

Schrödinger's Kitten

THE CLEAN CRESCENT MOON THAT BEGAN THE new month hung in the western sky across from the alley. Jehan was barely twelve years old, too young to wear the veil, but she did so anyway. She had never before been out so late alone. She heard the sounds of celebration far away, the three-day festival marking the end of the holy month of Ramadan. Two voices sang drunkenly as they passed the alley; two others loudly and angrily disputed the price of some honey cakes. The laughter and the shouting came to Jehan as if from another world. In the past, she'd always loved the festival of Id-el-Fitr; she took no part in the festivities now, though, and it seemed odd to her that anyone else still could. Soon she gave it all no more of her attention. This year she must keep a meeting more important than any holiday. She sighed, shrugging: The festival would come around again next year. Tonight, with only the silver moon for company, she shivered in her blue-black robe.

Jehan Fatima Ashufi stepped back a few feet deeper into the alley, farther out of the light. All along the Street, people who would otherwise never be seen in this quarter were determinedly amusing themselves. Jehan shivered again and waited. The moment she longed for would come just at dawn. Even now the sky was just dark enough to reveal the moon and the first impetuous stars. In the Islamic world, night began when one could no longer distinguish a white thread from a black one; it was not yet night. Jehan clutched her robe closely to her with her left hand. In her right hand, hidden by her long sleeve, was the keen-edged, gleaming, curved blade she had taken from her father's room.

She was hungry and she wished she had money to buy something to eat, but she had none. In the Budayeen there were many girls her age who already had ways of getting money of their own; Jehan was not one of them. She glanced about herself and saw only the filth-strewn, damp and muddy paving stones. The reek of the alley disgusted her. She was bored and lonely and afraid. Then, as if her whole sordid world suddenly dissolved into something else, something wholly foreign, she saw more.

Jehan Ashufi was twenty-six years old. She was dressed in a conservative dark gray woolen suit, cut longer and more severely than fashion dictated, but appropriate for a bright young physicist. She affected no jewelry and wore her black hair in a long braid down her back. She took a little effort each morning to look as plain as possible while she was accompanying her eminent teacher and advisor. That had been Heisenberg's idea. In those days, who believed a beautiful woman could also be a highly talented scientist? Jehan soon learned that her wish of being inconspicuous was in vain. Her dark skin and her accent marked her a foreigner. She was clearly not European. Possibly she had Levantine blood. Most who met her thought she was probably a Jew. This was Gottingen, Germany, and it was 1925.

The brilliant Max Born, who first used the expression “quantum mechanics” in a paper written two years before, was leading a meeting of the university’s physicists. They were discussing Max Planck’s latest proposals concerning his own theories of radiation. Planck had developed some basic ideas in the emerging field of quantum physics, yet he had used classical Newtonian mechanics to describe the interactions of light and matter. It was clear that this approach was inadequate, but as yet there was no better system. At the Gottingen conference, Pascual Jordan rose to introduce a compromise solution; but before Born, the department chairman, could reply, Werner Heisenberg fell into a violent fit of sneezing.

“Are you all right, Werner?” asked Born.

Heisenberg merely waved a hand. Jordan attempted to continue, but again Heisenberg began sneezing. His eyes were red and tears crept down his face. He was in obvious distress. He turned to his graduate assistant. “Jehan,” he said, “please make immediate arrangements, I must get away. It’s my damned hay fever. I want to leave at once.”

One of the others at the meeting objected. “But the colloquium—”

Heisenberg was already on his feet. “Tell Planck to go straight to hell, and to take de Broglie and his matter waves with him. The same goes for Bohr and his goddamn jumping electrons. I can’t stand any more of this.” He took a few shaky steps and left the room. Jehan stayed behind to make a few notations in her journal. Then she followed Heisenberg back to their apartments.

There were no mosques in the Budayeen, but in the city all around the walled quarter there were many mosques. From the tall, ancient towers, strong voices called the faithful to morning devotions. “Come to prayer, come to prayer! Prayer is better than sleep!”

Leaning against a grimy wall, Jehan heard the chanted cries of the muezzins, but she paid them no mind. She stared at the dead body at her feet, the body of a boy a few years older than she, someone she had seen about the Budayeen but whom she did not know by name. She still held the bloody knife that had killed him.

In a short while, three men pushed their way through a crowd that had formed at the mouth of the alley. The three men looked down solemnly at Jehan. One was a police officer; one was a qadi, who interpreted the ancient Islamic commandments as they applied to modern life; and the third was an imam, a prayer leader who had hurried from a small mosque not far from the east gate of the Budayeen. Within the walls the pickpockets, whores, thieves, and cutthroats could do as they liked to each other. A death in the Budayeen didn’t attract much attention in the rest of the city.

The police officer was tall and heavily built, with a thick black mustache and sleepy eyes. He was curious only because he had watched over the Budayeen for fifteen years, and he had never investigated a murder by a girl so young.

The qadi was young, clean-shaven, and quite plainly deferring to the imam. It was not yet clear if this matter should be the responsibility of the civil or the religious authorities.

The imam was tall, taller even than the police officer, but thin and narrow-shouldered; yet it was not asceticism that made him so slight. He was well known for two things: his common sense concerning the conflicts of everyday affairs, and the high degree of earthly pleasures he permitted himself. He, too, was puzzled and curious. He wore a short, grizzled gray beard, and his soft brown eyes were all but hidden within the reticulation of wrinkles that had slowly etched his face. Like the police officer, the imam had once worn a brave black mustache, but the days of fierceness had long since passed for him. Now he appeared decent and kindly. In truth, he was neither, but he found it useful to cultivate that reputation.

“O my daughter,” he said in his hoarse voice. He was very upset. He much preferred explicating obscure passages of the glorious Qur’ân to viewing such tawdry matters as blatant dead bodies in the nearby streets.

