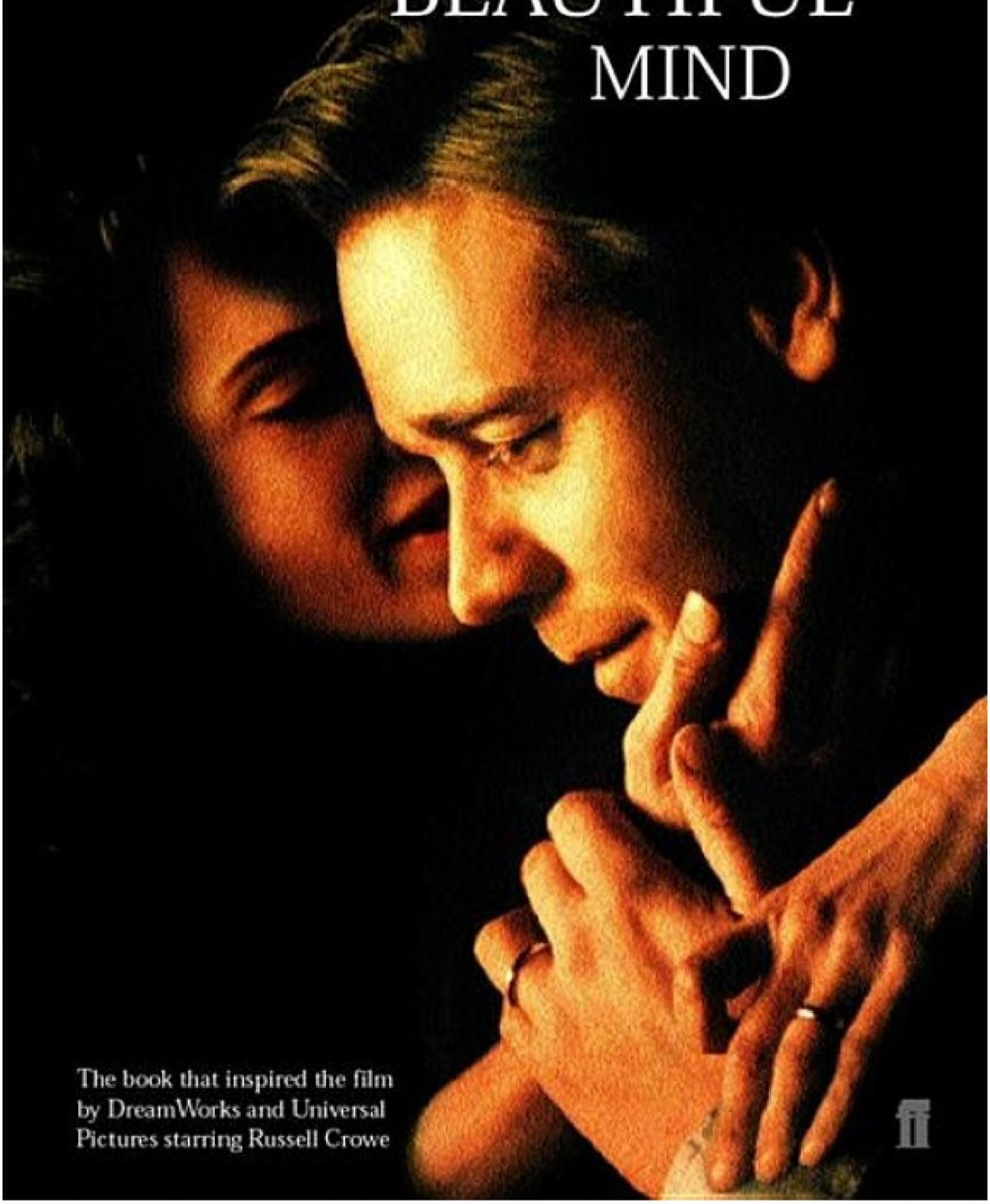
'A remarkable look into the arcane world of mathematics and the tragedy of madness.' Simon Singh, author of *Fermat's Last Theorem*

SYLVIA NASAR

A BEAUTIFUL MIND



The book that inspired the film by DreamWorks and Universal Pictures starring Russell Crowe

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A Beautiful Mind

SYLVIA NASAR

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Prologue

Where the statue stood
Of Newton with his prism and silent face,
The marble index of a mind for ever
Voyaging through strange seas of Thought, alone.
— *WILLIAM WORDSWORTH*

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

Nash looked up at last and fixed Mackey with an unblinking stare as cool and dispassionate as that of any bird or snake. "Because," Nash said slowly in his soft, reasonable southern drawl, as if talking to himself, "the ideas I had about supernatural beings came to me the same way that my mathematical ideas did. So I took them seriously."[1]

The young genius from Bluefield, West Virginia — handsome, arrogant, and highly eccentric — burst onto the mathematical scene in 1948. Over the next decade, a decade as notable for its supreme faith in human rationality as for its dark anxieties about mankind's survival,[2] Nash proved himself, in the words of the eminent geometer Mikhail Gromov, "the most remarkable mathematician of the second half of the century."[3] Games of strategy, economic rivalry, computer architecture, the shape of the universe, the 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 kinds: the ones who are just like all of us, but very much more so, and the ones who, apparently, have an extra human spark. We can all run, and some of us can run the mile in less than 4 minutes; but there is nothing that most of us can do that compares with the creation of the Great G-minor Fugue."[4] 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 non-rational. Like other great mathematical intuitionists — Georg Friedrich Bernhard Riemann, Jules Henri Poincaré, Srinivasa Ramanujan — Nash 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 Nash at MIT in the 1950s, 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 peak."[5]

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 — Albert Einstein, John von Neumann, and Norbert Wiener — but he joined no school, became no one's disciple, got along largely without guides or followers. In almost everything he did — from 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 wrong-headed. 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 Nietzsche.[7] Computers and science fiction were his passions. He considered "thinking machines," as he called them, superior in some ways to human beings.[8] At one point, he became fascinated by the possibility that drugs could heighten physical and intellectual performance.[9] 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, what job to accept, whether to marry — into calculations of advantage and disadvantage, algorithms or mathematical rules divorced from emotion, convention, and tradition. Even the small act of saying an automatic hello to Nash in a hallway could elicit a furious "Why are you saying hello to me?"[11]

His contemporaries, on the whole, found him immensely strange. They described him as "aloof," "haughty," "without affect," "detached," "spooky," "isolated," and "queer."[12] 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 — suggested something "mysterious 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 us" 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 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.[13]

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 mathematics.[14] 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.[15] 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.

