 46
 Nash's graduate work at, 45-47, 49, 58-
 98
 philosophy of education at, 60-61 rise of, 52-57, 58
 students of, 64-65 teatime at, 63, 67 Principia
 (Newton), 85
 Prisoner's Dilemma, 118-19, 150 Prisoner Dilemma
 (Poundstone), 76
 Private TerrorlPublic Places (Glass), 335 "Probl6me de Cauchy
 Pour les Equations
 Differentielles d'une Fluide G6tion6rale, Le0ggNash), 297
 Prospect High School, 192
 -----1213
 William Lowell Putnam Mathematics Competition, 43-44, 72, 144
 Pythagoras, 94 -
 Pythagoras'Trousers
 (Wertheim), 334
 quantum theory, 45, 70, 81, 138, 202, 220-

221, 222-23, 236

Queen MaFy,

265, 269, 282, 311-12

Rademacher, Hans, 246

Radio Corporation of America (RCA), 283,

341

Raiffa, Howard, 122

Ramanujan, Srinivasa, 12,45, 60-61 RAND Corporation, 72, 100,

103, 104-23,

124,147-51,321,363

description of, 105-7, 111-12

game theory and, 104-5, 108, 111, 115-122, 149-51
 location of, 108
 Nash's dismissal from, 184-89 Nobel deliberations and, 366
 practical jokes at, I
 -----1214

II
 "RAND Hymn, The0ggReynolds), 104 Randoll Burton, 286
 rational conflict and cooperation, theory of, 13
 Raymond, Sister, 193-94
 RCA (Radio Corporation of America), 283, 341
 Reboul, Mark, 332 Red Cross, 191 Reed-Solomon code, 144
 Reiderneister group, 69 relativity, 45, 56
 general theory of, 52, 70, 86, 380 special theory of, 51-52, 70, 86, 231 Reynolds, Donald V., 36, 37 Reynolds, Malvina, 104
 Ricardo, David, 88 Richardson, Gillian, 297 Rider College, 345, 351
 Riemann, Georg Friedrich Bernhard, 12, 129,157,230
 Riemann Hypothesis, 19, 20, 138, 229-32, 236,238,241,243,277 Nash's presentations on, 245-46, 251
 -----1215
 Riemannian manifolds, embedding of, 155-63,203,204,218,219,345
 Rigby, Fred D., 125, 126
 Risperadol, 384 Roberts, John, 376, 377 Robinson, Julia, 38
 Rockefeller, Nelson, 336 Rockefeller Foundation, 53,84 Rogers, Adrienne, 223
 Rogers, Hartley, 76, 223, 241 Roosevelt, Franklin D., 56 Rose, Wickliffe, 53 Rosenberg, Ethel, 110, 185 Rosenberg, Julius, 110, 185 Rota, Gian-Carlo, 59, 162, 220, 223, 236 Nash's McLean commitment and, 257 and onset of Nash's schizophrenia, 241, 251
 Rota, Terry, 223 Roth, A], 150, 362 Roth, Maus K, 226 Rothschild, Michael, 374 Rousseau, Jean-Jacques, 273
 Royal Swedish Academy of Arts and Letters, 357
 Royal Swedish Academy of Sciences, 356-373
 secrecy of, 357
 seealso
 -----1216

Nobel Prize in economics Rubinstein, Ariel, 354-55, 360, 362
 Rudolf, Archduke, 191

Russell, Bertrand, 14, 35, 118 Russell, Henry Norris, 51 Russell,
Lindsay, 172
Rutgers University, 346
Sabin, Betty, 195
SAC (Strategic Air Command), 121 Sacco, Nicola, 261
Sackel, Manfred, 293 St. Paul's church, 302
Salazar, Antonio de Oliveira, 290 Samuelson, Paul A., 55, 86,
265, 375 on MIT, 133, 134
on Nash's parsimony, 232-33 Nobel awarded to, 55, 358, 360 at
RAND, 108, 117 Santa Monica Evening Outlook,
108, 184,

187

A1216

Samak, Peter, 349 Sartre, Jean-Paul, 15, 271 Sass, Louis A., 18,
295 Sayles, John, 28
Schell, Haskell, 250, 251
Schelling, Thomas C., 111, 115-16, 122

-----1217

in Nobel deliberations, 363, 364 schizophrenia, 15-19, 324
achievement impaired by, 318-19 causes of onset of, 126, 188
creativity and, 15-16
as episodic illness, 345 extreme contrariness" in, 271 genius and,
19

Glass on, 278

Haslam's description of, 275 insensitivity to pain in, 328-29
negative symptoms of, 328, 352 studies on remission in, 351-53
suicide and, 308, 352, 353

see also

Nash, John Charles Martin; Nash, John F., Jr.

Schl5fli, Ludwig, 157 Schneider, Mark, 333

Schwartz, Jacob, 159-60, 162, 231 Scott, Frank L., 302, 306

Scott, T. H., 124 Segal, Irving E., 103

index

Selberg, Atle, 229, 230, 232, 241, 245, 296,
297, 312

IAS membership arranged by, 308 visiting

-----1218

positions sought through, 309 Selten, Reinhard, 98, 354, 362, 374
at 1961 conference, 297

Nobel deliberations on, 363, 364, 371, 373

Serling, Rod, 301 Serre, Jean-Pierre, 312

set theory, axiomatization of, 81 Shapiro, Harold N., 147, 245,
367 Shapley, Harlow, 39, 100, 152

Shapley, Lloyd S., 39, 99-103, 112, 113,

117, 119, 120, 122, 152, 208, 321,

388

in Econometric Society, 354 Nash's arrest and, 187

on Nash's illness, 299-300

in Nobel deliberations, 363, 364 remission noted by, 350

von Neumann prize arranged by, 338-

339, 354

Sheldon, Elizabeth, 27-28 Shelley, Mary Wollstonecraft, 27 3

Shelley, Percy Bysshe, 269 Sherman, Agnes, 284 Sherman, Michael,
284 Sherman Institute,

-----1219

26

Shubik, Martin, 63, 101, 102, 120, 208, 286 in Econometric Society, 354, 355

Nobel deliberations and, 366 Siegel, Carl Ludwig, 226 Siegel, George, 43, 45 Siegel, Robert, 42 Simon, Herbert, 108, 117

Singer, Isadore M., 142, 144-45, 162, 203 Nash's McLean commitment and, 260 singularities, canonical resolution of, 318

Slater, J. C., 222-23

Sloan Fellowships, 202, 236, 280 Smith, Adam, 15, 88, 119, 151, 374-75 Smith (Nash), Martha (grandmother), 26 Social Democratic Party (Sweden), 359, 364, 366

Sohlman, Michael, 357 Solomon, Gustave, 144, 180 "So A1219
Long, Sucker;` 102 Solow, Robert, 134, 232, 233 Sophocles, 94
Soviet Union, 109, 110, 118, 119, 121 special theory of
relativity, 51-52, 70, 86 Spencer, Donald, 93, 129-30, 131, 132,
-----1220
141,285,291,295 Carrier Clinic visits of, 307 description of, 130
IAS appointment obtained through, 296 Michigan position arranged
by, 303, 304 Moore visited by, 341
Sputnik,
106, 222
Stahl Ingemar, 362, 364-72 Stahl: Ingolf, 362
Stanton, Alfred H., 259 Starr, Norton, 344
Stearns, A. Warren, 261, 265
Steenrod, Norman, 64, 68, 69, 92, 93, 96,
129,131,137,204,229 Forrester and, 204 Kriegspiel played by, 76
Nash defended by, 73 Nash's job search and, 132
as sounding board for Nash, 71-72 Stein, Eli, 224, 229, 231, 232,
233, 237 Stelazine, 315, 329
Stern, Otto, 41 Sternberg, Shlomo, 216 Stevenson, Adlai, 140
Stier, Eleanor, 172-79, 199, 201, 208, 296,
327-28
-----1221
Alicia Larde's meeting with, 201-2 background of, 173
Bricker and, 177, 178, 181, 182, 206-7 John Charles Nash's stay
with, 345 Nash confronted by, 201
Nash's parents and, 206, 208, 209, 210 Nash's recent meeting
with, 387 Nash's renewed contact with, 315-16 Nash's support of,
207, 282, 330-31 pregnancy of, 175-76 support demanded by, 206-7
Stier, John David (son), 176-79, 201, 206-
210,282,321,326 brief reconciliation with, 344, 345 college plans
of, 344
John Charles Nash's first meeting with,
344
John Charles Nash's stay with, 345 recent reconciliation with,
386-87 renewed contact with, 315-16 Stiglitz, Joseph, 375
Stirling's formula, 350 Stone, Marshall, 55 Storr, Anthony, 15,
18
Strategic Air Command (SAC), 121 Stratton, Julius, 244
Struik, Dirk, 152
Stuyvesant High School, 142, 237 Suez
-----1222
crisis, 217
Sullivan, Harry Stack, 259 Summers, Lawrence, 375 surreal