Jehan looked up at him, but she said nothing. She looked back down at the unknown boy she had killed.

“O my daughter,” said the imam, “tell me, was it thou who hath slain this child?”

Jehan looked back calmly at the old man. She was concealed beneath her kerchief, veil, and robe; all that was visible of her were her dark eyes and the long thin fingers that held the knife. “Yes, O Wise One,” she said, “I killed him.”

The police officer glanced at the qadi.

“Prayest thou to Allah?” asked the imam. If this hadn’t been the Budayeen, he wouldn’t have needed to ask.

“Yes,” said Jehan. And it was true. She had prayed on several occasions in her lifetime, and she might yet pray again sometime.

“And knowest thou there is a prohibition against taking of human life that Allah hath made sacred?”

“Yes, O Wise One.”

“And knowest thou further that Allah hath set a penalty upon those who breaketh this law?”

“Yes, I know.”

“Then, O my daughter, tell us why thou hath brought low this poor boy.”

Jehan tossed the bloody knife to the stone-paved alley. It rang noisily and then came to rest against one leg of the corpse. “I killed him because he would do me harm in the future,” she said.

“He threatened you?” asked the qadi.

“No, O Respected One.”

“Then-”

“Then how art thou certain that he would do thee harm?” the imam finished.

Jehan shrugged. “I have seen it many times. He would throw me to the ground and defile me. I have seen the visions.”

A murmur grew from the crowd still cluttering the mouth of the alley behind Jehan and the three men. The imam’s shoulders slumped. The police officer waited patiently. The qadi looked

discouraged. "Then he didst not offer thee harm this morning?" said the imam.

"No."

"Indeed, as thou sayest, he hath *never* offered thee harm?"

"No. I do not know him. I have never spoken with him."

"Yet," said the qadi, clearly unhappy, "you murdered him because of what you have seen? As in a dream?"

"As in a dream, O Respected One, but more truly as in a vision."

"A dream," muttered the imam. "The Prophet, may blessings be on his name and peace, didst offer no absolution for murder provoked only by dreams."

A woman in the crowd cried out, "But she is only twelve years old!"

The imam turned and pushed his way through the rabble.

"Sergeant," said the qadi, "this young girl is now in your custody. The Straight Path makes our duty clear."

The police officer nodded and stepped forward. He bound the young girl's wrists and pushed her forward through the alley. The crowd of fellahin parted to make way for them. The sergeant led Jehan to a small, dank cell until she might have a hearing. A panel of religious elders would judge her according to Shari'a, the contemporary code of laws derived from the ancient and noble Qur'ân.

Jehan did not suffer in her noxious cell. A lifetime in the Budayeen had made her familiar with deprivation. She waited patiently for whatever outcome Allah intended.

She did not wait long. She was given another brief hearing, during which the council asked her many of the same questions the imam had asked. She answered them all without hesitation. Her judges were saddened but compelled to render their verdict. They gave her an opportunity to change her statement, but she refused. At last the senior member of the panel stood to face her. "O young one," he said in the most reluctant of voices, "The Prophet, blessings be on his name and peace, said, 'Whoso slayeth a believer, his reward is Hell forever.' And elsewhere, 'Who killeth a human being for other than manslaughter or corruption in the earth, it shall be as if he killed all mankind.' Therefore, if he whom you slew had purposed corruption upon you, your act would have been justified. Yet you deny this. You rely on your dreams, your visions. Such insubstantial defense cannot persuade this council otherwise than that you are guilty. You must pay the penalty even as it is written. It shall be exacted tomorrow morning just before sunrise."

Jehan's expression did not change. She said nothing. Of her many visions, she had witnessed this particular scene before also. Sometimes, as now, she was condemned; sometimes she was freed. That evening she ate a good meal, a better meal than most she had taken before in her life of poverty. She slept the night, and she was ready when the civil and religious officials came for her in the morning. An imam of great repute spoke to her at length, but Jehan did not listen carefully. The remaining acts and motions of her life seemed mechanically ordered, and she did not pay great heed to them. She followed where she was led, she responded dully when pressed for a reply, and she climbed the

platform set up in the courtyard of the great Shimaal Mosque.

“Dost thou feel regret?” asked the imam, laying a gentle hand on her shoulder.

Jehan was made to kneel with her head on the block. She shrugged. “No,” she said.

“Dost thou feel anger, O my daughter?”

“No.”

“Then mayest Allah in His mercy grant thee peace.” The imam stepped away. Jehan had no view of the headsman, but she heard the collective sigh of the onlookers as the great axe lifted high in the first faint rays of dawn, and then the blade fell.

Jehan shuddered in the alley. Watching her death always made her exceptionally uneasy. The hour wasn't much later; the fifth and final call to prayer had sounded not long before, and now it was night. The celebration continued around her more intensely than before. That her intended deed might end on the headsman's block did not deter her. She grasped the knife tightly, wishing that time would pass more swiftly, and she thought of other things.

By the end of May 1925, they were settled in a hotel on the tiny island of Helgoland some fifty miles from the German coast. Jehan relaxed in a comfortably furnished room. The landlady made her husband put Heisenberg and Jehan's luggage in the best and most expensive room. Heisenberg had every hope of ridding himself of his allergic afflictions. He also intended to make some sense of the opaque melding of theories and counter-theories put forward by his colleagues back in Gottingen. Meanwhile, the landlady gave Jehan a grim and glowering look at their every meeting but said nothing. The Herr Doktor himself was too preoccupied to care for anything as trivial as propriety, morals, the reputation of this Helgoland retreat, or Jehan's peace of mind. If anyone raised eyebrows over the arrangement, Heisenberg certainly was blithely unaware; he walked around as if he were insensible to everything but the pollen count and the occasional sheer cliffs over which he sometimes came close to tumbling.