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 other agents were present.[16] 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 thinks," 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 — the standard economic scenario — von Neumann's superlative instincts failed him. He was convinced that players would have to form coalitions, make explicit agreements, and submit to some higher, centralized authority to enforce those agreements.[17] Quite 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.[18]

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…."[19] His insight was that the game would be solved when every player independently chose his best response to the other players' best 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 Shenandoah 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 sophisticated version of Adam

Smith's great metaphor of the Invisible Hand.

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

Many great scientists and philosophers, among them René Descartes, Ludwig Wittgenstein, Immanuel Kant, Thorstein Veblen, Isaac Newton, and Albert Einstein, have had similarly strange and solitary personalities.[20] 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 turn to creative activity not only out of an impulse to experience aesthetic pleasure, or the delight of exercising an active mind, but also to defend himself against anxiety stimulated by conflicting demands for detachment and human contact.[21] In the same vein, Jean-Paul Sartre, the French philosopher and writer, called genius "the brilliant invention of someone who is looking for a way out." Posing the question of why people often are willing to endure frustration and misery in order to create something, even in the absence of large rewards, Storr speculates:

> Some creative people … of predominately schizoid or depressive temperaments … use their creative capacities in a defensive way. If creative work protects a man from mental illness, it is small wonder that he pursues it with avidity. The schizoid state … is characterized by a sense of meaninglessness and futility. For most people, interaction with others provides most of what they require to find meaning and significance in life. For the schizoid person, however, this is not the case. Creative activity is a particularly apt way to express himself … the activity is solitary … [but] the ability to create and the productions which result from such ability are generally regarded as possessing value by our society.[22]

Of course, very few people who exhibit "a lifelong pattern of social isolation" and "indifference to the attitudes and feelings of others" — the hallmarks of a so-called schizoid personality — possess great scientific or other creative talent.[23] And the vast majority of people with such strange and solitary temperaments never succumb to severe mental illness.[24] Instead, according to John G. Gunderson, a psychiatrist at Harvard, they tend "to engage in solitary activities which often involve mechanical, scientific, futuristic and other non-human subjects … [and] are likely to appear increasingly comfortable over a period of time by forming a stable but distant network of relationships with people around work tasks."[25] Men of scientific genius, however eccentric, rarely become truly insane — the strongest evidence for the potentially protective nature of creativity.[26]

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 lefthand corner of the front page contained an encrypted message from inhabitants of another galaxy that only he could decipher.[27] Even months later, after he had stopped teaching, had angrily resigned his professorship, and was incarcerated at a private psychiatric hospital in suburban Boston, one of the nation's leading forensic psychiatrists, an expert who testified in the case of Sacco and Vanzetti, insisted that Nash was perfectly sane. Only a few of those who witnessed the uncanny metamorphosis, Norbert Wiener among them, grasped its true significance.[28]

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

The origins of schizophrenia are mysterious. The condition was first described in 1806, but no one is certain whether the illness — or, more likely, group of illnesses — existed long before then but had escaped definition or, on the other hand, appeared as an AIDS-like scourge at the start of the industrial age.[29] Roughly 1 percent of the population in all countries succumbs to it.[30] 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.[31] No element of environment—war, imprisonment, drugs, or upbringing — has ever been proved to cause, by itself, a single instance of the illness.[32] 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.[33]

Eugen Bleuler, who coined the term *schizophrenia* in 1908, describes a “specific type of alteration of thinking, feeling and relation to the external world.”[34] The term refers to a splitting of psychic functions, “a peculiar destruction of the inner cohesiveness of the psychic personality.”[35] To the person experiencing early symptoms, there is a dislocation of every faculty, of time, space, and body.[36] None of its symptoms — hearing voices, bizarre delusions, extreme apathy or agitation, coldness toward others — is, taken singly, unique to the illness.[37] And symptoms vary so much between individuals and over time for the same individual that the notion of a “typical case” is virtually nonexistent. Even the degree of disability — far more severe, on average, for men — varies wildly. The symptoms can be “slightly, moderately, severely, or absolutely disabling,” according to Irving Gottesman, a leading contemporary researcher.[38] Though Nash succumbed at age thirty, the illness can appear at any time from adolescence to advanced middle age.[39] The first episode can last a few weeks or months or several years.[40] The life history of someone with the disease can include only one or two episodes.[41] Isaac Newton, always an eccentric and solitary soul, apparently suffered a psychotic breakdown with paranoid delusions at age fifty-one.[42] The episode, which may have been precipitated by an unhappy attachment to a younger man and the failure of his alchemy experiments, marked the end of Newton's academic career. But, after a year or so, Newton recovered and went on to hold a series of high public positions and to receive many honors. More often, as happened in Nash's case, people with the disease suffer many, progressively more severe episodes that occur at ever shorter intervals. Recovery, almost never complete, runs the gamut from a level tolerable to society to one that may not require permanent hospitalization but in fact does not allow even the semblance of a normal life.[43]

More than any symptom, the defining characteristic of the illness is the profound feeling of incomprehensibility and inaccessibility that sufferers provoke in other people. Psychiatrists describe the person's sense of being separated by a "gulf which defies description" from individuals who seem "totally 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 unpredictable.[45]

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 be.[46] He may have, indeed usually does have, a firm grip on certain aspects of present reality. While he was ill, Nash traveled all over Europe and America, got legal help, and learned to write sophisticated computer programs. Schizophrenia is also distinct from manic depressive illness (currently known as bipolar disorder), the illness with which it has most often been confounded in the past.

If anything, schizophrenia can be a ratiocinating illness, particularly in its early phases.[47] From the turn of the century, the great students of schizophrenia noted that its sufferers included people with fine minds and that the delusions which often, though not always, come with the disorder involve subtle, sophisticated, complex flights of thought. Emil Kraepelin, who defined the disorder for the first time in 1896, described "dementia praecox," as he called the illness, not as the shattering of reason but as causing "predominant damage to the emotional life and the will."[48] Louis A. Sass, a psychologist at Rutgers University, calls it "not an escape from reason but an exacerbation of that thoroughgoing illness Dostoevsky imagined … at least in some of its forms … a heightening rather than a dimming of conscious awareness, and an alienation not from reason but from emotion, instincts and the will."[49]

Nash's mood in the early days of his illness can be described, not as manic or melancholic, but rather as one of heightened awareness, insomniac wakefulness and watchfulness. He began to believe that a great many things that he saw — a telephone number, a red necktie, a dog trotting along the sidewalk, a Hebrew letter, a birthplace, a sentence in *The New York Times* — had a hidden significance, apparent only to him. He found such signs increasingly compelling, so much so that they drove from his consciousness his usual concerns and preoccupations. At the same time, he believed he was on the brink of cosmic insights. He claimed he had found a solution to the greatest unsolved problem in pure mathematics, 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 addressed as "a great necromancer and numerologist," Nash wrote:

> I have been considering Algerbiac [sic] questions and have noticed some interesting things that might also interest you … I, 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 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.[50]