numbers, 158 Surviving Schizophrenia
(Torrey), 324 Svenson, Lars, 364, 367
Synge, Hutchie, 281-82
Synge, John L., 41, 44, 46, 217, 281 -
282
Synge, John Millington, 41 Szasz, Thomas, 305 Szilard, Leo, 56
Tate, John, 64, 239, 242, 311 Tate, Karin, secArtin, Karin (Tate)
Taylor, Sir Hugh, 62, 73
Tech, The,
153, 190 Teller, Edward, 193 tensor calculus, 380
Texas Agricultural and Mechanical University, 26-27

Th6orie des Fonchons A1222

(Borel), 81

Th6orie des Nomhres

(Legendre), 230

Theory of Games and Econornic Beha vior,

-----1223

The

(von Neumann and Morgenstern), 81, 85, 86, 87, 88, 90,

94,96-97,116,363

Thinking Strategically

(Dixit and Nalebuff),

97,375

This Side of Paradise

(Fitzgerald), 49 Thom, Ren6, 226 Thompson, F. B., 117 Thompson,

John, 236

Thorazine, 250, 258, 260, 306, 307 Thorson, Ervin, 170-71, 174,

204 Thurmer family, 281

Time,

3 2

Tobin, James, 360 Tobin, Joseph, 291 topology, 46, 56, 64, 68, 69

algebraic, 59, 68

see also

manifolds, algebraic

Torrey, E. Fuller, 324

Trenton State Hospital, 287, 288-94, 302,

306,344,383

-----1224

Trial, The

(Kafka), 327

Trotter, Hale, 334, 337, 338, 350, 384 Troutman, Nelda, 170

Truesdell, Charlotte, 48 Truesdell, Clifford Ambrose, 47 Truman,

Harry S., 49, 62, 109, 123, 185 Tsuang, Min, 351, 352-53

Tucker, Albert, 69, 72, 75, 76, 137, 272,

285-86,291,312,338 Alicia Nash's pregnancy announced to,

235

Carnegie mathematics impressive to,

42

Carrier Clinic visits of, 307 description of, 95

game theory and, 64-65, 77, 83, 90, 91, 100,118,119,362 Michigan

position arranged by, 303 Nash defended by, 73, 74, 236 as Nash's

advisor, 92, 95-96

Nash's draft deferment and, 125, 202 Nash's job search and, 132

ONR grant of, 126 on Shapley, 103 as straitlaced, 64

Thkey, John, 62, 76 turbulence, 218-19

Turing, Alan, 56, 107, 188, 189 Tversky, Amos, 373

TwilightZone, 301

"Two Person Cooperative Games0ggNash), 120

two-person zero-sum games, 14, 87, 95, 96,

115,116,119

"Veber die Anzahl derphinzahlen unter einergegebenen Grosse"

(Riemann),

230

Uitti, Karl, 297-98, 310 Ulam, Stanislaw, 217 unified field

theory, 70 United Mine Workers (UMW), 28 United Nations, A1225
 192, 248-49
 United Nations High Commission for Refugees, 274
 universe, nonexpanding, 380, 382
 Index
 Vallcius, 94
 Vanzetti, Bartolomeo, 261
 Vasquez, A], 240, 244-45, 257,
 -----1226
 264, 299,
 314
 on Nash's decline, 319, 320 on Nash's improvement, 317
 Nash's 1959-60 European stay and, 281, 282
 Vaught, Robert, 205 Veblen, May, 49 Veblen, Oswald, 49, 50, 53,
 54, 56 Veblen, Thorstein, 15, 50
 Villard, Henry S., 278 Viner, Jacob, 86 Voltaire, 273
 von Neumann, John, 12, 19, 28, 45, 46, 50,
 52,59,63,74,215,216,270 background of, 81 death of, 217
 on decline of mathematical powers, 228 description of, 79-82
 Dr. Strangelove
 and, 80, 105
 game theory and, 13-14, 81, 83-87, 88, 90, 91, 92, 93-94, 95,
 96-97, 98, 100,
 111, 115, 116, 117-18, 119, 128, 149,
 150,362,363
 -----1227
 hydrogen bomb and, 81, 93, 109, 110 Kriegspiel played by, 76
 Manhattan Project and, 81, 107 Nash's meeting with, 93-94
 at RAND, 105, 106, 109, 111, 117-18,
 122
 recruited to Princeton, 53-54 on Shapley, 100
 John von Neumann Theory Prize, 338-39,
 354
 Wachtman, Jack, 43 Waggoner, Ray, 303 Walker, Nelson, 37 Wallace,
 A. D., 69 Wallace, Henry, 62 Wallenberg family, 368 Walter, John,
 205 Wan, Henry, 265 Warhol, Andy, 41 Warsh, David, 366
 Washington, University of, 203-5 Martha Washington College, 27
 Washnitzer, Gerard, 64 Way Ministry, 343 Weibull, Jbrgen, 356,
 360-61, 362, 363
 at Nobel ceremonies, 379, 380 Nobel deliberations and, 365, 366
 Weil, Andre,
 -----1228
 236

Weinberger, Hans, 42, 43, 44-45 Weinstein, Alexander, 41
Weinstein, Tilla, 217, 218 Weissblum, Walter, 144 Wertheim,
Margaret, 334
West, Andrew, 61 Westinghouse, 41
West Virginia University, 27
Weyl, Hermann, 52, 53, 54-55, 74, 157 Whitehead, George, 135,
141, 162, 163,
252
Moore visited by, 341 Whitehead, Kay, 252 Whiteman, Paul, 193
White Oak naval research project, 47 Whitney, Hassler, 55, 203,
266, 282 Wiener, Norbert, 12, 16, 28, 5 5, 129, 134,

137,142,202,218,235,307 description of, 135-36 A1228
 Nash's esteem for, 145, 146, 200 Nash's McLean commitment and,
 260
 Nash's 1959-60 European stay and,
 277
 Nash's professorship and, 162-63 Wiener,
 -----1229
 Theo, 136
 Wigner, Eugene, 50, 53-54, 56 Wilczek, Frank, 333
 Wilder, Raymond, 69 Wiles, Andrew, 203, 386 Wilks, Sam, 56
 William Lowell Putnam Mathematics Competition, 43-44, 72, 144
 Williams, John, 38-39, 83, 111, 112, 113, 114, 116-17, 119, 124, 170
 Nash's dismissal and, 185-86, 187,
 188
 Will to Power, The
 (Nietzsche), 139 Wilson, James Q., 261
 Wilson, Robert, 376, 377 Wilson, Woodrow, 51, 52-53, 61 Winokur,
 George, 351, 352-53 Winters, Robert, 291, 303, 304
 Wirtschaftsprognose
 (Morgenstern), 84 Wittgenstein, Ludwig, 15, 66 Wohlstetter, A],
 121 Wordsworth, William, 5, 11, 25 World Citizen Registry, 271
 World Federalists, 271
 Worldly Philosophers, The
 -----1230
 (Heilbroner),
 89
 World War 1, 27
 World War 11, 35-36, 39, 107, 124, 193 mathematics and, 55-57,
 100 Yale University, 51, 246-47
 Zariski, Oscar, 318
 zero-sum two-person games, 14, 87, 95, 96,
 115, 116, 119
 Zeuthen, Dane F., 89
 Zur Theorie der Gesellschaftspiele (von Neumann), 84
 Zweifel, Paul, 42, 43 Zyprexa, 384 Photo Credits
 1-7: Courtesy of Martha Nash Legg. 8-12, 21, 22: Courtesy of John
 D. Stier.
 13-16, 18, 19, 23: Courtesy of Alicia Nash.
 17: Adriano Garsia; courtesy of Alicia Nash.
 20: Courtesy of Richard Nash.
 24, 25: Pressens Bild.
 26: Dick Pettersson,
 -----1231

Upsala Nya Tidning.