Jehan was mindful of the old woman's disapproval. Jehan, however, had lived a full, harsh life in her twenty-six years, and a raised eyebrow rated very low on her list of things to be concerned about. She had seen too many people abandoned to starvation, too many people dispossessed and reduced to beggary, too many outsiders slain in the name of Allah, too many maimed or beheaded through the convoluted workings of Islamic justice. All these years Jehan had kept her father's bloodied dagger, packed now somewhere beneath her Shetland wool sweaters, and still as deadly as ever.

Heisenberg's health improved on the island, and there was a beautiful view of the sea from their room. His mood brightened quickly. One morning, while walking along the shoreline with him, Jehan read a passage from the glorious Qur'ân. “This surah is called The Earthquake,” she said. “ ‘In the name of Allah, the Beneficent, the Merciful. When Earth is shaken with her final earthquake, and Earth yields up her burdens and man saith: What aileth her? That day she will relate her chronicles, because thy Lord inspireth her. That day mankind will issue forth in separate groups to be shown their

deeds. And whoso doeth good an atom's weight will see it then. And whoso doeth ill an atom's weight will see it then.' "

And Jehan wept, knowing that however much good she might do, it could never outweigh the wrongs she had already performed.

But Heisenberg only stared out over the gray, tumbling waves of the ocean. He did not listen closely to the sacred verses, yet a few of Jehan's words struck him. "And whoso doeth good an atom's weight will *see* it then," he said, emphasizing the single word. There was a small, hesitant smile quivering at the corners of his mouth. Jehan put her arm around him to comfort him because he seemed chilled, and she led him back to the hotel. The weather had turned colder and the air was misty with sea spray; together they listened to the cries of the herring gulls as the birds dived for fish or hovered screeching over the strip of beach. Jehan thought of what she'd read, of the end of the world. Heisenberg thought only of its beginning, and its still closely guarded secrets.

They liked their daily, peaceful walk about the island. Now, more than ever before, Jehan carried with her a copy of the Qur'ân, and she often read short verses to him. So different from the biblical literature he'd heard all his life, Heisenberg let the Islamic scriptures pass without comment. Yet it seemed to him that certain specific images offered their meanings to him alone.

Jehan saw at last that he was feeling well. Heisenberg took up again full time the tangled knot that was the current state of quantum physics. It was both his vocation and his means of relaxation. He told Jehan the best scientific minds in the world were frantically working to cobble together a slipshod mathematical model, one that might account for all the observed data. Whatever approach they tried, the data would not fit together. *He*, however, would find the key; he was that confident. He wasn't quite sure how he'd do it but, of course, he hadn't yet really applied himself thoroughly to the question.

Jehan was not amused. She read to him: "Hast thou not seen those who pretend that they believe in that which is revealed unto thee and that which was revealed before thee, how they would go for judgment in their disputes to false deities when they have been ordered to abjure them? Satan would lead them all astray."

Heisenberg laughed heartily. "Your Allah isn't just talking about Gottingen there," he said. "He's got Bohr in mind, too, and Einstein in Berlin."

Jehan frowned at his impiety. It was the irreverence and ignorant ridicule of the kafir, the unbeliever. She wondered if the old religion that had never truly had any claim on her was yet still part of her. She wondered how she'd feel after all these years, walking the narrow, crowded, clangorous ways of the Budayeen again. "You mustn't speak that way," she said at last.

"Hmm?" said Heisenberg. He had already forgotten what he'd said to her.

"Look out there," said Jehan. "What do you see?"

"The ocean," said Heisenberg. "Waves."

"Allah created those waves. What do you know about that?"

“I could determine their frequency,” said the scientist. “I could measure their amplitude.”

“Measure!” cried Jehan. Her own long years of scientific study were suddenly overshadowed by an imagined insult to her heritage. “Look here,” she demanded. “A handful of sand. Allah created this sand. What do *you* know about it?”

Heisenberg couldn't see what Jehan was trying to tell him. “With the proper instruments,” he said, a little afraid of offending her, “in the proper setting, I could take any single grain of sand and tell you — “ His words broke off suddenly. He got to his feet slowly, like an old man. He looked first at the sea, then down at the shore, then back out at the water. “Waves,” he murmured, “particles, it makes no difference. All that counts is what we can actually measure. We can't measure Bohr's orbits, because they don't really *exist*! So the spectral lines we see are caused by transitions between two states. Pairs of states, yes; but that will mean an entirely new form of mathematical expression just to describe them, referencing tables listing every possible — “

“Werner.” Jehan knew that he was now lost to her.

“Just the computations alone will take days, if not weeks.”

“Werner, *listen* to me. This island is so small, you can throw a stone from one end to the other. I'm not going to sit on this freezing beach or up on your bleak and dreary cliff while you make your brilliant breakthrough, whatever it is. I'm saying goodbye.”

“What? Jehan?” Heisenberg blinked and returned to the tangible world.

She couldn't face him any longer. She was pouring one handful of sand through the fingers of her other hand. It came suddenly to her mind then: If you had no water to perform the necessary ablution before prayer in the direction of Makkah, you were permitted to wash with clean sand instead. She began to weep. She couldn't hear what Heisenberg was saying to her —if indeed he was.

It was a couple hours later in the alley now, and it was getting even colder. Jehan wrapped herself in her robe and paced back and forth. She'd had visions of this particular night for four years, glimpses of the possible ways that it might conclude. Sometimes the young man saw her in the alley shortly after dawn, sometimes he didn't. Sometimes she killed him, sometimes she didn't. And, of course, there was the open question of whether her actions would lead to her freedom or to her execution.

When she'd had the first vision, she hadn't known what was happening or what she was seeing. She knew only the fear and the pain and the terror. The boy threw her roughly to the ground, ripped her clothing, and raped her. Then the vision passed. Jehan told no one about it; her family would have thought her insane. About three months later, the vision returned; only this time it was different in subtle ways. She was in the alley as before, but this time she smiled and gestured to the boy, inviting him. He smiled in return and followed her deeper into the alley. When he put his hand on her shoulder, she drew her father's dagger and plunged it into the boy's belly. That was as much as the vision showed her then. It terrified her even more than had the rape scene.

As time passed, the visions took on other forms. She was certain now that she was not always

watching *her* future, *the* future, but rather *a* future, each as likely to come to pass as the others. Not all the visions could possibly be true. In some of them, she saw herself living into her old age in the city, right here in this filthy quarter of the Budayeen. In others, she moved about strange places that didn't seem Islamic at all, and she spoke languages definitely not Arabic. She did not know if these conflicting visions were trying to tell her or warn her of something. Jehan prayed to know which of these versions she must actually live through. Soon after, as if to reward her for her faith, she began to have less violent visions: She could look into the future a short way and find lost objects, or warn against unlucky travel plans, or predict the rise and fall of crop prices. The neighbors, at first amused, began to be afraid of her. Jehan's mother counselled her never to speak of these "dreams" to anyone, or else Jehan might be locked away in some horrible institution. Jehan never told her father about her visions, because Jehan never told her father about anything. In that family, as in the others of the Budayeen—and the rest of the city, for that matter—the father did not concern himself very much with his daughters. His sons were his pride, and he had three strong sons whom he firmly believed would someday vastly increase the Ashufi prestige and wealth. Jehan knew he was wrong, because she'd already seen what would become of the sons—two would be killed in wars against the Jews; the third would be a coward, a weakling, and a fugitive in the United States. But Jehan said nothing.

A vision: It was just past dawn. The young man—whose name Jehan never learned—was walking down the stone-paved street toward her alley. Jehan knew it without even peering out. She took a deep breath. She walked a few steps toward the street, looked left, and caught his eyes. She made a brief gesture, turned her back, and went deeper into the shadowy seclusion of the alley. She was certain that he would follow her. Her stomach ached and rumbled, and she was shaking with nervous exhaustion. When the young man put his hand on her shoulder, murmuring indecent suggestions, her hand crept toward the concealed knife, but she did not grasp it. He threw her down roughly, clawed off her clothing, and raped her. Then he left her there. She was almost paralyzed, crying and cursing on the wet, foul-smelling stones. She was found some time later by two women who took her to a doctor. Their worst fears were confirmed: Her honor had been ravaged irredeemably. Her life was effectively over, in the sense of becoming a normal adult female in that Islamic community. One of the women returned to Jehan's house with her, to tell the news to Jehan's mother, who must still tell Jehan's father. Jehan hid in the room she shared with her sisters. She heard the violent breaking of furniture and shrill obscenity of her father. There was nothing more to be done. Jehan did not know the name of her assailant. She was ruined, less than worthless. A young woman no longer a virgin could command no bride price. All those years of supporting a worthless daughter in the hopes of recovering the investment in the marriage contract—all vanished now. It was no surprise that Jehan's father felt betrayed and the father of a witless creature. There was no sympathy for Jehan; the actual story, whatever it might be, could not alter the facts. She had only the weeping of her sisters and her mother. From that morning on, Jehan was permanently repudiated and cast out from her house. Jehan's

father and three brothers would not even look at her or offer her their farewells.

The years passed ever more quickly. Jehan became a woman of the streets. For a time, because of her youth and beauty, she earned a good living. Then as the decades left their unalterable blemishes upon her, she found it difficult even to earn enough for a meal and a room to sleep in. She grew older, more bitter, and filled with self-loathing. Did she hate her father and the rest of her family? No, her fate had been fixed by the will of Allah, however impossible it was for her to comprehend it, or else by her own timidity in the single moment of choice and destiny in the alley so many years before. She could not say. Whatever the answer, she could not benefit now from either insight or wisdom. Her life was as it was, according to the inscrutable designs of Allah the Merciful. Her understanding was not required.

Eventually she was found dead, haggard and starved, and her corpse was contorted and huddled for warmth coincidentally in the same alley where the young man had so carelessly despoiled any chance Jehan had for happiness in this world. After she died, there was no one to mourn her. Perhaps Allah the Beneficent took pity on her, showing mercy to her who had received little enough mercy from her neighbors while she lived among them. It had always been a cold place for Jehan.

For a while estranged from Heisenberg, Jehan worked with Erwin Schrödinger in Zurich. At first Schrödinger's ideas confused her because they went against many of Heisenberg's basic assumptions. For the time being, Heisenberg rejected any simple picture of what the atom was like, any model at all. Schrödinger, older and more conservative than the Gottingen group, wanted to explain quantum phenomena without new mathematics and elusive imagery. He treated the electron as a wave function, but a different sort of wave than de Broglie's. The properties of waves in the physical world were well known and without ambiguity. Yet when Schrödinger calculated how a change in energy level affected his electron wave, his solutions didn't agree with observed data.

"What am I overlooking?" he asked.

Jehan shook her head. "Where I was born they say, 'Don't pour away the water in your canteen because of a mirage.'"

Schrödinger rubbed his weary eyes. He glanced down at the sheaf of papers he held. "How can I tell if this water is worth keeping or something that belongs in a sewer?"

Jehan had no reply to that, and Schrödinger set his work aside, unsatisfied. A few months later several papers showed that after taking into account the relativistic effects, Schrödinger's calculations agreed remarkably well with experimental results after all.

Schrödinger was pleased. "I hoped all along to find a way to drag Born and Heisenberg back to classical physics," he said. "I knew in my heart that quantum physics would prove to be a sane world, not a realm populated by phantoms and governed by ghost forces."

"It seems unreal to me now," said Jehan. "If you say the electron is a wave, you are saying it is a phantom. In the ocean, it is the water that is the wave. As for sound, it is the air that carries the wave.

What exists to be a wave in your equations?"

"It is a wave of probability, Born says. I do not wholly understand that yet myself," he said, "but my equations explain too many things to be illusions."

"Sir," said Jehan, frowning, "it may be that in this case the mirage is in your canteen and not before you in the desert."

Schrödinger laughed. "That might be true. I may yet have to abandon my mental pictures, but I will not abandon my mathematics."

It was a breathless afternoon in the city. The local Arabs didn't seem to be bothered by the heat, but the small party of Europeans was beginning to suffer. Their cruise ship had put ashore at the small port, and a tour had been arranged to the city some fifty miles to the south. Two hours later the travelers concluded that the expedition had been a mistake.

Among them was David Hilbert, the German mathematician, a lecturer at Gottingen since 1895. He was accompanied by his wife, Käthe, and their maid, Clarchen. At first they were quite taken by the strangeness of the city, by the foreign sights and sounds and smells; but after a short time, their senses were glutted with newness, and what had at first been exotic was now only deplorable.

As they moved slowly through the bazaars, shaded ineffectually by awnings or meager arcades of sticks, they longed for the whisper of a single cool breeze. Arab men dressed in long white gallebeyas cried out shrilly, all the while glaring at the Europeans. It was impossible to tell what the Arabs were saying. Some dragged little carts loaded with filthy cups and pots—Water? Tea? Lemonade? It made no difference. Cholera lingered at every stall; every beggar offered typhus as he clutched at sleeves.

Hilbert's wife fanned herself weakly. She was almost overcome and near collapse. Hilbert looked about desperately. "David," murmured the maid, Clarchen, the only one of Hilbert's amours Frau Hilbert could tolerate, "we have come far enough."

"I know," he said, "but I see nothing—nowhere—"

"There are some ladies and gentlemen in that place. I think it's an eating place. Leave Käthe with me there, and find a taxi. Then we shall go back to the boat."

Hilbert hesitated. He couldn't bear to leave the two unprotected women in the midst of this frantic heathen marketplace. Then he saw how pale his wife had become, how her eyelids drooped, how she swayed against Clarchen's shoulder. He nodded. "Let me help," he said. Together they got Frau Hilbert to the restaurant, where it was no cooler but at least the ceiling fans created a fiction of fresh air. Hilbert introduced himself to a well-dressed man who was seated at a table with his family, a wife and four children. The mathematician tried three languages before he was understood. He explained the situation, and the gentleman and his wife both assured Hilbert that he need not worry. Hilbert ran out to find a taxi.

He was soon lost. There were no streets here, not in the European sense of the word. Narrow

spaces between buildings became alleys, opened into small squares, closed again; other narrow passages led off in twisting, bewildering directions. Hilbert found himself back at a souk; he thought at first it was where he'd begun and looked for the restaurant, but he was wrong. This was another souk entirely; there were probably hundreds in the city. He was beginning to panic. Even if he managed to find a taxi, how could he direct it back to where his wife and Clarchen waited?

A man's hand plucked at him. Hilbert tried to shrug the long fingers away. He looked into the face of a lean, hollow-cheeked man in a striped robe and a blue knitted cap. The Arab kept repeating a few words, but Hilbert could make no sense of them. The Arab took him by the arm and half-led, half-shoved Hilbert through the crowd. Hilbert let himself be guided. They crossed through two bazaars, one of tinsmiths and one of poultry dressers. They entered a stone-paved street and emerged into an immense square. On the far side of the square was a huge, many-towered mosque, built of pink stone. Hilbert's first impression was awe; it was as lovely an edifice as the Taj. Then his guide was pushing him again through the throng, or hurrying in front to hew a path for Hilbert. The square was jammed and choked with people. Soon Hilbert could see why: a platform had been erected in the center, and on it stood a man with what could only be an executioner's axe. Hilbert felt his stomach sicken. His Arab guide had thrust aside everyone in their way until Hilbert stood at the very foot of the platform. He saw uniformed police and a bearded old man leading out a young girl. The crowd parted to allow them by. The girl was stunningly lovely. Hilbert looked into her huge, dark eyes—"like the eyes of a gazelle," he remembered from reading Omar Khayyam—and glimpsed her slender form undisguised by her modest garments. As she mounted the steps, she looked down directly at him again. Hilbert felt his heart lurch; he felt a tremendous shudder. Then she looked away.

The Arab guide screamed in Hilbert's ear. It meant nothing to the mathematician. He watched in horror as Jehan knelt, as the headsman raised his weapon of office. When the fierce, bellowing cry went up from the crowd, Hilbert noticed that his suit was now spattered with small flecks of red. The Arab screamed at him again and tightened his grip on Hilbert's arm until Hilbert complained. The Arab did not release him. With his other hand, Hilbert took out his wallet. The Arab smiled. Above him, Hilbert watched several men carry away the body of the decapitated girl.

The Arab guide did not let him go until he'd paid an enormous sum.

Perhaps another hour had passed in the alley. Jehan had withdrawn to the darkest part and sat in a damp corner with her legs drawn up, her head against the rough brick wall. If she could sleep, she told herself, the night would pass more quickly; but she would not sleep, she would fight it if drowsiness threatened. What if she should slip into slumber and waken in the late morning, her peril and her opportunity both long since lost? Her only companion, the crescent moon, had abandoned her; she looked up at fragments of constellations, stars familiar enough in their groups but indistinguishable now as individuals. How different from people, where the opposite was true. She sighed; she was not a profound person, and it did not suit her to have profound thoughts. These must

not truly be profound thoughts, she decided; she was merely deluded by weariness. Slowly she let her head fall forward. She crossed her arms on her knees and cradled her head. The greater part of the night had already passed, and only silence came from the street. There were perhaps only three more hours until dawn....

Soon Schrödinger's wave mechanics was proved to be equivalent to Heisenberg's matrix mechanics. It was a validation of both men's work and of the whole field of quantum physics as well. Eventually Schrödinger's simplistic wave picture of the electron was abandoned, but his mathematical laws remained undisputed. Jehan remembered Schrödinger predicting that he might need to take just that step.

Jehan had at last returned to Gottingen and Heisenberg. He had "forgiven her petulance." He welcomed her gladly, because of his genuine feelings for her and because he had much work to do. He had just formally developed what came to be known as the Heisenberg uncertainty principle. This was the first indication that the impartial observer could not help but play an essential, active role in the universe of subatomic particles. Jehan grasped Heisenberg's concept readily. Other scientists thought Heisenberg was making a trivial criticism of the limitations of their experiments or the quality of their observations. It was more profound than that. Heisenberg was saying that one can never hope to know both the position and the momentum of an electron at the same time under *any* circumstances. He had destroyed forever the assumption of the impartial observer.

"To observe is to disturb," said Heisenberg. "Newton wouldn't have liked any of this at all."

"Einstein still doesn't like it right this very minute," said Jehan.

"I wish I had a mark for every time he's made that sour 'God doesn't play dice with the universe' comment."

"That's just the way he sees a 'wave of probability.' The path of the electron can't be known unless you look; but once you look, you change the information."

"So maybe God doesn't play dice with the universe," said Heisenberg. "He plays vingt-et-un, and if He does not have an extra ace up His sleeve, He creates one —first the sleeve, then the ace. And He turns over more natural twenty-ones than is statistically likely. Hold on, Jehan! I'm not being sacrilegious. I'm not saying that God cheats. Rather, He invented the rules of the game, and He *continues* to invent them; and this gives Him a rather large advantage over poor physicists and their lagging understanding. We are like country peasants watching the card tricks of someone who may be either genius or charlatan."

Jehan pondered the metaphor. "At the Solvay conference, Bohr introduced his complementarity idea, that an electron was a wave function until it was detected, and then the wave function collapsed to a point and you knew where the electron was. Then it was a particle. Einstein didn't like that, either."

"That's God's card trick," said Heisenberg, shrugging.

“Well, the noble Qur’ân says, ‘They question thee about strong drink and games of chance. Say: In both is great sin, and some usefulness for men; but the sin of them is greater than their usefulness.’”

“Forget dice and cards, then,” said Heisenberg with a little smile. “What kind of game *would* it be appropriate for Allah to play against us?”

“Physics,” said Jehan, and Heisenberg laughed.

“And knowest thou there is a prohibition against taking of human life that Allah hath made sacred?”

“Yes, O Wise One.”

“And knowest thou further that Allah hath set a penalty upon those who breaketh this law?”

“Yes, I know.”

“Then, O my daughter, tell us why thou hath brought low this poor boy.”

Jehan tossed the bloody knife to the stone-paved alley. It rang noisily and then came to rest against one leg of the corpse. “I was celebrating the Id-el-Fitr,” she said. “This boy followed me and I became afraid. He made filthy gestures and called out terrible things. I hurried away, but he ran after me. He grabbed me by the shoulders and pressed me against a wall. I tried to escape, but I could not. He laughed at my fear, then he struck me many times. He dragged me along through the narrowest of streets, where there were not many to witness; and then he pulled me into this vile place. He told me that he intended to defile me, and he described what he would do in foul detail. It was then that I drew my father’s dagger and stabbed him. I have spent the night in horror of his intentions and of my deed, and I have prayed to Allah for forgiveness.”

The imam put a trembling hand on Jehan’s cheek. “Allah is All-Wise and All-Forgiving, O my daughter. Alloweth me to return with thee to thy house, where I may put the hearts of thy father and thy mother at their ease.”

Jehan knelt at the imam’s feet. “All thanks be to Allah,” she murmured.

“Allah be praised,” said the imam, the police officer, and the qadi together.

More than a decade later, when Jehan had daughters of her own, she told them this story. But in those latter days children did not heed the warnings of their parents, and the sons and daughters of Jehan and her husband did many foolish things.

Dawn slipped even into the narrow alleyway where Jehan waited. She was very sleepy and hungry, but she stood up and took a few wobbling steps. Her muscles had become cramped, and she could hear her heart beating in her ears. Jehan steadied herself with one hand on the brick wall. She went slowly to the mouth of the alley and peered out. There was no one in sight. The boy was coming neither from the left nor the right. Jehan waited until several other people appeared, going about the business of the new day. Then she hid the dagger in her sleeve once more and departed from the alley. She hurried back to her father’s house. Her mother would need her to help make breakfast.

Jehan was in her early forties now, her black hair cut short, her eyes framed by clumsy spectacles, her beauty stolen by care, poor diet, and sleeplessness. She wore a white lab coat and carried a

clipboard, as much a part of her as her title, Fraulein Professor Doktor Ashufi. This was not Gottingen any longer; it was Berlin, and a war was being lost. She was still with Heisenberg. He had protected her until her own scientific credentials became protection of themselves. At that point, the Nazi officials were compelled to make her an “honorary” Aryan, as they had the Jewish physicists and mathematicians whose cooperation they needed. It had been only Jehan’s long-standing loyalty to Heisenberg himself that kept her in Germany at all. The war was of little concern to her; these were not her people, but neither were the British, the French, the Russians, or the Americans. Her only interest was in her work, in the refinement of physics, in the unending anticipation of discovery.

She was glad, therefore, when the German atomic bomb project was removed from the control of the German army and given to the Reich Research Council. One of the first things to be done was the calling of a research conference at the Kaiser Wilhelm Institute of Physics in Berlin. The conference would be conducted under the tightest security; no preliminary list of topics would be released in advance, so that no foreign agents might see such terms as “fission cross-sections” and “isotope enrichment,” leading to speculation on the long-term goals of these physicists.

At the same time, the Reich Research Council decided to hold a second conference for the benefit of the government’s highest officials on the same day. The idea was that the scientists speaking at the Kaiser Wilhelm Institute’s meeting could present short, elementary summaries of their work in plain language so that the political and military leaders could be briefed on the progress being made toward a nuclear weapon. Then, following the laymen’s presentation, the physicists could gather and discuss the same matters in their more technical jargon.

Heisenberg thought it was a good idea. It was 1942, and material, political support, and funding were getting more difficult to find. The army wanted to put all available research resources into the rocketry program; they argued that the nuclear experiments were not showing sufficient success. Heisenberg was a theoretical physicist, not an engineer; he could not find a way to tell the council that the development of the uranium bomb must necessarily be slow and methodical. Each new step forward in theory had to be tested carefully, and each experiment was expensive in both time and money. The Reich, however, cared only for positive results.

One evening Jehan was alone in an administrative office of the Reich Research Council, typing her proposal for an important test of their isotope-separation technique. She saw on the desk two stacks of papers. One stack listed the simple synopses the physicists had prepared for Goring, Himmler, and the other Reich ministers who had little or no background in science. The second stack was the secret agenda for the physicists’ own meeting: “Nuclear Physics as a Weapon,” by Professor Dr. Schumann; “The Fission of the Uranium Atom,” by Professor Dr. Hahn; “The Theoretical Basis for the Production of Energy from the Fission of Uranium,” by Heisenberg; and so on. Each person attending the technical seminar would be given a program after he entered the lecture hall, and he would be required to sign for it.

Jehan thought for a long while in the quiet office. She remembered her wretched childhood. She

recalled her arrival in Europe and the people she had come to know, the life she had come to lead here. She thought about how Germany had changed while she hid in her castle of scientific abstractions, uninvolved with the outside world. At last she thought about what this new Germany might do with the uranium bomb. She knew exactly what she must do.

It took her only a few moments to hide the laymen's synopses in her briefcase. She then took the highly technical agendas and dropped them into the already-addressed envelopes to be sent to the Third Reich's highest officials. She had guaranteed that the brief introductory discussion would be attended by no one. Jehan could easily imagine the response the unintelligible scientific papers would get from the political and military leaders—curt, polite regrets that they would not be in Berlin on that day, or that their busy schedules prevented them from attending.

It was all so easy. The Reich's rulers did not hear the talks, and they did not learn how close Germany was to developing an atomic bomb. Never again was there any hope that such a weapon could be built in time to save the Reich—all because the wrong invitations had been slipped into a few envelopes.

Jehan awoke from a dream, and saw that the night had grown very old. It would not be long before the sun began to flood the sky with light. Soon she would have a resolution to her anxiety. She would learn if the boy would come to the alley or stay away. She would learn if he would rape her or if she would find the courage to defend herself. She would learn if she would be judged guilty or innocent of murder. She would be granted a glimpse of the outcome to all things that concerned her.

Nevertheless, she was so tired, hungry, and uncomfortable that she was tempted to give up her vigil. The urge to go home was strong. Yet she had always believed that her visions were gifts granted by Allah, and it might offend Him to ignore the clear warnings. For Allah's sake, as well as her own, she reluctantly chose to wait out the rest of the dying night. She had seen so many visions since last evening—more than on any other day of her life—some new, some familiar from years passed. It was, in a small, human way, almost comparable to the Night of Power that was bestowed upon the Prophet, may Allah's blessing be on him and peace. Then Jehan felt guilty and blasphemous for comparing herself to the Messenger that way.

She got down on her knees and faced toward Makkah and addressed a prayer to Allah, reciting one of the later surahs from the glorious Qur'ân, the one called "The Morning Hours," which seemed particularly relevant to her situation. "' In the name of Allah, the Beneficent, the Merciful. By the morning hours, and by the night when it is stillest, thy Lord hath not forsaken thee nor doth He hate thee, and verily the latter portion will be better for thee than the former, and verily thy Lord will give unto thee so that thou wilt be content. Did He not find thee an orphan and protect thee? Did He not find thee wandering and direct thee? Did He not find thee destitute and enrich thee? Therefore the orphan oppresseth not, therefore the beggar driveth not away, therefore of the bounty of thy Lord be thy discourse.'"

When she finished praying, she stood up and leaned against the wall. She wondered if that surah prophesied that soon she'd be an orphan. She hoped that Allah understood that she never intended anything awful to happen to her parents. Jehan was willing to suffer whatever consequences Allah willed, but it didn't seem fair for her mother and father to have to share them with her. She shivered in the damp, cold air and gazed up to see if there was yet any brightening of the sky. She pretended that already the stars were beginning to disappear.

The square was jammed and choked with people. Soon Hilbert could see why: a platform had been erected in the center, and on it stood a man with what could only be an executioner's axe. Hilbert felt his stomach sicken. His Arab guide had thrust aside everyone in their way until Hilbert stood at the very foot of the platform. He saw uniformed police and a bearded old man leading out a young girl. The crowd parted to allow them by. The girl was stunningly lovely. Hilbert looked into her huge, dark eyes—"like the eyes of a gazelle," he remembered from reading Omar Khayyam—and glimpsed her slender form undisguised by her modest garments. As she mounted the steps, she looked down directly at him again. Hilbert felt his heart lurch; he felt a tremendous shudder. Then she looked away.

The Arab guide screamed in Hilbert's ear. It meant nothing to the mathematician. He watched in horror as Jehan knelt, as the headsman raised his weapon of office. Hilbert shouted. His guide tightened his grip on the outsider's arm, but Hilbert lashed out in fury and threw the man into a group of veiled women. In the confusion, Hilbert ran up the steps of the scaffold. The imam and the police officers looked at him angrily. The crowd began to shout fiercely at this interruption, this desecration by a European kafir, an unbeliever. Hilbert ran to the police. "You must stop this!" he cried in German. They did not understand him and tried to heave him off the platform. "Stop!" he screamed in English.

One of the police officers answered him. "It cannot be stopped," he said gruffly. "The girl committed murder. She was found guilty, and she cannot pay the blood price to the victim's family. She must die instead."

"Blood price!" cried Hilbert. "That's barbarous! You would kill a young girl just because she is poor? Blood price! *I'll* pay your goddamn blood price! How much is it?"

The policeman conferred with the others, and then went to the imam for guidance. Finally, the English-speaking officer returned. "Four hundred kiam," he said bluntly.

Hilbert took out his wallet with shaking hands. He counted out the money and handed it with obvious disgust to the policeman. The imam cried a declaration in his weak voice. The words were passed quickly through the crowd, and the onlookers grew more enraged at this spoiling of their morning's entertainment. "Take her and go quickly," said the police officer. "We cannot protect you, and the crowd is becoming furious."

Hilbert nodded. He grasped Jehan's thin wrist and pulled her along after him. She questioned him in Arabic, but he could not reply. As he struggled through the menacing crowd, they were struck again

and again by stones. Hilbert wondered what he had done, if he and the girl would get out of the mosque's courtyard alive. His fondness for young women—it was an open joke in Gottingen — had that been all that had motivated him? Had he unconsciously decided to rescue the girl and take her back to Germany? Or was it something more laudable? He would never know. He shocked himself: While he tried to shield himself and the girl from the vicious blows of the crowd, he thought only of how he might explain the girl to his wife, Käthe, and Clarchen, his mistress.

In 1957, Jehan Fatima Ashufi was fifty-eight years old and living in Princeton, New Jersey. By coincidence, Albert Einstein had come here to live out the end of his life, and before he died in 1955 they had many pleasant afternoons at his house. In the beginning, Jehan wanted to discuss quantum physics with Einstein; she even told him Heisenberg's answer to Einstein's objection to God's playing dice with the universe. Einstein was not very amused, and from then on, their conversation concerned only nostalgic memories of the better days in Germany, before the advent of the National Socialists.

This afternoon, however, Jehan was sitting in a Princeton lecture hall, listening to a young man read a remarkable paper, his Ph.D. thesis. His name was Hugh Everett, and he was saying that there was an explanation for all the paradoxes of the quantum world, a simple but bizarre way of looking at them. His new idea included the Copenhagen interpretation and explained away all the objections that might be raised by less open-minded physicists. He stated first of all that quantum mechanics provided predictions that were invariably correct when measured against experimental data. Quantum physics *had* to be consistent and valid, there was no longer any doubt. The trouble was that quantum theory was beginning to lead to unappetizing alternatives.

Everett's thesis reconciled them. It eliminated Schrödinger's cat paradox, in which the cat in the box was merely a quantum wave function, not alive and not dead, until an observer looked to see which state the cat was in. Everett showed that the cat was no mere ghostly wave function. Everett said that wave functions do not "collapse," choosing one alternative or the other. He said that the process of observation chose one reality, but the other reality existed in its own right, just as "real" as our world. Particles do not choose at random which path to take—they take every path, in a separate, newly branched world for each option. Of course, at the particle level, this meant a huge number of branchings occurring at every moment.

Jehan knew this almost-metaphysical idea would find a chilly reception from most physicists, but she had special reasons to accept it eagerly. It explained her visions. She glimpsed the particular branch that would be "real" for her and also those that would be "real" for other versions of her, her own duplicates living on the countless parallel worlds. Now, as she listened to Everett, she smiled. She saw another young man in the audience, wearing a T-shirt that said, WIGNER: WOULD YOU PLEASE ASK YOUR FRIEND TO FEED MY CAT? THANKS, SCHRÖDINGER. She found that very amusing.

When Everett finished reading, Jehan felt good. It wasn't peace she felt, it was more like the release one feels after an argument that had been brewing for a long while. Jehan thought back over the turns and sidetracks she had taken since that dawn in the alley in the Budayeen. She smiled again, sadly, took a deep breath, and let it out. How many things she had done, how many things had happened to her! They had been long, strange lives. The only question that still remained was: How many uncountable futures did she still have to devise, to fabricate from the immaterial resources of this moment? As she sat there — in some worlds—Jehan knew the futures went on without her willing them to, needing nothing of her permission. She was not cautious of when tomorrow came, but *which* tomorrow came.

Jehan saw them all, but she still understood nothing. She thought, *The Chinese say that a journey of a thousand li begins with a single step. How shortsighted that is! A thousand journeys of a thousand li begin with a single step. Or with each step not taken.* She sat in her chair until everyone else had left the lecture hall. Then she got up slowly, her back and her knees giving her pain, and she took a step. She pictured myriad mirror-Jehans taking that step along with her, and a myriad that didn't. And in all the worlds across time, it was another step into the future.

At last, there was no doubt about it: It was dawn. Jehan fingered her father's dagger and felt a thrill of excitement. Strange words flickered in her mind. "The Heisenty uncertainberg principle," she murmured, already hurrying toward the mouth of the alley. She felt no fear.