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 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 he attributed to shock treatments.[51] He sometimes told others that his enforced idleness made him feel ashamed of himself, worthless.[52] More often, he expressed his suffering wordlessly. On one occasion, sometime during the 1970s, he was sitting at a table in the dining hall at the Institute for Advanced Study — the scholarly haven where he had once discussed his ideas with the likes of Einstein, von Neumann, and Robert Oppenheimer — alone as usual. That morning, an institute staff member recalled, Nash got up, walked over to a wall, and stood there for many minutes, banging his head against the wall, slowly, over and over, eyes tightly shut, fists clenched, his face contorted with anguish.[53]

While Nash the man remained frozen in a dreamlike state, a phantom who haunted Princeton in the 1970s and 1980s scribbling on blackboards and studying religious texts, his name began to surface everywhere — in economics textbooks, articles on evolutionary biology, political science treatises, mathematics journals. It appeared less often in explicit citations of the papers he had written in the 1950s than as an adjective for concepts too universally accepted, too familiar a part of the foundation of many subjects to require a particular reference: "Nash equilibrium," "Nash bargaining solution," "Nash program," "De Giorgi–Nash result," "Nash embedding," "Nash-Moser theorem," "Nash blowing-up."[54] When a massive new encyclopedia of economics, *The New Palgrave*, appeared in 1987, its editors noted that the game theory revolution that had swept through economics "was effected with apparently no new fundamental mathematical theorems beyond those of von Neumann and Nash."[55]

Even as Nash's ideas became more influential — in fields so disparate that almost no one connected the Nash of game theory with Nash the geometer or Nash the analyst — the 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 — and rejected.[56] No biographical sketch of Nash appeared in *The New Palgrave* alongside sketches of half a dozen other pioneers of game theory.[57]

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 with him always.[58]

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 institute.[59] 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 1980s, 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.”

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 faculty.[60] Bombieri, a dashing and erudite Italian, is a winner of the Fields Medal, mathematics’ equivalent of the Nobel. He also paints oils, collects wild mushrooms, and polishes gemstones. Bombieri is a number theorist who has been working for a long time on the Riemann Hypothesis. The exchange focused on various conjectures and calculations Nash had begun related to the so-called ABC conjecture. The letters showed that Nash was once again doing real mathematical research, Bombieri said:

> He was staying very much by himself. But at some point he started talking to people. Then we talked quite a lot about number theory. Sometimes we talked in my office. Sometimes over coffee in the dining hall. Then we began corresponding by e-mail. It's a sharp mind … all the suggestions have that toughness … there's nothing commonplace about those…. Usually when one starts in a field, people remark the obvious, only what is known. In this case, not. He looks at things from a slightly different angle.

A spontaneous recovery from schizophrenia — still widely regarded as a dementing and degenerative disease — is so rare, particularly after so long and severe a course as Nash experienced, that, when it occurs, psychiatrists routinely question the validity of the original diagnosis.[61] But people like Dyson and Bombieri, who had watched Nash around Princeton for years before witnessing the transformation, had no doubt that by the early 1990s he was "a walking miracle."

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

A mathematics seminar was just breaking up. Nash, who now regularly attended such gatherings and sometimes even asked a question or offered some conjecture, was about to duck out. Harold Kuhn, a mathematics professor at the university and Nash's closest friend, caught up with him at the door.[62] Kuhn had telephoned Nash at home earlier that day and suggested that the two of them might go for lunch after the talk. The day was so mild, the outdoors so inviting, the Institute woods so brilliant, that the two men wound up sitting on a bench opposite the mathematics building, at the edge of a vast expanse of lawn, in front of a graceful little Japanese fountain.

Kuhn and Nash had known each other for nearly fifty years. They had both been graduate students at Princeton in the late 1940s, shared the same professors, known the same people, traveled in the same elite mathematical circles. They had not been friends as students, but Kuhn, who spent most of his career in Princeton, had never entirely lost touch with Nash and had, as Nash became more accessible, managed to establish fairly regular contact with him. Kuhn is a shrewd, vigorous, sophisticated man who is not burdened with "the mathematical personality." Not 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 common memories and associations.

Kuhn, who had carefully rehearsed what he was going to say, got to the point quickly. "I have something to tell you, John," he began. Nash, as usual, refused to look Kuhn in the face at first, staring instead into the middle distance. Kuhn went 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 Executive Secretary of the Swedish Academy of Sciences. Kuhn's voice suddenly became hoarse with emotion. Nash now turned his head, concentrating on every word. "He's going to tell you, John," Kuhn concluded, "that you have won a Nobel Prize."

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

Notes

1. George W. Mackey, professor of mathematics, Harvard University, interview, Cambridge, Mass., 12.14.95.

2. See, for example, David Halberstam, *The Fifties* (New York: Fawcett Columbine, 1993).

3. Mikhail Gromov, professor of mathematics, Institut des Hautes-Études, Bures-sur-Yvette, France, and Courant Institute, interview, 12.16.97. The claim that Nash ranks among the greatest mathematicians of the postwar era is based on judgment of fellow mathematicians. The topologist John Milnor expressed a nearly universal opinion among mathematicians when he wrote: "To some, the brief paper, written at age 21, for which he has won a Nobel prize in economics, may seem like the least of his achievements." In "A Celebration of John F. Nash, Jr.," a special volume, *Duke Mathematical Journal*, vol. 81, no. 1 (Durham, N.C.: Duke University Press, 1995), the game theorist Harold W. Kuhn calls Nash "one of the most original mathematical minds of this century."

4. Paul R. Halmos, "The Legend of John von Neumann," *American Mathematical Monthly*, vol. 80 (1973), pp. 382–94.

5. Donald J. Newman, professor of mathematics, Temple University, interview, Philadelphia, 3.2.96.

6. Harold W. Kuhn, professor of mathematics, Princeton University, interview, 7.26.95.

7. John Forbes Nash, Jr., remarks at the American Economics Association Nobel luncheon, San Francisco, 1.5.96; plenary lecture, World Congress of Psychiatry, Madrid, 8.26.96.

8. John Nash, "Parallel Control," RAND Memorandum no. 1361, 8.7.54; plenary lecture, Madrid, 8.26.96, op. cit.

9. Interviews with Newman, 3.2.96; Eleanor Stier, 3.13.96.

10. John Nash, plenary lecture, Madrid, 8.26.96, op. cit.

11. Jürgen Moser, professor of mathematics, ETH, Zurich, interview, New York City, 3.21.96.

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PART ONE

A Beautiful Mind

1
Bluefield

1928–45

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

AMONG JOHN NASH'S EARLIEST MEMORIES is one in which, as a child of about two or three, he is listening to his maternal grandmother play the piano in the front parlor of the old Tazewell Street house, high on a breezy hill overlooking the city of Bluefield, West Virginia.[1]

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.[2] 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 sewn it herself, perhaps having 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 1890s house waving their goodbyes. Then, according to an account that appeared some weeks later in the Appalachian Power Company's company newsletter, they embarked in the groom's shiny new Dodge for an "extensive tour" through several northern states.[3]

The romantic style of the wedding, and the venturesome honeymoon, hinted at certain qualities in the couple, no longer in the first bloom of youth, that set them somewhat apart from the rest of society in this small American town.

John Forbes Nash, Sr., was "proper, painstaking, and very serious, a very conservative man in every respect," according to his daughter Martha Nash Legg.[4] What saved him from dullness was a sharp, inquiring mind. A Texas native, he came from the rural gentry, teachers and farmers, pious, frugal Puritans and Scottish Baptists who migrated west from New England and the Deep South.[5] He was born in 1892 on his maternal grandparents' plantation on the banks of the Red River in northern Texas, the youngest of three children of Martha Smith and Alexander Quincy Nash. The first few years of his life were spent in Sherman, Texas, where his paternal grandparents, both teachers, had founded the Sherman Institute (later the Mary Nash College for Women), a modest but progressive establishment, where the daughters of Texas's middle class learned deportment, the value of regular physical exercise, and a bit of poetry and botany. His mother had been a student and then a teacher at the college before she married the son of its founders. After his grandparents died, John Sr.'s parents operated the college until a smallpox epidemic forced them to close its doors for good.

His childhood, spent within the precincts of Baptist institutions of higher learning, was unhappy. The unhappiness stemmed largely from his parents' marriage. Martha Nash's obituary refers to "many heavy burdens, responsibilities and disappointments, that made a severe demand on her nervous system and physical force."[6] Her chief burden was Alexander, a strange and unstable individual, a ne'er-do-well, a drinker and a philanderer who either abandoned his wife and three children soon after the college's demise or, more likely, was thrown out. When precisely Alexander left the family for good or what happened to him after he departed is unclear, but he was in the picture long enough to earn his children's undying enmity and to instill in his youngest son a deep and ever-present hunger for respectability. "He was very concerned with appearances," his daughter Martha later said of her father; "he wanted everything to be very proper."[7]

John Sr.'s mother was a highly intelligent, resourceful woman. After she and her husband separated, Martha Nash supported herself and her two young sons and daughter on her own, working for many years as an administrator at Baylor College, another Baptist institution for girls, in Belton, in central Texas. Obituaries refer to her "fine executive ability" and "remarkable managerial skill." According to the *Baptist Standard,* "She was an unusually capable woman.… She had the capacity of managing large enterprises … a true daughter of the true Southern gentry." Devout and diligent, Martha was also described as an "efficient and devoted" mother, but her constant struggle against poverty, bad health, and low spirits, along with the shame of growing up in a fatherless household, left its scars on John Sr. and contributed to the emotional reserve he later displayed toward his own children.

Surrounded by unhappiness at home, John Sr. early on found solace and certainty in the realm of science and technology. He studied electrical engineering at Texas Agricultural & 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 the University of Texas. 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 whippet-thin. One account called her "one of the most charming and cultured young ladies of the community."[8] Outgoing and energetic, Virginia was a freer, less rigid spirit than her quiet, reserved husband and a far more active presence in her son's life. Her vitality and forcefulness were such that, years later, her son John, by then in his thirties and seriously ill, would dismiss a report from home that she had been hospitalized for a "nervous breakdown" as simply unbelievable. He would greet the news of her death in 1969 with similar incredulity.[9]

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, Eva, who had moved to Bluefield from North Carolina during the early 1890s. 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 — their first child, a boy, died in infancy; Virginia, the second, was left entirely deaf in one ear at age twelve after a bout of scarlet fever; a younger brother was killed in a train wreck; and one of her sisters died in a typhoid epidemic — but on the whole Virginia grew up in a happier atmosphere than her husband. The Martins were also well-educated, and they saw to it that all of their daughters received university educations. Eva Martin was herself unusual in having graduated from a women's college in Tennessee. Virginia studied English, French, German, and Latin first at Martha Washington College and later at West Virginia University, graduating at age sixteen. By the time she met her husband-to-be, she had been teaching for more than ten years. She was a born teacher, a talent that she would later lavish on her gifted son. Like her husband, she had seen something beyond the small towns of her home state. Before her marriage, she and another Bluefield teacher, Elizabeth Shelton, spent several summers traveling and attending courses at various universities, including the University of California at Berkeley, Columbia University in New York, and the University of Virginia in Charlottesville.

When the newlyweds returned from their honeymoon, the couple lived at the Tazewell Street house with Virginia's mother and sisters. John Sr. went back to his job at the Appalachian, which in those years consisted largely of driving all over the state inspecting remote power lines. Virginia did not return to teaching. Like most school districts around the country during the 1920s, the Mercer County school system had a marriage bar. Female teachers lost their jobs as soon as they married.[10] But, quite apart from her forced resignation, her new husband had a strong feeling that he ought to provide for his wife and protect her from what he regarded as the shame of having to work, another legacy of his own upbringing.

Bluefield, named for the fields of "azure chicory" in surrounding valleys that grows along every street and alleyway even today, owes its existence to the rolling hills full of coal — "the wildest, most rugged and romantic country to be found in the mountains of Virginia or West Virginia" — that surround the remote little city.[11] Norfolk & Western, in a spirit of "mean force and ignorance," built a line in the 1890s that stretched from Roanoke to Bluefield, which lies in the Appalachians on the easternmost edge of the great Pocahontas coal seam. For a long time, Bluefield was a rough and ready frontier outpost where Jewish merchants, African-American construction workers, and Tazewell County farmers struggled to make a living and where millionaire coal operators, most of whom lived ten miles away in Bramwell, battled Italian, Hungarian, and Polish immigrant laborers, and John L. Lewis and the UMW sat down with the coal operators to negotiate contracts, negotiations that often led to the bloody strikes and lockouts documented in John Sayles's film *Matewan.*

By the 1920s, when the Nashes married, however, Bluefield's character was already changing. Directly on the line between Chicago and Norfolk, the town was becoming an important rail hub and had attracted a prosperous white-collar class of middle managers, lawyers, small businessmen, ministers, and teachers.[12] A real downtown of granite office buildings and stores had sprung up. Handsome churches had also gone up all over town. Snug frame houses with pretty little gardens edged by Rose of Sharon dotted the hills. The town had acquired a daily newspaper, a hospital, and a home for the elderly. Educational institutions, from private kindergartens and dancing schools to two small colleges, one black, one white, were thriving. The radio, telegraph, and telephone, as well as the railroads and, increasingly, the automobile, eased the sense of isolation.

