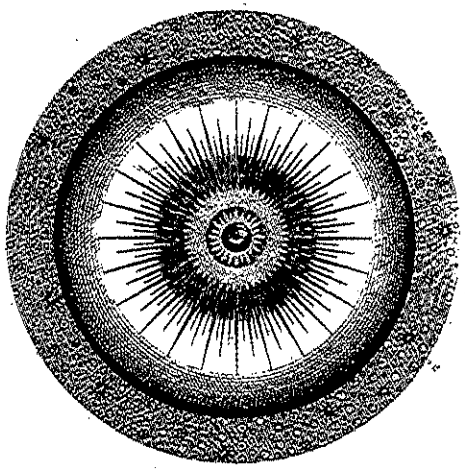
CARL SAGAN

CONTACT

A NOVEL



SIMON AND SCHUSTER
New York

The only outside calls she was permitted were to the rest home in Janesville, Wisconsin. All incoming calls except from Janesville were screened out. Polite apologies were provided. Letters from der Heer, Valerian, from her old college friend Becky Ellenbogen, she filed unopened. There were a number of messages delivered by express mail services, and then by courier, from South Carolina, from Palmer Joss. She was much more tempted to read these, but did not. She wrote him a note that read only, "Dear Palmer, Not yet. Ellie," and posted it with no return address. She had no way to know if it would be delivered.

A television special on her life, made without her consent, described her as more reclusive now than Neil Armstrong, or even Greta Garbo. Ellie took it all with cheerful equanimity. She was otherwise occupied. Indeed, she was working night and day.

The prohibitions on communication with the outside world did not extend to purely scientific collaboration, and through open-channel asynchronous telenetting she and Vaygay organized a long-term research program. Among the objects to be examined were the vicinity of Sagittarius A at the center of the Galaxy, and the great extragalactic radio source, Cygnus A. The Argus telescopes were employed as part of a phased array, linked with the Soviet telescopes in Samarkand. Together, the American-Soviet array acted as if they were part of a single radio telescope the size of the Earth. Operating at a wavelength of a few centimeters, they could resolve sources of radio emission as small as the inner solar system if they were as far away as the center of the Galaxy.

She worried that this was not good enough, that the two orbiting black holes were considerably smaller than that. Still, a continuous monitoring program might turn up something. What they really needed, she thought, was a radio telescope launched by space vehicle to the other side of the Sun, and working in tandem with radio telescopes on Earth. Humans could thereby create a telescope effectively the size of the Earth's orbit. With it, she calculated, they could resolve something the size of the Earth at the center of the Galaxy. Or maybe the size of the Station.

She spent most of her time writing, modifying existing programs for the Cray 21, and setting down an account—as detailed as she possibly could make it—of the salient events that had been squeezed into the twenty minutes of Earthtime after they activated the Machine. Halfway through, she realized she was writing samizdat. Typewriter and carbon paper technology. She locked the original and two copies in her safe—beside a yellowing copy of the Hadden Decision—secreted the third copy behind a loose plank in the electronics bay of Telescope 49, and burned the carbon paper. It generated a black acrid smoke. In six weeks she had finished reprogramming and just as her thoughts returned to Palmer Joss, he presented himself at the Argus front gate.

His way had been cleared by a few phone calls from a special assistant to the President, with whom, of course, Joss had been acquainted for years. Even here in the Southwest with its casual sartorial codes, he wore, as always, a jacket, a white shirt, and a tie. She gave him the palm frond, thanked him for the pendant, and despite all of Kitz's admonitions to keep her delusional experience quiet, immediately told him everything.

They adopted the practice of her Soviet colleagues, who whenever anything politically unorthodox needed to be said, discovered the urgent necessity for a brisk walk. Every now and then he would stop and, a distant observer would see, lean toward her. Each time she would take his arm and they would walk on.

He listened sympathetically, intelligently, indeed generously—especially for someone whose doctrines must, she thought, be challenged at their fundaments by her account . . . if he gave them any credence at all. After all his reluctance at the time the Message had first been received, at last she was showing Argus to him. He was companionable, and she found herself happy to see him. She wished she had been less preoccupied when she had seen him last, in Washington.

Apparently at random, they climbed up the narrow metal exterior stairways that straddled the base of Telescope 49. The vista of 130 radio telescopes—most of them rolling stock on their own set of railway tracks—was like nothing else on Earth. In the electronics bay she slid back the plank and retrieved a bulky envelope

with Joss's name upon it. He put it in his inside breast pocket, where it made a discernible bulge.

She told him about the Sag A and Cyg A observing protocols. She told him about her computer program.

"It's very time-consuming, even with the Cray, to calculate pi out to something like ten to the twentieth place. And we don't know that what we're looking for is *in* pi. They sort of said it wasn't. It might be *e*. It might be one of the family of transcendental numbers they told Vaygay about. It might be some altogether different number. So a simpleminded brute-force approach—just calculating fashionable transcendental numbers forever—is a waste of time. But here at Argus we have very sophisticated decryption algorithms, designed to find patterns in a signal, designed to pull out and display anything that looks nonrandom. So I rewrote the programs . . ."

From the expression on his face, she was afraid she had not been clear. She made a small swerve in the monologue.

". . . but not to calculate the digits in a number like pi, print them out, and present them for inspection. There isn't enough time for that. Instead, the program races through the digits in pi and pauses even to think about it only when there's some anomalous sequence of zeros and ones. You know what I'm saying? Something nonrandom. By chance, there'll be some zeros and ones, of course. Ten percent of the digits will be zeros, and another ten percent will be ones. On average. The more digits we race through, the longer the sequences of pure zeros and ones that we should get by accident. The program knows what's expected statistically and only pays attention to unexpectedly long sequences of zeros and ones. And it doesn't only look in base ten."

"I don't understand. If you look at enough random numbers, won't you get any pattern you want simply by chance?"

"Sure. But you can calculate how likely that is. If you get a very complex message very early on, you know it can't be by chance. So, every day in the early hours of the morning the computer works on this problem. No data from the outside world goes in. And so far no data from the inside world comes out. It just runs through the optimum series expansion for pi and watches the

digits fly. It minds its own business. Unless it finds something, it doesn't speak unless it's spoken to. It's sort of contemplating its navel."

"I'm no mathematician, God knows. But could you give me a f'r instance?"

"Sure." She searched in the pockets of her jump suit for a piece of paper and could find none. She thought about reaching into his inside breast pocket, retrieving the envelope she had just given him and writing on it, but decided that was too risky out here in the open. After a moment, he understood and produced a small spiral notebook.

"Thanks. Pi starts out 3.1415926 . . . You can see that the digits vary pretty randomly. Okay, a one appears twice in the first four digits, but after you keep on going for a while it averages out. Each digit—0, 1, 2, 3, 4, 5, 6, 7, 8, 9—appears almost exactly ten percent of the time when you've accumulated enough digits. Occasionally you'll get a few consecutive digits that are the same—4444, for example—but not more than you'd expect statistically. Now, suppose you're running merrily through these digits and suddenly you find nothing but fours. Hundreds of fours all in a row. That couldn't carry any information, but it also couldn't be a statistical fluke. You could calculate the digits in pi for the age of the universe and, if the digits are random, you'd never go deep enough to get a hundred consecutive fours."

"It's like the search you did for the Message. With these radio telescopes."

"Yes; in both cases we were looking for a signal that's well out of the noise, something that can't be just a statistical fluke."

"But it doesn't have to be a hundred fours—is that right? It could *speak* to us?"

"Sure. Imagine after a while we get a long sequence of just zeros and ones. Then, just as we did with the Message, we could pull a picture out, if there's one in there. You understand, it could be *anything.*"

"You mean you could decode a picture hiding in pi and it would be a mess of Hebrew letters?"

"Sure. Big black letters, carved in stone."

He looked at her quizzically.

"Forgive me, Eleanor, but don't you think you're being a mite too . . . indirect? You don't belong to a silent order of Buddhist nuns. Why don't you just tell your story?"

"Palmer, if I had hard evidence, I'd speak up. But if I don't have any, people like Kitz will say that I'm lying. Or hallucinating. That's why that manuscript's in your inside pocket. You're going to seal it, date it, notarize it, and put it in a safety-deposit box. If anything happens to me, you can release it to the world. I give you full authority to do anything you want with it."

"And if nothing happens to you?"

"If nothing happens to me? Then, when we find what we're looking for, that manuscript will confirm our story. If we find evidence of a double black hole at the Galactic Center, or some huge artificial construction in Cygnus A, or a message hiding inside pi, this"—she tapped him lightly on the chest—"will be my evidence. Then I'll speak out. . . . Meantime, don't lose it."

"I still don't understand," he confessed. "We know there's a mathematical order to the universe. The law of gravity and all that. How is this different? So there's order inside the digits of pi. So what?"

"No, don't you see? This *would* be different. This isn't just starting the universe out with some precise mathematical laws that determine physics and chemistry. This is a *message*. Whoever makes the universe hides messages in transcendental numbers so they'll be read fifteen billion years later when intelligent life finally evolves. I criticized you and Rankin the time we first met for not understanding this. 'If God wanted us to know that he existed, why didn't he send us an unambiguous message?' I asked. Remember?"

"I remember very well. You think God is a mathematician."

"Something like that. If what we're told is true. If this isn't a wild-goose chase. If there's a message hiding in pi and not one of the infinity of other transcendental numbers. That's a lot of ifs."

"You're looking for Revelation in arithmetic. I know a better way."

"Palmer, this is the *only* way. This is the only thing that would convince a skeptic. Imagine we find something. It doesn't have to be tremendously complicated. Just something more orderly than could accumulate by chance that many digits into pi. That's all we need. Then mathematicians all over the world can find exactly the same pattern or message or whatever it proves to be. Then there are no sectarian divisions. Everybody begins reading the same Scripture. No one could then argue that the key miracle in the religion was some conjurer's trick, or that later historians had falsified the record, or that it's just hysteria or delusion or a substitute parent for when we grow up. *Everyone* could be a believer."

"You can't be sure you'll find *any*thing. You can hide here and compute till the cows come home. Or you can go out and tell your story to the world. Sooner or later you'll have to choose."

"I'm hoping I won't have to choose, Palmer. First the physical evidence, then the public announcements. Otherwise . . . Don't you see how vulnerable we'd be? I don't mean for myself, but . . ."

He shook his head almost imperceptibly. A smile was playing at the corners of his lips. He had detected a certain irony in their circumstances.

"Why are you so eager for me to tell my story?" she asked.

Perhaps he took it for a rhetorical question. At any rate he did not respond, and she continued.

"Don't you think there's been a strange . . . reversal of our positions? Here I am, the bearer of the profound religious experience I can't prove—really, Palmer, I can barely fathom it. And here you are, the hardened skeptic trying—more successfully than I ever did—to be kind to the credulous."

"Oh no, Eleanor," he said, "I'm not a skeptic. I'm a believer."

"Are you? The story I have to tell isn't exactly about Punishment and Reward. It's not exactly Advent and Rapture. There's not a word in it about Jesus. Part of my message is that we're not central to the purpose of the Cosmos. What happened to me makes us all seem very small."

"It does. But it also makes God very big."

She glanced at him for a moment and rushed on.

"You know, as the Earth races around the Sun, the powers of this world—the religious powers, the secular powers—once pretended the Earth wasn't moving at all. They were in the business of being powerful. Or at least pretending to be powerful. And the truth made them feel too small. The truth frightened them; it undermined their power. So they suppressed it. Those people found the truth dangerous. You're sure you know what believing me entails?"

"I've been searching, Eleanor. After all these years, believe me, I know the truth when I see it. Any faith that admires truth, that strives to know God, must be brave enough to accommodate the universe. I mean the *real* universe. All those light-years. All those worlds. I think of the scope of your universe, the opportunities it affords the Creator, and it takes my breath away. It's much better than bottling Him up in one small world. I never liked the idea of Earth as God's green footstool. It was too reassuring, like a children's story . . . like a tranquilizer. But your universe has *room* enough, and time enough, for the kind of God I believe in.

"I say you don't need any more proof. There are proofs enough already. Cygnus A and all that are just for the scientists. You think it'll be hard to convince ordinary people that you're telling the truth. I think it'll be easy as pie. You think your story is too peculiar, too alien. But I've heard it before. I know it well. And I bet you do too."

He closed his eyes and, after a moment, recited:

> He dreamed, and behold a ladder set up on the earth, and the top of it reached to heaven: and behold the angels of God ascending and descending on it. . . . Surely the Lord is in this place; and I knew it not. . . . This is none other but the House of God, and this is the gate of heaven.

He had been a little carried away, as if preaching to the multitudes from the pulpit of a great cathedral, and when he opened his eyes it was with a small self-deprecatory smile. They walked down a vast avenue, flanked left and right by enormous white-

washed radio telescopes straining at the sky, and after a moment he spoke in a more conversational tone:

"Your story has been foretold. It's happened before. Somewhere inside of you, you must have known. None of your details are in the Book of Genesis. Of course not. How could they be? The Genesis account was right for the time of Jacob. Just as your witness is right for this time, for our time.

"People are going to believe you, Eleanor. Millions of them. All over the world. I know it for certain. . . ."

She shook her head, and they walked on for another moment in silence before he continued.

"All right, then. I understand. You take as much time as you have to. But if there's any way to hurry it up, do it—for my sake. We have less than a year to the Millennium."

"I understand also. Bear with me a few more months. If we haven't found something in pi by then, I'll consider going public with what happened up there. Before January 1. Maybe Eda and the others would be willing to speak out also. Okay?"

They walked in silence back toward the Argus administration building. The sprinklers were watering the meager lawn, and they stepped around a puddle that, on this parched earth, seemed alien, out of place.

"Have you ever been married?" he asked.

"No, I never have. I guess I've been too busy."

"Ever been in love?" The question was direct, matter-of-fact.

"Halfway, half a dozen times. But"—she glanced at the nearest telescope—"there was always so much noise, the signal was hard to find. And you?"

"Never," he replied flatly. There was a pause, and then he added with a faint smile, "But I have faith."

She decided not to pursue this ambiguity just yet, and they mounted the short flight of stairs to examine the Argus mainframe computer.

CHAPTER 24

The Artist's Signature

Behold, I tell you a mystery; we shall not all sleep, but we shall all be changed.

—I CORINTHIANS 15:51

The universe seems . . . to have been determined and ordered in accordance with number, by the forethought and the mind of the creator of all things; for the pattern was fixed, like a preliminary sketch, by the domination of number preexistent in the mind of the world-creating God.

—NICOMACHUS OF GERASA
Arithmetic I, 6 (ca. A.D. 100)

SHE RUSHED up the steps of the nursing home and, on the newly repainted green veranda, marked off at regular intervals by empty rocking chairs, she saw John Staughton—stooped, immobile, his arms dead weights. In his right hand he clutched a shopping bag in which Ellie could see a translucent shower cap, a flowered makeup case, and two bedroom slippers adorned with pink pompoms.

"She's gone," he said as his eyes focused. "Don't go in," he pleaded. "Don't look at her. She would've hated for you to see her like this. You know how much pride she took in her appearance. Anyway, she's not *in* there."

Almost reflexively, out of long practice and still unresolved resentments, Ellie was tempted to turn and enter anyway. Was she prepared, even now, to defy him as a matter of principle? What was the principle, exactly? From the havoc on his face, there was no question about the authenticity of his remorse. He had loved her mother. Maybe, she thought, he loved her more than I did, and a wave of self-reproach swept through her. Her mother had been so frail for so long that Ellie had tested, many times, how she would respond when the moment came. She remembered how beautiful her mother had been in the picture that Staughton had sent her, and suddenly, despite her rehearsals for this moment, she was wracked with sobs.

Startled by her distress, Staughton moved to comfort her. But she put up a hand, and with a visible effort regained her self-control. Even now, she could not bring herself to embrace him. They were strangers, tenuously linked by a corpse. But she had been wrong—she knew it in the depths of her being—to have blamed Staughton for her father's death.

"I have something for you," he said as he fumbled in the shopping bag. Some of the contents circulated between top and bottom, and she could see now an imitation-leather wallet and a plastic denture case. She had to look away. At last he straightened up, flourishing a weather-beaten envelope.

"For Eleanor," it read. Recognizing her mother's handwriting,

she moved to take it. Staughton took a startled step backward, raising the envelope in front of his face as if she had been about to strike him.

"Wait," he said. "Wait. I know we've never gotten along. But do me this one favor: Don't read the letter until tonight. Okay?"

In his grief, he seemed a decade older.

"Why?" she asked.

"Your favorite question. Just do me this one courtesy. Is it too much to ask?"

"You're right," she said. "It's not too much to ask. I'm sorry."

He looked her directly in the eye.

"Whatever happened to you in that Machine," he said, "maybe it changed you."

"I hope so, John."

• • •

She called Joss and asked him if he would perform the funeral service. "I don't have to tell you I'm not religious. But there were times when my mother was. You're the only person I can think of whom I'd want to do it, and I'm pretty sure my stepfather will approve." He would be there on the next plane, Joss assured her.

In her hotel room, after an early dinner, she fingered the envelope, caressing every fold and scuff. It was old. Her mother must have written it years ago, carrying it around in some compartment of her purse, debating with herself whether to give it to Ellie. It did not seem newly resealed, and Ellie wondered whether Staughton had read it. