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 0fulympian 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
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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
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A former economics correspondent for
The Ncw York Timcs,
SYLVIA NASAR is
the Knight Professor of Journalism at Columbia University. She
lives in Tarrytown, New York.
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er

shadows and radiant light effects ... simply a beautiful
A8
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- The Economist
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"A magnificent biography."- Roy Weintraub,
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"High drama." comWade Roush,
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- Richard Wyatt and Kay Jamison,
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- Kenneth Arrow, Nobel Laureate,
The Times Higher Education Supplement
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V-
IIUR ALICIA ESTHER LARDE NASH Another race hath been, and ot

her
palms are won. Thanks to the human heart by which we live, T
hanks
----------------------------------------------------------------
---16
to its tenderness, its joys, and fears,
To me the meanest flower that blows can give Thoughts that d
o
often lie too deep for tears.
com11MLLIAM WORDSWORTH,
"Intimations of Immortality"

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"ere the statue stood
  A20
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OfNewton 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 machi
ne --
had been sitting with his visitor, also a mathematician, for

nearly half an hour. It was late on a weekday afternoon in t
he
spring of  1959, and, though it was only May,
uncomfortably warm. Nash was slumped in an armchair in one c
orner
of the hospital lounge, carelessly dressed in a nylon shirt
that
hung limply over his unbelted trousers. His powerful frame w
as
slack as a rag doll's, his finely molded features expression
less.
He had been staring
dully at a spot immediately  in front of the left
foot of Harvard professor George Mackey, hardly moving excep
t 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 c
ould
you,"bbgan
--------------------------------------------------------------
---22
Mackey, "how could you, a mathematician, a man devoted to re
ason
and logical proof... how could you believe that extraterrest
rials
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 s

tare
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 mathemat
ical
ideas did. So I took them seriouslydd"I
The young genius from Bluefield, West Virginia -- handsome,
arrogant, and highly eccentric comburst onto the mathematica
l
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, economi
c
rivalry, computer architecture, the shape of the universe, t
he
geometry of imaginary spaces, the mystery of
-------------------------------------------------------------

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 k
inds:
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
A23
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,

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
Nietzschedd7 Computers and science fiction were his passions. He
considered "thinking machinesea"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 performancedd9 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



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 A30
best response to the other players` best
-------------------------------------------------------------------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 hirnself. 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 Ren6 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,



contends that an individual who "fears love almost as much as he fears hatred" may ti-im 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
A33
rewards, Storr speculates:
Some creative people ... of predominately schizoid or depres
sive
temperaments ... use their creative capacities in a defensiv
e
way. If creative work protects a man from mental illness, it
 is
small wonder that he pursues it with avidity. The schizoid s
tate
... is characterized by a sense of meaninglessness and futil
ity.
For most people, interaction with others provides most of wh
at
they require to find meaning and significance in life. For t
he
schizoid person, however, this is not the case, Creative act
ivity
is a particularly apt way to express himself ... the activit
y is
solitary
---------------------------------------------------------------
---34
... [but] the ability to create and the productions which re
sult
from such ability are generally regarded as possessing value
 by
our society.,, Of course, very few people who exhibit "a lif
elong
pattern of social isolation"and "indifference to the attitud
es
and feelings of others"-the hallmarks of a so-called schizoi
d
personality- possess great scientific or other creative
talentdd"Andthe vast majority of people with such strange an
d
solitary temperaments never succumb to severe mental illness
dd14
Instead, according to John G. Gunderson, a psychiatrist at
Harvard, they tend "to engage in solitary activities which o
ften
involve mechanical, scientific, futuristic and other non-hum
an
subjects ... [and] are likely to appear increasingly comfort
able
over a period of time by forming a stable but distant networ
k of
relationships with people around work tasks."" Men of scient
ific
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



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
36
uncanny metamorphosis, Norbert Wiener among them, grasped it
s
true significance."
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 th
ree
decades, Nash suffered from severe delusions, hallucinations
,
disordered thought and feeling, and a broken will. In the gr
ip of
this "cancer of the mind," as the universally dreaded condit
ion
is sometimes called, Nash abandoned mathematics, embraced
numerology and religious prophecy, and believed himself to b
e a
"messianic figure of great but secret importance." He fled t
o
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 brillia
nt
graduate student, oddly dressed, muttering to himself, writi
ng
mysterious messages on
-------------------------------------------------------------
---37
blackboards, year after year.
The origins of schizophrenia are mysterious. The condition w
as
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 industr
ial
agedd19 Roughly
1 percent of the population in all countries succumbs to xdd
10
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 -- ha

s 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.0"Ffthe person experiencing early symptoms, there is a dislocation of every faculty, of time, space, and body." None of its symptoms comhearing voices, bizarre delusions, extreme apathy or agitation, coldness toward others comis, taken singly, unique to the illnessdd"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 disabilityfar more severe, on average, for men -- varies wildly.

The symptoms can be "slightly, moderately, severely, or
A38
absolutely disablingea"ac to Irving Gottesman, a leading
contemporary researcher." Though Nash succumbed at age thirt
y,
the illness can appear at any time from adolescence to advan
ced
middle agedd19 The first episode can last a few weeks or mon
ths
or several yearsdd41 The life history of someone with the di
sease
can include only one or two episodes
.41
Isaac Newton, always an eccentric and solitary

soul, apparently suffered a psychotic breakdown with paranoi
d
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 s
eries
of high public positions and to receive many honors. More of
ten,
as happened in Nash's case, people with the disease suffer m
any,
progressively more severe episodes that occur at ever shorte
r
intervals. Recovery, almost never complete, runs the gamut f
rom a
level tolerable to society to one that may not require perma
nent
hospitalization but in fact does not allow even the semblanc
e of
a normal lifedd41
More than any symptom, the defining characteristic of the il
lness
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"f individuals who seem "total
ly
strange, puzzling,
inconceivable, uncanny and incapable of empathy,

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 unpredictableea41
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 bedd46 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 he
lp,
and learned to write sophisticated computer programs.
Schizophrenia is also distinct from manic depressive illness

(currently known as bipolar disorder), the illness with whic
h 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 schizoph
renia
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 fi
rst
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 i
t
"not an escape from reason but an exacerbation of that
thoroughgoing illness Dostoevsky imagined ... at least in so
me of
its
-------------------------------------------------------------
---42
forms ... a heightening rather than a dimming of conscious
awareness, and an alienation not from reason but from emotio
n,
instincts and the willdd049
Nash's mood in the early days of his illness can be describe
d,
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 s
igns
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

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addressed as "a great necromancer and numerologistea"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 numerological 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 A43
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 anguis
h."
While Nash the man remained frozen in a dreamlike state, a
phantom who haunted Princeton in the 1970's and 1980's scrib
bling
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---45
on blackboards and studying religious texts, his name began
to
surface everywhere-in economics textbooks, articles on
evolutionary biology, political science treatises, mathemati
cs
journals. It appeared less often in explicit citations of th
e
papers he had written in the 1950's than as an adjective for

concepts too universally accepted, too familiar a part of th
e
foundation of many subjects to require a particular referenc
e:
"Nash equilibrium,0"Nash bargaining solution Nash program,0"
De
Giorgi-Nash result,0"Nash embedding Nash-Moser theorem;` "Na
sh
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 wi
th
apparently no new fundamental mathematical theorems beyond t
hose
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
46
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

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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."

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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, Bombleri 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
A48
theory. Sometimes we talked in my office. Sometimes over cof
fee
in the dining hall. Then we began corresponding by e-mail. I
t'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 k
nown.
In this case, not. He looks
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---49
at things from a slightly different angle. A spontaneous rec
overy
from schizophrenia comst widely regarded as a dementing and
degenerative disease comis so rare, particularly after so lo
ng
and severe a course as Nash experienced, that, when it occur
s,
psychiatrists routinely question the validity of the origina
l
diagnosisdd61 But people like Dyson and Bombieri, who had wa
tched
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 thi
s
intellectual Olympus would have become privy to these
developments, dramatic as they appeared to Princeton insider
s, if
not for another scene, which also took place on these ground
s 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 N
ash's
closest friend, caught up with him at the
doordd61
Kuhn had telephoned Nash at home earlier that
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day and suggested that the two of them might go for lunch af
ter
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 personalitydd"ation 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
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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, Johnea" he began. Nash, as usual, refused to look Kuhn in the face at first,

staring instead into the middle distance. Kuhn went
A51

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, Johnea"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

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1928-45

I was taught to feel, perhaps too much The self-sufficingpower ofsolitude.

- WILLIAM WORDSWORTH

AMONG JOHN NASHS 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



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 honey
moon,
hinted
at certain qualities in the couple, no longer in the first b
loom
of youth, that set them somewhat apart from the rest of soci
ety
in this small American town, John Forbes Nash, Sr., was "pro
per,
painstaking, and very serious, a very conservative man in
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---54
every respect", according to his daughter Martha Nash Leggdd
bled
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 we
st
from New England and the Deep South.` He was born in 1892 on
 his
maternal grandparents' plantation on the banks of the Red Ri
ver
in northern Texas, the oldest of three children of Martha Sm
ith
and Alexander Quincy Nash. The first few years of his life w
ere
spent in Sherman, Texas, where his paternal grandparents, bo
th
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, th
e
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 hi
s
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 institu
tions
of higher learning, was
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unhappy. The unhappiness stemmed largely from his parents`
marriage. Martha Nash's obituary refers to "many heavy burde
ns,
responsibilities and disappointments, that made a severe dem
and
on her nervous system and physical forcedd06 Her chief burde
n was
Alexander, a strange and unstable individual, a ne'er-do-wel
l and
a philanderer who either abandoned his wife and three childr
en
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 an
d to
instill in his youngest son a deep and ever-present hunger f
or
respectability. "He was very concerned with appearances `"hi
s
daughter Martha later said of her father; "he wanted everyth
ing
to be very proper."`
John Srdd`s mother was a highly intelligent, resourceful wom
an.
After she and her husband separated, Martha Nash supported
herself and her two young sons and daughter on her own, work
ing
for many years as an administrator at Baylor College, anothe
r
Baptist institution for girls, in Belton, in central Texas.
Obituaries refer to her "fine executive ability"and
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---56
"remarkable managerial skill." According to the Baptist Stan
dard,
"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 descr
ibed
as an "efficient and devoted"mother, but her constant strugg
le

against poverty, bad health, and low spirits, along with
A56
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.

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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 whippetthin. 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 incredulitydd9

Like her husband, Virginia grew up in a family



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 car 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
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---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 t
alent
that she would later lavish on her gifted son. Like her husb
and,
she had seen something beyond the small towns of her home st
ate.
Before her marriage, she and another Bluefield teacher, Eliz
abeth
Shelton, spent several summers traveling and attending cours
es at
various universities, including the University of California
at
Berkeley, Columbia University in New York, and the Universit
y of
Virginia in Charlottesville.
When the newlyweds returned from their honeymoon, the couple

lived at the Tazewell Street house with Virginia's mother an
d
sisters. John Sr. went back to his
job at the Appalachian, which in those years consisted large
ly of
driving all over the state inspecting remote power lines.
Virginia did not return to teaching. Like most school distri
cts
around the country during the 1920's, the Mercer County scho
ol
system had a marriage bar. Female teachers lost their jobs a
s
soon as they married." But, quite apart from
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---60
her forced resignation, her new husband had a strong feeling
that
he ought to provideflo This wife and protect her from what he

regarded as the sbame of having to work, another legacy of h
is
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 com"the wildest, most rugged and romantic country to
 be
found in the mountains of Virginia or West Virginia"-that
surround the remote little citydd"Norfolk and Western, in a
spirit of "mean force and ignoranceea"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 Pocaho
ntas
coal seam. For a long time, Bluefield was a rough and ready
outpost where Jewish merchants, African-American constructio
n
workers, and Tazewell County farmers struggled to make a liv
ing
and where millionaire coal operators, most of whom lived ten

miles away in Bramwell, battled Italian, Hungarian, and Poli
sh
immigrant laborers, and John L. Lewis and the UMW sat down w
ith
the coal operators to negotiate contracts,

negotiations that often led to the bloody strikes and lockou
ts
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 teacher
s." A
real downtown of granite office buildings and stores had spr
ung
up. Handsome churches bad also gone up all over town. Snug f
rame
houses with pretty little gardens edged by Rose of Sharon do
tted

the hills. The town had acquired a daily newspaper, a
A61
hospital, and a home for the elderly. Educational institutio
ns,
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 scholarsea"z John Nash lat
er
said with more than a hint of ironydd"Xs bustling commercial
ism,
Protestant
------------------------------------------------------------
---62
respectability, and small-town snobbery couldn't have been
further removed from the atmosphere of the intellectual hoth
ouses
of Budapest and Cambridge which produced John von Neumann an
d
Norbert Wiener. Yet while John Nash was growing up, the town
had
a sizable group of men with scientific interests and enginee
ring
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 h
igh
school or one of the two local colleges. In his autobiograph
ical
essay, Nash described "having to learn from the world's know
l-
edge 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 multiface
ted
mathematician, not to mention a certain pragmatism of charac
ter,
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 middl
e
class, they formed a tight alliance and devoted themselves
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---63
to achieving financial security and a respectable place for themselves in the town's social pyramiddd16 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
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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

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

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



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



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

He was a singular little boy, solitary and introverteddd17 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

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,



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 housewifedd"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 eriroll at Bluefield College to take courses in
English, science, and math. John Sr4'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
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---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



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

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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 Bluefieldd17 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

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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 nightea"Martha said. "They thought it was very important in helping make him well rounded.



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

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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, th

at
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 i
t 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.
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---76
32
The earliest hint of Johnny's mathematical talent, ironicall
y,
was a B-minus in fourth-grade arithmetic. The teacher told
Virginia that Johnny couldn't do the work, but it was obviou
s to
his mother that he had merely found his own ways of solving
problems. "He was always looking for different ways to do
thingsea"his sister commenteddd31 More experiences like this

followed, especially in high school, when he often succeeded
 in
showing, after a teacher had struggled to produce a laboriou
s,
lengthy proof, that the proof could be accomplished in two o
r
three elegant steps.
There is no sign of a mathematical pedigree in Nash's ancest
ry or
any indication that mathematics was much in the air at the N
ash
household. Virginia Nash was literary. And for all his inter
est
in contemporary developments in science and technology, John
 Sr.

was not well-versed in abstract mathematics. Nash does not A76
recall ever discussing his later research with his fatherdd14
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

occurred when Nash at around age thirteen or fourteen read E. T
Bell's extraordinary book,
Men of Mathemddqtics-an
experience he alludes to in his autobiographical essaydd"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 comand, as it turns out, not entirely accurate
combiographical sketchesdd16 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"z a "slovenly dreamer
totally devoid of common sensedd"He assured his readers that the
great mathematicians of history were an exceptionally virile and
even adventuresome breed.

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 Pascaldd"I' 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



whose life was "quiet, laborious and uneventfulea"t caught Nash's eyedd31 The main interest of Fermat, who shares the credit for inventing calculus with Newton and analytic geometry with Descartes, was number theory com"the higher arithmeticdd"Number theory "investigates the mutual relationships of those common

whole numbers, 1, 2, 3, 4, 5 ... which we utter almost as
A79
soon as we learn to talk."
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 medd19
Nash does not describe his feelings when he
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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 pdd41 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 rifledd42 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

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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
A84
Brainsdd046 Once some boys in the neighborhood
tricked him into a boxing match and he took a beatingdd47 Bu
t
because he was tall, strong, and physically courageous, the
teasing only rarely degenerated into outright bullying. He r
arely
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
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---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 m
y
way." Occasionally the pranks got him into hot water. One
incident involving a small explosion in the high school chem
istry
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 f
rom
across the street, Donald Reynolds and Herman Kirchner, bega
n
fooling around with homemade
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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 happendd"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
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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 presi
dent
of the American Mathematical Society, said in her autobiogra
phy
that she believed that many mathematicians felt themselves t
o be
ugly ducklings as children, unlovable and out of kilter with

their more conventional, conforming peersdd14 Johnny's appar
ent
sense of superiority, his standoffishness, and his occasioil
al
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"t prevents other children with more soci
al
contact from feeling either unrealistically weak or
unrealistically powerfuldd"If he could not believe he was
lovable, then feeling powerful was a good substitute. As lon
g 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
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---88
school. With Virginia's encouragement, he took courses at
Bluefield College. He read voraciously, mostly futuristic fa
ntasy
books, popular science magazines, and real science textsdd16
"He
was just an outstanding problem solverea"his high school
chemistry teacher later told the
Blueandld Daily Telegraph.
"When I put a chemistry problem up on the blackboard, all th

e
students would get out a pencil and a piece of paper. John
wouldn't move. He would stare at the formula on the board, t
hen
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 pape
r.""
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 he
roes
out of scientists, Johnny's classmates assumed he was slated
 to
become onedd58
In high school, Nash became friendly -- though not close fri
ends
-- with a couple of fellow students, John Williams and John
Louthan, both sons of Bluefield College professors. The
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three rode a public bus to school together and Johnny helped

Williams with Latin translations. Williams recalled, "We wer
e
attracted to him. He was an interesting guy. That was sort o
f it.
I don't think we ever went over to John's house. It was pret
ty
much of a school thingdd059 The three also constantly maneuv
ered
to get out of their classes as much as possible. Before the
widespread use of the SAT's, college recruiters routinely ca
me 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 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
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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.
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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

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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 6migr6, the 1943 Nobel Prize
for physicsdd7

Nash's engineering aspirations did not survive his first

semester, killed off by an unhappy experience in mechanical drawing: "I reacted negatively to the regimentationea"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 equipmentdd9 He was so bored at his summer job at the Westinghouse Lab that he spent most of his two

months there making and polishing a brass egg in the lab's machine shopdd10 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.0"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 com Synge wore a black patch over one eye and a filter that protruded from one of his nostrils comhe was a man of great charm who attracted younger scholars like Richard Duffin, Raoul Bott, and Alexander Weinstein, a European 6migr6 whom Einstein had once invited to become a

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 Gaussdd015 He took courses in tensor
calculus comthe mathematical too] used by Einstein to formulate
the general theory of relativity comand relativity from Synge.
16
Synge was impressed with Nash's originality and his appetite for
difficult problemsdd"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

fait acomplidd11
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
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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 tea

sed.
That he was envied for his size and his brains only fueled t
he
teasing. "He was the butt of people's jokes because he was
differentea"recalled George Hinman, a physics studentdd28 "H
ere
was a guy who was socially underdeveloped and acting much
younger. You do what you can to make his life miserable` "Zw
eifel
admitted. "We tormented poor John. We were very unkind. We w
ere
obnoxious.
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---99
We sensed he had a mental problem."
29

That first summer, Nash, Paul Zweifel, and a third boy spent
 an
afternoon exploring the subterranean maze of steam tunnels u
nder
Carnegie. In the dark, Nash suddenly turned to the others an
d
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 adolesc
ents,
Nash discovered that he was attracted to other boys. He spok
e and
acted in ways that seemed natural to him only to find himsel
f
exposed to his peers' contempt. Zweifel and other boys in th
e

dormitory started calling Nash "Homo"and "Nash-Mo."""Once
  A99
the statement was made"George Siegel said, "it stuck. John t
ook 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 doordd"Another time, Zwei
fel
and a few others, knowing of Nash's extreme aversion to ciga
rette
smoke, rigged up a contraption that smoked an entire pack of

cigarettes and collected the smoke. "A bunch of us crowded a
round
John's door and blew the smoke under itea"Zweifel recalled.
"Almost instantaneously, his room filled up with cigarette
smokedd014 Nash exploded in rage. "He came roaring out of hi
s
room, picked up Jack [Wachtman], and threw him down on the b
ed
`"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 h
ow.
He wasn't practiced in invective, sarcasm, or ridicule, so h
e
went for childish displays of contempt. "'You stupid fool; h
e'd
sayea"Siegel recalled. "He was openly contemptuous of people
 who
he didn't think were up to his level intellectually. He show
ed
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 Ski
bo
Hall, the student centerdd31 Like the fairground magician wi
th
his swords, he would sit in a chair and challenge other stud
ents
to throw problems at him to solve. A lot of students came to
 him

with their homework. He was a star comb 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 deansdd17 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.

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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



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 stoodea"said Harold Kuhn recently. "It was always important to be in the clubdd019 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
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autobiography that the Putnam still rankled and implied that the failure played a pivotal role in his graduate careerdd40 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 frowningdd41 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-

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

boardea"said Duffin. "See if you can get me out of
105
troubledd"Nash leaped up and strode to the boardd d41
"He was infinitely more sophisticated than the rest of usea" said
Bott. "He understood the difficult points naturally. When Du ffin
got stuck, Nash could back him up. The rest of us didn't
understand the techniques you needed in this new mediumdd041
"He
always had good examples and counterexamplesea"another stude nt
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 p roved
it indirectly using the principle of contradiction. That's w hen
you show that if something's not there, something dreadful w ill
happen. Don't know if Nash had ever heard of Brouwerdd041
Nash took Duffin's course in his third and final year at
Carnegie. At nineteen, Nash already had the style of a matur e
mathematician. Duffin recalled, "He tried to reduce things t o
something tangible. He tried to relate things to what he kne w
about. He tried to get a feel for things before he actually tried
them. He tried to do little problems
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with some numbers in them. That's how Ramanujan, who claimed he
got his results from spirits, figured things out, Poincar6 s aid
he thought of a great theorem getting off a
busdd046
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 co uld
see him thinking. Others would be sitting there with their n ose
in a bookdd041 Weinberger recalled that "Nash knew a lot mor e
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
maddd041
"Diophantine equations were his loveea"recalled Siegel. "None of
us knew anything about them, but he was working on them then
dd049
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,
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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

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less-thanstellar 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 studentsdd 16 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,
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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 mathematicianea"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
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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 chorddd61

Something else weighed on Nash's mind that last spring at Carnegie. As graduation drew closer, he became more and more worried about being draftedd d61 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 11
---------------------------------------------------------------------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 Lefschetzdd64Nash 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 eventualitydd61

Though Nash did not display outward signs of



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 w
rite
something before
48

he left at the end of the summer. But Nash seemed to have tr
ouble
working. He made no apparent progress on any of the problems
he
had mentioned vaguely to Truesdell at the start of the summe
r,
and he never handed in a paper. At the end of the summer, he
was
forced to apologize to Truesdell for having wasted his timed
d68
Nash spent most of his days, evidently, simply walking aroun
d
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 thinkin
g,
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 itea"she said, "but he thought

about it a lotdd069
Princeton, Fall 1948
. . .
a quaint ceremonious village.
comALBERT Eiationsmm
...
the mathematical center of the universe. comHARALD

BoHR
J_ IASH 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,

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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
1930Sddbled
Depression and wars had scarcely changed the place, May Vebl
en,
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 gentilit
y.
One mathematician from the West recalled, "I always felt lik
e my
fly was opendd06
Even the university's mathematics building conjured
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up images of exclusivity and wealth. "Fine Hall is, I believ
e,
the most luxurious building ever devoted to mathematics", on
e
European 6migr6 wrote envioUS-LYDD7
It was a gabled, NeoGothic red brick and slate fortress, bui
lt in
a style reminiscent of the College de France in Paris and Ox
ford
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. Desi
gned
by Oswald Veblen, a nephew of the great sociologist Thorstei
n
Veblen, it was meant to be a sanctuary that mathematicians w
ould
be "loath to leave.", The dim stone corridors that circled t
he
structure were perfect for both solitary pacing and mathemat
ical
socializing. The nine "studies"-not offices!-for senior
professors had carved paneling, hidden file cabinets, blackb
oards
that opened like altars, oriental carpets, and massive,
overstuffed furniture. In a gesture to the urgency of the ra

pidly
advancing mathematical enterprise each office was equipped w
ith a
telephone and each lavatory with a reading light. Its
well-stocked
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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 w
ere
nearby) didn't have to go home before returning to their off
ices
comthere was a locker room with showers. When its doors open
ed in
1921, an undergraduate poet called it "a country club for ma
th,
where you could take a bath."
Princeton in 1948 was to mathematicians what Paris once was
to
painters and novelists, Vienna to psychoanalysts and archite
cts,
and ancient Athens to philosophers and playwrights. Harald B
ohr,
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 W
ar
11, it was in Princetondd"Fine Hall housed the world's most
competitive, up-to-the-minute mathematics department. Next d
oor
-- connected, in fact --
was the nation's leading physics department, whose members,
including Eugene Wigner, had driven off to Illinois, Califor
nia,
and New Mexico during the war, lugging bits of laboratory
equipment, to help build the atomic bombdd"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, G6del, 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

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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 place0"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

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 researchea"Lefschetz

recalled. "In the beginning we had no quarters. Everyone worked
at homedd011 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
A120
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
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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 "irrelevantdd011
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 G6menttingen, 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
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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 motiondd19
At around the same time, at the University of Gatingen, 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 11axiomatization of all of
mathematics so that it could be mechanized and solved in a
routine mannerdd"G6menttingen 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
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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 mechanicsea"b 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.0"The catalyst for Princeton's transformation into a world capital of

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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 s
ome
top-notch scientists, among them mathematicians G. D. Birkho
ff,
Oswald Veblen, and Luthor Eisenhart, to teach graduate stude
nts.
They were known around Princeton as

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"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 afte
r the
dean's premature death in 1928 in a cycling accident on Nass
au
Street had it not been for several dramatic instances of pri
vate
philanthropy that turned Princeton into a magnet for the wor
ld's
biggest mathematical stars. Most people think that America's
 rise
to scientific prominence was a by-product of World War IL Bu
t in
fact the fortunes accumulated between the gilded eighties an
d 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 an
d its
representatives started to give away some of the money, they
 were
animated by dissatisfaction with the state of higher educati
on in

America and a firm belief that
A125

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"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

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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,

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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
 A128
pressures of the outside world. Flexner toyed with the idea
of
making a school of economics the core of the institute but w
as
soon persuaded that mathematics was a sounder choice since i
t was
more "fundamental." Furthermore, there was infinitely greate
r
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 th
e
international band of academic superstars Flexner
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hoped to recruit. Princeton was more like it. Legend has it
that
it was Oswald Veblen who convinced the Bambergers that Princ
eton
really could be thought of ("in a topological senseea"z he p
ut
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 independ
ence.
His undertaking coincided with Hitler's takeover of the Germ
an
government, the mass expulsion of Jews from German universit
ies,
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 bec
ome
the center for the natural sciences." Kurt Gbdel, the Vienne
se
wunderkind of logic, came in 1933 as well, and Hermann Weyl,
 the
reigning star of German mathematics, followed Einstein a yea
r

later. Weyl insisted, as a condition of his acceptance, that the
Institute appoint a bright light from the next generation. Von
Neumann,
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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"0the late 1940'sdd16 Its legendary
chairman G. D.
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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
A131
Study. Einstein had used to complain around the Institute that
"Birkhoff is one of the world's great academic
anti-Semitesdd"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 11 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 Il 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 Japandd"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 Atlanticdd33
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
Ordnancedd14 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
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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"Wigne
r at
Princeton and Leo Szilard at Columbia composed a letter, whi
ch
they brought to Einstein to sign, warning President Roosevel
t
that a German physicist, Otto Hahn, at the Kaiser Friedrich
Institute in Berlin had succeeded in splitting the uranium a
tom.
Lise Meitner, an Austrian Jew who was smuggled into Denmark,

performed the mathematical calculations on how an atomic bom
b
could be constructed from these findings. Niels Bohr, the Da
nish
physicist, visited Princeton in 1939 and transmitted the new
s.
"It was they rather than their American born colleagues who
sensed the military implications of the new knowledge," wrot
e
Davies. Roosevelt responded by appointing an
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advisory committee on uranium in October 1939, two months in
to
the war, which eventually became the Manhattan Project.
The war enriched and invigorated American mathematics, vindi
cated
those who had championed the 6migr6's, and gave the mathemat

ical 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
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research. journals

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"andthe 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 com the
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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. Bu

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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

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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 degreesggeabled 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 A138
parties. But Lefschetz had overcome
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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"f Princeton. "My years in the west
with total
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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 heredd09 Legend had it that he never wrote a correct proof or stated an incorrect theoremdd10 His first comprehensive treatise on topology, a highly influential book in which he coined the term "algebraic topology,0"hardly contains one completely correct proof. It was rumored that it had been written during one of Lefschetz` sabbaticals ... when his students did not have the opportunity to revise itdd"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

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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 mathematicianea"he told one student.0"Let a Princeton barber cut your hairea"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,
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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
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bureaucracy. Lefichetz was not exaggerating when he said that the
department had no course requirements. The department offere

d
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
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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

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Indian mathematician Ramanuian, 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 Ramanuian 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



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

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
envisioneddd19 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,

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



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

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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 al
lowed
to join the larger group was Saturday lunch in the Breakfast

Room.
In short, social life was rather enveloping comx would be ha
rd to
become really lonely-and at the same time limited to other m
en,
in Nash's case specifically to other mathematicians. The par
ties
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 studen
ts at
Lefschetz's request to entertain some visitor but actually t
o get
his
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students much-needed job contacts. 16
The quality, diversity, and sheer volume of mathematics talk
ed
about in Princeton every day, by professors, Institute
professors, and a steady stream of visitors from all over th
e
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 we
re
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, w
here
most of the mathematicians lived, as well as the daily after
noon

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
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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.

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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,

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. Tucke r 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 a 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



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

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
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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"which 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,



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



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-downdd"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 doingddbled 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 outdd"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

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eighteenth-century mathematics, nowadays taught in advanced courses on the theory of complex variablesdd6

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 aristocracyea"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 gooddd08 He once asked Davis whether Davis had grown up in a slum.

Nash appeared to be interested in almost everything mathematical comtopology, algebraic geometry, logic, and game theory-and he seemed to absorb a tremendous amount about each of these during his first yeardd9 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
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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.
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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
Mo and let
Mi equals G, (MO)
be the Grassmann variety of tangent k-planes to Mo. Then Vo lifts
naturally to a k-dimensional variety Vi c Mi. Continuing
inductively, we obtain a sequence ofk-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.)"
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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
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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 be 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

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 Reiderneister group based on homotopy chainsdd021 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 problemsea"said Milnor.

"He really cross-examined people on what were the important
167
problems. It showed a tremendous amount of ambition."", In t
his
search, as in so much else, Nash displayed an uncommon measu
re of
self-
confidence and self-importance. On one occasion, not long af
ter
his arrival at Princeton, he went to see Einstein and sketch
ed
some ideas he had for amending quantum theory.
That first fall in Princeton, Nash sometimes took a slight d
etour
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 clapb
oard
house at 112 Mercer Street to his office at the Institute. O
n
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 imagin
ed
how he might strike up a conversation, stopping Einstein in
his
tracks with some startling observation." But once when he pa
ssed
him walking with Kurt G6del, Nash caught snatches of German
and
sadly wondered whether his own lack of that language might
constitute an
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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 propa
gated
in space not as waves but as discrete particles. The general

theory of relativity appeared in 1916. Astronomers' confirma
tion
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

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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."

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,
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Nash made an appointment to see

Einstein in his office in Fuld Hall. He told Einstein's assistant that he had an idea that he wished to discuss with Professor Einsteindd19 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 sp

oke,
Nash became aware of a mild form of echolalia: deep, deep,
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interesting, interestingdd41
Nash had an idea about "gravity, friction, and radiationea"z 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
wellldd41
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 fruitfuldd41 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
172
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 beholdendd041 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 crimedd46 Steenrod also happened to be friendly, helpful, and patient.
He was immensely impressed by Nash, found him more
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charming than not, and treated the young man's brashness and eccentricity with amused tolerancedd41 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 themselvesea"said one fellow student. "He liked to exchange ideasdd041 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 boydd49

In his freshman year, in a differential geometry course taught by Albert Tucker, be 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 assignmentdd"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

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can't find itdd"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 Anndd7]ness 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 scholarshipgg.51
Nash was choosy about whom he would talk mathematics with. M
elvin
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
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having a conversation about mathematics. Even fhe full profe
ssors
would discuss problems they were working on with other peopl
e.""
On one occasion in the common room, however, Nash was sketch
ing
an idea when another graduate student got very interested in
 what
he was saying and started to elaborate on the ideadd"Nash sa
id,
"Well, maybe I ought to write a Note for the
Proceedings of the NNa] Academy
on thisdd"The other student said, "Well, Nash, be sure to gi
ve me
a creditdd"Nash's reply was, "All right, I'll put in a footn
ote
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 friendea"Calabi recalled. "I don't know many people wh
o
felt any warmth for himdd014 Most of the graduate students w
ere
slightly odd ducks themselves, beset by shyness, awkwardness
,
strange mannerisms, and all
kinds of physical and psychological tics, but they collectiv
ely
felt that Nash was even odder. "Nash was out of the
ordinaryea"said a former graduate
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student from his time. "If he was in a room with twenty peop

le,
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]dd016
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 such4'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 persondd011
His sense of humor was not only childish but odd.

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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 weeks
dd611
In the spring of 1949, Nash ran into some trouble
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.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
eccentricea"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



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 fellowshipdd61 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.

A179

Princeton, Spring 1949

JOHN 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

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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?0"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

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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



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
languagedd6 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
comwas 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
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and Kriegspiel, the latter frequently with Steenrod or Tukey
dd9
He was by no means a brilliant player, but he was unusually
aggressivedd"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 agodd"I I 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 oversightea"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."" 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
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to have been entirely independentdd14
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
A184
else, had it not been for another graduate student named Dav
id
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 Grad
uate
College.
16
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Gale, Kuhn, and Tucker ran the weekly game theory seminar. N
ow a
professor at Berkeley and the editor of a column on games an
d
puzzles in
The MddblegtheMdd76671;Intelligencer,
Gale is an aficionado of mathematical puzzles and games. Nas
h
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 gri
d and
then abruptly challenging whoever was dining across the tabl
e to
solve some puzzle. (This is exactly what Gale did when he sa
w
Nash for the first time after a fifty-year hiatus at a small

dinner in San Francisco to celebrate Nash's Nobeleagg17
One morning in late winter 1949, Nash literally ran into the
much
shorter, wiry Gale on the quadrangle inside the Graduate Col
lege.
"Gale! I have an example of a game with perfect informatione
a"he
blurted out. "There's no luck, just pure strategy. I can pro
ve
that the first player always wins, but I have no idea what h
is
strategy will be. If the first player loses at this game, it
's
because he's made a mistake, but nobody knows what
-----------------------------------------------------------------
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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 diagonalea"he saiddd"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 boardea"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 wellldd"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
roorndd14
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 wo
uld
never sell. It was a marvelous game though. I then sent it o
ff to
Parker Brothers, but I never got a response."" Gale is the o
ne
who suggested the name Hex in his letter to Parker Brothers,

which Parker used for the Dane's game. (Kuhn remembers Nash
describing the
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game to him, very likely over a meal at the college, in term
s 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 toodd27
Milnor still has a board that he made for his childrendd"His

poignant essay on Nash's mathematical contri butions for the

MathematicalIntelliaencer,
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 firmamen
t and
the apostle of the new mathematical era. At forty-five, he w
as
universally considered the most cosmopolitan, multifaceted,
and
intelligent mathematician

the twentieth century had produced.` No one was more
A189
responsible for the newly found importance of mathematics in America's intellectual elite.
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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 Neumannea"Harold Kuhn recalledddbled Nash was to come under his spell.` Possibly the last true polymath, von Neumann made a brilliant career comhalf 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 programsdd6 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
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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 wasworldly and engaged. Hardy abhorred politics, considered applied mathematics repellent, and saw pure mathematics as an esthetic pursuit best practiced f

or its own sake, like poetry or musicdd9 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 Commissiondd"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.



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 A192
Place were "frequent and famous and long," according to Paul

Halmos, a mathematician who knew von Neumanndd"His rapid-fire
repartee in any of four languages was packed with references to
history, politics, and the stock marketdd19
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
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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 firstdd010
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.pddh. At the same

time, a fly that travels at a steady 15 m.pddh. 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 ho

ur
after they start so that the fly had just an hour for his travels; the answer must therefore be 15 miles.
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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!0"What trickea"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
precociousdd"At age eight, be 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,
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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 nineteendd14By 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 axiornatization of set theory. Later he found the first mathematically rigorous proof of the ergodic theorem, solved

Hilbert's socalled 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 tbree-quarters dimension). He was also a leader in the drive

among mathematicians to colonize other disciplines by inventing new approachesdd16Von Neumann was still in his twenties when he wrote his famous paper on the theory of parlor games and his

groundbreaking
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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



explosion with nuclear fuel, an idea credited with shortening the time needed to develop the bomb by as much as a yeardd19 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.

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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

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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

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

The invention of deliberately oversimphfied theories is one

of
the major techniques ofscience, particularly of the "exact"
sciences, which make extensive use ofmathernatical analysis
Ifa
biophysicist can usefidly employ simplified inodels of the
celland the cosmologist simplified models of the universe th
en we
can reasonably expect that simplibed games mayprove to be us
eful
models for more complicated conflicts. comJoHN WILL-IAms,
The
Compleat Strategyst
I
11ASH 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 hum
an
rationality.
The first edition of
The Theory of Games and Economic Behavior by von Neumann and

Oskar Morgenstern came out in
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1944.1 Tucker
was running a popular new seminar in Fine on game theory.` T
he
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 milit
ary
orientation, as "trivial;` "just the latest fadea"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 spe
akers
in Tucker's serninar.` Nash was intrigued by the apparent we
alth
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 cliqu
e."`
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Mathematicians have always found games intriguing. Just as g
ames
of chance led to probability theory, poker and chess began t
o
interest mathematicians around G6menttingen, the Princeton o
f 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 GcselIschaftspiele, 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 ef
fect
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 give
n
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 fermentdd16 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 t
ime,
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--203
angling for, but never receiving, an appointment there. "The
re is
a spark missing," he wrote disdainfully to a friend, referri
ng 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 o
f the
economy was a futile endeavor." One reviewer called it as
disremarkable for its pessimism as it is for any ... theoret
ical
innovationdd"19 Unlike those in astronomy, economic predicti
ons
have the peculiar ability to change outcomes." Predict a
shortage, and businesses and consumers will react; the resul
t 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 decis
ions,
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
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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, specifica
lly
in problems of exchange of goods between two or more persons
, in
problems of
The Theojy of Games
monopoly, oligopoly and free competition. It was in a discus
sion

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



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
A205
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 mathernatization, using his invention of
the
calculus, of physicsdd"One reviewer, Leo Hurwicz, wrote, "Te
n
more such books and the future of economics is assuredddO19
The essence of von Neumann and Morgenstern's
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message was that economics was a hopelessly unscientific
discipline whose leading members were busily peddling soluti
ons
to pressing problems of the day-such as stabilizing employme
nt
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 economi
c
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 rea
lly
are.""
Instead of pretending that they had the expertise to solve u
rgent
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


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
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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 cha

irman
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
bibleea"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
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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 withdd46 More important, the best-developed part
of the theory comwh took up one-third of the book comcccerned

zero-sum two-person games, which, because they are games
 A210
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 incompletcdd41 He couldn't prove
that a solution existed for all such gamesdd49 The last eighty
pages of
The Theory ofGames and Economic Behqvior 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 deficitdd10 As one commentator was
later to write, "This artifice helped but did not suffice for a

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/tateea7. ?- 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.

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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 solutiondd2 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
213
interact, or how they would split up the pieddbled
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
mathe-
matical tradition of physics, writes Robert Heilbroner in
The Worldly Philosophersdd6
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 quqntities
and because anything that dealt with quantities could be translated into
mathernaticsdd1
Edgeworth thought of people as so many profit-and-loss
calculators and recognized that the world of perfect competition
had "certain properties peculiarly
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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 mathemat

ical
models captured the results of competition, but the consequences
of cooperation proved elusivedd9
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
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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, includ
ing
the Englishmen John Hicks and Alfred Marshall and the Dane F
.
Zeuthen, took up Edgeworth's problem, but they, too, ended u
p
throwing up their handsdd"Von Neumann and Morgenstern sugges
ted
that the answer lay in reformulating the problem as a game o
f
strategy, but they themselves did not succeed in solving it.
"
Nash took a completely novel approach to the
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problem of predicting how two rational bargainers will inter
act.
Instead of defining a solution directly, he started by writi
ng
down a set of reasonable conditions that any plausible solut
ion
would have to satisfy and then looked at where they took him
.
This is called the axiomatic approach -- a method that had s
wept
mathematics in the 1920's, was used by von Neumann in his bo
ok 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 o
ne 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 was
n't
enough information so one had to make additional assumptions
.
Nash's theory assumes that both sides` expectations about ea
ch
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 opportuni

ty
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--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 conditi
ons
would any solution comany split comh to satisfy? He then pos
ed
four conditions and, using an ingenious mathematical argumen
t,
showed that, if his axioms held, a unique solution existed t
hat
maximized the product of the players' utilities. In a sense,
 his
contribution was not so much to "solve" the problem as to st
ate
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 t
hat
it provides an answer to an important problem. Reading Nash'
s
paper today, one is struck most by its originality. The idea
s
seem to come out of the blue. There is some basis for this
impression. Nash arrived at his essential idea-the notion th
at
the bargain depended on a combination of the negotiators' ba
ck-up
alternatives and the potential benefits of striking a deal c
omz
an undergraduate at Carnegie Tech before he came
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to Princeton, before he started attending Tucker's game theo
ry
seminar, and before. he had read von Neumann and Morgenstern
's

book. It occurred to him while be was sitting in the only
A218
economics course be would ever attend.
16
The course, on international trade, was taught by a clever a
nd
young Viennese
6migr6
in his thirties named Bert Hoselitz. Hoselitz, who emphasize
d
theory in his course, had degrees in law and economics, the
latter from the University of Chicagodd"International agreem
ents
between governments and between monopolies had dominated tra
de,
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 s
pring
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 theori
st at
Northwestern University, in
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1996.11 One of Nash's axioms, if applied in an international

trade context, asserts that the outcome of the bargain shoul
dn't
change if one country revalued its currency. Once at Princet
on,
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 applicabilit
y."
Very likely Nash sketched his ideas for a bargaining solutio
n in
Tucker's seminar and was urged by Oskar Morgenstern -- whom
Nash
invariably referred to as Oskar La Morgue -- to write a pape
r."
Legend, possibly encouraged by Nash himself, soon had it tha
t
he'd written the whole paper in Hoselitz's class commuch as
Milnor solved the Borsuk problem in knot theory as a homewor
k
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:

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"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

1 was playings non-cooperative game in rebtion to von
A220
Neumann rather than
simply seeking to join his coalition. comJoHN F NA-SH, JR.,
1993
IN
THE SUMMER OF
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--221
1949, Albert Tucker caught the mumps from one of his childre
n.`
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, w
hen
Nash walked in to ask whether Tucker would be willing to
supervise his thesis.
Nash's request caught him by surprise.` Tucker had liffle di
rect
contact with Nash during the latter's first year and had bee
n
under the impression that he would probably write a thesis w
ith
Steenrod. But Nash, who offered no real explanation, told Tu
cker
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-z tradition demanded of men who h
ad
just passed their generals.` The mathematicians were growing
more
boisterous and drunken by the minute. A limerick
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--222
competition was in full swing. The object was to invent the
cleverest, dirtiest rhyme a`0
a member of the Princeton mathematics department, preferably

about one of this ones present, and shout it out at the top of
one's lungsdd"At one point, a shaggy t Scl
aptly named Macbeath jumped to his feet, beer bottle in hand, and
began to b4ilt 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 breaststShe said, `Young man, I like that
best`/ggChorus) 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
Spencerdd7 The whole nerve-racking event had gone

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
Poincar6 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 li ke 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

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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 compuiers, 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 A225
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
ldeviqted somewhat from the Wne'ggz ifof (mliticalpanv 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 fivedimensional unified theory of gravitational and electric fields but later supported its publicationdd"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

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David Gale. "I think I've found a way to generalize von Neumann's min-max theoremea"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.0"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. "Hmmea"he

said, "that's quite a thesisdd"Gale realized that Nash's
A228
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 disarmamentea"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
resultea"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 thatea"Gale said
recently, "so he gave me his proof and I drafted the NAS
notedd"Lefschetz submitted the note immediately and it appeared
in the November proceedingsdd19 Gale added later, "I certainly
knew right away that it was a thesis. I didn't know it was a

Nobeldd010
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
machineea"implying that Tucker was methodical but

unimaginativedd"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 be] ieved 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 braindd"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 caseea016 Tucker said. The recommendation, to his mind, was largely esthetic. "W,n you deal with the general case you have to deal with sophisticated notation that is very hard to readea"he saiddd"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 timeea"Tucker recalled."

Nash was actually considering dropping the thesis with Tucker and pursuing another topic, an ambitious problem in algebraic geometry, with Steenrod insteaddd19 He chose to interpret Tucker's demands for revisions-along with von Neumann's coldly dismissive reaction-z 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 comand to make the requested changes. "Nash had an answer for everythingea"he said. "You couldn't catch him out in a

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mathematical fault.0"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.0"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 th

e
changedd011
The entire edifice of game theory rests on two theorems: von Neumann's min-max theorem of 1928 and Nash's equilibrium theorem of 1950.11 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 worlddd14 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

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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
 A233
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 tha
t
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 Dix
it
and Barry Nalebuff in
Thinking Strategical]
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--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 ch
oose
to do and vice versa. Games like tic-tac-toe and chess invol
ve
one kind of interdependence. The players move in sequence, e
ach
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 respon
d to
his current move, how he will respond in turn, and so forth.
 The
player anticipates where his initial decision will ultimatel
y
lead and uses the information to make his current best choic
e. In
principle, any game that ends after a finite sequence of mov
es
can be solved completely. The player's best strategy can be
determined by looking ahead to every possible outcome. For c
hess,
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 resul
tant
positions on the basis of experience.
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Games like poker, on the other hand, involve simultaneous mo
ves.

"In contrast to the linear chain of reasoning for sequential games, a game with simultaneous moves involves a logical circleea"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



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
 A236
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
coms long as one allows mixed strategies. But some

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 biologydd19 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 Pqlgrave,
"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.0"O 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 inevitabledd41 As Reinhard Selten, the German
economist who shared
the 1994
Nobel with Nash and John C. Harsanyi, said: "Nobody would ha

ve
foretold the great impact of the Nash equilibrium on economi
cs
and social science in general. It was even less expected tha
t
Nash's equilibrium point concept would ever have
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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 Neumanndd43
Lloyd
Prfnceton, 1950
All mathematicians live in two different worlds. They live i
n a
crystalline world ofperfectplatonic forms An ice palace But
they
also live in the common world where things are transient,
ambiguous, subject to vicissitudes. Mathematicians go backwa
rd
and forward from one world toanother. Thev-e ddults in the
crystalline world, Jufmts in the real one. -- 5
CAPPELL,
Courant Institute ofMathematics, 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
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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
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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-communistsdd1
Lloyd Shapley was a war heroddbled 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

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 lotdd06
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 ownea"said another fellow student, "He
went out of his way to find nonstandard moves. No one was going
to anticipate themdd"He was also well read. He played the piano
beautifullyally, His manner suggested an acute awareness of
pedigree and prospects. When Lefschetz wrote him a letter telling
him of a very
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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.
Shapleydd011
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
horsedd"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 furydd14 His
perfectionism, which would later prevent him from publishing a
large portion of his research, was extreme." He was, moreove

r,
acutely self-conscious about being a few years older than so
me of
the brilliant young men around the Princeton mathematics
departmentdd16
Nash was one of the first students Shapley met at the Gradua
te
College. For a time, they shared a bathroom. Both of them
attended Tucker's game
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theory seminar every Thursday, now run by Kuhn and Gale whil
e
Tucker was at Stanford. The best way to describe the impress
ion
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 s
aw
comthe childishness, brattiness, obnoxiousness comb he saw a

great deal more. He was dazzled by what he would later descr
ibe
as Nash's "keen, beautiful, logical mind." 11 Instead of bei
ng
alienated like the others by the younger man's odd manner an
d
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 draw
n to
Shapley? In Nash's eyes, Shapley had it all. A brilliant
mathematician. War hero. Harvard man. A son of Harlow. Favor
ite

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
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around Princeton, other than Milnor, who could really hold N
ash's
attention in a mathematical conversation, challenge him, and
 help
him to pursue the implications of his own reasoning. And, fo
r
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 disrupti
ng
his beloved Kriegspiel games, sometimes by sweeping the piec
es to
the ground. He rifled through his mail. He read the papers o
n his
desk. He left notes for Shapley: "Nash was hereff"He played
all
kinds of pranks on him. Shapley's greatest eccentricity at t
he
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 disap
pear
from sight," another student recalled. "That's what he said.
 We
accepted anything.0"Waking Shapley when he was lost to the w
orld
became an ongoing prank. "A group of us was attending a regu
lar
seminar at the institute given by de Rham and Kodaira. We we
re
always very anxious to go but only three or four of us had c
ars.
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--245
Lloyd Shapley was one but there was one difficulty. Lloyd li
ked
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 with
out

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."
14
--------------------------------------------------------------246
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 intelligen
ce,
also befriended Shapley and apparently aroused Nash's jealou
sy.
One day McCarthy got an inquiry from a Philadelphia haberdas
hery
about a massive shirt order he had placeddd16 How good was h
is
credit, the company wanted to know? McCarthy, who hadn't pla
ced
any such order, immediately suspected Nash and asked Shapley
if
Nash was the culprit. Shapley confirmed that this was highly

likely. McCarthy asked the cornpany for the original order.
Sure
enough, a postcard came back with Nash's unmistakable
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scrawl in green ink, the color Nash always used. Shubik and
McCarthy cornered Nash and confronted him. "There was no den
ying
what he had done. We threatened him with postal inspectors.
The
post office refused to merely bawl him out. `If we do anythi
ng,
we'll prosecute him,` they saiddd"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 coversdd27
It was Shapley who reacted to Nash's absurd behavior with am
used
tolerance, who proposed that they might channel his mischiev
ous
impulses in a more intellectually constructive way. So Nash,

Shapley, Shubik, and McCarthy, along with another student na
med
Me] Hausner, invented a game involving coalitions and
double-crosses. Nash called the game comwh was later publish
ed
under the name "So Long, Sucker"-Fuck Your Buddy." The game
is
played with a pile of different-colored poker chips. Nash an
d 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
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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 anymoreea"Nash kept saying, over and overdd19

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
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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.

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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 yrnn,

TE
DC-3 SHOOK as
it droned past the desert and mountains toward the opaque Pacific
and water-colored sky. Los

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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
rumpled, 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
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War, started promisingly in the summer of 1950, just as the Korean War began, and ended traumatically in the summer of 1954, when McCartbyism 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.

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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. Strangeloved d1

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
254
nuclear strategyea6

[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

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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

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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
A256
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

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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 5 7, proved remarkably prescient. In "Preliminary Design of an Experimental World-Circling Spaceshipea"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

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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 codedd"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 chasesdd13

The recruitment of scientists by the military hadn't

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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 A259
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 Alamosdd14
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 toolsea"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,
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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 unthinkabledd"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.



Take Kenneth Arrow, one of the early Nobel Laureates in economics. When Arrow came to RAND in 1948, he was an unknown youngsterdd"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 1948ea"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
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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.
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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 opendd019 It was one of the most difficult buildings in the United States to get into, Fortune

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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 A264
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, stooddd"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
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von Neumann and Herman Kahn had shouting matches in the
hallwaysdd"There was a feeling around the place of "wanting to
outrun the enemy'"z a former RAND vice-president later
put xdd24
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 visiondd025
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 Uniondd16 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 weaponsdd"The shock was that they had

succeeded so quickly. Physicists and mathematicians, who were less



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 greatdd"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

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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 breachesdd14 Four years later, in April of 1954, Robert Oppenheimer, the former head of the Manhattan Project, the director of the

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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 publicitydd"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 Qsdd37
Everybody needed a top-secret clearance. People who arrived without a temporary security clearance were
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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, He
rman
Kahn, and Thomas Schellingdd411
Everyone had a safe in his office for storing classified
documents, and everyone was warned about taking documents ou
t of
the building or talking out of

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--270
schooldd41 Papers had to be put in the safes at the end of e
very
day. There were spot checks. There was a public address syst
em
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. Wit
hout
a doubt, fear about potential leaks brought to a boil many
simmering antagonisms against individuals and groups who pos
ed
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 Eisenh
ower
guidelines.
Like the decade itself, RAND had a split personality. Its st
yle
was informal. It tolerated quirky people. It was in some way
s
more democratic

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than a university. Almost everyone, including von Neumann, w
as

called by his or her first name, except by the guards, never

Doctor or Professor or Sir. Graduate students rubbed shoulde
rs
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 see
n in
a suit and tie. All but one or two of the mathematicians,
including Nash, came to work in short-sleeved shirts. Appear
ances
were so casual that one mathematician, who found it all very

d6class6, felt obliged to rebel by wearing a three-piece sui
t and
a tie to the office every daydd41 Practical jokes were as mu
ch a
part of the RAND culture as pipes and crewcuts. Mathematicia
ns
and physicists mixed rubber bands into the pipe tobacco,
substituted dog biscuits for cookies, and tilted desks so pe
ncils
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
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funny little cartoon figures and full of jokey examples star
ring
John Nash, Alex Mood, Lloyd Shapley, John Milnor, and other
members of the math department

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A272
The mathematicians were, as usual, the freest spiritsdd46 Th
ey
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 summ
er
and continued to insist on the sanctity of his sleep cycle,
was
rarely seen before midafn. Another man, an electrical engine
er
named Hastings, typically slept in the "shop" next to his be
loved
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 Kriegspie
l,
usually in total silence, occasionally punctuated by a wrath
ful
outburst from Shapley, who frequently lost his temper over a
n
umpire's or opponent's error. Even though the games typicall
y
lasted well into the afternoon, they were
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--273
rarely finished and finally reluctantly abandoned midgame. P
oker
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 prob
lems
encountered by researchers, picking up problems to solve as
the
spirit moved themdd47 People would drift into each other's
offices or, more frequently, simply stop to chat in the corr
idors
near the coffee stations. The grids and courtyards of RAND's

permanent headquarters comto which the mathematics group mov
ed in

1953, the year before Nash's final summer at RAND-were designed,
by John Williams, as it happens, "to maximize chance
meetingsdd0411 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 appeardd49 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` conventi
onal
wisdom in late-night, 125-mile-an-hour drives along the Paci
fic
-----------------------------------------------------------------
--275
Coast Highway.
Williams's approach to management would have made him very m
uch
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 w
as a
great believer in basic research. He was a very relaxed
administrator. That's why people thought the math division w
as
pretty weirdddd011 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 thinkin
g
we'd like
to bid for systematically is that which you spend shaving: w
e'd
like you to pass on to us any ideas that come to you while s
o
engageddd011 When Williams first arrived, RAND was a tiny an
nex
inside a mammoth Douglas Aircraft factory where thirty thous
and
workers punched time cards every day. Williams was the one w
ho
freed the mathematicians from the clock and then proceeded t
o
demand coffee and blackboards for his mathematicians, explai
ning
that not providing these would guarantee that none of them w
ould
produce anything worthwhile. After RAND and Douglas Aircraft

parted company, Williams went further. He
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insisted that the building be open twenty-four hours a day
instead of just between eight and five. He got private offic
es.

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

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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 ftom 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
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force and maintenance crew found Nash an entertaining subjec
t.
They would watch him as he left the building walking north o
n
Fourth Avenue. On several occasions some of them complained
to a
RAND manager that they had seen Nash tiptoing exaggeratedly
along
the avenue, stalking flocks of pigeons, and then suddenly ru
shing
forward, "trying to kick `em."``
We hope [the theory ofgamesst will work, just as we hoped in
1942
that the atomic homb would work. comAN-ONymous PENTAGON SCIE
NTIST
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 Bro
adway
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
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strategists, and economists at RAND had focused almost
exclusively on games of total conflict commy win is your los
s 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 wer
e
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 mutu
al
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-t
acit,
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 b
e
usefully applied to real-life military and economic conflict
s,
one
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--283
had to focus on games that allowed for cooperation as well a
s
conflict. "Everybody was already bothered by the zero-sum
gameea"Arrow recalled. "You're trying to decide whether to g
o to
war or not. You couldn't say that the losses to the losers w
ere
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 Econ
omic
Behavior and the few that didn't, like John Kenneth Galbrait
h
writing in
Fortune
and Carl Kaysen, later director of the Institute for Advance
d
Study, turn out to have had significant contact with militar
y
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

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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 scientistsdd"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
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mathematical underpinning for a theory of human conflict and

spread to disciplines other than mathematics. Williams convi
nced
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 Girsc
hick,
and economists Paul Samuelson, Kenneth Arrow, and Herbert Si
mon."
Most of the RAND military applications of game theory concer
ned
tactics. Air baffles between fighters and bombers were model
ed as
duelsdd14 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 f
or
being hit. The question is when to fire. There's a tradeoff.
 By
waiting a little longer each opponent improves his own chanc
e of
scoring a hit, but also increases the risk of being
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shot down. Such duels can be both noisy and silent. With "si
lent
gunsea"the duelist doesn't know the other has fired unless h
e 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 theo
ry
research between the fall of 1947 and the spring of 1949 giv
es
the flavordd"The mathematicians describe a problem of stagge

red
attacks in a bombing mission:
Problem A single intercepter 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 I bombers including A,
bomb carriers on the first attack and t minutes later he sends
N2 equals
N -- N, bombers including A2 equals A
--------------------------------------------------------------------287
comA, 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 (0eaAggI -- I 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
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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
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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

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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

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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 strate gy.

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

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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 ingenio
us
argument for selecting a unique stable equilibrium that coin
cides
with the bargaining solution he previously derived axiomatic
ally.
He showed that each player had an "optimal"threat, that is,
a
threat that ensures that a deal is struck no matter what str
ategy
the other player chooses.
Nash initially wrote up his results in a RAND memorandum dat
ed
August 3 1,
1950, suggesting that he managed to finish the paper just be
fore
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. Acc
epted
for publication sometime during the following academic year,
 "Two
Person Cooperative Games"did not in fact appear
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until January 1953.11 It was Nash's last significant contrib
ution
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 sto
pped
working in the field in 1950. The dominant thrust of game th
eory
at RAND came from the mathematicians, particularly Shapley,
and
they were guided less by applications than by the mathematic
s
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
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what was probably RAND's single most influential strategic study.
The study was the brainchild of Also 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 theredd"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



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 dismissile 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
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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 u
pon."
14
The golden age at RAND, from the point of view of the
mathematicians, strategic thinkers, and economists, was alre
ady
coming to a closedd35 After a time, RAND's sponsors grew les
s
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 retur
ned
after the summer of 1954. Flood left for Columbia University
in

1953. Von Neumann, who in any case had played a very small r
ole
in the group after inspiring it, dropped his RAND consultanc
y in
1954 when he accepted an appointment as a member of the Atom
ic
Energy Commission.
Game theory, in any case, was going out of vogue
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--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 hav
e
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 ma
de
their solution a practical matter of a few years' work. This
has
not turned out to be the case."" The military strategists we
re of
the same mind. "Whenever we speak of deterrence, atomic
blackmail, the balance of terror ... we are evidently deep i

n
game theoryea"Thomas Schelling wrote in 1960, "yet formal ga
me
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
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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 ye
ar in
Princeton. Tucker had arranged for his support by assigning
him
to teach a section of undergraduate calculus I and making hi
m a
research assistant on his Office of Naval Research grant.` I
n
fact, Nash intended to devote most of his energy to his own
research and to looking for an academic opening for the foll
owing
fall. But before he could turn to these matters, he was forc
ed to
confront an immediate threat to his career plans, namely, th
e
Korean War.
North Korea had invaded the South on June 25, 1950, about th
e

time that Nash was flying to Santa Monica.` A week later
 A300
Truman promised to send American troops to repel the invasio
n.
The first reinforcements landed July 19. By July
31, Truman had issued an order to the Selective Service to c
all
up one hundred thousand young men right away, twenty thousan
d
immediately. A week or two later, John Sr. and Virginia wrot
e
that Nash might be in imminent danger of being
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drafted. Like most Republicans, they disliked Truman and had

their doubts about the war. They urged Nash to come to Bluef
ield
as soon as practical to talk with members of the local draft

board personally to sound them out about a II-A. Surely, the
y
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 Cambridgeddbled 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. Wit
h a
war on, even an unpopular and undeclared war, who knew how l
ong
he would have to serve? Any interruption of his research cou
ld
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 brill
iant
youngsters clamoring for the handful of instructors hips. Hi
s
game theory thesis
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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

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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 11-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 11-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



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 A305
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
organizN`"adding, however, that in all likelihood "this will not
be necessary.0"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 11.11 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 11.11 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. His 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 researchersdd14 None of the life events known to produce mental disorders such as depression or anxiety neurosis comcombat, death of a loved one, divorce, loss of a job comh 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

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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

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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

[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`l Apparently, the
board had simply postponed the designation for active service
until June 30, 195 1. 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 mathematicsea"x 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 manifoldiSdd0bled

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

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 comsch 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
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of intuitive threads that have to be woven together. And som
e 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 pap
er
ready before the annual job market got under way in February
,
urged Nash to go to Donald Spencer, the visiting professor w
ho
had been on Nash's generals committee and had just been hire
d
away from Stanford, and to use Spencer as a sounding board f
or
completing the paper."
As a visiting professor, Spencer occupied a tiny office sque
ezed
between Artin's huge corner office and an equally grand stud
y
belonging to William Feller. Spen-
cer, as Lefschetz wrote to the dean of faculty, was "probabl
y the
most attractive mathematician in America at that momentea"z
well
as "one of the most
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versatile American born mathematicians."
14

A doctor's son, Spencer grew up in Colorado and was
A316
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 coauthordd"Spencer did brilliant work in complex analysis, a branch of pure mathematics that has widespread engineering applicationsdd16 He was a much sought-after collaborator, his most celebrated collaboration being with the Japanese mathematician Kunihiko Kodaira, a Fields medalistdd17 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.0"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 comand still talk circles around

-------------------------------------------------------------------317

other mathematiciansdd"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.0"B 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
thoughtfullydd"He also liked Nash for not being a whiner. Na
sh
never talked about himself, Spencer recalled. "Unlike other
students

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who felt underappreciated`"he said, "Nash never complaineddd
"The
more he listened to Nash, moreover, the more Spencer appreci
ated
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 hav
e
thought of this problem."
Many breakthroughs in mathematics come from seeing unsuspect
ed
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 an
d 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,
A318
on the surface of a cube). His "nice discovery," essentially
, was
that these objects were more manageable than they appeared a
t
first glance because they were in fact closely related to a
simpler class of objects called real algebraic varieties,
something previously unsuspected.
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--319
Algebraic varieties are, like manifolds, also geometric obje
cts,
but they are objects defined by a locus of points described
by
one or more algebraic equations. Thus x1
plus
y' equals I represents a circle in the plane, while xy
equals
I represents a hyperbola. Nash's theorem states the followin
g:
Given any smooth compact k-dimensional manifold M, there exi
sts a
real algebraic variety Vin R11 plus 1 and a connected compon
ent
Wof Vso that Wis a smooth manifold diffeomorphic to
M14
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 Sci
ences
in 1996 were to write: "It had been assumed that smooth
----------------------------------------------------------------
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manifolds were much more general objects than varieties.0"Td
,
Nash's result still impresses mathematicians as "beautiful"a
nd
disstriking"-quite apart from any applicability. "Just to
conceive of the theorem was remarkable," said Michael Artin,

professor of mathematics at MITDD16 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 b
y
only minor differences to trace evolutionary patterns,
mathematicians seek to fill in the gaps in the continuum bet
ween
bare topological spaces at one end and very elaborate struct
ures
like algebraic varieties at the other. Finding a missing lin
k in
this great chain comz Nash did with this result comopened up
 new
avenues for solving problems. "If you wanted to solve a prob
lem
in topology, as Mike and I didea"said Mazur recently, disy c
ould
climb one rung of the ladder and use techniques from algebra
ic
geometrydd011
What impressed Steenrod and Spencer, and later on, mathemati
cians
of Artin and Mazur's

generation, was Nash's audacity. First, the notion that ever
y
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 narrow
ly,
as highly special and unusual cases.
29
By early winter, Spencer and Nash were satisfied that the re
sult
was solid and that the various parts of the lengthy proof we
re
correct. Although Nash did not get around to submitting a fi
nal
draft of his paper to the
Annals ofMathernatics until
October 1951,11 Steenrod, in any case, vouched for the resul
ts
that February,
referring to "a piece of research which he has
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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 ye
ar
what it was that he had proved in his thesis."
Nash's paper on algebraic manifolds -- the only one he was e
ver
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 off
er
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 exceptiona
l
promise. Lefschetz and Tucker very likely dropped hints that
an
offer was a real possibility. Although most of the faculty o
ther
than Tucker neither understood nor displayed any interest in
his
thesis topic, they were aware that it had been greeted with

respect by economistsdd14
In January, Tucker and Lefschetz made a formal proposal that
 Nash
be offered an assistant
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professorshipdd"Bochner and Steenrod were strongly in favor,

although Steenrod, of course, was not present at the discuss
ion.
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, incl
uding
Emil Artin, voiced strong opposition. Artin simply did not f
eel
that he could live with Nash, whom he regarded as aggressive
,
abrasive, and arrogant, in such a small departmentdd16 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. T
he
thought must have occurred to Nash that he was being rejecte
d
less on the basis of his work than on the basis of his
personality. It was an even greater blow because the same fa
culty
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
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having cut into university enrollments. Having been turned d
own
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 hirin
g
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 suppo
sedly
difficult personality. Tucker, meanwhile, was pushing Chicag
o to
do the samedd41 When MIT offered Nash a C. L. E. Moore
instructorship, Nash, who liked the idea of living in Cambri
dge,
accepteddd41 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 Bri
dge,
over the yellow-gray river to east Cambridge where MIT's mod
ern,
aggressively utilitarian campus lay sprawled between the riv
er
and a swath of
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factories and warehouses. Even before he reached the far sid
e, he
could smell the factory smells, including the distinct odors
 of
chocolate and soap mingling together from a Necco candy fact
ory
and a PandG detergent plant.` As he turned right onto Memori
al
Drive, he could see Building Two looming ahead, a featureles
s
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 ceilin
g,
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 wa
s
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 com
were
either infants or gleams in some
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academic's eye. It was, in spirit and in fact, still very mu
ch
the nation's leading engineering school, not a great researc
h
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 o
f the
Midwest. The military, as well as industry, loomed awfully l
arge,

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
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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.""



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
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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

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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

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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 lvies 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 recalleddd21 And Martin didn't. He came to value Nash, not just as "a brilliant and
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creative young manea"b as an ally in his quest to make the department great. He would come to particularly rely on Nash's absolute intellectual honesty: "Vvlen 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 mathematicsdd24 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 Marincr's." 11 He puffed on fat cigars. He waddled like a duck, a myopic
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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 Mathematidan, 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 as

k, 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 lunchdd016 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 bookdd17 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.""

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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 195 1, Wiener embraced him enthusiastically and encouraged Nash's growing interest in the subject of fluid dynamics-an interest that eventually led Nash to his

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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.0"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 for ties, 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



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.[17]

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

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ininschools, 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 prot6ong6 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

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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

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.
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1995

7h e Grea t Man

...
is colder, harder, less hesiWing, and without fear of opinion "he #7cks the virtues thataccompany respectand 'espectahility, and aitoe'ther everything that is the "virtue of the herd "Ifhe cannot lead, he goesalone... He knows he is incommunicable: hefinds it t7nessteless to he familiar. .
.
. "en not speaking to himself, he wears a mask. There is a

solitude within him that is inaccessible to praise or
A339
blame. -
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
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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

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 "mischievousdd"I Joseph Kohn, later the chairman of the Princeton mathematics department, called him "a bit of a gamesterdd06 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

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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 `hard1'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

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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 I 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 doea"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

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

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

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

gameea"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
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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 t

hem
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 deviati
ons
in dress. One fellow insisted on wearing pants with fly butt
ons
with a button or two
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undonedd"One graduate student recalled: "At that time we tho
ught
of eccentricity and being good in math as going together. We
were
all enjoying ourselves by being a little bit wild. We though
t 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 anno
unced
that he was an atheistdd"He created his own vocabularydd14 H
e
began conversations in midstream with "Let's take this
aspectdd"He referred to people as "humanoids." Nash picked u
p the
mannerisms of other eccentric geniuses. For example, Wiener,
who
was terribly nearsighted, would keep one of his fingers in t
he
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 Beethove
n.

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

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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

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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 cam era 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

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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 h
e was
flippant, but not really annoyed. They considered him a bad
boy,
but a great one, a great golden boy."
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The gang around Nash included Newman, aka D.J., a Harvard
graduate student who spent most of his time at MIT hanging o
ut
with his old friends from City College and with Nash, becaus
e
"Harvard was too snooty."" Other members of the group includ
ed
Walter Weissblum, a brilliant sad sack, drunk, and hunchback
 with
a heart of gold, who never finished his degree; 19 Harry Gon
shor,
who later became a professor at Rutgers, an
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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 coinv
entor
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 ni
ce
but it was excitingdd044
Nash's closest equal, in brains, competitiveness, and genera
l
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 Na
sh,

of being a three-time Putnam winner. He was already a husband and father, with

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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 otherea"Arthur Singer recalleddd46 "They admired each other's sarcasmea"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 yeardd047

Newman went to a seminar given by Nash. "I sat in on some of Nash's lecturesea"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,

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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 conver
sed.
Once, at the Minskys', Nash demanded that his listeners chal
lenge
him with a difficult mathematical problem. He said, "I've ha
d a
few drinks. Are my thinking powers stronger or weaker on dri
nk?""
He was not above dissembling slightly to wow an audiencedd"H
e
would pout if he was bested in an argumentdd14 And he hated
being
challenged by someone he considered to be an inferior. One d
ay in
the common

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--357
room, a group of students was talking about a famous World W
ar 11
logistics puzzle, the "Jeep" problem.
15
The essence of the jeep problem is that you want to cross th
e
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 sta
rting
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 ha
lf as
big. Nash contemptuously dismissed Haber's solution. When Ha
ber
insisted that he prove it, Nash said, "My solution's much
better."
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--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 o
ut to
be mostly right, but he was extremely annoyed with me. He wa
s
angry for my having forced him to do this grungy work when i
t 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 exampl
e: at
lunch one day, a graduate student was describing an axiomati
c
approach to a problem outlined by one of his professors. Nas
h
fairly exploded, "Don't give me all that crap! Tell me how y
ou'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 sobri
quet
"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 Hilbe
rt'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



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
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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 recal
led
in 1997 that this secretiveness struck her
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--362
as strange. As they started out, Ruth drove with Nash, Marth
a
with Milnor. Ruth was struck by Nash's complete indifference
 to
her. "I was slim, attractive, intelligentea"she recalled in
1997.
Nash "never even noticed that I was thereea"she said. She wa
s
also struck by the seemingly distant relationship between Na
sh
and Milnor. "They just sort of stood around. They could have
 met
the day before. They never referred to shared experiences. T
hey
didn't seem to really know each otherdd"Even the relationshi
p
between brother and sister seemed disa little standoffish, n
ot
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 sec
ret
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 Milno
r was
a freshman at Princeton four years earlier. Though he had no
t 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 brilliantl
y
lucid mind, and the younger man's lanky good looks.
Ruth said her good-byes as soon as the quartet arrived in Sa
nta
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
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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 prepar
ed a
meal -- I decided to ask for eggs. John pushed the remnants
of a
previously fried egg aside in the frying pan. 'Very nice peo
ple,`

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

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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 comt is, the one that was most advantageous to them comwhether 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, "r-person"game of von Neumann's theory. Subjects were told they could win cash by forming coali-tions, 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

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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, D
oes
it help us to understand the real world? Does it make predic
tions
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 the
y
understand the precise rules of the game, and that they have

complete information about the objectives of all of the othe
r
players. Clearly, this is seldom completely true.
One point which should particularly be noticed is the
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linearity hypothesis in Nash's theorem. This is a direct
application of the von Neumann-Morgenstern theory of numeric
al
utility-, the claim that it is possible to measure the relat
ive
desirability of different possible outcomes by a real-valued

function which is linear with respect to probabilities.... M
y own
belief is that this is quite reasonable as a normative theor
y,
but that it may not be realistic as a descriptive theory.
Evidently, Nash's theory was not a finished answer to the pr
oblem
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

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 homophobicea"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
...

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 childrendd1
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
373
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 comn to mention growing complications of his personal life comthan 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 studded 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, astrologerdd"B as the red hunt gathered momentum, the entire scientific commu-



nity felt vulnerable. Princeton's Solomon Lefsehetz would be identified as a possible communist sympathizer by an investigative bodyddbled 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 schoolsea"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 comsons of
former Communist Party head Earl Browder, who had all studied or
were studying mathematics at MIT and were scholarship recipients,
as

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welldd7
"MIT was turned topsy-turvyea"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 feedd9 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

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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, optimismea"Mrs. Levinson recalled. "The younger people -- Nash's group -- didn't want to be too friendly. They were scared. They distanced themselvesdd"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 Amadur 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 namesdd011 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



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 itdd"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 ofmathematical contributions. work lhat important to the history of mathematics and work tbat simply a triumph of the human spirit -
PA uL I 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 originalea"wh 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

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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 thisdd"Robe
rt
Aumann recalled: "Ambrose came to class one day with one sho
elace
tied and the other untied. `Did you know your right shoelace
 is
untied?` we asked. `Oh, my God; he said, 'I tied the left on
e and
thought the other must be tied by considerations of symmetry
.`
114

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--381
The older faculty in the department mostly ignored Nash's
putdowns and jibes. Ambrose did not. Soon a tit-for-tat riva
lry
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. Whe
n
Ambrose wrote what Nash considered an ugly argument on the
blackboard during a seminar, Nash would mutter, "Hack, Hacke
a"f
the back of the room.`
Nash made Ambrose the target of several pranks. "Seminar on
the
REAL mathematicsff"read a sign that Nash posted one day. "Th
e
seminar will meet weekly Thursdays at 2 Pddm. in the Common
Room." Thursday at 2:00 Pddm. was the hour that Ambrose taug
ht
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 ros
es
delivered to the podium as if Ambrose were a ballerina takin
g her
bows.`
Ambrose needled back. He wrote "Fuck

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--382
Myf"on the "To D"list that Nash kept hanging over his desk o
n a
clipboarddd9 It was he who nicknamed Nash "Gnash" for consta
ntly

making belittling remarks about other mathematicians. 10 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 Riernarmdd11 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.0"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,

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analyst, algebraist, geometer, topologist, or mathematical physicist. But he zeroed in on areas in these fields where essentially nobody had

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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
haddd"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 everywhereea"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 conjecturedd"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 Mein 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
A385
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

handkerchief, without distorting it. Nobody would have expec
ted
Nash's theorem to be true. In fact, everyone would have expe
cted
it to be false. "It showed incredible originalityea"said Mik
hail
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 foll
ow
paths prepared by others. But most of us could never produce

anything comparable to what Nash produced. It's like lightni
ng
striking. Psychologically the barrier he broke is absolutely

fantastic. He has completely changed the perspective on part
ial
differential equations. There has been some tendency in rece
nt
decades to move from harmony to chaos. Nash says chaos is ju
st
around the corner. 19
John Conway, the Princeton mathematician who discovered surr
eal
numbers
and invented the game of Life, called Nash's result "one of
the
most impottant pieces of mathematical analysis in this
century.""`
It was also, one must add, a deliberate jab at then-fashiona
ble
approaches to Riemannian

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 Jargen 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 problemsdd"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 tbinkerdd014 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 brea
k led
to a curious result about the embeddability being realizable
 in
surprisingly low-dimensional ambient spaces provided that on
e
would accept that the embedding would have only limited
smoothness. And later, with "heavy analysisea"the problem wa
s
solved in terms of embedding with a more proper degree of
smoothnessdd19 Nash presented his initial, "curious"result a
t 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.
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"Well, that's all well and good, but what about the embeddin
g
theorem""said Artin. "You'll never get it."
"I'll get it next weekea"Nash shot back." One night, possibl
y en
route to this very talk, Nash was hurtling down the Merritt
Parkwaydd"Poldy Flatto was riding with him as far as the Bro
nx.
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 an
d

almost shouted at Flatto, asking whether he had meant to
A390
say that Schwartz had solved the problem. "I didn't say thatea"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 havedd"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:
1 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
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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

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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 ma
ke a
go of it and straighten everything
oUtdd017
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 d
rafts
ensued. Nash did not submit the revised version of the paper

until nearly the end of the following summer. His acknowledg
ment
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to Federer was, by Nash's standards, effusive: "I am profoun
dly
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 N
ash
gave a lecture on his embedding theorem, remembers the audie
nce's
shocked reaction. "Nobody believed his proof at firstea"he
recalled in 1995. "People were very skeptical. It k looked l
ike 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-
1tionge him publicly, but they talked privatelydd019
(Characteristically, Nash's report to' his parents merely sa
id
"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
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so novel, that even the experts had tremendous difficulty
understanding what he had done. Nash used to leave drafts ly
ing
around the MIT common roomdd41 A former MIT graduate student

recalls a long and confused discussion between Ambrose, Sing
er,
and Masatake Kuranishi (a mathematician at Columbia Universi
ty
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 c
ould
generalize and give an abstract form and realize it was
applicable to situations other than the specific one he trea
ted.
But I didn't quite get to the bottom of it eidd44 Later, Hei
nz
Hopf, professor of mathematics in Zurich and a past presiden
t of
the International Mathematical Union, "a great man with a sm
all
build, friendly, radiating a warm glow, who knew everything
about
differential geometry," gave a talk on Nash's embedding theo
rem
in New Yorkdd41 Usually Hopfs lectures were
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--397
models of crystalline clarity. Moser, who was in the audienc
e,
recalled: "So we thought, `NOW we'll understand what Nash di
d.`
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 overwhelmeddd046
Several years later, Jargen Moser tried to get Nash to expla
in
how he had overcome the difficulties that Levinson had origi
nally
pointed out. "I did not learn so much from him. When he talk
ed,
he was vague, hand waving, `You have to control this. You ha
ve to
watch out for that.` You couldn't follow him. But his writte
n
paper was complete and correCtdd047
Federer not only edited Nash's paper to make it more accessi
ble,
but also was the first to convince the mathematical communit
y
that Nash's theorem was indeed correct. Martin's surprise
proposal, in the early part of 1953, to offer Nash a permane
nt
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

supporters. But others, like Warren Ambrose and George White
head,
the distinguished topolob gist, were opposed. Moore
Instructorships weren't meant to lead to tenure-trAk positio
ns.
More to the point, Nash had made plenty of enemies and few
friends, in

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 claims dd049 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

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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



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 squared plus RTF equals 0, a "very personal"
equation Nash included in a 1968 postcard that begins, "Dear

Mattuck, Thinking 
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 wh
ile
he was preoccupied with the effect of others on him, he most
ly
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-1 thought I was such a great mathematician," he was t
o say
ruefully, looking back at this period comand, of course, to
some
extent they were satisfied. But when people inevitably wante
d or
needed more he found the strains unbearable.
Santa Monica, Summer 1952
Away from contact with a few specisl sorts ofindividuals Ism

lost, lost completely in the wildemess... so, so, so, i6 bee
n a
h3rd life in many ways.
comJOHN FoRBE's NASH, JR.,
1965
AFTER
JOHN NASH LOST EVERYTHING- family, career, the ability to th
ink
about mathematics comhe confided in a letter to his sister M
artha
that only three individuals in his life had ever brought him
 any

real happiness: three "special sorts of individuals"with who
m 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 roman
tic
qualityea"Donald Newman observed in 1996. "He was very
adolescent, always with the boys."` Some were inclined to se
e
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 wa
s
very experimental, very try-outishea"said Newman in 1996. "M
ostly
he just kisseddd0bled
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

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--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 o
n to
medd"D.J. and Nash were cruising around in Newman's white
Thunderbird when Nash kissed him on the mouth. D.J. just lau
ghed
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. T
he
encounter must have been fleeting, coming in the last days o
f
August, just before he was due to leave for Boston, and very

furtive. But it was nonetheless decisive because for the fir
st
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

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"special"friend in his 1965 letter and a series of elliptical references to Tin letters in the late 1960'sdd9 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 Corporationdd12 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
A405
Viking,
was the dream of exploring Mars, his sister Nelda Troutman
recalled in 1997.
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--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
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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 retu
rned

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 an
d
mid-1960's is not known. But Nash continued to think of Thor
son
and to refer to him obliquely until at least
1968.
These mathematicians are very exclusive. They occupya very h
igh
terrain, from which they look down on everyone else. That ma
kes
their relationships with women quite problematic. -- ZIPPORA
H
LEVINSON, 1995
ASH WAS BACK in Boston in his old quarters by Labor Day. Num
ber
407 Beacon Street was

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--408
an imposing brick row house built before the turn of the cen
tury
facing the Charles.` Its current owner, Mrs. Austin Grant, w
as
the widow of a Back Bay physician. She liked to point out he
r
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

againea"she said to Nash the day he moved in.
 A408
Nash occupied one of the front bedrooms, a large, comfortabl
y
furnished room with a fireplace. Lindsay Russell, a young
engineer who had recently graduated from MIT, lived next doo
r.
Mrs. Grant regularly took Russell aside to remark on Nash's
idiosyncrasies. Nash acquired a huge set of barbells and beg
an
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""N
ash's
mail also received comment, particularly the postcards from
his
mother expressing the

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--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 visit
ors.
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 hospi
tal
on the second Thursday in September was named Eleanor.` He w
as
due to have some varicose veins removed I and seemed awfully

nervous -- and young, more like a student than a professordd
bled
Eleanor knew his doctor to be a notorious incompetent.` And
a
drunk. She was curious how an MIT professor had wound up wit
h a
quack like that. Nash told her that he'd chosen the doctor a
t
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 sw
eet,
but when he left, she hardly expected to see him again.

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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"Elean
or
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 sec
ond
floor. He kept staring at her, not saying much, waiting for
her
to choose a coat. She started to enjoy herself "John was ver
y
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 ou
t
each coat for her to slip into. She thought she liked a purp
le
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 blushe
d,
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 intelligenceea"with "simple manners"and "a very peculiar way of speakingdd07 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 homedd9

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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 disgustingdd010 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 comendlessly. 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



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 woman7's arms suggests either love at first sight or some resolution "to take the plungedd"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 "masculinitydd"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 nurseea "said Eleanordd"Alth 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.0"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 meeti 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
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--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 thou
ght
that he was, after all, a remarkable young man. She told her
self
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 b
aby
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 lo
st
its playful and lighthearted quality. That winter, Eleanor w
as
often tense and tired. She fretted a great deal about the
symptoms of pregnancy and the long hours at the hospital. Na
sh's
mind was, more often than not, elsewhere. Soon, he and Elean
or
were engaged in a tug of war that occasionally turned quite
ugly.
When Eleanor irritated him with her complaints, Nash would n
eedle
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 intellec
tual
equal. "He was always putting me down," she
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--417
recalled. "He was always making me feel inferior."
15
She, in turn, began to resent what she called his superior a
irs
and lack of sensitivity. Their evenings together frequently
degenerated into nasty spats. Eleanor, a friend of Nash's la
ter
reported, once complained that Nash had pushed her down a fl
ight
of stairs."
But there were also tender moments comwhen, for example, Nas
h
told her that he liked the way she looked with her big belly

comand Eleanor's feelings about Nash were, on the whole, lov
ing.
She was convinced that he loved her and would do right by th
e
baby, whom he seemed to be looking forward to with great
eagerness. She still recalled that period of their relations
hip
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 achi
eved
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
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--418
time, Nash finally introduced her to one of his friends from
 MIT,
a graduate student. 19 Eleanor took this as an encouraging s
ign.
John David Stier was born on June 19, 1953, six days after N
ash's
twenty-fifth birthday. Nash rushed to the hospital and was
greatly excited when Eleanor presented him with their sondd1
0 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 o
n
Park Drive. It wasn't a happy homecoming. Nash wouldn't buy
any

baby clothes, Eleanor recalled. "He didn't want us to A418 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 herdd"Despite the employer's insistence on "no male visitorsea"Nash came over frequently. "He wanted to be around him all the timeea"Eleanor recalleddd14 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 fireddd"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 caredd26

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 plungeddd"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 homesicknessdd21 Sometimes she brought him back to her apartment where she kept a large supply of toys and baby booksdd19

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 unders
tood,
even remotely, what such a separation might mean for a mothe
r or
her child. "I should have been home to take care of himea"El
eanor
said in 1995.ea"ful 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 swee
tness
and outbursts of cruelty. He continued to keep his affair wi
th
Eleanor under wraps, told no one at first except Jack Bricke
r,
who was enjoined to keep the secret. "He never told anyone a
bout
us," said Eleanor, still unable to fathom his behaviordd"Mos
t 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 existencedd"He and Eleanor
sometimes had
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--421
Mattuck, who seemed to like Eleanor, over to dinner. They to
ld
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
A421
affairs.
Or was it? Eleanor was in love with Nash. "People told me ne
ver
to see him again `"said she. "It's better if you have a norm
al
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 v
ery
attractive in a way. Love is foolish."" As late as 19 5 5 an
d 19
56, after Nash introduced Mattuck to Eleanor, Eleanor's atti
tude
toward Nash was "adoringdd"Mattuck recalled: "Eleanor realiz
ed
Nash was a total egoist, but she was dazzled by his brillian
ce.
He thought he was a genius. She was sleeping with one of the

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--422
smartest men in America. Did he love her? She didn't know. S
he
didn't ask. In those days, it wasn't 'Talk to me! If you sle
pt
with a man, you assumed he loved yoUdd016
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, de
spite
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 i
t
was, as it were, too late, until a rival appeared on the sce
ne?

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



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. Vhether 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
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--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.
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--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 ] over, 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 natu

ral
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"hypnotizedea"and "enamoredea"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-worshiped Johnea"Eleanor recalled. "He was alw
ays
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 near
ly
five years until Nash married.
Once Nash had told Herta Newman, Donald's wife, that he real
ized
"there was something that happened between people that he di
dn't
experience.0"What was missing from Nash's life, to a singula
r
degree, was what the biographer of another genius called "th
e
strong force that binds people together." Now he knew what t
hat
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 sp
ecial
sorts of individuals, the Brickers in his life, young men wh
o
were "colorful,0"amusingea"and
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--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 societys terms. He carried on as before. Even as his
emotional involvement with Bricker grew, be 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 be 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
nextea"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 o

f the spring term, Nash finally let Bricker in on his secret, telling him in somewhat melodramatic tones, "I have a mistressdd"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



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
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--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 t
he
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 po
int.
However, he waited until February 1957, by which time Nash w
as
away on sabbatical, before dropping out of graduate school a
nd
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 letter
s.
They were pretty disturbing.""
Only one postcard, unsigned and dated August 3, 1967,
surviveddd19 The only message
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--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 obviousl
y
been Mr. B who has caused me the largest personal injury," h
e
wrote to Mattuck in 1968.11 But even then, there are sad not

es 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 whi
ch
time Bricker
himself was ill and in virtual isolation, his first question
s
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 disc
uss
it furtherea"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 increasingl
y
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 noxi
ous
smog resulted from the chemical action of sunshine on auto
exhaUS-TDD2
Meanwhile, a heat wave drew tens of thousands of Angelenos t
o the
Santa Monica beaches.` Nash, too, was drawn to the beachddbl
ed He
spent hours at a time walking on the sand or along the prome
nade
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
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--437
RAND's security detail got a call from the Santa Monica poli
ce
station,` which, as it happened, wasn't far from RAND's new
headquarters on the far side of Main. It seemed that two cop
s in
vice, one decoy and one arresting officer named John Otto
Mattsonea6 had picked up a young guy in a men's bathroom in
Palisades Park in the very early morning. He had been arrest
ed,
charged with indecent exposure, a misdemeanor, and releasedd
d7
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 inde
ed a
RAND employee. He took down the details of the arrest, thank
ed
the cop for the backchannel heads-up, and, as soon as he'd h
ung
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 tuberculosisdd8 After his discharge, he wound up at RAND
soon
after RAND had moved to Fourth and Broadway and was assigned

to
the "front office"

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--438
where RAND's handful of top executives was clustered. Discre
et
and capable, Best had an easy manner that made him popular b
oth
with his bosses and with RAND's rank and file. His first
assignment was to set up RAND's library, but he quickly adop
ted
the role of general factotum and troubleshooter. In 1953, af
ter
the new Eisenhower security guidelines were issuedea9 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 individu
als'
private lives was nasty and not altogether necessary. But he
felt
he owed RAND, which had kept him on after he suffered a rela
pse
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 w
as
clear. Nash had a top-secret security clearancedd10 He'd bee
n
picked up in a "police trapdd011 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 "dirt
y
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 clearancedd"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
bomosexualdd16 But McKinsey was one of the first
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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 RANDDD"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 riot think o

f a single case where it had been granted"in the two decades since he had been 1in his job." backslash 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 RANDDD"Williams told Best that Nash was "a nut, an eccentricea"b 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.



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 areadd19 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 employerdd10 "We lost five or six people to police programs over a period of several yearsea"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
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unthreatening but direct and he proceeded calmly. RAND would be
forced immediately to suspend Nash's Air Force clearancedd"The
Air Force would be notifieddd"And -- this was the bottom line --
Nash's consulting arrangement with RAND was over for good.
"You're too rich for our blood, Johnea"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 behavi

oral 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.



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



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 an d 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 nothipg 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

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September, he described comwith remarkable detachment comanother kind of storm: "The hurricane was a fascinating experience.0 "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 madedd"RAND negotiated with the Santa Monica police, who wound up dropping the charge in return fo

r
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 comt was impossible given Nash's sudden eviction
from his office comb 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
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told the officers he was just thinking and ... they finally
learned that what he had told them was trueea"Mood said laterdd16
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 consultantsdd"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 oudd19 Shapley later told
another mathematician that Nash had been playing some kind of
game."` 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 MITEA"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

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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

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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 thro
ugh
young adulthood produces strains that mount like straws on t
he
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 University
dd14
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
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committed suicide in 1953 within two years of being fired by

RANDDD15 Alan Turing, the mathematical genius who cracked th
e
Nazi submarine code, was arrested, tried, and convicted unde
r
Britain's anti-homosexual statutes in 1952; he committed sui
cide
in the summer of 1954 by taking a bite of a cyanidelaced app
le in
his laboratorydd36 Others, less well known, less obviously
brutalized,

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
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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
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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-1one-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. Eloi 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
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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

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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 11,
when Alicia was eleven. In 1944, in the midst of a yearlong
popular insurrection against dictator Hernandez Martinezea12

Alicia's uncle Enrique had suddenly left for Atlanta with his
wife and five

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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

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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

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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,

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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 positiondd 16

The school's atmosphere, appropriately to girls being groomed to become wives of Catholic leadersea"was cosmopolitan and cultureddd17 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



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
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anonymous men like Oppenheimer and Teller into public heroes
.
Instantly, the image of the "nuclear physicist"seized the po
pular
imagination the same way that "rocket scientist"did
after Sputnik.
Alicia, already showing signs of her father's talent and int
erest
in scientific subjects, knew what she wanted to be. "The wor
ld
was physics. It was what kids with a talent for, and interes
t 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 Ali
cia
too.""
Her aptitude for mathematics and science had long been evide
nt
and became more so at Marymount. By the late 1940's, the sch
ool
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 Econom
ics
-- Sister Raymond -- who was not only an ardent Keynesian, b
ut a
gifted educator determined to raise the educational standard
s of
the place. Sister Raymond improved the caliber of stu-
dents by introducing scholarships and gave more
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intellectual heft to the school's curriculum by adding serio
us
science and mathematics courses. Alicia had a choice between
 a
classical education emphasizing the arts and languages and o
ne
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 definiteea"she sddd14 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
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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 h

er friends at Pritchett lounge every day, and generally was up for whatever the girls

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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 byea"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

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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 mearly [sic] been kidnaped judging from the amount o
f
communication you have received from me; the sad truth of co
urse
is my laziness. Except for one week that I went to Canada wi
th
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 wi
ll be
able to walk home with you (the dorm is only about a block a
nd
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;
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my cum. is still above 3 though; .02 above that is. I'm unha
ppy
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 m
y
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 wi
ser.
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 lect
urc.
She was sitting, her best friend Joyce beside her, in the fr
ont
row of M 3 5 1, Advanced Calculus for Engineers, a course
required of all physics majors. John Nash arrived late weari
ng a
haughty and bored expression. Without so much as a glance or
a
word to the assembled, he closed all the windows, flipped op
en
his copy of Hildebrand, and embarked on a lackluster
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--467
exposition of the properties of ordinary differential equati
ons.
It was mid-September, Indian summer weather, and as Nash dro
ned
on, the room got quite hot. First one, then several students

interrupted Nash to complain and to ask that he let them ope
n 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 recalleddd"At that point, Alicia jumped up from her s
eat,
ran over to the windows in her high heels, and opened them o
ne
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 t
o
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 colddd"Joyce transferred out of the section after the fir
st

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 encount
ers
as student and professor conveys much about the
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elementary force that was to bind her to him. In MIT's
intellectual hierarchy-where "mathematics was the highest th
ing,"
as Joyce was to say-Nash was the closest thing to royaltydd1
6 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 irresistibl
e.
Herta Newman, Donald's wife, said the same thing in less bal
d
terms: "He was going to be famous. He was also cutedd017 Emm
a
Duchane, a physics major two years behind Alicia at MIT, sai
d,
"Alicia thought he was gorgeous. She thought he had beautifu
l
legs.0"Nash wasn't scruffy like many of the mathematicians.
He
was always neatly combed, pressed, and shined. His haughty m
anner
and cool indifference only confirmed his desirability. His n
ame,
two monosyllables that advertised his Anglo-Saxon ancestry,
added
to his appeal. "He was very, very good-looking;` Alicia late
r
said. "Very intelligent. It was a little bit of a hero worsh
ip
thingdd019
Nash took no notice of her, but Alicia was quite prepared to
 woo
him. All that
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--469
year, she would seek him out. "Come with me to the music lib
rary,
Joyceea"or, "Come with me to Walker Memorial. I want to see
Nashdd040 "She set her cap for himea"Joyce recalled. "She ha
d 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 illustriou

s man
might also satisfy her ambitions. Nash seemed to fit the bil
l.

"John could give her a lot of things she didn't haveea"obser
ved
John Moore, a mathematician who fell in love with Alicia som
e
years later.
44
-------------------------------------------------------------
--472
Sadly, the romantic girl whose favorite song was "Lady of Sp
ain"
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 da
ngers
of his sexual experiments had become suddenly, devastatingly

obvious. Marriage was a possible answer and he had, at his m
ost
frightened, almost convinced himself that he would marry Ele
anor.
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 ef
fect
of her intelligence on him should not be underestimated. Nas
h was
easily bored. He found her interesting company, liked the fa
ct

that she set her own compass, and was amused by her
A472
flashes of sarcasm

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--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

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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



to get the idea and just follows me around, so far he has written
a couple of cute poems that I'm keeping as suveniers (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  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

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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

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 th

ings,
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

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.
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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
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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

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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
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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

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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 studen
t
during Nash's final year. After they starting talking, howev
er,
Nash remembered
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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 h
ad
interesting things to say. He was fast, aggressive, and seem
ed to
know everything about everything that came up in their
conversation. Forrester explained some of the details of Mil
nor's
work to Nash. They also talked, then and later, about Nash's

embedding papers, which Forrester appeared to know quite wel
l.
Forrester invited Nash to come to see his living quarters, m
oored
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 Bri
cker
to the Beatles com"young,0"colorful,0"amusing," and
"attractive"-someone who made him feel like "the girls who l
ove
the Beatles so wildly."
There was much to draw them together. Forrester, who had jus
t
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
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given him spectacular references. He was disorganized and sl
oppy
but he had a photographic memory and wide-ranging interests.
 He
hadn't done much since arriving in Seattle in 1954 and, inde
ed,
hadn't been able to publish his dissertation because it turn

ed 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



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 knewea"said John Isbell, a professor of

mathematics at the State University of New York at Buffalo a
nd 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 becaus
e
things were beginning to loosen up even in Seattle comhe had

concluded that he no longer had to pretend to be what he was
not.
Robert Vaught, a retired logician at the University of Calif
ornia
at Berkeley, shared a house with Forrester during their firs
t
year as instructors in Seattle. He recalled:
It wasn't that he "discovered" his homosexuality
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then. It was very difficult for homosexuals then. In those d
ays
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 homosexu
al.
Sometime during his third year in Seattle he bought himself
a
houseboat-there was a far-outgroup living on the waterfront-
and
gradually he began to let people know about his homosexualit
y. 10
Nash always found the people who could give him what he need
ed.
Forrester was the kind of smart, verbal, quick-witted man Na
sh
was frequently attracted to. Forrester was also emotionally
available. Under his eccentric, sometimes brash and loud ext
erior
Forrester was an exceptionally sweet man. "Kind and gentle,
much
loved by his studentsea"was the description given by Albert
Nijenhuis, another of Forrester's colleagues." Forrester als
o 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.
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Amasa encouraged me to find a psychiatrist in Seattle. I cou
ld
talk to him.0"In his first year at Seattle, Forrester "adopt
ed" a
mentally ill graduate student-a computer genius who had suff
ered
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 be might appear, would respond to his sympathetic
interest. "Amasa was pretty sharp. He would have seen throug
h the
veilea"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 subseque
nt
years. Forrester stayed very much on Nash's mind, however. E
leven

years later, on a pilgrimage that took
A487
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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,
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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

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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

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 itll 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

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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 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
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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 shakendd"B the death of his father produced another fissure in the foundation of
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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



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 comincluding 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



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 Couranfs 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 herdd14 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, Alic
ia
complained in a PS to Joycedd18 "This hotel-the Amazon-was f
or
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 livin
g
where men couldn't get at them and deceive them; and they we
re
all going to posh secretarial schools like Katy Gibbs, where
 they
had to wear hats and stockings and gloves to class, or ... s
imply
hanging around in New York waiting to get married to some ca
reer
man or otherdd019
Whether or not Alicia came to New York as Nash's fianc6ence
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 od
d and
pennypinching, that he wanted to buy one in Antwerp, directl
y
from a diamond wholesalerdd21 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 th
e
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 i
n
anything domestic, a young woman completely out of Virginia'
s
ken. While Virginia and Martha busied themselves in the kitc
hen,

Alicia and Nash spent most of Thanksgiving Day sitting on A500
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 motherdd14
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 happyea"Enrique Larde later
recalled. "It was a great apartment. They were just showing

off
their new marriage. He looked very handsome. It seemed very
romanticdd025

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 .7 peculiar life ofits own
and is better compared to a creative one, governedalm entirely hy
aesthetical motivations... As a mathematical discipline ttavels,
orafter much `bsliact" inbreeding, [it] is in danger of
degeneration.... whenever this stige is reached, the only remedy
seems to me to be the rejuvenating return to the source. the

reinjection ofmore 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 hoteldd"I 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 conditionsdd114 By 1956, Einstein was dead,

Gbdel 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 puredd"I

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 findddd06

By contrast, the Courant Institute of Mathematical Sciences at New York University was "the national capital of applied mathematical analysisisea"z Fortune



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 comwith 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
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mathematics worth speaking of. Undaunted, Courant immediatel
y 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 riva
ling
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 Hbrmande
r, 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 surpri
sing
that Nash was soon spending at least as much time there as a
t the
Institute for Advanced Study. At first Nash would stop by fo
r an
hour or two before driving down to Princeton, but he soon fo
und
himself staying the whole day." He never
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--507
came too early, for he liked to sleep late after

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 competitivene
ss of
MIT or the snobbery of the Institute, it was happy to have h

im.
Tilla Weinstein, a mathematician at Rutgers, who recalled th
at
Nash liked to pace around on one of the building's fire esca
pes,
said, "He was just a delight. There was a wit and humor abou
t him
that was thoroughly unstandard. There was a wonderful playfu
l
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 Hbrmande
r
recalled his first impressions: "He wore a serious expressio
n.
Then he'd break out into a sudden smile. He was an
enthusiastdd"Is Peter Lax, who had spent the war at Los Alam
os,
was

interested in Nash's research and "his own way of looking at

thingsdd019
At first, Nash seemed more interested in the political catac
lysms
of that fall
Nasser
nationalized the Suez Canal, prompting an invasion by Englan
d,
France, and Israel, the Russians crushed the Hungarian upris
ing,
and Eisenhower and Stevenson were again baffling for the
presidency comthan in pursuing mathematical conversations. "
He'd

be in the common roomea"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 stro
ng
opinions on the Suez crisis, which was going on at that time
." 10
Another mathematician remembered a similar conversation in t
he
institute dining room: "When the British and their allies we
re
trying to grab Suez, and Eisenhower had not made his positio
n
unmistakably clear (if he ever did), one day at lunch Nash
started in on Suez. Of course, Nasser wasn't black, but he w
as
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 forefron
t 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

changedd"0The mid-fifties, as Fortune
noted, mathematicians knew relatively simple routines for so
lving
ordinary differential equations using computers. But there w
ere
no straightforward methods for solving most nonlinear partia
l
differential equations that crop up when large or abrupt cha
nges
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 analyticallyea"saying that they "defy ev
en

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

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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 claimeddd"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

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of the top scholars in the field. Precise, careful, and immensely knowledgeable, H6rmander 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 dimensionsea"Hiirmander 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
A513
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 timesea"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 conti-
nuity theorems once again using novel methods of his
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--514
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
geniUSDD31
H6rmander's mentor at the University of Lund, Lars Girding, 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 offerdd"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
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Massachusetts as opposed to New Yorkdd19

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 attach6 in London. It was an Office of Naval Research sinecuredd40 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 mathemati
cal
chair in Italy, he lived a life of ascetic poverty, complete
ly
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 jou
rnal
imaginable, the proceedings of a regional academy of science
s.
Garabedian proceeded to report De Giorgi's results in the Of
fice
of Naval Research's European newsletter.
Nash's own account, written after he had won the Nobel for h
is
work in game theory, conveys the acute disappointment he fel
t:
I ran into some bad luck since, without my being sufficientl
y
informed on what other people were doing in the area, it hap
pened
that I was working in parallel with Ennio De Giorgi of Pisa,

Italy. And De Giorgi was first actually to achieve the ascen
t of
the summit (of
the figuratively described problem)
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--517
at least for the particularly interesting case of "elliptic
equationsdd041
Nash's view was perhaps overly subjective. Mathematics is no
t an
intramural sport, and as important as being first is, how on
e
gets to one's destination is often as important as, if not m
ore
important than, the actual target. Nash's work was almost
universally regarded as a major breakthrough. But this was n
ot
how Nash saw it. Gian-Carlo Rota, a graduate student at Yale
who
spent that year at Courant, recalled in 1994: 1"en Nash lear
ned
about De Giorgi he was quite shocked. Some people even thoug

ht 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

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recently. This manner is unjustifiably aggressivedd045 After calling his own behavior unjustified, Nash nonetheless immediately justified it by calling "most physicists (also some mathemati-



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
A518
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 originaldd46 "I embarked on [a
project] to revise quantum theoryea"Nash said in his 1996 Madrid
lecture. "It was not a priori absurd for a non-physicist.
Einstein had criticized the

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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 termSdd41 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 realitydd049
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 destabilizingdd
"10
What the matter with being a loner and innovative? Isn't that
line? But the flone genius] has the

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--520

same wishes as otherpeople. ff he were back in high school doing
science projects, fine. But ifhe too isolated and he

disappointed in something big, i6 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,



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
A521
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 fundsddbled Alicia got a
job as a physics researcher at Technical Operations, one of the
small high-tech companies that were springing up
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along Route 128.1 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 gatheringdd6 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, bow others reacted to him. He too, seemed always aware of her, even when he appeared to be ignoring her. That he wasn't

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-willedea"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 acc
ount
of what he had done, was in very rough shapedd10 "It was," a

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--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 exactl
y how
to orchestrate it."" As it turned out, it would take most of
 the
year, and a collective effort, before the final product comw
h
some mathematicians regard as Nash's most important work com
was
finally ready to be submitted to a journal.
To complete it, Nash came as close as he ever had or would t
o 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 MI
T
that term. "This was the beginning of nonlinear theory. It w
as
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 t
o
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
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--525
to cooperatedd011
Besides Moser and Carleson, Nash also turned to Eli Stein, n
ow a
professor of mathematics at Princeton University but then an
 MIT
instructor. "He wasn't interested in what I was doing` "reca

lled
Stein. "He'd say, `You're an analyst. You ought to be intere
sted
in this!
"14
Stein was intrigued by Nash's enthusiasm and his constant su
pply
of ideas. He said, "We were like Yankees fans getting togeth
er
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 Ste
in in
1995. "If you build an edifice based on one plausible propos
ition
after another, the whole thing is liable to collapse after a
 few
steps. But somehow he knew it wouldn't. And it didn't."
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--526
16
Nash's thirtieth year was thus looking very bright. He had s
cored
a major success. He was adulated and lionized as never befor
e."
Fortune
magazine was about to feature him as one of the brightest yo
ung
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 seeme
d at

times only to highlight the gap between his ambitions and
A526
what he had achieved. If anything, he felt more frustrated a
nd
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 th
at
his latest result, along with the offer from Courant, would
convince the department to award him both that winterdd"Gett
ing
these things after only five years would be unusual, but Nas
h
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, Marti
n had
told him, just as his initial appointment had been." A numbe
r of
people in

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--527
the department felt he was a poor teacher and an even worse
colleague. Martin felt Nash's case would be stronger once th
e
full version of the parabolic equations paper appeared in pr
int.
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 wa
s 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 Fie
lds
Medal.
Forty years later, after winning a Nobel, Nash referred in h
is
autobiographical essay, in his typically elliptical fashion,
to
his dashed hopes:
It seems conceivable that if either De Giorgi or Nash had fa
iled
in the attack on this problem (or .7
priori
estimates of Holder continuity) then that the ]one 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)."

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--528
The next Fields Medal would be awarded in August 1958, and a
s
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 ulti
mate
distinction that a mathematician can be granted by his peers
, the
trophy of trophies.
14
There is no Nobel in mathematics, and mathematical discoveri
es,
no matter how vital to Nobel disciplines such as physics or
economics, do not in themselves qualify for a Nobel. The Fie
lds
is, if anything, rarer than the Nobel. In the fifties and ea
rly
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 for
ty
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 yo
ung

mathematicians"and "future work."" The incentive,
A528
incidentally, is of an

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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 Gbttingen, and then at Courantd d"The deliberations got under way in late 1955 and were concluded early

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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

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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 himdd"Moser said, "Nash was somebody who
 A531
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 peopledd014 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
questionea"Moser said recently. `It would never have happene
d.
I'm sure nobody even thought about him any-
A measure of how badly Nash wanted to win the
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--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 f
ive
yearsdd16 It was due to be awarded in February 1959, which m
eant
that the deliberations would take place in the latter part o
f
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 conv
inced
of the paper's great importance. Nash let Carleson know he w
anted
the paper published as quickly as possible and urged Carleso
n to
give it to a referee who could vet the paper in a minimum of

time. Carleson gave the manuscript to H6rmander to referee.
H6rmander 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 forma
l
acceptance, which was, in any case, largely a foregone
conclusion, Nash withdrew his paper.
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When the paper subsequently appeared in the fall issue of th
e
American Journal ofMathematics,
H6rmander concluded that Nash had always intended to publish
 the
paper there, since the 136cher restricted eligible papers to

those published in American journals comor, worse, had submi
tted
the paper to both journals,

a clear-cut breach of professional ethics. "It turned out th
at
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 pa
per
to
Acta
before learning that doing so would exclude it from consider
ation

for the Bbcher, but that upon discovering this fact, he
A533
was willing to antagonize Carleson and Mirmander in
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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 p
rize
meant to Nash. Summer 1958
It struck me that I knew every-thing; everj4hing was reveale
d to
me, all the secrets of the world were mine during those spac
ious
hours. -
GERARD DE NERVAL
ASH TURNED THIRTY
that June. For most people, thirty is simply the dividing li
ne
between youth and adulthood, but mathematicians consider the
ir
calling a young man's game, so thirty signals something far
more
gloomy. Looking back at this time in his life, Nash would re
fer
to a sudden onset of anxiety, "a fear"t the best years of hi
s
creative life were over.`
What an irony that mathematicians, who live so much more in
their
minds than most of humanity, should
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feel so much more trapped by their bodies! An ambitious youn
g
mathematician watches the calendar with a sense of trepidati
on
and foreboding equal to or greater than that of any model, a
ctor,
or athlete.
The Mathematician Apology
by G. H. Hardy sets the standard for all laments of lost you
th.

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 n
ot
saying you won't equal it. I would like to think that you co
uld.
But I don't think you will ever do better. That's my gut
feeling."` Von Neumann used to say that "the primary mathema
tical
powers decline at about twenty-sixea"af which the mathematic
ian
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, fee
ls
from the inside like an intramural competition, a race. One
never
forgets the crowded

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--536
field. And one's relative standing, vis-…-vis past and prese
nt
competitors, is what counts. Again, Hardy best conveyed what

motivates many mathematicians, including himself. He wrote t
hat
he could not recall ever wanting to be anything but a
mathematician, but also that he could not remember feeling a
ny
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 abou
t it.
"John was the most age-conscious person I've ever metea"reca
lled
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 t
hat
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

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--537
of something that would equal his early accomplishments.`
Steenrod slipped into a deep depression. When one of his stu
dents
published a note on "Steenrod's Reduced Powers"- the referen
ce
was, of course, mathematical, not personal -- other
mathematicians smirked and said, "Oh, yes, Steenrod's reduce
d
powers!"" Nash's thirtieth birthday produced a kind of cogni
tive
dissonance. One can almost imagine a sniggering commentator
inside Nash's head: "What, thirty already, and still no priz
es,
no offer from Harvard, no tenure even? And you thought you w
ere
such a great mathematician? A genius? Ha, ha, ha!" Nash's mo
od
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 h
e 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 tbe 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
A538
many primes.
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--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 18 59 a string of mathematical giants -- G. H. Har
dy,
Norman Levinson, Atle Selberg, Paul Cohen, and Bombieri, amo
ng
others-have attempted, unsuccessfully, to prove the Riemann
Hypothesisdd"George Polya once gave a young mathematician wh
o had
confided in him that he was working on the Riemann Hypothesi
s a
reprint of a faulty proof of the conjecture by a G6menttinge
n
mathematician who thought he'd solved the problem. "I think
about
it every day when I wake up in the morningea"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 1, a German banker endowed a
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--540
prize, lodged in G6menttingen, for whoever proved or disprov
ed
the hypothesis. The prize was never awarded and, indeed, van
ished
in the inflation of the 1920'sdd11
Nash's first encounter with Georg Friedrich Bernhard Riemann
and
his famous conjecture took place when Nash was fourteen, pro
bably
lying on the den floor in front of the radio, reading Bell's

Men ofMathematicsll
Riemann, the sickly son of an impoverished Lutheran minister
, was

also fourteen and preparing to follow in his father's footst
eps
when a sympathetic headmaster, who sensed that the boy was m
ore
suited to mathematics than the ministry, gave him a copy of
Legendre's
Th6orie des Nombres
to read. 19 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 itdd"Th episode, which took
place
in 1840, was likely the origin of Riemann's lifelong interes
t 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 Groess
e"
("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 I plus
1/2's plus 1/3's plus 'As
plus . . . in which s is a complex number, say s equals u plus 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

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 I 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 threedimensional 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 o

f 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 th
e
logic of one proof had to apply to the other. It's a proof b
y
logic and it doesn't relate to the real context. It's not pr
oving
that one object is related to another objectdd014
Stein was dubious. "He told me this very sketchy thing. It w
as 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 m
e as
simply unbelievable. This was as opposed to my earlier
conversations with him about parabolic equations, which stru
ck 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
pi, p,, p, .
. . of integers that have many of the same distribution
properties as the sequence 2, 3, 5, 7, . . . of prime number
s.
For each of these one can
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--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 pr
oblem
that can be attacked by elementary methods. It had already g
iven
rise to an extensive and thorny literaturedd017 By the time
Nash
turned to it seriously, that literature had grown several-fo
ld.
Both Ingham and Selberg, possibly others as well, warned Nas
h
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

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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 be turned thirty and while he was licking various wounds to what he would later call his 11 merciless superegoea"10 suggests that a fear of failure Jay behind his willingness to take unusual

risks. Stein's impression of Nash during their
A546
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 tal
ked.
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 wor
ks on
work out. You overestimate your own abilities. After

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 attem
pt to
solve Riemann's conjecturedd"B, as it was, Nash's compulsion
to
scale this most difficult, most dangerous peak proved centra
l to
his undoing.
There were other signs that Nash felt, at that particular
juncture, a growing pressure to prove himself comz well as a

newfound taste for taking risks. Nash had always been obsess
ed
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 w
ith
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

once told him "to cut out his cheese-paring waysdd"Levinson said:
"One extra theorem will earn you more than all that stuff.0ggation 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
horrifiedea"he recalled. "That's something elseea"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
be de Francedd19
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
youngea"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
wholesaferdd41 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 backscat gossiping (at that time, Eva recalled,
"Nash wouldn't talk to women0gg.41 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 Browderizeddd041
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.

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NASHES WERE BACK-IN

Cambridge and Nash was already teaching when Alicia discovered, half with joy, half with dismay, that she was

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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

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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
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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 theoryea"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

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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
 A556
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
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his old friend from Stuyvesant, Eli Stein, to help him get a
n
instructorship at MIT." This Stein had managed to do, and Co
hen
had come to Cambridge as soon as class inines ended at Roche
ster.
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 nex
t, of
becoming a physicist, a composer, even a novelist. Stein, wh
o
became a close friend of Cohen's, said: "What drives Cohen i
s
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 instr
uctor
put it. "He was good at tearing people
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down," Adriano Garsia recalled in 1995.11 They challenged ea
ch
other with problems. "Well, Nash what kind of garbage are yo
u
working on now""Cohen would say. "What wrong theorems did yo
u

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 homosexualea"Cohen recalled. Or he'd say a word and ask A559
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 meansdd"P 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
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work on any problem he wantedea"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 breakdowndd"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 any
thing 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 isolationdd019 There is a kindling. A

slowfire burning. comJosEPH BRENNER, psychiatrist, Cambridge, Massachusetts, 1997

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SOMEONE WAS CALLING, "It's time to play charades. It's time to play charadesdd"I 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

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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 ofPure Reason!

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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,""ddturbing."
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
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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 A]
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

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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 recalle

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that he
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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 be 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 disappeareddd10
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
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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 h

e was
just being pesky. But he thought that they were broadcasting

messages to him. The things he did were mad, but we didn't r
eally
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 A
sia.
The student recalled, "He seemed to be joking around."
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His manner took on a certain furtiveness.
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Another student, an undergraduate, recalled, "I have this
impression of him darting about. I'd walk into a stairwell a
nd
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 settl
ed
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 someh
ow

had expected her to read his bids. "He expected me to A569 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
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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

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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
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talking it was gibberish. Probability is everything!!! I kne
w
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 righ
t.
Then he fixed a long gaze on Moser. "Thisea"he said, pointin
g to
the potato, "is the universedd"Moser nodded. Moser was at th
at
time engaged in trying to apply Nash's implicit function the
orem
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 N
ash
was having a nervous breakdown. "Tell me about itea"said Mar
tin,
who said later that he "almost didn't believe in these
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thingsdd"Martin recalled, "Levinson said, `He's very paranoi
d. 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 Sund
ay
night, Nash edged himself over between me and the door.""
Strange letters began turning up in the department mail. Rut
h
Goodwin, the department secretary, would put them aside and
show
them to Martindd16 They were addressed to ambassadors of var
ious
countries. And they were from John Nash. Martin panicked. He

tried to retrieve the letters, not all of which were address
ed
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

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
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seeing a copy of Nash's letter, is supposed to have said, "T
his
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,
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didn't normally attend departmental seminars, but Also Vasqu
ez, 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 ro
ws
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 tha
t
Nash was talking to him. "Vasquez, did you know that I'm on
the
cover of
Life
magazine""Nash kept repeating until Vasquez turned arounddd1
9
Nash told Vasquez that his photograph had been disguised to
make
it look as if it were Pope John the Twenty-third. Vasquez, h
e
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? T
wo
ways, he explained. First because John wasn't the pope's giv
en
name but a name that he had
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chosen. Second, because twenty-three was Nash's "favorite pr
ime
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
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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
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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 tack-
ling 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

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.0" ation
for the pianistea"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
 A579
present. In fact, he wrote a brilliant paper on How Not to S
olve
the Riemann Hypothesis. It was
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--580
Nash's first downfall. Everybody knew something was wrong. H
e
didn't get stuck. It was his chatter. The math was just luna
cy.
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 o
ther
people, and try to figure out what they just heard. Nash's t
alk
wasn't good or bad. It was horribledd36
Cathleen Morawetz, who had enjoyed joking around with Nash a
t
Courant two years earlier, ran into Nash in the stairwell af
ter
the talk: "He was laughed out of the auditoriumea"she recall
ed.
"I felt terrible. I said something nice to him, but I was
disturbed. He seemed very depressed.0ggLater Cathleen used t
he
phrase "heaping scorn on him"ffdescribe the audience reactio
n.)
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
be couldn't find his way there. He kept calling Felix Browde
r,
then teaching at Yale, and telling him that he couldn't
understand how to get off the Merritt Parkway.
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--581
Nash talked about the Riemann Hypothesis just as he had at
Columbia. Again, it was a disastrous performance, as recalle
d by
Browder, who contrasted his

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 ta
lk. 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 likea tornado. You want to hang on to whatyou have. You don't want to see everything go. comAL-RCIA NA-SH

DSPITE 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

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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

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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

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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 sillyea"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 prac
tical
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 th
eir
money, to start an international organization. She was looki
ng
into the laws. She found
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--587
out that you could have somebody committed for a limited tim
e
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 ask
ed
Lettvin what Alicia should do. The result was that Alicia go
t
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-Freud
ian

institution that eschewed shock treatments
A587
in
favor of psychoanalysis and new antipsychotic drugs like Thorazine. Alicia rejected the notion of shock treatment. "She was very concerned with preserving his geniusea"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 treatmentsdd011
In January, the department voted to give Nash
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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.0"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
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reassuring letters home. "My talk in New York went reasonably wellea"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 lowdd017

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
insanedd010
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
patientsdd"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
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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.

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 regist
ered
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. K
ay
recalled in 1995: "The word was `Tomorrow, Alicia is having
John
committed! Obviously, there was a lot of talk about
itdd014
in Bowditch Hall
McLean Hospital, April-May 1959
This is the way day breaks in Bowditch Hall at McLean 'Kakin
g in
the Blue,"
Life Studies,
ROBERT LOWELL
V V HEN A STRANGER in a suit knocked
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on Paul Cohen's office door to inquire whether he had seen D
r.
Nash that afternoon, the man's slightly unctuous, selfimport
ant
manner made Cohen wonder whether this was the psychiatrist w
ho
was going to have Nash "locked up." I For days the younger p
eople
in the department had been speculating- based on hints dropp
ed by
Ambrose and some of the other senior faculty comt Nash's wif
e was
about to have him committed. Furious controversies had broke
n 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 someh
ow

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

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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 Levinsonddbled 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:

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They would have tried to figure out how to get him into therapy without coercion. A lot of beads 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
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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 Har
vard
Club!
McLean was, as it still is, connected to Harvard Medical Sch
ool.
So many of the wealthy, intellectual, and famous came there
--
Sylvia Plath, Ray Charles, and Robert Lowell among them9-tha
t
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 u
p for
a
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special kind of RandR.
The resident on duty that evening urged Nash to sign a "volu
ntary
paperdd"Nash refused. There was a great movement for world p
eace,
he said, and he was its leader. He called himself "the princ
e of
peace."" He was informed of his legal rights, including his
right
to file a petition for release. A tentative diagnosis was ma
de,
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 t
he
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 thereea"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

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--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 escapeeea"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.

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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: "1 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

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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"anda v
iew.
There were no screams, no violent episodes, no straitjackets
. His
fellow patients, "thoroughbred mental casesea"were polite, f
ull
of concern, eager to make his acquaintance, lend him their b
ooks,
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 tha
n the
doctorsea"z 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.0ggNearly h
alf
of McLean's patients were geriatric, like Lowell's
"BobbiestPorcellian `29ea"who strutted around Bowditch late
at
night "in his birthday suit.") I I
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--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 Lowel
l's
words, "Azure day/makes my agonized blue window bleakerdd"Th
e
days must have seemed very long: "[H]ours and hours go bydd"
Above
all, there was the terrible awareness when visitors came tha
t
they were free to go back through the locked doors through w
hich
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 chi
ld;
not brutally, but efficiently, firmly, patronizingly.0"He ha
d
merely relinquished his rights as an adult human being. Like

Lowell, he must have asked himself, "What good is my sense o
f

humor?"
Alicia urged everyone they knew to visit Nashdd"Fagi Levinso
n
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
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--602
McLean, all felt the more companionship and support he had,
the
quicker he would recover." One afternoon, Also Vasquez ran i
nto
Paul Cohen, who was extremely upset. He had been out to McLe
an 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 shockeddd011 Vasquez -- along with most
 of
the students in the department -- hadn't even known that Nas
h was
in the hospital.
It was a list of some sort of committee. I remember Cohen be
ing
very upset. That was the first time I was aware that Nash ha
d
been hospitalized. I have a memory of about twenty people [o
n 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 wou
ldn'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 withou
t his
shoes, was furious. "My wife, my own wife. . . "he said to

Adriano Garsia, one of the first to visit. He threatened
A602
to sue Alicia for divorce, to "take away her power." 16
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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 somew
hat
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 ev
er
been. "He was saying such reasonable thingsea"she said."` Wh
en
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 ask
ed
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. Donal
d
Newman was the most vehement that Nash was sane. "There's no

discontinuityff"he kept repeatingdd12 Garsia recalled in 199
5: "1
was
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--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 dro
wsy
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 ide

as
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 inevitabledd019 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 pro-
duced 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 curesdd044
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 timedd046 The
staff was dedicated to encouraging all new patients, no matter
what the diagnosis, to relate. Along with this
11 milieu"therapy, as it was called, intensive, five-day-a-week
psychoanalysis was the main mode of treatmentdd47 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 McLeanea"said Brenner. "It was the dawn of
psychopharmacology. We were desperately creating cures in all
good faith
dis041
"Our knowledge of schizophrenia was negligibleea"Fagi remembered
sadly. "I was a dope. All he needed was a good shrink and support and everything would be over soon. Everyone at MIT

pretended that Nash was going to recover in a flasb. 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 tearsea049
Isadore Singer and Alicia came to visit Nash one evening. There was no one
else in

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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 bad that picture in my mind for years. "It's all over for himea"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,
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--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
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--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 releasedd"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 polieydd 16 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
A613
Vanzetti.
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 s
poke
of any delusions nor admitted to hallucinations. "I couldn't
say
he's psychotic`"Stearns wrote to Bradley. "He was straightfo
rward
and frank and of course is anxious to get out.0"Around May 2
0,
ten days before the second, forty-day, phase of Nash's commi
tment
was due to expire, Stearns went back a third time to study t
he
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
comadmitted that they "doubted Nash was committable"any long
er."`
I still do not know what is the matter with him` "Stearns, w
ho
was being paid one
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--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 remai
n in
the hospital. At that point, Alicia told them she was unwill
ing
to sign another petition for commitment although she agreed
to
make arrangements for her husband to be treated by a psychia
trist
after his release from McLean
.62
Accordingly, on May 28, after fifty days of incarceration, j
ust
over one week after the birth of his son, Nash was once agai
n 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 meea"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

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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



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

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--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 import

ant
in my life are invited! YOU KNOW WHO YOU ARE!" Over the foll
owing
week, he went around to everyone's office and asked each mem
ber
of the department if he were coming. If the person said `Yes
ea"he
asked them
"Why"0bled
He referred to the party as a "Mad Hatter's Teaea"and he ask
ed
people to dress up in costumes.` Whether the event was his i
dea
or Alicia's isn't
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--620
clear. Fagi Levinson, Norman's wife, thought that Alicia com
who
was home with a week-old baby had organized it for the purpo
se 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 pla
ce at
181h Tremont Street. Fagi remembered it as a "big party." Th
e
Nashes held at least one dinner party too. The mystified gue
st
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 w
ent
there and there was Alicia, the baby, and Alicia's mother. J
ohn
was behaving very oddly. Whenever John got up, Alicia's moth
er

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 overwhelmin
g.
Nash couldn't sit
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--621
still. He'd bolt up and as soon as he did, Alicia's mother w
ould
jump up and fuss over this and that. But she wouldn't let hi
m 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. Fu
rious
that MIT had connived in his involuntary hospitalization, Na
sh
"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 th
e
full-time faculty." Levinson was aghast. With Martin and oth
ers,
he tried to persuade Nash that what he wished to do was mad.
 He
told Nash that MIT would not accept his resignation. Levinso
n
acted in the
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--622
most altruistic fashion. He was well aware of the heavy expe
nses
of medical treatment, and he was anxious for Nash to retain
the
insurance coverage that MIT provided its faculty members. "N

orman
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

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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 bec
ame
clear to her that he would go, she made up her mind to accom
pany
him and to leave their son behind in her mother's care.
Nash had an invitation to spend the year in Paris at the Col
lege
de France, the leading French center of mathematics. Alicia
hoped
that a few months abroad, away from the pressures of Cambrid
ge
and among new faces, would let Nash forget his dreams of wor
ld
peace, world government, and world citizenship; he might set
tle
down to work again.
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--624
TO Nash, however, the journey seemed to promise a more perma
nent
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 Na
sh
had refused to eat facing the huge mirror opposite the dinin
g
tabledd17;They left their Mercedes, its trunk full of old

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 littl
e
mathematical joke-behind as well, Alicia's mother had alread
y
taken the infant home with her to Washington.", Mrs. Larde,
they
had agreed, would join them in Paris with the baby as soon a
s

they were settled.
PART FOUR
The
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--625
Lost Years
Paris and Geneva, 1959-60
I have a difficult taskaheadofme and I have dedicated my who
le
life to it.
- K, in
The Castle,
hy
FRAN-Z KAFKA
I seem as in .7 trance suhlime 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
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--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
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--627
looked up and saw the Nashes. "I was surprised, but not
surprisedea"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 ]a R6publique, in a nondescript but perfectly respectable blue-collar neighborhood on the Right Bankdd6 Paris, indeed all of Europe, was sizzling hot

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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
A628
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 com the 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 Neuma
nn
comwho acted as midwives to the nuclear agedd"One of Nash's
contemporaries in graduate school, John Kemeny-a brilliant y
oung
logician, the assistant to
Einstein, and later the president of Dartmouth College -- wa
s a
leader of the World Federalists. However, the one-worlder wh
o
fired Nash's imagination was

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--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 de
clare
him "the first citizen of the worlddd010 Davis, "sick and ti
red
of war and rumors of warea"wished to start a world governmen
t.0"E
paper headlined the story," the columnist Art Buchwald recal
led
in his Paris memoirdd"Albert Einstein, eighteen members of t
he
British Parliament, and a slew of French intellectuals, incl
uding
Jean-Paul Sartre and Albert Camus, had come out in support o
f
Davis."
Nash intended to follow in Davis's footsteps. In the overwro
ught,
hyperpatriotic atmosphere of the America he was leaving behi
nd,
Nash was choosing the "path of most resistanceea"and one tha
t

captured his radical sense of alienation. Such "extreme
 A630
contrariness"aimed at cultural norms has long been a hallmar
k of
a developing schizophrenic consciousness.
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--631
14
In ancestor-worshiping Japan the target may be the family, i
n
Catholic Spain the Church. Motivated as much by antagonism t
o his
former existence as by an urge for self-expression, Nash
particularly desired to supersede the old laws that had gove
rned
his existence, and, quite literally, to substitute his own l
aws,
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 wi
shed
to trade his American passport for some more universal ident
ity
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 Cit
izen
Registry, an organization founded by Davis. The smaller and
more
obscure the country, the less likely that turning in his Ame
rican
passport would result in immediate arrest and deportation. F
rance
was a
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--632
notoriously bad site for protests of this sort. When Nash ar
rived
at the Central Station in the city of Luxembourg, he walked
to
the American embassy at 22 Boulevard Emmanuel Servais, deman
ded
to see the ambassador, and announced that he no longer wishe

d 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 f
ormer
colleagues at MIT, it proved to them that the confinement at

McLean had done little to halt the galloping illness. Virgin
ia,
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
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--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 f
act
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 mi
nd
was full of other aspects of his intended transformation. He
 was
visiting
the "Bibliotekea"t is, the Bibliothque Nationale, which is t
he
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)." H
e
also confided in his mother that he wished "to take up paint
ing."
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 vacat
ion,

Nash decided that he



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 Leman, 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 Rousseaudd17 Mary Wollstonecraft Shelley had spent the summer of 1816 in the suburb of

Cologny 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

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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 fil ed 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

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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 lifeea"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
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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
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--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 gro
up 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 y
ear
that fell into the category of "unusual" in the sense that t
hey
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 milita
ry
authorities. These authorities cautiously turned to Berne fo
r
advice, and Berne, in turn, consulted Washingtondd"In Septem
ber,
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 servi
ce
dans les forces arm6ences des

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--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 main
tenir
la guerre froide on pr6parer la guerrc0gghe is renouncing hi
s

American passport, for the sole reason that he doesn't
A641
want to be drafted into the United States Army, nor lend to
official organizations his services as a mathematician, fear
ing
that his collaboration might aid the authorities of his nati
on in
maintaining the Cold War or in preparing for wargg.19
In November, the Geneva authorities were informed that Nash
was,
for all practical purposes, far beyond the American draft ag
e and
that he was in no way obligated to do defense-related resear
ch.
Moreover, Nash had committed none of the acts that would pro
voke
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 juridiquedd041 In other wor
ds,
since he had not signed the oath of renunciation, he was sti
ll
technically an American citizen. At that point, the police
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began threatening Nash with deportation.
His sense of himself was now full of the starkest contradict
ions.
On the one hand, Nash's most intimate thoughts and actions s
eemed
to be those of another, controlling psyche com"I am the left
foot
of God on earthdd"On the other, he felt himself to be at the

epicenter of the universe, with outer reality simply a proje
ction
of his mind. At times his posture was that of an abject
petitioner, at other times that of a "religious figure of gr
eat,
but secret, importancedd041 He spent a great deal of time op
ening
various bank accounts -- usually under false names, includin
g one
that he later said was "mysticalea"and wiring money to vario
us
countries. "I shifted money from one bank to another," Nash
recalled in his Madrid lecture in
1996.
"1 opened an account at a Swiss bank. It was Credit Andorra.
The

account was in Swiss francs. But I didn't have very much
moneydd041 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
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defense against "an invasion of aliensdd041 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
worldea"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
 A643
with reality. The clearest evidence that reality
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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, wai
ting,
endlessly waiting. At the end of September, he wrote to Virg
inia
and Martha: "My life is not exciting at present.... Waiting
for
favorable developments. I'm somewhat disillusioned with a gr
eat
many of my former associates, colleagues, friends, etcdd046
His dark mood may have reflected more than his difficult cur
rent
situation. Martha had written that Virginia had had "a nervo
us
breakdown and spent two weeks in the hospitaldd041 Nash foun
d 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 aw
ay
his passport. Alicia later recalled that he had merely "lost
" it
and while that is certainly possible, later events suggest
otherwisedd41 When
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the consulate became aware of this action, an effort was mad
e 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 cou
ntry;
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 Leman. 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



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 Pia
zza
San Marco surrounded by pigeons.
At the end of August, Alicia returned to Paris and began mak
ing
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 Nas
h
called Baby Epsilondd14 ("Baby
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Epsilon" was a tongue-in-cheek reference to a well-known
mathematical anecdote about a famous mathematician who belie
ves
that all infants are born knowing the proof of the Riemann
Hypothesis and retain that knowledge until they are six mont
hs 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 vi
sited
Odette in Grenoble. "We'd go to my room and eat pastries, ba
ba au
rhumea"Odette recalled. "We'd gossip about the other student
s. We
went skiing."" Back in Washington, Baby Epsilon was finally
christened with his grandparents and Martha in attendancedd1
7 The
baby, dressed in a little sweater on a bright fall day when
leaves littered the ground, was named John Charles Martin Na
sh.
The christening took place at St. John's in Lafayette Square
, the
same church where Nash and Alicia had exchanged marriage vow
s.
(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
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--648
replacement, the first child.)
In early December, when the frigid north wind called
le hise
swept across Lac Leman and made walking along its shores a
misery, Nash's mood was bleaker than ever. One can almost fe
el
his "sense of helplessness in an ice-cold universe."", His
efforts to renounce his citizenship and to obtain refugee st
atus
had been, for reasons baffling to him, frustrated. He spent
most
of his time indoors writing letters. His feeling of having c
hosen
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 sti
ll
very strange in a certain area with which we are both famili
ar.
And yet, to see this strangeness, the viewer must be

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 thinkingea"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



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 abso

lute
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 t
wo or
three times every
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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 arreste
d,
for the

second timedd66 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 Collegeea61 now serving as
assistant science attach6 in Paris, arrived in Geneva by
overnight train. He was accompanying an exhausted and
apprehensive Alicia Nashdd61 Together they hoped to persuade

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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
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train and, at 11: 15 Pddm., 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] requireddd010 Nash and Alicia celebrated Christmas at 49 Avenue de la R6publique. It was, as Nash was to write to Virginia, "interestingdd071 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, recalleddd71 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



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



brilliant, charismatic, highly eccentric young algebraic geometer who wore his bead 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 ttudes 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



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 i

nto 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 Khrushcbev 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 Parisdd"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 Hbrm
ander
in a letter in late January,
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was "of Swiss resident or domicileedd'19 As Nash explained i
n 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 hims
elf
"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 Americ
an
passport Nash had no hope of obtaining a visa. Hbrmander, no
w
impatient, wrote back: "Personally I would strongly advise y
ou to
reconsider your views concerning NATO and other countries.""


Nash then managed a rather extraordinary feat. In early Marc
h, he
traveled,
alone and without passport, to East Germanydd"Hard as it is
to
believe that an American without documents could get into th
e DDR
in 1960, Nash confirmed in 1995 that he had indeed traveled
there, explaining that
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--658
in his "time of irrational thinking"he had gone "places wher
e you
didn't need an American passportdd081 What actually must hav
e
happened, given the tremendously tight security at the borde
r at
that time, was that Nash applied to the DDR for asylum and w
as

then permitted by the authorities to enter the country until
 the
request was decided. In any case, he went to Leipzig and sta
yed
with a family named Thurmer for several days. According to a
 card
he sent Martha and Virginia, he was able-presumably as a gue
st of
the government comto attend a famous propaganda event that
happened to be taking place at the time, the Leipzig industr
ial
world fair, which was the Iron Curtain's answer to the Bruss
els
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 base
d 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-w
as
aware that Nash's
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--659
actions were those of a very sick man. Apparently, however,
the
incident would prompt the FBI to raise questions about Alici
a'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 w
here
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 Princet
on's
Emil Artin, found a letter from Nash, after the death of his

father, in his father's files. "It started out plausibly abo
ut
mathematicsea"Artin recalled. "But it was stamped all over,
with
[Metro] tickets and tax stamps pasted on it. By the end of t
he
letter it was obvious that it was completely fantastic. It w
as
about K6chel's numbers for Mozart symphonies. K6chel had
catalogued all of Mozart's works, more than five
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--660
hundred. It was very graphic. It must have affected my fathe
r
very much because he had kept it for all those years."" A]
Vasquez, the MIT undergraduate Nash had gotten to know in hi
s
final year in Cambridge, recalled: "His letters were filled
with
numerology. I didn't keep them. They weren't just letters. T
hey
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 recall
ed
that her father, John Synge, who had taught Nash tensor calc
ulus
at Carnegie, received postcards from Nash at this time and w
as
frightened by them. They reminded him, he told her, of his
brilliant brother Hutchie, who suffered from schizophrenia a
nd
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 lik
e
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

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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 ]a

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 Miry 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. "1 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"0bled
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 summe
r.
Initially, at least, Princeton seemed to offer a respite aft
er
the anxious final months in Paris. Alicia and Nash were very
much
part of a crowd that had gathered around John Danskin and Od
ette
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 s
cent
of honeysuckle. Napthall Afriat, a game theorist who worked
with
Morgenstern at the time, lived there, as did Jean-Pierre Cau
vin,
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 wif
e,
and Georg Kreisel, a logician, were also frequent visitorsdd
8 The
parties lasted long into the night, with Beethoven sonatas,
a
great deal of wine, barbecued steaks and shish kebab, nightt
ime
swims in the canal, and bright conversation led by the convi
vial,
cultivated, mercurial Danskin. Cauvin remembered John Nash v
ery
vividly. He had a kind of childlike air and disposition, a
gentleness, this very vulnerable quality, a kind of helpless
ness.
It blew my mind that someone who gave this appearance of bei
ng 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 h
im
ever initiating a conversation. He would respond
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--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



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 b
e
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, interven
ed.
She asked Donald Spencer comthe mathematician at Princeton w
ho
had helped Nash work out the final version of his paper on
algebraic varieties in
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1950 and 19 5 1 comto write to Leray to ask that Leray disco
urage
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 ag.... 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 workdd019 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 man
ner
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 fe
et.

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 garmentdd10 He seemed, as one graduate student



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 ceasesdd"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.0"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?0"On another, "What do
Spain and the Sinai have in common?0ggTh was after Israel's
takeover of the Sinai.) He answered his own question, "They both
start withS."
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

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--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, "We
ll,
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 notebo
ok.
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 rec
alled
Nash's wry sense of humor, which he remembered as "intention
al,
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

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--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 experien

ces
in Paris and Geneva. The job with Morgenstern fell through.
As
Danskin recalled, Nash refused to fill out the necessary W-2

formseaeaclaiming that he was a citizen of Liechtenstein and
 not
subject to taxes.
I got him a job in the economic research group by calling Os
kar
Morgenstern. Oskar said fine. I got an application. It calle
d for
his social security number and asked whether he was a citize
n 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 Dece
mber,
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 h
e
heard that Martin Shubik was applying game theory to the the
ory
of money, he sent Shubik a
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--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 recalle
d: "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

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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 boyea"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 heautiful 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

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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 a top 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

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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
A677
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.

Peter Baumecker, who worked at both the hospital's insulin u
nit
and the rehabilitation ward during Nash's stay. The poorest
and
sickest patients wound up at Trenton. "I remember very few
patients specificallyea"Baumecker said. "There was one patie
nt
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 ki
lled
his father. But that was very exceptionaldd06
"There were good wards and bad wards. Trenton was not as plu
sh as
other
places. As a matter of fact, Trenton was pretty crummyea"rec
alled
Baumecker in 1995. "But I remember a lot of warmth, a lot of

caring. We helped an awful lot of
peopledd07
Later Nash would recall, with great bitterness, the fact tha
t he
was assigned a serial number at Trenton, as if he were an in
mate
of a prisondd8 To occupy a room shared by thirty or forty ot
hers,
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 soa
p or
shaving cream, is an experience that few people can imagine.
Yet
this is how Nash coma man who craved, because of his nature
and
the nature of his

illness, solitude and mobilitylived for the next six months,

surrounded by strangers. If he had dreaded military duty, wh
at
must this have been like for him?
Nash would have been brought to Payton One, the men's admitt
ing
ward, on the ground floor of Payton, off to the right of the
 main
administration building. Baumecker was in charge of admissio
ns
then and conducted the initial interview. "Nash was my patie
nt;`
said Baurnecker. "He didn't like me because my name started
with
a T4'He had something against the letter Bdd09
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 he
ar
voices?" He tried to find out whether Nash had delusions and

whether they were elaborate. He watched his expressions to s
ee
whether the emotions he showed were appropriate to what he w
as
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 obta
in
asylum in Brazil comwas, it
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--680
seemed, very much on Nash's mind; he had his own private the
ory
about it."
The following morning, Nash's "case" was presented to the st
aff,

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:
1 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



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."
14
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

1trumpets blowing in their minds."" Very soon after that A682
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 anybody dd019
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 w
ake
him and give him an insulin injection. By the time Baumecker
 got
to the ward at eight-thirty, Nash's blood sugar would alread
y
have dropped precipitously. He would have been drowsy, hardl
y
aware of his surroundings, perhaps half-delirious and talkin
g to
himself One woman used to yell, "Jump in the lake. jump in t
he
lake," all the time. By nine-thirty or ten, Nash would be
comatose, sinking deeper and deeper into unconsciousness unt
il,
at one stage, his body would become as rigid as if it were f
rozen
solid and his fingers would be curled. At that point, a nurs
e
would put a rubber hose through his nose and esophagus and a

glucose solution would be administered. Sometimes, if necess
ary,
this would be done intravenously. Then he would wake up, slo
wly
and agonizingly, with nurses hovering over him. By eleven in
 the
morning, Nash would
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--685
be conscious again. And by the late afternoon, when the whol
e
group would walk over to occupational therapy, he would be a
mong
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

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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 o
f
sugar and the sugar had a lot of calories. For some of these

spindly, skinny schizophrenics it wasn't such a bad thingdd0
19
But patients often hated it. Nash's subsequent obsession wit
h his
diet and weight may well have stemmed from this experience o
f
being "force-fed."
Treating schizophrenic patients with insulin coma was the id
ea of
Manfred Sackel, a Viennese
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physician who thought of it during the 1920's and used it on

psychotic patients, especially ones with schizophrenia, in t
he
mid-1930'sdd10 His notion was that if the brain were deprive
d 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 effecti
ve
than antipsychotics, especially with regard to delusional
thinkingdd"No one understood the mechanism, but two large-sc
ale
studies in the late
1930's found that insulin-treated patients had better and mo
re
lasting outcomes than untreated individuals, but evidence fo
r
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.

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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 memoryea14 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

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fever therapy. We had a strain of malaria that we would inoc ulate 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 A690
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 be
was allowed out on passes, she took him to her folk-dancing group
and out to Swifts Colonial Dinerdd40 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
downdd041 He was discharged on July 15, a month after his
thirty-third birthdaydd41 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,
doctordd041

41 An Interlude of Enforced Rationality

July 1961 comApril 1963

"en I had been long enough hospitalized... I wouldfinally
renounce my delusional hypotheses and revert to thinking ofmyfas
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

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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
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--693
July 15 suggest how modest Nash's view of reality had become
:
In my situation and anticipated situation a fellowship ... w
ith
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 bee
n 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, Mar
ston
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 Nash
dd6
Nash's application, dated July 19, 1961, stated that he wish
ed to
"continue the study of partial differential equations"and
mentioned "other research interests, some related to my earl
ier
workea"z well.`
In late July, Alicia's mother brought John Charles, a big,
handsome two-yearold,
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--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 confere
nce
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 confl

icts
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 gre
at
help that Mrs. Larde cared for Johnny while Alicia went to w
ork,
but living together created another layer of strain, especia
lly
for Alicia.
They tried to make the best of it. Nash attempted to care fo
r his
son, picking him up at nursery
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--695
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 move
d
there the previous fall, and to see John Stier." The visits
were
rather fraught and Eleanor used to call John Danskin afterwa
rd to
complain about Nash. On one visit, apparently, Nash had come
 with
a bag of doughnuts. "Eleanor kept saying, `How cheap!` "Odet
te
recalled."
In early October, Nash attended a most historic conference i
n
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

was little mention of noncooperative games or bargaining. Bu
t
John Harsanyi, a Hungarian, Reinhard Selten, a German, and J
ohn
Nash, dressed in odd mismatched clothing, mostly silent, wer
e all
there.
14
This was the first time these three men bad met, and they wo
uld
not meet again until they traveled to Stockholm a
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--696
quarter of a century later to accept Nobel Prizes. Harsanyi
remembers asking one of the Princeton people why Nash said s
o
little during the sessions. The answer, Harsanyi recalled, i
n a
conversation in Jerusalem in 1995, was "He was afraid he wou
ld
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 mathemati
cal
analysis of the motion of fluids and certain types of nonlin
ear
partial differential equations that can be used as models fo
r
such flows. He finished his paper on fluid dynamics, begun w
hile
he was in Trenton State hospitaldd"X was titled "Le ProWme d
e
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 noteworthyea"eventually inspired a good de
al of
subsequent work on the so-called
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--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 Frenchea"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?0"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 bad 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
theredd17 0ppenheimer 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 separa
te
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
clothesea"Stefan Burr, then a graduate
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--701
student, recalled. "He didn't seem at all aggressive. In som
e
ways his manner was not that different from a lot of
mathematicians`dis019 For a while, Burr and Nash were playin
g
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, "H
e was
not quite right. He seemed to me very diminished. His mathem
atics
was not at the same level. I found him odd, unpredictable,
nonsensical. It was very painful. The secretaries were afrai
d of
him. He was someone to avoid. You never knew what he would d
o or
say.""
One time the Borels had Alicia and Nash over for tea. "We se
rved
tea and cookiesea"said Borel. "Nash went into the kitchen. I

followed him. `What do you want?` I asked. `Well, I'd like s
ome
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 a
nd
restless, and he was beginning again to harp on his old
obsessions. He decided, rather suddenly,
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--702
to travel to the West Coast, where he saw, among others, Als
o

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
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--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 wayea"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 medd"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. E

d
Nelson, who had become quite friendly with Nash over the aca
demic
year, recalled Leray's saying that it was a scandal that the
re
were no global existence theorems. "The feeling he conveyed,
"
Nelson said, "was that we had better get to work, or the wor
ld
might come to an end at any moment."
17 Most
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--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 hi
s
"pidgin Frenchdd019 He did not speak extemporaneously but re
ad
from his notes in his very soft voice and with his very stro
ng
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 sa
id:
Malgrange, the official conference organizer, had a dinner f
or
the participants. At the table, Nash exchanged his plate wit
h 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

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
Londondd44 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 th

ird week of August in Stockholmdd46 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

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labeled "Des Secretsdd"He wrote "Could you sign this carte d'identit6 ... a man all alone in a strange worldea"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 csto 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 ho
me
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 ca
lls
to mathematicians in Princeton and elsewhere.
He was still obsessed with the idea of asylum. A letter to M
artha
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
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--709
Ecumenical Council and previous letters he had written to th
e
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, Na
sh no
longer interpreted his difficulties as a sign of illness but

rather as the results of machinations by the Ecumenical Coun
cil.
By January, his letters to Martha and Charlie had become nea
rly
incomprehensible, the thoughts skipping from Albanians to St
alin
to "secrets can't reveal"and "wood and nails of the true
crossdd"I I
Exhausted and dispirited by three years of turmoil and convi
nced
that Nash's condition was more or less hopeless, Alicia cons
ulted
an attorney and instituted divorce proceedings. She had marr
ied
someone who she thought could look after her but couldn't, w
ho
resented her bitterly, and who accused her of having malevol
ent
intentions. To Martha and Virginia she wrote that being marr
ied
was helping to create Nash's problems and that she felt that

being freed from the marriage would be better for him as wel

l. 12
Alicia's attorney, Frank L. Scott, a genial Princeton divorce lawyer with an office

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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
711
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."



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

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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 woul
d of
course be very fine not only for him but also for mathematic
s
dis061
Albert E. Meder, Jr., the society's treasurer, was enthusias
tic
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] lette
r of
March
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--714
25.... I would be inclined to go ahead dis061
Nash's increasingly bizarre behavior was triggering complain
ts,
including some at the Institute for Advanced Study. Mostly t
hese
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 wa
s
being doused with water. The institute's dining hall was the
n on
the fourth floor of Fuld, and it turned out, upon investigat
ion,
that Nash had been pouring water from the window above the m
ain
doordd64
It was Donald Spencer, a man who could not stand to see anyo
ne in
trouble without intervening, who was elected to try to convi
nce
Nash to accept the Michigan offer and enter the clinic
voluntarilydd61 Spencer chose, as he usually did, a bar as h
is
venue. He invited Nash for some beers in Nassau Tavern, wher
e
Nash had once celebrated passing his generals. They sat in t
he
booth for hours, Spencer downing warm martinis, Nash nursing
 a
single beer. Spencer talked and

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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 involuntaril
y.
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 m
other
and I are waiting to hear from Alicia when she has arrangeme
nts
made.... We really had thought we would do this in March.
We were very hopeful that we could persuade John to go to th
e
University of Michigan and take advantage of the opportuniti
es
for research and treatment there. Unfortunately John will no
t
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. O
nce
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
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--717
one of only two private mental hospitals in New Jersey. Loca
ted
in the picturesque hamlet of Belle Meade, amidst rolling hil
ls
and lush farmland, Carrier was just five miles north of
Princeton. Despite its easy proximity, however, it was gener
ally
avoided by Princetonians. As Robert Garber, a former preside
nt of
the American Psychiatric Association who was Carrier's medic
al
director at the time, recalled: "They didn't want to be in a

psychiatric facility close to home. It was a disgrace, a ter
rible
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

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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 O
ne,
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 clu
b, at
least more like a reform school than a prison. There were ju
st
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, dru
g
addiction, and depression rather than from psychotic illness
es."
Carrier had a dozen psychiatrists on its staff, a more adequ
ate
nursing staff than at Trenton, and a reasonable complement o
f
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
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--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 nu
mber
of others from Princeton, among them Spencer, Tucker, and th
e
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 nig

ht
that Nash was brought to Carrier, was assigned to care for h
im. A
short, soft-spoken, dapper man of Italian descent who got hi
s
medical degree at Long Island College of Medicine and did hi
s
residency at Mt. Sinai Hospital in New York City, Mele was q
uiet
and carefuldd"Described by his former colleagues as
disccventional,0"cautious,0"n an exciting man," Mele was, as

later events
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--723
showed, competent and caringdd17 He was respected by the nur
sing
staff. Belle Parmet, the institute's social worker at the ti
me,
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 s
ix
weeks. Two weeks after his commitment, Nash wrote a relative
ly
lucid letter to Norbert Wiener, saying, among other things,
"My

problems seem to be essentially problems of
A723
communications. I don't know how they can be resolved. Perha
ps I
shall be able to approach their solution as a result of begg
ing
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
favoreddd10 There was, however, no thought of releasing him
quickly. As Garber said, "Paranoid schizophrenics are not th
at
responsive. Once you do get them under control, you have to
satisfy yourself that they've stabilized. You
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--724
don't want a relapse, especially if there's been a commitmen
t
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 Alici
a's
visit on the weekend and was "thinking of getting out.0"He a
dded
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 wrot
e
again saying that Sunday was "a sad day" because Alicia had
to
work overtime and couldn't come to take him out. He said tha
t 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 propects
for a
reconciliation"with Alicia."
It is a discouraging but well-documented fact that people wh
o
suffer from schizophrenia face an extremely high risk of sui
cide,
comparable to those who suffer from severe depressions and o
ne
hundred times that of the general populationdd14 This risk i
s

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
726
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 tho
ught
you might be in a position to know whether such a person exi
sts
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.
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--728
Nash stayed out of sight at the Institute. Few of that year'
s
visitors recalled seeing him there. He complained in the fal
l 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 h
er
son hard to handle. But when her mother took John Charles to
 El
Salvador for several months that winter, she missed him terr
ibly.
Nash tried to be sympathetic, writing in March that "Alicia
is
seeing a psychiatrist. She is very depressed. She was crying
dd"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
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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 Andr6 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 disappointeddd010

By May, Nash was complaining that he was having trouble work
ing:
"I have some ideas but many of them don't seem to work out."
"
Nash had apparently been in touch with Grothendieck once mor
e.
Grothendieck evidently responded with an invitation to the I
HES
for the following year. At the beginning of the summer, Nash

wrote to a colleague in Europe, saying that he wished to spe
nd
the following year in France rather than stay in Princeton a
nd
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



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 roo
m. He
wrote that he expected something to change by June 1, but th
at 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), drawin
g a
circle in the middle of the page accompanied by the parenthe
tical
remark, "(Ici-compris ma situation de famille, etc., etc.)"

(Including my family situation). He went on, "Et si je
A733
peux travailler effectivement aux math6matiques par 1ence te
mps
de I'automne, je pense que je devrais accepter l'offre de
Grothendieck plut6ment que l'off-re de l'Universit6, s'il po
urra
encore me dormer cet offre d'emploi0ggAnd if I can work
effectively at mathematics by the fall, I think I should acc
ept
Grothendieck's offer over the offer from the university, if
he
will still extend me this offer of
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--734
employment).
As far as the institute knew, Nash was planning to spend the

entire summer at Fuld Hall, with the exception of about thre
e
weeks, before going to France in the fall. On May 24, in res
ponse
to a note from Oppenheimer granting him funds for the summer

"with the understanding that you will remain at the Institut
e
during the summer;` Nash wrote that he planned to be away fr
om
June 22 through July
19 at a conference in Woods Hole on Cape Cod, organized by J
ohn
Tate, on the theory of singularities, classifications of sur
faces
and modules, Grothendieck cohomology, zeta-functions, and
arithmetic of Abelian varieties." According to Tate and othe
r
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 trie
d to
get in touch with Grothendieck, who evidently wasn't in town
dd16
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
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--735
figure.0"Th may have
accounted for his desire to be in Rome, where, as he later s
aid,
he visited "the Forum and the catacombs but avoided the
Vaticandd018 The Pope was, in any case, not in Rome at the t
ime.
He was standing in front of the Forum when he began to hear
voices "like telepathic phone calls from private individuals
dd019
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 a
nd
one of their favorite words was pronto. So ifs like ping-pon
g,
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 ce
ntral
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 Septembe
r 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 hm dd64
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 wa

s
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.

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

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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

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When Nash got out of Carrier this time, in mid-July, he spen t 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,
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--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, Patt ison 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



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 h mbb7
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.0"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 aloofdd"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 motherdd9 They included, between infancy and six,
a series of foster homes in Massachusetts and Rhode

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 child care,
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 edgedd010
It was, as he said, "a miserable childhood, a shitty
childhood.0"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

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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 lifedd"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
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that he was once again using her without much intention of g
iving
her very much in return. But at the end of February, Eleanor
and
John David were "among my few social contacts." 11 There wer
e
repeated flare-ups. "Eleanor was not nice to meea"he wrote a
fter
they went to a restaurant togetherdd14 In April when Eleanor

moved to a new apartment, several days went by before she wa
s
willing to give him her new telephone numberdd"In May there
is
another reference to Eleanor's not being nice, which again m
ade
Nash feel rather "sad."
16
If Nash's reappearance in Boston raised again the possibilit
y 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 th
e
fact that she was discouraging him from visiting her in
Princeton, as he had hoped to do, on Thanksgiving. She appar
ently
put him off with excuses, citing among other things "proprie
ty."
11 Nash persisted and Alicia
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continued to discourage him, so that a week before the holid
ay
Nash said that he still had no invitation. Alicia was now ta
lking
of his coming down at Christmas, but it is not clear that th
e
visit took place. In and amongst it all, perhaps because he
was
now aware of John David's discomfort around him, he expresse

d
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
A748
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 beendd"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,
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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 probleme a"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 mo
re
and more normal. He started interacting with people. We most
ly
talked about mathematics. He never talked about his personal

lifedd016
Nash's renewed appetite for life was most
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evident in the energy with which he was able to work that ye
ar.
During that fall at Brandeis he wrote a long paper, "Analyti
c-
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
Anndd715 ofMathemdtiCs
in early Januarydd"Armand Borel, one of the editors, sent it
to
Jilettergen Moser to referee. After a few telephone consulta
tions
between Borel and Nash, Nash quickly revised the paper and g
ot 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 journaldd019

His renewed productivity produced a rush of self-confidence.
He

went to see Oscar Zariski at Harvard to discuss some new A750 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 justcompleted paper and talked over ideas for future work. Brieskorn was doing some interesting work in singularities. "Nash had interesting ideasea"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 himself0"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 higherdd"I` 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 singularitiesdd"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 commentsdd"Nash quite likely submitted this

paper to the Annals as well, but it was never publisheddd14 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 ofMathematics in 199 5 in a special issue in honor of Nash.
The quality of these two papers comthe 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,

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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
Squaredd40 Kohn was off for a year's sabbatical in Ecuador.
The
sublet was arranged by Fagi Levinson, who recalled: "Everybo
dy
wanted to help Nash. His was a mind too good to waste dis041

Nash enrolled in Operation Match, a Cambridge computer datin
g
service. He was going on blind dates, acutely aware that "I'
ll
need to learn how to behave properly and be polite etcdd"He
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--754
wrote that he was "hopeful and optimistic": "I think I'll de
velop
some good friends and I'll get remarried if not to Alicia an
d
then I'll have a happy family lifedd041 He had an appointmen
t 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 tal
king
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.
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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

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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 A756
especially you and Martha will be much better.0"At
Thanksgiving he wrote: I didn't have much to be thankful for this
Thanksgivingea"He planned to go to Roanoke for Christmas and to
spend New Year's-Alicia's birthday comin 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 goingdd14
Nash was still attending the Harvard math colloquiurn 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
himea"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

was very concerned about not being able to contribute. "I started
out so wellea"he said. "I think of myself as a valuable person.
But I'm not contributingdd"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 Franciso 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
wildddd060
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
fallddd61
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 c

an be
rather confidently expected but is more the pioneer type who

proceeds along new paths. He is thus rather unpredictable; b
ut 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 wo
uld
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 D
avid
locked him out on the porch on a freezing nightdd64 Nash tol
d
Palais at some point that he'd stopped taking medication. "W
hy,
when they were making you well, did you stop taking drugs""H
e
answered, "If I take drugs I stop hearing the voices
dis061
A letter from Nash to Moser captures something of
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Nash's state of mind when he returned to Cambridge in late M
ay.
Nash gives his return address as Heilwigklang University, Ha
rbin,
Manchuria.
The Oblast in Russia, on the Manchurian border ... there's t
he
city of Birbidzhan.... If all the atomic powers of the secur
ity
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, s
hady,
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
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--762
Fagi called Joe Kohn and said she'd get a moving van and sen
d
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 Ann
a
Rosa, Kohn's wife, went into the Parker Street apartment: "T
here
were folded bags, one upon another, and cereal boxes. Not aw
ful,
but signs of compulsiondd010 A few days later, Norman Levins
on
wrote to Martha: For the past two years John has been employ
ed as
a research associate on my contract. John doesn't want to li
ve
here and I couldn't convince him to stay. A few days ago Joh
n
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 ver
y
well and did fine work."
in a Strange World
Roanoke, 1967-70
And then a Plank in Reason, broke, And I dropped down, and d
own
An d h it a World, a t e very plunge..

- Emm
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--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 coma pretty little city at the foot of the Appalachians
and the headquarters of the Norfolk and Western Railroad com was

the end of the line.
A763
He lived with Virginia in a small garden apartment
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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 Japane
se
teacups (a souvenir of her
long-ago summer in Berkeley), sipping Formosa oolong, whistl
ing
Bach.
7
The sleepwalker's gait and fixed, faraway expression gave fe
w
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
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reaches of the globe: Cairo, Zebak, Kabul, Bangui, Thebes,
Guyana, Mongolia. In these faraway places, he lived in refug
ee
camps, foreign embassies, prisons, bomb shelters. At other t
imes,
he felt that he was inhabiting an Inferno, a purgatory, or a

polluted heaven ("a decayed rotting house infested by rats a
nd
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

struck him as ominous, among them May 29.
Persistent, complex, and compelling delusions are among the defining symptoms of schizophreniadd9 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 A766 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"z 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.



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 absurdea"is the sort of preface of which he was quite capabledd"His sentences were filled with phrases like "consider,0"z if,0"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.

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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
769
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 irrationalityea"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 slaveryea"finding "a simple methodea"creating "a model" or "a theorydd"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

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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-indenf` 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
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... 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
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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,"

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
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rejects his claim: "See, away from the fatness of the earth shall
your home bestand away from the dew of heaven on high./0Yr sword
you shall liveeastand you shall serve your brotherbb/b when you
break looseeasty 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

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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 lifeea"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 absentiadd"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.0"He thinks of a "court of inquiry"investigating "the life histories and ... interactions" of Jacob and Esau, whom he identifies as Bricker and himself.

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,

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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 surprisingl
y
clearly, how there's as it were, a time

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--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: "M
y
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 f
rom
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 asl
eep
or waking up. The content of schizophrenic hallucinations ca
n 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

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--778
Greek: affective flattening, alogia, and avolition. There wa
s no
trace of the sharp looks, the enthusiastic gesturing, the br
ash
body language that announced, "I'm Nash with a capital Ndd"H
is

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

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.""

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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.

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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."

A781
For Virginia, Nash's illness was something that Martha later

called, in her tactful and understated way, "a private sorro
w.""
Virginia never talked about it
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with the few acquaintances she had in Roanoke, mostly people
she
had met playing bridge, and only rarely with Martha. Her fri
ends
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 loc
k on
her phone.
Martha, whose second child was born in 1969, was at least an
gry.
"It was so frustrating day by day. You wondered, is this eve
r
going to get any better""She realized, at least, that Roanok
e was
not a kind environment. "Only one time did I ask for
helpea"recalled Martha. "The minister stopped me after churc
h and
told me I should be helping my mother more. He didn't ask wh
ether
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 a
t 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. "T
he
landlord accused John of setting it `was Martha recalled. He
had
talked to the neighbors, who were
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up in arms. They found this large, strange man who walked ar
ound
the grounds of the apartment complex alarming. It was only b
y

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.



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



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
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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 a
fter

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--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 invo
lving
the factoring of very long, ten-
to fifteen-digit numbers into two large priMeSdd6
"Nobody knew where they came fromea"recalled Mark Reboul, wh
o
graduated in 1977. "Nobody knew what they meantdd"I
Eventually, some sophomore or junior would clue in the newco
mer
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 res
ult;
or upon learning that his wife had fallen in love with a
mathematical rivaldd8 He had friends in high places at the
university, the older student would add. Students were not t
o
bother hmdd9
Among the students, the Phantom was often held up as a cauti
onary
figure:
Anybody who was too much of a grind or who lacked social gra
ces

was warned that he or she was "going
 A786

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--787
to wind up like the Phantom.0"Yet if a new student complaine
d
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, althoug
h
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 onl
y to
encounter the Phantom in front of the blackboard writing a f
ew
days later, "sweating, trembling, and practically cryingdd"T
he
student never erased another."
Students and young faculty members studied the Phantom's mes
sages
and sometimes copied them down verbatim. The messages create
d an
aura around the Phantom and confirmed the legends of his gen
ius.
Frank Wilczek, a physicist at the Institute for Advanced Stu
dy
who lives in Einstein's old house on Mercer Street, was an
assistant professor at the university at the time. He rememb
ered
feeling "intrigued and impressed"and "in the presence of a g
reat
mind.0"Mark Schneider, a physics professor

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--788
at Grinnell who was a graduate student in 1979, recalled: "W
e all
found the remarkable connections, level of detail, and bread
th of
knowledge ... exceptional, which is why I ... collected a fe
w
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 r
ead:

N1 plus 11 plus X1 plus 01 plus N1 equals 0
Can Hironaka resolve this singularity?"
Some of the messages seemed purely mathematical, at least un
til
one looked at them more closely, as in this 1979 message:
Open Letter to Prof. Heisuke Hironaka
0 equals Ell plus V11 plus El plus R11 plus El plus
T1,9
plus T10
2 3 2
The above algebraic variety of dimension 6, represented in a
ffine
7-space is singular, having a point singularity at the origi
n
(0,0,0,0,0,0,0) of the coordinates.
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--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 sor
t 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 dise
ase
of xanthochromatosis, the same disease which previously affe
cted
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
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--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 n
amed
Ya Ya Fontana who made mysterious pronouncements about curre
nt
events, principally in the Middle Eastdd19 In another period
,
Alexandre Grothendieck's name appeared frequentlydd10 In sti
ll
another, Diophantine equations comequations like x-
plus y-
z, comdominated."
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 "mystica
l,
cultic religious efflorescence"
- aren't merely the ravings of madmen but conscious, painsta
king,
and often desperate attempts to make sense out of chaos.
Nash was making up numbers out of names and was often
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extremely worried about what he found. "He was quite agitate
d
when he thought that the numbers were portents of something
serious `was recalled Peter Cziffra, the head librarian at F
ine
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 simila

rity
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, Pete
r
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 da
y he
called me and started with the

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date of Khrushchev's birth and worked right through to the D
ow
Jones average. He kept manipulating and putting in new numbe
rs.
What he came out with at the end was my Social Security numb
er.
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. Nas
h 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
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paved the way for an eventual remission. As James Glass, the
author of
Private TerrorlPublic 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
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based on the letter-number correspondence, factoring the
resulting numbers, and then comparing the primes in the hope
of
discovering "secref` messages. Daniel Feenberg, a graduate
student of economics who ran into Nash at the computer cente
r
around
1975, recalled: "Nash had an obsessive concern with Nelson
Rockefeller. He would take the letters, assign numbers to ea
ch
letter, get a very large number, and then analyze that numbe
r 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 fin
ding
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. Performin
g
these calculations would have been tremendously tedious and
would
have required writing down intermediate results as he went a
long,
since these calculators had very little storage capacity and

weren't programmable. Generating the equations that constitu
ted
the core of his blackboard messages was not just fancy
arithmetic,
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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. H
e 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 bad 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

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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 ou
tput.
Someone suggested, said Trotter, "Why not give him his own
account?" Everybody agreed to give him a free account. "He n
ever,
never made any trouble. If anything, he was embarrassingly
diffident. Sometimes if one was having a conversation with N
ash,
it was hard to break away."
For most of the 1970's, Nash conducted his elaborate researc
hes
in the reference room of Firestone Library, where he was kno
wn 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 spen
t
evenings in the
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reference room, his floppy golf hat on the broad wooden tabl
e
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 heade
d 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 o
f
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

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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 *Encyclopaedid 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]dd"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
deaddd040
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
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equilibria
.41
Lloyd Shapley was on the prize committee. It was his idea. "I
felt sentiment and nostalgiaea"he recalleddd43 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-es
teem.
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 Princ
eton
to present Nash with the awardd41 He said: "We gathered in
Also
Tucker's office. Al and Harold Kuhn were there, so we chatte
d a
while. Nash was sitting in the corner. Let me tell you, seei
ng
this man who was a genius and now functioning at subadolesce
nt
level really was tragic. There's a difference between knowin
g and
seeingdd041
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--803
Princeton, 1970-90
I have been sheltered here and thus avoided homelessness. co
mJOHN
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 una
ble
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 simp
ly
not prepared to turn her back on him.
Alicia also was moved by the conviction that she had somethi
ng
more to offer Nash than physical shelter. She believed, perh
aps
somewhat wishfully, that living in an academic community amo
ng
his own kind, without the threat of further hospitalization,

would help him get well. She took Nash's own assessment of h is 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

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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

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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

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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

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had been periodically buffeted by contract cancellations and layoffi. 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 a
ll
dayea"she later recalled. "But I never got any offers. It wa
s
very depressingdd"I
Things got so bad after her unemployment benefits ran out th
at
she was forced to go on welfare and to use food stampsdd9 He
r
hope of marrying Moore came to nothing. He backed away, find
ing
the prospect of taking on a stepson as well as a wife "too
muchdd010 Her mother "held everything togetherea"z Alicia la
ter
said, but it was very hard." Alicia and her mother were forc
ed to
give up the nice
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house they were sharing on Franklin Street in the heart of
Princeton proper." Alicia found a tiny nineteenthcentury fra
me
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 friend
s.
But Alicia had little choice.
Nash moved to the Junction with her, contributing some of hi
s
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 hmdd14 Alicia had taught her son, who wou
ld
later become a chess master, how to play.
Nash was very withdrawn, very quiet. "He was not a
troublemakerea"Odette recalleddd"Haphazardly dressed, his gr
ay
hair long, his expression blank, he would wander up and down

Nassau Street. Teenagers would taunt him, planting themselve

s in
his path, waving their arms, shouting rude things
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directly into his startled facedd16 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 deman
ds on
Nash. Looking back, her gentle manner probably played a
substantial role in his recoverydd"Had she threatened or
pressured Nash, he very well might have wound up on the stre
et.
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 r
ecent
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 p
lan
things. They just turn out that waydd019 She does see that i
t
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 b
asic
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'sdd11 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 workingdd"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

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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 averagedd14 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 upea"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 be 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
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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 comat the Carrier Clinicd
d17
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 bad 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
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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
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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

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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 fatherea"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
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to school with
hiMdd041
The reunion between Nash and John Stier did not lead to a lasting
reconciliation. "It just sort of petered outea"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 Nixonea"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 historydd"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 himea"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

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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

"1 don't need to take calculusea"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

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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.

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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 theorydd 41 "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 Erd6's in the 1930's for a special

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case of so-called B sequencesdd"Nei Erd6's 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.D4's
A820
to tenured positions somewhere in academia. While Johnny was
in
graduate school, Alicia Larde returned to El Salvador for go
od
and Alicia Nash moved to a job as a computer programmer at N
ew
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. lt just a questio
n
Oflivinga quiet life. ALSO-ICIA NA-SH,
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1994

PETER

SARNAK,
a brash thirty-five-year-old number theorist whose primary
interest is the Riemann Hypothesis, joined the Princeton fac
ulty
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 be
en
told many times Nash was completely mad, he wanted to be kin
d. He
promised to send Nash the paper. A few days later, at teatim
e,
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 hi
mself
having to concentrate quite hard. Later, as he turned the
conversation over in his mind, he felt rather astonished. Na
sh
had spotted a real problem in one of Sarnak's arguments. Wha
t's
more, he also suggested a way around it. "The way he views t
hings
is very different from other peopleea"Sarnak said

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
A822
of this decade, really began. But, in contrast to the onset
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of his illness, which became full-blown in a matter of month
s,
the remission took place over a period of years. It was, by
his
own account, a slow evolution, "a gradual tapering off in th
e
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 mathemati
cal
numerology. Playing with formulas and factoring. It wasn't
coherent math research, but it had lost its bizarre quality.

Later it was real researchdd"I
As early as 1983, Nash was beginning to come out of his shel
l and
making friends with students. Marc Dudey, a graduate student
in
economics, sought Nash out in 1983. "1 felt bold enough at t
he
time to want to meet this legendddObled He discovered that h
e and
Nash shared an interest in the stock market. "We'd be walkin
g
along Nassau Street and we'd be talking about the market `"D
udey
recalled. Nash struck Dudey as a "stock picker" and on occas
ion
Dudey followed his advice (with less than stellar
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results, it must be said). The following year, when Dudey wa
s
working on his thesis and was unable to solve the model he w
anted
to use, Nash helped to bail him out. "The calculation of an
infinite product was involved;` Dudey recalled. "I was unabl
e 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 donedd"All durin
g
this time, Nash struck Dudey as no odder than other
mathematicians he had encountered.
By 1985, Daniel Feenberg, who bad helped Nash factor a numbe
r
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 mu
ch
better. He described his work in the theory of prime numbers
. I'm
not competent to judge it, but it seemed like real mathemati
cs,
like disreal research. That was very gratifying."`
The changes were for the most part visible only to a few. Ed
ward
G. Nilges, a programmer who worked in Princeton University's

computer center from 1987 to
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1992, recalled that Nash "acted frightened and silent"at
firstdd6
In Nilges's last year or two in Princeton, however, Nash was

asking him questions about the Internet and about programs h
e 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
thenea"Shapley recalled. "He was free of this distraction. H
e'd

learned how to use the computer. He was working on the Big
A825
Bang. I was very pleased."`
That Nash, after so many years of severe illness, was now "w
ithin
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 rea
lly
symptoms of bipolar illness, which is generally less debilit
ating
and carries better odds of recovery?
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Absent a re-diagnosis based on Nash's psychiatric records, n
o
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 mo
re
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 individ
uals
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 wit
h
paranoid schizophrenia and schizoaffective disorder is stron
g
evidence that Nash himself had schizophreniadd9 In contrast
to
the Freudian theories popular in the 1950's, when Nash was f
irst
diagnosed, schizophrenia is now thought to have a strong gen
etic
component. 11
The duration and severity of Nash's symptoms comhis inabilit
y to
do work that was, prior to and since his illness, the princi

pal
passion of his life, and his withdrawal from most human contact
comis also powerful evidence. Moreover, Nash has described his
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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 downdd"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
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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.
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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 dise

ase.
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 w
ere
still institutionalized, apparently unresponsive to any drug
s or
to electroshock treatment, which was used far more extensive
ly
than in the United States. Another group was living with the
ir
families, but still had symptoms, especially the

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negative symptoms of lethargy, lack of drive, and lack of
interest and pleasure in life. But a surprisingly large grou
p --
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 befo
re
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 stu
dy
results spread through the small global community of
schizophrenia researchers, a team in the United States at th
e
University of Vermont decided to undertake a similar long-te
rm
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



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 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

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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
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irrational thinkingea"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 gro
wing
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 recogniza
bly,
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 reco
very:
Actually, it can be analogous to the role of willpower in
effectively dieting: if one makes an effoyt to "rationalize"
one's
thinking then one can simply recognize and reject the irrati
onal
hypotheses of delusional thinking."
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"A key step was a resolution not to concern myself in politi
cs
relative to my secret world because it was ineffectualea"he
wrote
in his Nobel autobiography. "This in turn led me to renounce

anything relative to religious issues, or teaching or intend
ing
to teach.
"I began to study mathematical problems and to learn the com
puter
as it existed at the time. I was helped (by mathematicians w
ho
got me computer time)dd011 By the late 1980's, Nash's name w
as
appearing in the titles of dozens of articles in leading
economics journalsdd"B Nash himself remained in obscurity. M
any
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 lobotomydd"Even the best-informed sa
w

him, for the most part, as a sort of ghost. In particular, with the exception of the 1978 von Neumann Prize comthe result of Lloyd Shapley's efforts comthe recognition and honors routinely accorded scholars of his stature simply failed to materializedd19

One particularly egregious episode in the academic year 1987-88 illustrated just how powerfully the perceptions of Nash's mental illness worked

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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
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five-member nominating committee-one of whose main tasks was
, in
any case, to "determine whether
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previous nominating committees had overlooked p"and to corre
ct
such oversights." As a result, the nomination was forwarded
to
the committee, which took it up in the spring of 1989. By th
en,
Rubinstein, a game theorist who holds professorships at the
University of Tel Aviv and Princeton University, was a membe
r of
the committee. The other members, all professors of economic
s,
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 Tr
uman
Bewley at Yaledd14
ReRVSS-IOn
The proposal to put Nash on the ballot sparked an intense
controversy be-
tween Rubinstein and the rest of the committee, one that dra
gged
on for months. From the start, the issue was Nash's mental
illness. Mervyn King said in 1996: "People felt in some vagu
e
sense this was relevant."" Other committee members pointed o
ut
that Nash had no recent publications, was not even a member
of
the society, and was unlikely to participate actively, if
elected.
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At one point Truman Bewley, the committee's chairman, wrote
to
Rubinstein, "I doubt [Nash] would be elected, since he is we
ll
known to have been crazy for years,"ddmissing the nomination
 as
"frivolous."
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When Rubinstein refused to back down, Bewley asked him to fi
nd
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
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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 Gbdeldd41 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 Michig
an,
and Roger Myerson, at Northwestern Universityggea41 he recei
ved,
according to the Secretary of the society, Julie Gordon, "th
e
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.
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CARL-OL-OF JA-COBsoation,
secretary general, Royal Swedish Academy of Sciences, Februa
ry
1997
IT
is
TuESDAY,
October 12, 1994. J6rgen Weibull, a personable young profess
or of
economics, looks at his watch for perhaps the fiftieth time.
` He
is standing near the front of the massive Sessions Hall of t
he
Royal Swedish Academy of Sciences coma jewelbox of a room wi
th a
heavily ornamented ceiling and portrait-lined walls comwh, a
t the
moment, is crowded with reporters and camera crews, jammed i
n
narrow aisles between the U-shaped tables. Near-pandemonium
reigns. Everybody is milling around, speculating in loud voi
ces
about the delay. Weibull had been so elated when he left his

office at the University of Stockholm that midmorning that h
e
half walked, half ran through the highway underpass and up t
he

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



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 thatea"be said later, "but I saw right
A840
away that everything had turned out all
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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 remotedd bled
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 comintent on
preserving the Olympian aura that surrounds the prizes-have tried
very hard to keep under wraps. The academy is one
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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
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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-G6ran Mdler, 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

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stepchilddd9 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 scholarsdd01 1

The criteria, rules, and procedures for the economics prize are patterned after those that apply

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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.

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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

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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 indust

ry
have long been closely entwined, have traditionally wielded
a
great deal more political power than their American counterp
arts.
16 Bertil Ohlin, the committee's first chairman, was for yea
rs
the leader of Sweden's opposition. Gunnar Myrdal, who won th
e
prize in 1974, was a minister in the Social Democratic
government. Lindbeck himself was a prot6ong6 of Prime Minist
er
Olof Palme, has held many political advisory posts, and has
been
involved in most public policy
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debates since the 1960's.
Unlike Ohlin and Myrdal, Lindbeck never abandoned his resear
ch
career to become a full-time politician. Indeed, he is gener
ally
considered a likely contender for a Nobel himself. Even toda
y, at
age sixty-eight, there is a small assembly line on the shelv
es
behind his desk at the University of Stockholm: impressively

large piles of paper marked "Articles Under
Preparation,0"Articles Submittedea"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 Laf9ren, an adju
nct
member of the economics prize committee and a professor of
resource economics at the University of Umea.
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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.
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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.
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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 paperdd15 Rubinstein's sense of indebtedness to Nash and his



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
A851
relativesdd16
The Nobel Prize committee did not take up the matter again u
ntil
1987, when it commissioned a second report, this time from
Weibulldd17 After he submitted it, Lindbeck told him that th
e
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 wer
e
hardly necessary. As a member of Sweden's small academic eli
te,
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
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he was being given the opportunity to participate at the ear
liest
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 to
ol
for investigating a wide range of interesting economic probl
ems.
By the second meeting, however, Lindbeck, the committee chai
rman,
zeroed in on Nash. Was what Nash did merely mathematics? Lin
dbeck
asked. Did he simply formalize ideas that economists had
formulated at least a hundred years earlier? Was it true tha
t
Nash had stopped doing research in game theory in the early
1950's? That question was the closest anyone came to mention

ing
the subject of Nash's mental illnessdd19

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When Weibull left the meeting, he thought that there was a g
ood
chance that the committee would eventually agree to award a
prize
in game theory, but he had no reason, given Nash's illness a
nd
the decades that had passed since his early papers, to belie
ve
that Nash would make the cut.
Eric Fisher, a visitor at Stockholm University's Institute f
or
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 hangin
g out
in the foyer of Firestone Library. Lindbeck wanted to know
whether Nash was "competent enough to handle the publicity t
hat
winning [a Nobel] might entaildd010
It was two years later, the fall of 1989, that Weibull hurri
ed
across the Princeton University campus to meet Nash for the
first
time." After weeks of delicate negotiation, with the chairma
n of
the mathematics department acting as a go-between, the elusi
ve
mathematician had finally agreed to have lunch. Weibull had
a
specific motive for the meeting. Lindbeck had pulled him asi
de
shortly before his departure from Sweden and asked him to re
port
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

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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

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 Stockholmdd"Sch symposia, sponsored by the prize committee, are invariably seen as Nobel beauty contests. This one was organized by Karl-Gbran Maler with the help of J6rgen 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, Also Roth, Paul Milgrom, and Eric

Maskin. The topic? Rationality and Equilibrium in
 A856
Strategic Interaction.
Most of the participants took it for granted that they were
performing for the benefit of the prize committee and assume
d
that the three graybeards in the group, Harsanyi, Selten, an
d
Aumann, were the likely Laureatesdd14 Aumann, the white-bear
ded
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Israeli dean of game theory, was strutting around "as if he
had
already wondd"Much was made of the choice of topic, which wa
s
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 committin
g
itself to a candidatedd"Protestations that the main motivati
on
for the symposium was to create an opportunity for the commi
ttee
"to educate itselfea"z Torsten Persson of the prize committe
e put
it later, were accurate. Only one other prize committee memb
er
besides MA-LER was even there-and that was Ingemar Stahl. Hi
s
brother, Ingolf, was one of the speakers, and Ingemar intima
ted
that he had come to hear him. But everyone assumed that he w
as
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 nu
mber
of documents, among them Nash's Ph.D. thesis and a RAND
memorandum-"no later than mid-August pleasedd03fulWeibull al
so
asked Kuhn to get him a transcript of an
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--858
interview with Nash conducted by Robert Leonard, the histori
an.
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 re
port
to the so-called Ninth Class of the academy-all the academy
members in the social sciences. 19 The bulk of the report, o
f
course, was devoted to the proposed candidates for 1993, two

economics historians, Robert Fogel of the University of Chic
ago
and Douglass North of Washington University in St. Louis. Bu
t the
committee also updated the class on two or three other propo
sals
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, t
he
fiftieth anniversary of John von Neumann and Oskar Morgenste
rn's
great opus.
Lindbeck and the others were still toying with "every possib
le
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--859
configuration"of two and three winners
.41
The short list comthe candidates that the committee had focu
sed
most of its attention on comhad scarcely changed since the p
rize
was first conceiveddd41 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
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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 an
d
best equipped intellectually
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--862
to challenge him was Ingemar Stahl, a sixty-year-old profess
or at
Lund with a joint appointment in economics and law." Stahl i
s a
quick study and a brilliant debater, a man who delights in t
aking
contrarian, often extreme positions, in any debate. He had l
ong
been one of the most active committee members and had writte
n
many of the committee's prize proposals since the early 1980
's.
Stahl is short, with a large head and a big belly. His detra
ctors
call him Zwergel or "little dwarf"bbh his back. A onetime
wunderkind who never quite lived up to his early promise, St
ahl
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, S
tahl
began his upward climb early, while he was still in high sch
ool,
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 adamantl
y
opposed to awarding the prize to Nash. From the start, he wa
s
highly
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--863
skeptical of game theory comz indeed he is of all pure theor
y. 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 Buchan
an 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 A864
last time H6rmander 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 ghostdd"H6rmander

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 illnessea"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, unremitting, 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 Lindbeek 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 downea"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

thatdd019
He asked what would happen at the ceremony, "Would he come? Could
he handle it? It's a big shoWdd061
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
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--867
He brought up Nash's lack of interest in game theory after
graduate school. As Lindbeck, Jacobson, the academy's secret
ary
general, and others later hinted, Stahl was not the first me
mber
of a Nobel Prize committee who was motivated by deep animus
toward a particular candidate or who embraced a wide range o
f
intellectual objections in an effort to derail the candidate
dd61
But as the spring wore on, Stahl made a great many midnight
phone
calls. He seemed, Weibull later recalled, to be trying out a
ny
and all arguments against Nash's candidacydd61
What was certainly the case throughout those months, a membe
r of
the Swedish academy said, was a growing feeling on Stahl's a
nd
others' part that "a few bad choices would sink the prize. N
ash
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 watchin
g to
see what the Swedish Academy of Sciences is going to do abou
t
Nash. The Swedes are known to be worried about what Nash mig
ht
saydd066 Christer Kiselman, head
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of the mathematics class of the academy at the time and a me
mber
of the academy's governing council, remembers talking to Sta
hl.
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 sixt
een,
had a different interpretation: "[Stahl) was afraid of
schizophrenia. So he had some prejudices. So he thought othe
r

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 bad 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
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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.
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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 newsdd 71
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



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
A872
present.
The economics prize has never been especially popular within
the
academy, "Many people question the Nobel Prize [in economics
]
hereea"said one longtime member." Oldtimers still thought it
had
been a grave mistake to add a new Nobel to the original priz
es.
They thought it cheapened the currency and had, after the
"mistake" of accepting the economics prize, successfully fou
ght
off efforts to establish other prizes that used the Nobel na
me.
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.0"He adds:
This is not
really
a Nobel Prize. It should never be spoken of together with th
e
other prizes. The academy should never have accepted the pri
ze in
economics. I have been against
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--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, slipp
ed 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 N
ash's
prize was for "a very small thing."

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

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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 A874 the economics prize committee seemed to be a lifetime sinecure and that its members could choose winners without any real accountability to the

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--875

academy.

In February, an academy committee had "suggested"t the economics prize committee be forced to operate by the same rules that apply to the physics and chemistry committeesdd19 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 Classdd90

Thus the debate between Lindbeck and Stahl over

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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 candidacydd91 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 comthe 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 decideea"z a Nobel Foundation booklet puts it: "Even a unanimous committee recommendation may be overruleddd091 Only when the plenary session has cast ballots and the votes are counted and the results



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
A877
releases or
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 ceremoni
al
affair, the final flourish after a lengthy selection procedu
re
that is more or less completely dominated by the senior memb
ers
of the prize committees. In the case of the economics prize,
a
few dozen random academicians coma fraction of the number wh
o
turn out for the physics or chemistry prizes, the other two
Nobel
awards administered by the academy- assemble in the second w
eek
of October largely for the pleasure of hearing
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--878
a distinguished lecture on the proposed candidates' contribu
tions
to scientific progress. As one academy member put it, "Membe
rs
attend less for the vote itself than for a chance to hear th
e
presentations."
14
In some recent years, the modest quorum of forty academy mem
bers
has proved difficult to achievedd91 According to the rules,
academy members have three options. They may vote for the
candidate or candidates proposed by the committee and endors
ed by
the Social Sciences Class. They may vote for an alternative
candidate of their own choosing. Or they may vote not to giv
e 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 ht auditorium tucked in a far
comer
of the academy's ground floorea96 promised to be no more or

less
interesting than previous years' meetings. Fewer
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than sixty members were scattered around the room, but, as t
he
officials present noted with satisfaction, there was no ques
tion
of not getting a quorum. (A couple of years earlier, thirty-
nine
members had sat in that room waiting for a fortieth -- who d
id
finally show updddgg91 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 r
oom.
Lindbeck was at the podium in a few long strides. Wearing hi
s
thick blackrimmed glasses and usual frown of concentration,
Lindbeck dove right into his subject, an overview of the ent
ire
process by which the committee had arrived at its recommenda
tion
for a prize in game theory, Always intense, Lindbeck stutter
ed
with excitement, waved his long arms, and made a good many v
ery
dry jokesdd91 He was followed by Jacobsonealow-keyed by cont
rast,
who gave the official endorsement of the Social Sciences Cla
ss.
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 usualdd 99 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
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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

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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
A882
century. It was an unassailable choice.
Lindbeck, who had at first seemed stunned by the audacity of

Stahl's surprise attack, told the members in no uncertain te
rms
what Stahl was implying. He reminded the members that Stahl
had
signed on to the game-theory prize and accused Stahl of wish
ing
to scuffle the prize because of Nash's illness. He told the
membership that it would be a grave injustice to withhold th
e
prize. He did not
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tell them that, in an absolute breach of the Nobel rules, he
had
already informed Princeton University's president, Alicia Na
sh,
and Nash himself that he was getting the prize. But those fa
cts
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 la
rge
number of academicians stayed to
hear the vote count. Two members of the academy chosen by th
e
president and Jacobson removed the ballots in front of the
audience and tallied the votes. The paper was handed to Jaco
bson,
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, ve
ry
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
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deny that anything extraordinary had happened. They would pr
etend
that Wer's report had been unusually long, that there had be

en a
great many questions, that the Laureates had been difficult
to
reach, or simply state baldly that the delay had never occur
red.
But behind closed doors, within the academy, there would be
shock, consternation, and fingerpointing. "It was a unique e
vent.
It had never happened beforeea"said one member of the academ
y.
"It's not good for the academy to have close votesea"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 th
at
Stahl had been "used by the physicistsdd0101 Stahl's double-
cross
had backfired. Instead of being regarded as the man who save
d the
prize committee from an embarrassing mistake, he had set int
o
motion the very consequences he feared. Like players in So L
ong
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

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determined to punish Stahl and get him off the committee --
even
if the new rules meant that they bad 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 textb
ook

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

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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 n
ot
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 collea
gues
at the
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academy, he bad 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 incredibl
e
poignancy for Jacobson, "the greatest momentea"he later said
, of
his twenty-year tenure at the academy.
"He was unusually calmea"he said afterward. "That was my tho
ught.
'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 N
ewark
Airport on his way to Stockholm, where he would, in a few da
ys'
time, receive from the King of Sweden the gold medal engrave
d
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
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the opening of "the greatest auction ever."`

There was, as
The New York Times
would later report, no fast-talking auctioneer, no

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banging gavel, no Old Masters.` On the auction block was thi
n
airairwaves 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 ha
ve
three competing cellular phone services. In the secret war r
ooms
and bidding booths were CEO's of the world's biggest
communications conglomerates comand an unlikely group of blu
e-sky
economic theoreticians who were advising them. When the auct
ion
finally closed the following March, the winning bids totaled
 more
than $7 billion, making it the biggest sale in American hist
ory
of public assets and one of the most successful (and lucrati
ve)
applications of economic theory to public policy everdd4Mich
ael
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

thoughtdd"I

The juxtaposition of Core and Nash, the high-tech auction an
d the
medieval pomp of the Nobel ceremony, was hardly an accident.
 The
FCC auction was designed by young economists who were using

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tools created by John Nash, John Harsanyi, and Reinhard Selt
en.
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 comand 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 policyrnakers 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

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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'sdd9 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
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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."
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Economists like Nobel Laureate Ronald Coase have advocated t
he
use of auctions by government since the 1950's. 14Auctions h
ave
long been used in markets where sellers of unusual items --
from
vintage wines to movie rights -- have no idea what bidders a
re
willing to pay. Their basic purpose is to make bidders revea
l how
much they value the item. But the arguments of Coase and oth
ers
were stated in abstract, entirely theoretical terms, and lit
tle
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 domi
nated
by political pressures, outrageously expensive paperwork, an
d
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 r
esell
licenses. Although the reform did speed up the granting of
licenses, the process was still hugely inefficient-and unfai
r.

Bidders with no intention of operating an actual telephone A892
business
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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 Milgrorn said, that "the mere design
of some
auction wasn't enough.... (Gletting the auction design right was
also critically important"
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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'
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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 perfe

ct 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 Milgrorn, one of the economists who designed the FCC auction of which Gore was speaking."

A second source of complexity, Milgrorn says, is that the purpose of the licenses is

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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
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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

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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 band? 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

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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

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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

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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 beautifuldd 0bled
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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

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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 Insul brick
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"infftown, 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
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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 A903 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'sff"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.`

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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 restor

e
what has been lost. For Nash, the primary pleasure in life h
ad
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 t
he
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 illne
ss
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 fr
ont
of an audience of psychiatrists to whom

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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 nor
mal
life, is a great thingff"B then he paused, stepped back, and
 said
in a far stronger, more assertive voice: "But maybe it is no
t
such a great thing. Suppose you have an artist. He's rationa
l,
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, "althoug
h 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 A905 University Press in 1995 to publish his collected works. "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

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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

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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)."



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

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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-offactly 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
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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 exampleea"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 Jo
hnny
is now Nash's main task in life. Except when Johnny is "on t
he
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,
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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 inter
ested
in the computer and plays computer chess with him. He has sa
id:
`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 li
ke
his father, and he and his father share an interest in
mathematics and chess. But Johnny's illness has dragged on f
or
more than half his life, a quarter of a century. He has been

treated with the newest generation of drugs, including Cloza
ril,
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 long
er
competes in chess tournaments comonce his greatest joy. He n
o
longer reads, saying that he has not been able to for a
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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

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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
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choosing
to escape from `the world! "11
Despite such moments of insensitivity, the truth is that Nas
h
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 th
inks
will help him. When his friend Avinash Dixit invites him for

dinner, he immediately asks if he might bring Johnny alongdd
14
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.
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--914
"Dad, if you keep doing that, you'll winea"says Johnny.
"But when I play against the computer, I'm allowed to take b
ack
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," Na
sh
accompanies Aliciadd21 When it is time to attend an open hou
se at
the outpatient program where Johnny is sometimes enrolled, N
ash
is there and on timedd16 Alicia sees this and feels supporte
d by
him. She feels that she couldn't do without him.
Marriage is easily the most mysterious of human relationship
s.
Attachments that seem superficial can become surprisingly de
ep
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, an
d
disappointments. She takes Nash clothes shopping. She frets,

when
he travels, that he'll be kidnaped by terrorists or killed i
n a
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--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 o
ld
photograph of him in bathing trunks at a poolside in Califor
nia
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 wi
th
her to family therapy every Monday night. She is the one to
whom
he faithfully reports the day's events, whom he ran into, wh
at
the lecture was about, what he ate for lunch. They argue abo
ut
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 sa
id,
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

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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
A918
misunderstandings as it unlocked happier feel-
ingsdd11 When the two men finally met face to face, John Stier
was no longer the nineteen-year-old Amherst College history
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--919
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
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--920
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.

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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 ...
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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 stepdda big step, "according to
 A923
John-in piecing together lives cruelly shattered by
schizophrenia. "The
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--924
divorce shouldn't have happenedea"he told me. "We saw this a
s 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 m
e
about "the amazing metamorphosis"he had witnessed in John's
life
since the Nobel. It's not just the many other honors and spe
aking
invitations from around the world that have followed, or the
 much
wider audience that now appreciates the full range of exciti
ng
intellectual contributions made during his brief but brillia
nt
career, or even the glamour of having his remarkable story t
old
by Hollywood. At seventy-three, John looks and sounds wonder
fully
well. He feels increasingly certain that he won't suffer a
relapse. "It's like a continous process rather than just wak
ing
up from a dreamea"he told a
New York Times
reporter recently. "When I dream ... it
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--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 t
hat
he is less embarrassed by talking about his past, and now sp
eaks
to groups that see his experience as "something that helps t
o

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."

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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 A926 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'sea"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

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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 neutralitydd"Since its publication, however, "A lot of my friends, family, and relations persuaded me it was a good thingdd"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 b
een
something of a solace.
When John met Russell Crowe, who plays
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him in the movie inspired by his life, he told me that his f
irst
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
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like the least of his achievementsdd"ln"Acellratin of John F
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26. Kuhn, interview.
27. Ibid.
28. Milnor, interview, 9.26.95.
7: John von Neumann
1. See, for example, Stanislaw Ulam, "John von Neumann,
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vol. 64, no. 3, part 2 (May 1958); Stanislaw Ulam,
Adventures of a Mathematician
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R. Halmosea"The Legend of John von Neumann,"
American Mathematical Monthly,
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80 (1973); William Poundstone,
Prisoner Dilemma,
op. cit.; Ed Regis,
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op. cit.
2. Poundstone, op. cit.

3. Ulam, "John von Neumannea"op. cit.; Poundstone, op. cit., pp.
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4. Harold Kuhn, interview, 1. 10.96. 5. In remarks at a Nobel
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Nash traced from Newton to von Neumann to himself. Nash shared
von Neumann's interest in game I equals . I I b es, hydrodynamic
turbulence, and computer architecture. theory, quite. echaDiCs,
rea A oTnrcraic variabI
6. See, for example, Ulam, "J von Neumannea"op. cit.
7. Norman McRae,

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(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 (Februa
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1957), pp. 89-90, as quoted by Poundstone, op. cit., people.
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14. Poundstone, op. cit.
15. Ulam, "John von Neumannea"op. cit.
16. Harold Kuhn, interview, 3.97.
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17. Paul R. Halmos, "The Legend of John von Neumann;` op. ci
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18. Ibid.
19. Poundstone, op. cit.
20. Halmos, op. cit.
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Adventures of a Mathematician,
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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,
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31. Poundstone, op. cit.
32. Herman H. Goldstine, "A Brief History of the Computerea"
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33. John von Neumann, as quoted in ibid. 8: The Theory of Ga
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The Theory of Games and Economic Behavior (Princeton: Prince
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W. Tucker, interview, 10.94. See also Martin Shubik, "Game T
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Foundation Preliminary Paper, undated, people. 3; David Gale
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3, A. W, Tucker, "Combinatorial Problems Related to Mathemat
ical
Aspects of Logistics: Final Summary Report0ggU.S. Department
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4. Melvin Hausner, interview, 2.6.96.
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5. Interviews with David Yarmush, 2.6.96, and John Mayberry,

4.15.96.
6. David Gale, interview.
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9. Robert J. Leonard, "From Parlor Games to Social Scienceea "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 Scienceea"op. cit.

12. Ibid.
13. Ibid.
14. Dorothy Morgenstern Thomas, interview, 1.25.96. Morgenstern
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15. Letter from George Mowbry to author, 4.5.95.
16. Leonard, "From Parlor Games to Social Scienceea"op. cit.

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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
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26. Leonard, "From Parlor Games to Social Scienceea"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.
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32. Ibid.
33. Ibid., people. 4.
34. Ibid., people. 7,
35. Ibid., people. 1
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New York Times,
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39. See, for example, Herbert Simon,

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s,"
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40. Leonard, "From Parlor Gaines to Social Scienceea"op. cit
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42. Ibid.
43. Shubik, "Came Theory and Princeton:` op. cit., people. 2
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44. Von Neumann and Morgenstern, op. cit. See also Falwell,
Milgate, and Newman, op. cit.
45. Von Neumann and Morgenstern, op. cit. 46. Ibid.
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48. Von Neumann and Morgenstern, op. cit. 49. Ibid.
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51. Harsanyi, op. cit.
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Econometrica,
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2. Nash's barpainin `g solution was "virtually] unanticipate
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the literatureea"ac 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,"
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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 Caroli
na,
interview, 10.2.96.
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specifically, of bilateral monopoly as treated by Cournot,

Bowley, TintneT, Fellner and othersea"Nash, "The Bargaining
Problemea"p. 155. As Harold Kuhn points out, Nash's delineat
ion
of the history of the problem was undoubtedly supplied by Os
kar
Morgenstern, "It is now clear that Nash had not read those
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For a delightful short history of exchange, including the
references to pharaohs and kings, see Robert L. Heilbroner,
The
Worldly

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Philosophers,
6th edition (New York: Touchstone, 1992), people. 27.
4. John C. Harsanyi, "Approaches to the Bargaining Problem B
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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.
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odel,
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, 18
8 1),
reprinted in Mathematical Psychics and Other Essays (Mountai
n
Center, Calif.: James and Gordon, 1995). Martin Shubik write
s,
"Even as a graduate student I was struck by the contrast bet
ween
cooperative game theory, the seeds of which I regarded as al
ready
present in Edgeworth and noncooperative theory which was pre
sent
in Cournot;` Martin Shubik,
Collected Works,
forthcoming, people. 6. For lively accounts of
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Edgeworth's life and contributions, see Heilbroner, op. cit.
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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. Ibidddeap. 174.
8. Ed worth, op. cit.
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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 theo
ry of
games was an essential step toward a strong bargaining theor
y,
their own analysis of two-person bargaining games did not go

significantly beyond the weak bargaining theory of neoclassi
cal
economicsea"Harsanyi, "Bargainingea"op. cit., pp. 56-57.
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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 "axiomatic
s"in
Robert J. Aumann, "Game Theory," in John Eatwell, Murray Mil
gate,
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 seco
nd,
1947, edition of
Theory of Games and Economic Behavior. `dividual Valu
problem in social sciences, I believe, was Kenneth J. Arrow'
s
Ph.D. thesis
Social Choice and In es
(New York: John Wiley and Sons, 195 1). Lloyd S. Shapley's "
A
Value of N-Person
Gamesea"Contributions to the Theory of Games II
(Princeton: Princeton University Press, 195 3), pp. 307-17,
is
another stellar

exa le.
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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 wit
h 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 aft
er
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 pose
d by
Hoselitz. Roger Myerson, professor of economics, Northwester
n
University, interview, 8.7.97.
2 1. Myerson, e-mail, 8.11.97.
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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 m
ailed
a copy of his first draft to Von Neumann while he was still
at
Carnegie. Also interviews with David Gale, 9.20.95, and Will
iam
Browder,
12.6.96.
24. After historian Robert Leonard published the established

version of the origins of the paper in "Reading Cournot, Rea
ding
Nash: The Creation and Stabilisation of the Nash Equilibrium
,"
The Economic journal,
no. 164 (May 1994), people. 497, Nash corrected the record a
t a
lunch with Harold Kuhn and Roger Myerson, 5.96, Kuhn, person

al
communication, 5.96.
25. John Nash, "The Bargaining Problemea"op. cit., people. 1
55.
26. John Nash,
Les Prix Nobel 1994,
op. cit., people. 277.
10: Nash's Rival Idea
1. Harold Kuhn, interview, 4.14.97.
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2. Albert William Tucker, interview, 10.94.
3. The beer party scene was reconstructed from the recollect
ions
of Melvin Hausner, 2.6.96, Martin Davis, 2.20.96, and Hartle
y
Rogers, 1. 16.96, who attended several such parties in the c
ourse
of their graduate school careers.
4. Davis, interview.
5. Ibid. Amazingly, Davis was able, forty years later, to re
call
the entire song, a few lines of which are given here, interv
iew.
6. Kuhn, interview, 4.16.97.
7. Ibid.
8. Henri Poincart, quoted in E. T. Bell,
Men ofMathematics,

op. cit., people. 5 5 1.
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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 himea"ac to Donald
Spencer, interview, 11.8.95.

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11. Von Neumann's dress and manner are described by George Mowbry
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,?-municated

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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 Problemea"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.
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32. Ibid.
33. See, for example, introduction, John Eatwell, Murray Milgate,
and Peter Newman,
The New P-41ongrave,
op. cit.
34. "It so happens that the concept of the two-person zero-sum

games has
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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 a
mong
animals requires the use of non-cooperative game theory:`
according to Reinhard Selten, "Nobel Seminar,"
Les Prix Nobel 1994,
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op. cit., people. 288.
40. "Came Theoryea"in Eatwell, Milgate, and Newman, op. cit.
,
people. xiii. 41. Michael Intriligator, personal communicati
on,
6.27.95.
43. Von Neumann, as Nash always acknowledged, nonetheless he
lped
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 Nas
h'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 0. J. Vrieze (Boston: Kluwer Academic
Publishers, 1989).
2. See, for example, Carl Sagan,
Broca Brain
(New York: Random House, 1979).
3. David Halberstam,
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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 timeea"Minsky, interview.

9. Hausner, interview, 2.6.96.

10. Danskin, interview, 10.19.95.

11. Letter fiom Lloyd Shapley to Solomon Lefichetz, 4.4.49.

12. Interviews with Nancy Nimitz, 5.21.96, and Kuhn,
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4.4.96.
13. Shapiro, interview, 12.13.96.
14. Intr`linin ator, interview, 6.27.95. 15. Shubi , intervi
ew,
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. Shap
ley,
and M. Shubik, "So Long Sucker-A Four-Person Gameea"mimeo
provided by Hausner.
29. Interviews with Shubik and McCarthy.
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30. John Nash and Lloyd Shapley, "A Simple Three-Person Poke
r
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, Princet
on
University, 1953. Shapley published his famous result-the
so-called Shapley value coma value for n-person games, in 19
53.
34. Martin Shubik, "Came Theory at Princeton, op. cit., peop
le.
6: "We all believed that a problem of importance was the
characterization of the concept of threat in a twoperson gam
e and
the incorporation of the use of threat in determining the
influence of the employment of threat in a bargaining situat
ion.
[Nash, Shapley, and 11 worked on this problem, but Nash mana
ged
to formulate a good model of the two person bargain utilizin

g
threat moves to start withdd"Shubik is referring here to Nas
h's
"Two-Person Cooperative Games;`
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published in
Econometrics
in 1953 but actually written in August 1950 during Nash's fi
rst
summer at RAND.
35. Letter from Albert W. Tucker, 1953.
36 lbiand
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 195 1).

2. William Poundstone,
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Prjsoner 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
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L. R. Smith,
The RAND Corporation
(Cambridge: Harvard University Press, 1966); Bruno W. Augens
tein,
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 ofNational Defense
(New York: Random House, 1959), as
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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 compute
r
groups is based largely on interviews with RAND staff and
consultants from the early Cold War period, incluggTing Kenn
eth
Arrow, 6.26.95; Bruno Augenstein, 6.13.96; Richard Best, 5.2
2.96;
Bernice Brown, 5.22.96; John Danskin, 10.19.95; Martha Dresh
er,

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. Moo
d,
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 Shapir
o,
2.29.96; Lloyd S. Shapley, 11.94; Herbert Simon, 10.16.95; R
obert
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 Universi
ty,
interview, 6.26.95. 19. McDonald, interview.
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20. Richard Best, former manager of security, RAND Corporati
on,
interview, 5.22.96.
21. Interviews with Alexander M. Mood, professor of mathemat
ics,
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.
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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
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41. Best, interview.
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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,
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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.
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between April 10 and April 26, 1948), gives the clearest
statement of why Nash wanted to avoid the draft: "Should the
re
come a war involving the U.S. I think I should be more usefu
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and better off, working on some research project than foing,

sayeaeainffthe infantry."
6. Letter from Fred D. Rigby, Office of Nava Research Washin
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D.C., to Albert W. Tucker, 9.15.50.
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Raymond 1. Woodrow to Local Board No.
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sual
willingness to reach out to colleagues in trouble. He became

deeply involved in helping Max Shiffinan, a bright young
mathematician at Stanford who was diagnosed with schizophren
ia;

John Moore, a mathematician who suffered a severe depression
; and
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36. Letter from Albert W. Tucker to Hassler Whitney, 4.5.5 5
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40. William Ted Martin, professor of mathematics, MIT, inter
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3. Felix Browder, interview, 11. 14.95. 4. Gian-Carlo Rota,
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14. Arthur Mattuck, professor of mathematics, MIT, e-mail,
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19. Gian-Carlo Rota, interview.
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27. Zipporah Levinson, interview, 9.11.95.
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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, 11.2.9
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Memorandum to President J. B. Wiesner, 3.14.74; William Tcd
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38. Arthur Mattuck, "Norman Levinson and the Distribution of

Primesea"address to MIT shareholders,
10.6.78.
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interview, 12.28.95; Leopold Flatto, Bell Laboratories,
interview, 4.25.96,
2. Sigurdur Helgason, professor of
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mathematics, MIT, interview, 2.13.96.
3. Course catalog, MIT, various years. 4. Arthur Mattuck,
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Hebrew University, interview, 6.25.95.
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6. Joseph Kohn, interview, 7.19.95. 7. Ibid.
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9. Seymour Haber, professor of mathematics, Temple Universit
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10. George Whitehead, professor of mathematics, MIT, intervi
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12. Barry Mazur, interview, 12.3.97. 13. Harold Kuhn quotes
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16. Singer, interview.
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24. Neuwirth, interview.
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26. Mattuck, interview, 2.13.96.
27. Interviews with Neuwirth and F. Browder, 11.2.95.
28. Jurgen Moser, professor of mathematics, Eidgenbssische
Techische Hochschule, Zurich, interview,
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3.23.96.
29. Marvin Minsky, professor of science, MIT, interview, 2.1
3.96.
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 Storiesea"ATANDT Bell Laboratories, 4.29.95 (Xerox). 43. Mat tuck,
interview, 5.21.95, and

Neuwirth, interview.
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44. Neuwirth, interview.
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Technology, Stockholm, Sweden, e-mail, 5.21.97.
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48. D. Newman, interview, 3.2.96.
49. Helgason, interview, 12.3.94; also interviews with Mattuck
and Singer.
50. Flatto, interview.
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53. Singer, interview.
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60. Ibid.
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62. Ibid.
63. H. Newman, interview.
64. Fred Brauer, professor of mathematics, University of
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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
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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;
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5. M. Legg, interview.
6. Ibid.
7. Ibid.
8. Ibid.; Milnor, interview.
9. John M. Danskin, interview, 10.29.95.

10. M. Legg, interview.
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11. Ibid .
12. John Milnor, "Games Against Natureea"in
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John Wiley and Sons, 1954).
13. "Some Games and Machines for Playing Themea"RAND Memorandum,
D-I 164, 2.2.52.
14. John Nash and R. M. Thrall, "Some War Gamesea"RAND
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15. G. Kalisch, J. Milnor, J. Nash, and E. Nering, "Some
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16. M. Legg, interview.
17. The description of the experiment is based on, apart fro
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original paper, Evar Nering, professor of mathematics, Unive
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18. Kal e1 and Roth, op. cit.
19. MiTnor, interview, 10.28.94.
20. John Milnor, "A Nobel Prize for John Nashea"op. cit.
2L 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
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4.22.5 3 and 4.23.5 3. Unless otherwise noted, all reference
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3. David Halberstam,
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4. Letter from Harold W. Dodds, president, Princeton Univers
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Archives.
5. See, for example, F. David Peat, Infinite Potential. The
Life
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(Reading, Mass.: Addison Wesley, 1997). 6. Z. Levinson,
interview.
7. Ibid. See also Felix Browder, interview, 11.10.95.
8. Z. Levinson, interview.
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11. Z. Levinson, interview.
12. Ibid.
13, William Ted Martin, interview.
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15. Fred Brauer, e-mail, 6.23.97; Arthur H. Copeland, profes
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of mathematics, University of New Hampshire, e-mail, 6.24.97
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16. John Nash, plenary lecture, World Congress of Psychiatry
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Madrid, 8.26.96, op. cit.

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1. Letter from Warren Ambrose to Paul Halmos, undated (writt
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2. The portrait of Ambrose is based on the recollections of
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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.
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3. See, for example, 1. M. Singer and H. Wn, "A Tribute to W
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4. Robert Aumann, interview, 6.28.95. 5. Gabriel Stolzenberg
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6. Leopold Flatto, interview, 4.15.96. See also "The Leo
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8. George Mackey, interview, 12.14.95. 9. Felix Browder,
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11. Despite its apocryphal ring, the story appears to be tru
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has been confirmed by Nash. Harold Kuhn, personal communicat
ion,
8,97. 12. Armand Borel, professor of mathematics, Institute
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13. F. Browder, interview.
14. Ibid.
15. Joseph Kohn, interview, 7.19.95. Phrasing the question
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mea distion t preserve distances"- after "embedding."
16. Shlomo Sternberg, pro essor of mathematics, Harvard
University, interview, 3.5.96.
17. Mikhail Gromov, interview, 12.16.97.
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18. John Forbes Nash, Jr., Les Prix Nobel 1994,
op. cit.
19. Gromov, interview.

20. John Conway, professor of mathematics, Princeton Univers ity,
interview, 10.94. 21. JiIrgen Moser, e-mail, 12.24.97. 22,
Richard Palais, professor of mathematics, Brandeis Universit y,
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, K yosi
[to, ed,, Encyclopcandc Dictionary ofMathernatics (Mathemati cal
Society of Japan; Cambridge: MIT Press, 1987), people. 1076, Lars
Hbrmander, "The Boundary Problems of Physical Geodesy,"
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-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.
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-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 collaborater and friend of Federer.
37. Fleming, interview.
3 8. 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.
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-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 t hree

"special friendshipsdd"Thorson was working in Santa
A1034
Monica, California, at Douglas Aircraft.
9. The references to Tin Nash's letters continued
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-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,
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-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. Elea
nor
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 N
ash's
concern with enhancing his mental powers but also his concer
ns
about his own "manliness,"
12. E. Stier, interview, 3.13.96.
13. Ibid.
14. M. Legg, interview.
15. E. Stier, interview, 3.15.96,
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-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, intervi
ew.
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.

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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 Bri
cker
is based on interviews with Mattuck; Newman; Herb Kamowitz;
Jerome Neuwirth, 5 .23,97 and 6.5.97; Leopold Flatto, 4.25.9
6;
Lawrence Wallen, 5.20.97.
4. Jacob Bricker, interview, 5.22.97. 5. Jack Kotick, interv
iew,
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,

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-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, 1
948).
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 Societ
y,
the first American advocacy group for homosexuals, founded i
n
1951 (source: Neil Miller, Out

of the Past: Gay and Lesbian History from 1869 to the
A1039
Present
[New York: Vintage Books, 1995],
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-1040
pp. 334-38).
21. Bricker, interview.
22. Bricker, interview, 1.26.98.
25: The Arrest
IininNash mostly pursued his growing interest in computers a
nd
wrote a paper in which he proposed the idea of parallel cont
rol.
"Higher Dimensional Core Arrays for Machine Memoriesea"RAND
Memorandum, D-2495, 7.22.54; "Parallel Control," RAND Memora
ndum,
RM-1 361, 827.54. He wrote two other papers as well, includi
ng
"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.
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6. Letter from John Nash toArthur Mattuck, 1.15.73. In a
reference to his 1954 arrest, Nash named the arresting offic
er.
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 M
ay 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: Gar
land

Publishing, 1992), pp. 461-93. "In 1961 every state in the U
nited
States had sodomy lawsea"f Lesbians, Gay Men and the Law,
edited by William B. Rubenstein (New York: The New Press, 19
93),
people. xvi.
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-1042
12. See, for example, jerel McCrary and Lewis Gutierrez, "Th
e
Homosexual Person in the Military and in National Security
Employment,"
journal of Homosexuality,
vol. 5, nos. I and 2 (Fall 1979-Winter 1980); Ellen Schrecke
r,
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, inter
view,

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 Lawea"op
.
cit.
21. Best, interview.
22. Ibid.
23. Ibid.
24. Ibid.

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-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 1. 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 itea"and that Levi
nson
later regarded the affes asdatsignrof "approaching
schizophrenia."
32. As quoted by N. Shapiro, interview. "L 0ity 0 d e it was

John."
33. Irving I. Gottesman, professor of psych (logy, Universit
y of
Virginia, interview, 1. 16.98.
34. Nikki Erlenmeyer-Kimling, professor of

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-1044
genetics and development, Columbia University, interview,
1.17.98.
35. "J. C. C. McKinsey0ggobituary), Proceedings and Addresse
s of
the American Philosophical Association,
vol. 27 (1954).
36. Andrew
HodgeseaAJ-AN 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.

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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. 0. Larde, interview, 1.7.97.
12. See, for example, Patricia Parkman, Nonviolent Insurrect
ion
in El Salvador (Tucson: University of Arizona Press, 1988).
13. 0. Larde, interview.
14. Tinker Cassell, Veterans Administration, Biloxi, Mississ
ippi,
interview, 8.97.
15. The sketch of Marymount is based on interviews with A. N
ash,
4,18.97; Elizabeth
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-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. 0. 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.
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33. J. Davis, interview.
34. Letter from Alicia Nash to Joyce Davis, June or July 195
2.

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 Universi
ty,
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, inter
view,
5.22.97. 6. Duchane, interview, 6.26.97.
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-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, intervie
w,
4.30.96.
13. "Grant in Aid, Support for Dr. John F. Nash, Jr., as Alf
red
F. Sloan Research Fellow in Mathematics," 5.15.56; also, Rep
ort
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, un
dated
(probably written in early faW01955).
15. Letter from John Nash to Hassler Whitney, 10.55; John Fo
rbes
Nash, Jr., membership application, Institute for Advanced St
udy,
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 Anken
y,
who joined the MIT faculty in the fall of 1955, witnessed th
e
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-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 intervie
w,
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 Washin
gton
in Seattle. Dates and participants given in a memorandum fro

m
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, interv
iew,
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:
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-1050
Arthur Mattuck, interview, 5.21.97, e-mail, 6.13.97; Isbell,

interview, 6.14.97; Calabi, interview, 3.2.96; Albert Nijenh
uis,
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, inter
view,
6.13.97; Robert L. Vaught, interview, 6.13.97; Ramesh Gangol
li,
interview, 6.16.97. Mary Sheetz provided the dates of Forres
ter'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.
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-1051
16. Klee, interview.
17. This scene is reconstructed on the basis of recollection
s
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
ofRobert 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,
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-1052
from Paris, 9.28.59.
9. M. Legg, interview.
10. Letter from J. Nash to H. Kuhn, 8.97. 11. Death certific
ate
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,
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-1053
2.57.
25. Enrique Larde, interview, 12.21.95. Part Three: A SLOW F
IRE
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, prof
essor
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, 1
976).
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 Cit
y
that year and that parking it caused him innumerable headach
es,
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.
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-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, "Continui

ty 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 Ell
iptic
Equations," op. cit. 27. Louis Nirenberg, professor of
mathematics, Courant Institute, interview, 10.94. See also L
ax,
interview.
28. Ibid.
29 Ibid.
30. Lax, interview.
31. Ibid.

32. Nirenberg, interview.
A1055
33. H6rmander, interview.
34. Ibid.
35. Lax, interview.
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-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 (1957),

pp. 754-58. The full paper was submitted to the
American Journal of Mathematics
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-1058
nearly a year later, on
5.26.58, and published in vol. 80 (1958), pp. 931-58.
11. Elias Stein, professor of mathematics, Princeton Univers
ity,
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 consideri
ng
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, 3.3
0.96.
20. Letter from John Nash to Albert W.
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-1059
Tucker, 10.58.
21. At that time, tenure was normally not awarded until the
candidate's seventh year. At MIT, unlike some other institut
ions,
tenure was paired with promotion to full, not associate,
professor. 22. Gian-Carlo Rota, interview, 10.94. 23. John F
orbes
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 sou
rce.
27.
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(Providence, R.I.: American Mathematical Society, 1960).
28. Jtirgen Moser, interview, 3.71.96. 29.
Proceedings, International Congress of Mathematicians, op.
Cit.
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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 fo
r the
American Mathematical Society.
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er,
interview, 2.13.97. 38. H6rmander, e-mail, 12.16.97.

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32: Secrets
1. John Forbes Nash, Jr., plenary lecture, World Congress of

Psychiatry, Madrid, 8.26.96, op. cit.
2. G . H. Hardy,
The Mathcmatician Apo]offl7 (Cambridge, UX.: 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,
1903-1957ea"op. cit., people. 5. 5. Hardy, op. cit.
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6. Felix Browder, interview, 11. 10.9 5.
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 ofMathematics,
A1061
op. cit.
13. Enrico Bombieri, interview, 12.6.95. 14. Bell, op. cit.
15. Andrew Wiles, professor of mathematics, Princeton Univer sity,
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,
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1.29.96.
23. Jerome Neuwirth, interview, 5.27.97. 24. Stein, intervie w.
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.
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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 Universi ty,
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 mathemat ics,
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, 10.8.5 8.
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 H6rman der,
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 describ ed by
Emery is also based on the recollections of Jurgen and Gertr ude
Moser, John and Karen Tate, Adriano Garsia, Gian-Carlo Rota, and
Alicia Nash.
2. Alicia Nash, interview, 2.7.96.

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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
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-1067
later, but Gangolli and Galmarino recall that Nash didn't me
et
his classes for the last coupt of weeks of the term which en
ded
1.21.59 and Rota recalled that Nash stopped by his apartment

before "driving south."
II. Jerome Neuwirth, interview, 6.4.97; also Carsia, intervi
ew,
12.31.95.
12, Hartley Rogers, interview, 2.16.96. 13. Ducharie, interv
iew,
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.
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-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 Ku
hn,
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 fruitle
ss.
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 Matbematical 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,
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-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 mathemat
ics,
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 ha
ndled
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)
Burstein, 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 h
is
will is baselon a
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-1071
contemporaneous account by a former dean of Tufts Medical Sc
hool,
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 relie
d 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 th
at
era, including Pau Howard, former associate psychiatrist in
chief
and director of the clinical service, 2.15.95; Kahne; Joseph

Brenner,
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-1072
7.23.97; Arthur Cain, psychiatrist, 8.20.97; Alfred Pope, se
nior
neuropathologist, McLean Hospital, and professor of
neuropatbology, 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,
7he 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, Isado
re
Singer, and

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-1073
Arthur Mattuck, recall encounters with Lowell, and therefore
 it
seems that Nash, too, was confined to Bowditch. Since we hav
e no
firsthand reports from Nash, I have made use of Lowell's
irripressi"ns from 1957 and 1959, augmented by the impressio
ns of
some of Lowell's visitors, including his wife, writer Elizab
eth
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 Fr
ost
to Robert Lowell to Sylvi Plath
(New York: Knopf, 1994), and interview, 8.11,97.

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-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"lette
r
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. L
owell
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 other
wise
noted.
20. From "Waking in the Blue"; also Duchane, interview.
21. Letter from R. Lowell to E. Bishop; also "Waking in the
Blue."
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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, intervi
ew,
25. Vasquez, interview.

26. Carsia, interview.
A1075
27. Jiirgen Moser, interview, 3.23.96. 28. Duchane, intervie
w.
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. 1 am assuming that Nash's treatment
was
similar to that of other patients and have based my account
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-1076
on the recollections of Paul Howard, clinical director of Mc
Lean
at the time, as well as other McLean staffers, including Jos
eph
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, interv
iew,
2.13.96. 44. See, for example, MaTiani, op. cit., and Hamilt
on,
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.
Steams to B. Bradley, 5.20.59.
52. Duchane, interview.
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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 betwe
en A.
Warren Steams and Bernard E. Bradley, attorney,
5.13.59. In an interview (8.19.97), Bradley said that he han

dled
many similar cases, but did not recall Nash.
56. The sketch of A. Warren Stearns is based on a biographic
al
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,

5.20.59.
62. Ibid.
37: Mad Hatter's Tea
1. Emma Duchane, interview, 6.26.97. The sketch of Alicia Na
sh

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 sourc
e.
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 (arrive
d
around 6.1.59).
9. Gab Borel, interview, 9.94.
1 jo
0. n Nash, flenary lecture, World Congress of Psychiatry, Ma
drid,
8.26.96, op. cit. Il. Paul Samueson, interview, 3.16,97.
12. Z. Levinson, interview.
13. William Ted Martin, interview, 9.7.95.
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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.
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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 andModernism,
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.
17. Edward A. Betancourt, Overseas Citizens Services, Immigr
ation
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 exampl
e,
Paul Hofmann, Switzerland
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(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 I'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
, 195
1, United Nations High Commissioner for Refugees, Geneva.
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38. Zurbuchen, op. cit.
39. Ibid.
40. Direktion der Eidg. Militarverwaltung, Berne to Contr6fu

le de
I'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. 18.6
0.

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 reside
nt of
Liechtenstein, which levied no income tax, and refused to si
gn
U.S. tax forms
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-1084
(source: H. Kuhn, interview, 8.92).
53. 0. 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. 0. 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 introducti
on,
Kafka,
The Castle, op.
Cit.
63. James M. Glass,
Delusion
(Chicago: University of Chicago Press, 1985).
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64. Telegram from A. Houghton to C. A. Herter.
65. Telegram from Henry S. Villard, U.S. consul to Switzerla
nd,
to Secretary of State Christian A. Herter, 12.16.59. 66. Ibi
and
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; 0. Larde,
interview, 12.8.95. 72. 0. Larde, interview, 12.8.95,
73. Shiing-shen Chem, professor of mathematics, University o
f
California at Berkeley, interview, 6.17.97.
74. A. Nash, interview.
75. "Alexandre Grothendieckea"History of Mathematics Arcbive
,
School of Mathematical and Computational Sciences, Universit
y of

St. Andrews, Scotland; see also interviews with Nick
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Katz, professor of mathematics, Princeton University, 8.26.9
7;
Arthur Mattock, 9.19.97; Paulo Ribcnboim, professor of
mathematics, Queens University, Kingston, Ontario, Canada,
9.28.97; Tony Phillips, 8.26.97.
76. 0. Larde, interview, 12.8.85.
77. A. Nash, interview.
78. Felix Browder, interview, 9.6.97. See also Larkin Farinh
olt'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 Lar
s

H6rmander 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.
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88. Al Vasquez, interview, 6.17,97.
89. Cathleen Morawetz, interview, 2.29.96.
90. John Danskin, interview, 10,19.95. 91. M. Legg, intervie
w.
92. Eleanor Stier, interview, 3.18.96. 93. Letter from J. Na
sh 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 J
ohn
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.
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7. Jean-Pierre Cauvin, professor of French, University of Te
xas
at Austin, interview, 8.25.97; also Agnes Sherman, interview
,
8,26.96.
8. 0. 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 Dou
glas
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.

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
A1089
Princeton University, was unable to confirm these events, wh
ich
would have been handled by someone on the campus security de
tail
in any case, interview, 9.10.97.
33. A. Nash, interview.
34. 0. 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
AmerIntemationaljoumalofIawandPsychistry,
vol. 3 (1980), pp. 295-3 10. Also
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interview with Grob, professor of history, Rutgers Universit
y,
8.4.97.
4. See biographies of Dorothea Dix, including Rachel Basker,

Angel of Mercy.- The Story of Dorothea Dix (New York: Messne
r,
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 wit
h
psychiatrists who were affiliated with the hospital, includi
ng
Robert Garber, former president, American Psychiatric
Association, 5.6.96; Peter Baurnecker, 5.1.96, 5.2.96, 5.9.9
6;
Arthur A. Sugarman, 8.2 5.97.
6. Baurnecker, interview.
7. Ibid.
8. Ariel Rubinstein, e-mail, 2.3.97. 9. Baurnecker, intervie
w.
Bprobably refers to Jacob Bricker (see Chapter 44). 10. John

Danskin, interview, 10. 19.96. For an account of the hijacki
ng,
see
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Time
magazine, 2.3.61.
11. M. Legg, interview.
12. Danskin, interview.
13. Robert Winters, interview, 8.9.95. 14. Letter from Rober

t
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 Insani
ty
Bitea"op. cit.
17. Baurnecker, interview.
18. Phillip Ehrlich, psychiatrist, Princeton Hospital, inter
view,
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).
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29. Baumecker, intervieggv.
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 o
f
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.,
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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 fr
om
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.

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10. Alicia Nash, interview, 8.15.96.
11. Interviews with John Danskin, 10.19.95, and Odette Larde
,
12.7.95. 12. 0. Larde, interview.
13. "Recent Advances in Came Theoryea"Princeton, October 4-6
, 196
1. 14. Reinhard Selten, professor of economics, University o
f
Bonn, interview, 6.27.95.
15. John Harsanyi, interview, 6.27.95. 16. Harold Kuhn, pers
onal
communication, 8.97.
17. John Nash, "Lc Problindme de Cauchy Pour Les Equations
Differentielles; d'une Fluide GE-N6RALE,"
Bulletin de ]a Socjand6 Math6matique de France,

vol. 90 (1962), pp. 487-97. Submitted 1.19.62.
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18. John Nash,
Les Prix Nobel 1994,
disment
19. According to the
Encyclopedia oAL-THEMATICS,
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"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.
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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 sour

ce.
46. Proceedings, International Congress of Mathematicians, Stockholm, 1962.
47. Letter from John Nash to Martha Nash Legg,
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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. fohn Forbes Nash, Complaint, Superior Cour
t of
New Jersey, Mercer County,

12.27.62; Frank L. Scott, attorney, interview, 8.12.97.
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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 Jers
ey,
Mercer County,
5.1.63.
57. Final Judgment (Divorce), Alicia L. Nash and John Forbes

Nash, 8.2.63.
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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, interv
iew.
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.
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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, intervie
w.
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,
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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,
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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. Dougla
s
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 s
aying
that he hoped to accept a visiting position at the Institut
des
Hautes 9mentudes near Paris, arranged by Alexandre
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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.
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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.
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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.
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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 1. 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 Solu
tions
of Implicit Function Problems with Analytic Data," Annals
ofMathematics,

vol. 84 (1966), pp. 345-55. 28, Harold Kuhn, interview,
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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. Le 2.27,66. 33. Letter from J. Nash
to V. NT, 1.9.66. 34. Kuhn, interview, 5.9and 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 Cian-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
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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.
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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,
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67. Z. Levinson, interview, 11. 15.96. 6and Letter from J. N
ash
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 N
ash
to Arthur Mattuck, 8.5.68.
2. Ibid.
3. Letter from John Nash to a colleague, 1967. 4. Martha Nas
h
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

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 disorientat
ion
in schizophrenia are relatively rateea"Richard S. E. Keefe a
nd
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, Universit
y 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.

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 nume rous
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.
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31. See, for example, Keefe and Harvey, op. cit., people. 11
0.
32. Letter from J. Nash to A. Mattuck, 11.
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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. Na
sh 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 th
is
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 Instit
ute,
2.29.96. 5. Lee Mosher, protessor of mathematics, Rutgers
University at Newark, interview, 9.20.97.
6. Derbes, e-mail.
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7. Mark Reboul, interview, 8.30.97.
8. Steven Ebstein, 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 Advan
ced
Study, interview, 9.11.97.
14. Letter from May B. Schneider, professor of physics, Grin
nell
College, to author, 9.20.95.
15. Letter from David A. Cox, professor of mathematics, Amhe
rst
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.
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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 Universit
y,
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 Mary
land,
interview, 10.94. 29. Steven Bottone, e-mail, 9.2.97. 30. Da
niel
Feenberg, research associate, National Bureau of Economic

Research, interview, 10.94.

31. Trotter, interview, 9.11.97.
32. Reboul, interview.
33. Feenberg, interview.
34. Trotter, interview, 9.30.96,
35. Marc Fisher, reporter,

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 Universi
ty,
interview, 8.30.95.
40. Feenberg, interview.
41. Alicia Nash, interview, 12.6.97. 42. Interviews with Ala
n
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

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.
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16. Moore, interview, 10.94. 17. Richard Keefe, interview, 5
.95.
18. Richard S. E. Keefe and Phillip D. Harvey,
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Academy of Sciences, including Carl-Olof Jacobson, 2,12.97,-

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 were
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I did

not nominate himea"Shubik later recalled. "He was better
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than several of the o`
people I nominatedea£t it seemed that they'd throw him out
because he's nuts. The other reason was that I thought the
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