Bluefield was not "a community of scholars," as John Nash later said with more than a hint of irony.[13] Its bustling commercialism, Protestant respectability, and small-town snobbery couldn't have been further removed from the atmosphere of the intellectual hothouses of Budapest and Cambridge which produced John von Neumann and Norbert Wiener. Yet while John Nash was growing up, the town had a sizable group of men with scientific interests and engineering talent, men like John Sr. who were attracted by the railroad, the utility, and the mining companies.[14] Some of those who came to work for the companies wound up as science teachers in the high school or one of the two Baptist colleges. In his autobiographical essay, Nash described "having to learn from the world's knowledge rather than the knowledge of the immediate community" as "a challenge."[15] But, in fact, Bluefield offered a good deal of stimulation — admittedly, of a down-to-earth variety — for an inquiring mind; John Nash's subsequent career as a multi faceted mathematician, not to mention a certain pragmatism of character, would seem to owe something to his Bluefield years.

More than anything, the newly married Nashes were strivers. Solid members of America's new, upwardly mobile professional middle class, they formed a tight alliance and devoted themselves to achieving financial security and a respectable place for themselves in the town's social pyramid.[16] 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 Elks 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 Sr.'s job with the Appalachian remained secure right through the Depression of the 1930s. The young family fared considerably better in this period than many of their neighbors and fellow churchgoers, especially the small businessmen. John Sr.'s 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 — of 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 Eva Martin, the Nashes were soon able to move to their own modest but comfortable three-bedroom 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 Main Street that has long since been converted to other uses. Other than that single fact, again suggestive of the Nashes' comfortable 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 suggest any such trauma. The big, blond 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 introverted.[17] 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.[18] Johnny Nash certainly did not fit this now-discredited 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 — or 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 cousins.[19] The Highland Street house to which the Nashes had moved shortly after his birth was within easy 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 Matchbox 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 housewife." Virginia, who became actively involved in the PTA, taught Johnny to read by age four, sent him to a private kindergarten, saw to it that he skipped a grade early in elementary school, tutored him at home and, later on, in high school, had him enroll at Bluefield College to take courses in English, science, and math. John Sr.'s hand in his son's education was less visible. More distant than Virginia, he nonetheless shared his interests with his children — taking Johnny and Martha on Sunday drives to inspect power lines, for example — and, more important, supplied answers to his son's incessant questions about electricity, geology, weather, astronomy, and other technological subjects and the natural world. A neighbor remembers that John Sr. always spoke to his children as if they were adults: "He never gave Johnny a coloring book. He gave him science books."[20]

At school, Johnny's immaturity and social 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, age nine or ten, 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.[21]

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 value.[22]

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 experiments.[23] A neighbor recalls Johnny rigging the Nash telephone to ring with the receiver off.[24]

Though he had no close companions, he enjoyed performing in front of other children. At one point, he would hold on to a big magnet that was wired with electricity to show how much current he could endure without flinching.[25] 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.[26]

One afternoon, he went to a carnival that had come to Bluefield.[27] 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 it," he said as he rejoined the others. How did you do that? asked one of the children. "Static electricity," 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" became a family obsession.[28] Whether his apparent resolve to march to his own drummer was a question of his temperament or of his parents' concerted 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.

Virginia pushed Johnny as hard socially as she 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 Alden 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 *Bluefield Gazette*. In order to get him to the paper, "they got up at the wee hours of the night," Martha said. "They thought it was very important in helping make him well rounded. 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."[29]

Johnny did not openly rebel — he dutifully trotted off to 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 — all the things that so many of his peers found fascinating and enjoyable — as tedious distractions from his books and experiments. 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 — much to his parents' embarrassment. And on his summer jobs he found ways to entertain himself. One of Nash's classmates recalled that Nash, after disappearing for hours from his post at Bluefield Supply and Superior Sterling, was discovered rigging an elaborate system of mousetraps.[30] At a dance, he pushed a stack of chairs onto the dance floor and danced with them rather than with a girl.[31]

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 — poignant hints of her hopes and fears:

> Queer little twists and quirks go into the making of an individual. To suppress them all and follow clock and calendar and creed until the individual is lost in the neutral gray of the host is to be less than true to our inheritance.... Life, that gorgeous quality of life, is not accomplished by following another man's rules. It is true we have the same hungers and same thirsts, but they are for different things and in different ways and in different seasons.... Lay down your own day, follow it to its noon, your own noon, or you will sit in an outer hall listening to the chimes but never reaching high enough to strike your own.[32]

The earliest hint of Johnny's mathematical talent, ironically, was a B-minus in fourth-grade arithmetic. The teacher told Virginia that Johnny couldn't do the work, but it was obvious to his mother that he had merely found his own ways of solving problems. "He was always looking for different ways to do things," his sister commented.[33] More experiences like this followed, especially in high school, when he often succeeded in showing, after a teacher had struggled to produce a laborious, lengthy proof, that the proof could be accomplished in two or three elegant steps.

There is no sign of a mathematical pedigree in Nash's ancestry or any indication that mathematics was much in the air at the Nash household. Virginia Nash was literary. And for all his interest in contemporary developments in science and technology, John Sr. was not well-versed in abstract mathematics. Nash does not recall ever discussing his later research with his father.[34] 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 Mathematics*—an experience he alludes to in his autobiographical essay.[35] 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 — and, as it turns out, not entirely accurate — biographical sketches.[36] 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" as a "slovenly dreamer totally devoid of common sense." He assured his readers that the great mathematicians of history were an exceptionally virile and even adventuresome breed. He sought to prove his point with vivid accounts of infant precocity, monstrously insensitive educational authorities, crushing poverty, jealous rivals, love affairs, royal patronage, and many varieties of early death, including some resulting from duels. He even went so far, in defending mathematicians, as to answer the question "How many of the great mathematicians have been perverts?" None, was his answer. "Some lived celibate lives, usually on account of economic disabilities, but the majority were happily married.… The only mathematician discussed here whose life might offer something of interest to a Freudian is Pascal."[37] 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 uneventful," that caught Nash's eye.[38] The main interest of Fermat, who shares the credit for inventing calculus with Newton and analytic geometry with Descartes, was number theory — "the higher arithmetic." Number theory "investigates the mutual relationships of those common whole numbers, 1, 2, 3, 4, 5 … which we utter almost as soon as we learn to talk."

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

> Here were assertions, as for example the intersection of three altitudes of a triangle at one point which, — though by no means evident — could nevertheless be proved with such certainty that any doubt appeared to be out of the question. This lucidity and certainty made an indescribable impression on me.[39]

Nash does not describe his feelings when he succeeded in devising a proof for Fermat's assertion that if *n* is any whole number and *p* any prime, then *n* multiplied by itself *p* times minus *n* is divisible by *p*.[40] 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."[41]

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 mathematician. Although as a high-school student Nash took mathematics at Bluefield College, as late 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.

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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 rifle.[42] 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 Virginia hometown, remote and surrounded by mountains as it 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, rattling 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 — and troop trains crowded with sailors and soldiers, round-faced farm boys from Iowa and Indiana and edgy factory hands from Pittsburgh and Chicago.[43] 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 Wealthy Be Great / Roll in splendor and State / I envy them not, / I declare it*.

Adolescence wasn't easy for an intellectually precocious boy with few social skills or 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 bats.[44] But they found him — his speech, his behavior, the knapsack he insisted on carrying — weird.[45] “He was teased more than average — simply because he was so far out,” 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 Brains.”[46] Once some boys in the neighborhood tricked him into a boxing match and he took a beating.[47] But because he was tall, strong, and physically courageous, the teasing only rarely degenerated into outright bullying. He rarely passed up a chance to prove that he was smarter, stronger, braver.

Boredom and simmering adolescent aggression led him to play pranks, occasionally ones with a nasty edge. He caricatured classmates he disliked with weird little cartoons. He later told a fellow mathematician at MIT that, as a youngster, he had sometimes “enjoyed torturing animals.”[48] He once constructed a Tinkertoy rocking chair, wired it electrically, and tried to get Martha to sit in it.[49] He played a similar prank on a neighboring child. Nelson Walker, head of Bluefield’s Chamber of Commerce, told a newspaper reporter the following story:

> I was a couple of years younger than Johnny. One day I was walking by his house on Country Club Hill and he was sitting on the front steps. He called for me to come over and touch his hands. I walked over to him, and when I touched his hands, I got the biggest shock I’d ever gotten in my life. He had somehow rigged up batteries and wires behind him, so that he wouldn’t get shocked but when I touched his hands, I got the living fire shocked out of me. After that he just smiled and I went on my way.[50]

Occasionally the pranks got him into hot water. One incident involving a small explosion in the high school chemistry lab landed him in the principal’s office.[51] Another time, he and some other boys were picked up by the police for a curfew violation.[52]

When he was about fifteen, Nash and a couple of boys from across the street, Donald Reynolds and Herman Kirchner, began fooling around with homemade explosives.[53] They gathered in Kirchner’s garage, 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 famous Harvard astronomer Harlow Shapley, also won a Westinghouse that year made the 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.

Notes

1. John Forbes Nash, Jr., autobiographical essay, *Les Prix Nobel 1994*, op. cit.

2. "Nash-Martin," *Appalachian Power & Light Searchlight*, vol. 3, no. 9 (September 1924), p. 14.

3. Ibid.

4. Martha Nash Legg, interview, Roanoke, 7.31.95.

5. The history of the Nashes is based on genealogical materials, regional histories, and newspaper clippings supplied by Martha Legg and Richard Nash, including *The History of Grayson County, Texas*, vol. 2 (Grayson County Frontier Village, 1981) and Graham Landrum and Allan Smith, *Grayson County: An Illustrated History* (Fort Worth, Tex.: Historical Publishers). The facts of John Forbes Nash, Sr.'s early life are based on interviews with Martha Nash Legg as well as his obituary.

6. Obituaries of Martha Nash, *Baptist Standard* (1944); M. Legg, interview, 8.1.95; R. Nash, interview, San Francisco, 1.7.97.

7. M. Legg, interview, 7.31.95.

8. The history of the Martins and the facts of Virginia Martin's early life are based on interviews with Martha Legg as well as obituaries of Emma Martin and Virginia Martin in the *Bluefield Daily Telegraph.*

9. Letter from John Forbes Nash, Jr., to Martha Legg, undated (1959).

10. For a short history of the marriage bar, see Claudia Goldin, "Career and Family: College Women Look to the Past," Working Paper No. 5188 (Cambridge, Mass.: National Bureau of Economic Research, July 1995).

11. C. Stuart McGehee, *The City of Bluefield: Centennial History 1889–1989* (Bluefield Historical Society).

12. Ibid.; John E. Williams, professor of psychology, Wake Forest University, interview, 8.95.

13. John Nash, *Les Prix Nobel 1994,* op. cit.

14. Williams, interview, 10.24.95; William Lewis, McKinsey & Partners, interview, 10.94.

15. John Nash, *Les Prix Nobel 1994,* op. cit.

16. M. Legg, interview, 8.3.95.

17. Ibid.

18. John G. Gunderson, "Personality Disorders," op. cit., pp. 343–44; also Nikki Erlenmeyer-Kimling, professor of genetics and development, Columbia

University, interview, 1.17.98.

19. M. Legg, interview.

20. George Thornhill, quoted in William Archer, *Bluefield Daily Telegraph*, 10.94.

21. Report cards, various years, supplied by Martha Legg.

22. John Nash, *Les Prix Nobel 1994,* op. cit.

23. M. Legg, interview, 8.1.95.

24. Eddie Steele, quoted in William Archer, *Bluefield Daily Telegraph*, 10.13.94.

25. Donald V. Reynolds, interview, 6.29.97.

26. Ibid.

27. Ibid.

28. M. Legg, interview, 8.2.95.

29. Ibid.

30. E. T. Bell, *Men of Mathematics,* op. cit.; Betty Umberger, quoted in William Archer, *Bluefield Daily Telegraph*, 10.13.94.

31. Janice Thresher Frazier, personal communication, 9.97.

32. The origin of this quotation is unknown.

33. M. Legg, interview, 10.94.

34. Kuhn, interview, 3.97.

35. John Nash, *Les Prix Nobel 1994,* op. cit.

36. Bell, op. cit.

37. Ibid.

38. Ibid.

39. Denis Brian, *Einstein: A Life* (New York: John Wiley & Sons, 1996).

40. Bell, op. cit.; also Kuhn, interview, 10.21.97.

41. Bell, op. cit.

42. M. Legg, interview, 8.1.95.

43. Williams, interview.

44. Donald V. Reynolds, interview.

45. Interviews with Peggy Wharton, 12.96; Robert Holland, 6.9.97; John Louthan, 6.21.97; John Williams; Reynolds.

46. Reynolds, interview.

47. Ibid.

48. Felix Browder, president, American Mathematics Society, interview, 11.2.95.

49. M. Legg, interview, 11.94.

50. Nelson Walker, quoted in William Archer, *Bluefield Daily Telegraph*, 10.94.

51. Edwin Elliot, quoted in William Archer, *Bluefield Daily Telegraph*, 11.14.94.

52. M. Legg, interview, 8.2.95.

53. Reynolds, interview; see also William Archer, "Boys Will Be Boys," *Bluefield Daily Telegraph*, 11.14.94.

54. Julia Robinson, in Donald Albers, Gerald L. Alexanderson, and Constance

Reid, *More Mathematical People* (New York: Harcourt Brace Jovanovich, 1990), p. 271.

55. Anthony Storr, *The Dynamics of Creation,* op. cit.

56. M. Legg, interview, 11.94.

57. Vernon Dunn, quoted in William Archer, *Bluefield Daily Telegraph,* 11.94.

58. Beaver High School Yearbook, 1945.

59. Interviews with Williams and Louthan.

60. M. Legg, interview, 8.1.95.

61. John Nash, *Les Prix Nobel 1994,* op. cit.

62. John F. Nash and John F. Nash, Jr., “Sag and Tension Calculations for Cable and Wire Spans Using Catenary Formulas,” *Electrical Engineering,* 1945.

63. *Uncle App’s News,* 7.45.

group. Paul Zweifel, an avid bridge player, taught Nash how to play 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."[25] Nash roomed with Weinberger for a term, but the two clashed constantly — Nash once pushed Weinberger around to end an argument[26] — and Nash moved into a private room at the end of the hall. "He was extremely lonely," recalled Siegel.[27]

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 — the other boys were afraid of his strength and temper — as ostracized and relentlessly teased. That he was envied for his size and his brains only fueled the teasing. "He was the butt of people's jokes because he was different," recalled George Hinman, a physics student.[28] "Here was a guy who was socially underdeveloped and acting much younger. You do what you can to make his life miserable," Zweifel admitted. "We tormented poor John. We were very unkind. We were obnoxious. 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 under Carnegie. In the dark, Nash suddenly turned to the others and blurted out, "Gee, if we got trapped down here we'd have to turn homo." 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 him.[30]

Away from home, living in close proximity with other adolescents, Nash discovered that he was attracted to other boys. He spoke and acted in ways that seemed natural to him only to find himself exposed to his peers' contempt. Zweifel and other boys in the dormitory started calling Nash "Homo" and "Nash-Mo."[31] "Once the statement was made," George Siegel said, "it stuck. John took a lot."[32] No doubt, he found the label hurtful and humiliating, but his anger is all that anyone witnessed.

The boys made him the butt of various pranks. One time, Weinberger and a couple of others used a footlocker as a battering ram to break down Nash's door.[33] Another time, Zweifel and a few others, knowing of Nash's extreme aversion to cigarette smoke, rigged up a contraption that smoked an entire pack of cigarettes and collected the smoke. "A bunch of us crowded around John's door and blew the smoke under it," Zweifel 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 board,” said Duffin. “See if you can get me out of trouble.” Nash leaped up and strode to the board.[42]

“He was infinitely more sophisticated than the rest of us,” said Bott. “He understood the difficult points naturally. When Duffin got stuck, Nash could back him up. The rest of us didn’t understand the techniques you needed in this new medium.”[43] “He always had good examples and counterexamples,” another student recalled.[44]

Afterward, Nash hung around. “I could talk to Nash,” Duffin recalled shortly before his death in 1995. “After class one day he started talking about Brouwer’s fixed point theorem. He proved it directly using the principle of contradiction. That’s when you show that if something’s there, something dreadful will happen. Don’t know if Nash had ever heard of Brouwer.”[45]

Nash took Duffin’s course in his third and final year at Carnegie. At nineteen, Nash already had the style of a mature mathematician. Duffin recalled, “He tried to reduce things to something tangible. He tried to relate things to what he knew about. He tried to get a feel for things before he actually tried them. He tried to do little problems with some numbers in them. That’s how Ramanujan, who claimed he got his results from spirits, figured things out. Poincaré said he thought of a great theorem getting off a bus.”[46]

Nash liked very general problems. He wasn’t all that good at solving cute little puzzles. “He was a much more dreamy person,” said Bott. “He’d think a long time. Sometimes you could see him thinking. Others would be sitting there with their nose in a book.”[47] Weinberger recalled that “Nash knew a lot more than anybody else there. He was working on things we couldn’t understand. He had a tremendous body of knowledge. He knew number theory like mad.”[48] “Diophantine equations were his love,” recalled Siegel. “None of us knew anything about them, but he was working on them then.”[49]

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.[50] Nash himself does not recall. He did, however, take a course in international trade, his one and only formal course in economics, before graduating.[51] It was in this course that Nash first began to mull over one of the basic insights that eventually led to his Nobel Prize.[52]

> Should there come a war involving the US I think I should be more useful, and better off, working on some research project than going, say into the infantry. Working on government sponsored research this summer would pave the way toward the more desirable eventuality.[65]

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.[67] 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 no instructions and merely saying that he hoped Nash would write something before he left at the end of the summer. But Nash seemed to have trouble working. He made no apparent progress on any of the problems he had mentioned vaguely to Truesdell at the start of the summer, and he never handed in a paper. At the end of the summer, he was forced to apologize to Truesdell for having wasted his time.[68]

Nash spent most of his days, evidently, simply walking around rather aimlessly, lost in thought. Charlotte Truesdell, Truesdell's wife and the project's girl Friday, recalls that Nash seemed terribly young, "like a sixteen-year-old," and almost never spoke to anyone. Once when she asked him what he was thinking, Nash asked whether she, Charlotte, didn't think it would be a good joke if he put live snakes in the chairs of some of the mathematicians. "He didn't do it," she said, "but he thought about it a lot."[69]

Notes

1. Nash's interest in number theory, topology, and other branches of pure mathematics was recalled by Robert Siegel, professor of physics, College of William and Mary, interview, 10.30.97; Hans F. Weinberger, professor of

3
The Center of the Universe

Princeton, Fall 1948

> … *a quaint ceremonious village.* — ALBERT EINSTEIN

> … *the mathematical center of the universe.* — HARALD BOHR

NASH ARRIVED in Princeton, New Jersey, on Labor Day 1948, the opening day of the Truman-Dewey race.[1] He was twenty years old. He came by train, directly from Hinton, near 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 shuttles 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.[2] 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, 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*, F. Scott Fitzgerald had described Princeton circa World War I as "the pleasantest country club in the world."[3] Einstein called it "a quaint, ceremonious village" in the 1930s.[4] Depression and wars had scarcely changed the place. May Veblen, the wife of a wealthy Princeton mathematician, Oswald Veblen, could still identify by name every single family, white and black, well-to-do and of modest means, in every single house in 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 formulae are stuck to your palm. If one wants 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."[13]

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Princeton's unique position in the world of mathematics had been achieved practically overnight, barely a dozen years earlier.[14] The university predated the Republic by a good twenty years. It started out as the College of New Jersey in 1746, founded by Presbyterians. It didn't become Princeton until 1896 and wasn't headed by a layman until 1903 when Woodrow Wilson became its president. Even then, however, Princeton was a university in name only — "a poor place," "an overgrown prep school," particularly when it came to the sciences.[15] 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 research," Lefschetz recalled. "In the beginning we had no quarters. Everyone worked at home."[16] 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.[17] Henry Norris Russell, a distinguished astronomer by the 1920s, 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 Harvard. Yale refused for seven years to pay a salary to the physicist Willard Gibbs, already famous in Europe, on the grounds that his studies were "irrelevant."[18]

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

John D. Davies, a historian of science, writes of a dramatic revolution in the understanding of the very nature of matter:

> The absolute world of classical Newtonian physics was breaking down and intellectual ferment was everywhere. Then in 1905 an unknown theoretician in the Berne patent office, Albert Einstein, published four epoch-making papers comparable to Newton's instant leap into fame. The most significant was the so-called Special Theory of Relativity, which proposed that mass was simply congealed energy, energy liberated matter: space and time, previously thought to be absolute, were dependent on relative motion. Ten years later he formulated the General Theory of Relativity, proposing that gravity was a function of matter itself and affected light exactly as it affected material particles. Light, in other words, did not go "straight"; Newton's laws were not the real universe but one seen through the unreal spectacles of gravity. Furthermore, he set forth a set of mathematical laws with which the universe could be described, structural laws and laws of motion.[19]

At around the same time, at the University of Göttingen, a German mathematical genius, David Hilbert, had unleashed a revolution in mathematics. Hilbert set out a famous program in 1900 of which the goal was nothing less than the "axiomatization of all of mathematics so that it could be mechanized and solved in a routine manner." Göttingen became the center of a drive to put existing mathematics on a more secure foundation: "The Hilbert program emerged at the turn of the century as a response to a perceived crisis in mathematics," writes historian Robert Leonard. "The effect was to drive mathematicians to 'clean up' dean's premature death in 1928 in a cycling accident on Nassau Street had it not been for several dramatic instances of private philanthropy that turned Princeton into a magnet for the world's biggest mathematical stars. Most people think that America's rise to scientific prominence was a by-product of World War II. But in fact the fortunes accumulated between the gilded eighties and the roaring twenties paved the way.

The Rockefellers made their millions in coal, oil, steel, railroads, and banking — in other words, from the great sweep of industrialization that transformed towns like Bluefield and Pittsburgh in the late nineteenth and early twentieth centuries. When the family and its representatives started to give away some of the money, they were animated by dissatisfaction with the state of higher education in America and a firm belief that "nations that do not cultivate the sciences cannot hold their own."[23] 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-1920s, the Rockefeller Foundation decided that "instead of sending Mahomet to the Mountain, it would fetch the Mountain here." That 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 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 — the congenial floating seminars of professors and students where the latest research was discussed. Wigner wondered if they were part of the window dressing, like the faux-Gothic buildings. But von Neumann, an 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 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 Bell Jar*. References were required to obtain lodging there. And the rooms, tiny and white with metal beds, were only for sleeping, Alicia complained in a PS to Joyce.[18] “This hotel – the Amazon – was for women only,” writes Plath, who spent the summer of 1952 in residence, “and they were mostly girls my age with wealthy parents who wanted to be sure their daughters would be living where men couldn’t get at them and deceive them; and they were all going to posh secretarial schools like Katy Gibbs, where they had to wear hats and stockings and gloves to class, or … simply hanging around in New York waiting to get married to some career man or other.”[19]

Whether or not Alicia came to New York as Nash’s fiancée at the end of October, she visited Nash’s family in Roanoke that Thanksgiving.[20] Nash did not give her a ring, however. He had some idea, typically odd and pennypinching, that he wanted to buy one in Antwerp, directly from a diamond wholesaler.[21]

Virginia found Alicia charming and dignified and was impressed by Alicia’s obvious devotion to Nash, but at the same time she thought her quite different from the sort of girl she had imagined for her son’s bride.[22] She thought the relationship between the two strange. Alicia was a physicist who talked about her job at a nuclear reactor company and displayed no interest in anything domestic, a young woman completely out of Virginia’s ken. While Virginia and Martha busied themselves in the kitchen, Alicia and Nash spent most of Thanksgiving Day sitting on the floor of Virginia’s living room poring over stock quotations. Martha’s reaction was similar to her mother’s. (At Virginia’s insistence, and thinking it might turn Alicia’s head in the right direction, Martha took Alicia shopping in Roanoke one afternoon to buy a hat.)

all these things were explained by fetus envy."[41] Cohen said: "His psychoanalysts theorized that his illness was brought on by latent homosexuality."[42] These rumored opinions may well have been held by Nash's doctors. Freud's now-discredited theory linking schizophrenia to repressed 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 panic."[43]

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 — by going to McLean's library or talking with his fellow inmates — what his doctors were thinking.

*

Everyone was very upbeat. The optimism was part of that "heavily psychoanalytic" era at McLean. Lowell's doctors were telling his wife, Elizabeth Hardwick, that the most serious illnesses, psychotic illnesses, the kind that produced the chronic cases like Lowell's Bobbie, were now susceptible to "permanent cures."[44]

Alfred H. Stanton had been charged by McLean's trustees in 1954 to modernize McLean.[45] Before Stanton arrived in the early 1950s, as Kahne recalled, "The nurses were spending all their time classifying fur coats and writing thank you letters." Moreover, patients spent most of the day lying in bed as if they were suffering from some physical ailment. Stanton hired a large number of nurses and psychiatrists, expanded the medical residency program, instituted an intensive psychotherapy program, and organized social, educational, and work activities.

McLean's treatment philosophy boiled down to the notion that "it was impossible to be social and crazy at the same time."[46] The staff was dedicated to encouraging all new patients, no matter what the diagnosis, to relate. Along with this "milieu" therapy, as it was called, intensive, five-day-a-week psychoanalysis was the main mode of treatment.[47] 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 Freud, and had helped run Chestnut Lodge, a private hospital

About the Author

Sylvia Nasar was born in Bavaria in 1947 to a German mother and Uzbek father. Her family emigrated to the United States in 1951 and lived in New York and Washington, DC, before moving to Ankara, Turkey, in 1960. In 1965, she returned to the USA and attended Antioch College where she majored in literature. After working for several years, she entered the PhD programme in Economics at New York University, completing a Master's degree in 1976. For a time, she did economics research, including with Nobel Laureate Wassily Leontief. At the age of thirty-five Nasar became a journalist. Since 1983 she has been a writer at *Fortune*, a columnist at *US News & World Report* and a reporter at the *New York Times* where she currently covers economics. *A Beautiful Mind*, her first book, was the winner of the National Book Critics Circle Award for Biography, and a finalist for the Pulitzer Prize in Biography and the Helen Bernstein Book Award.

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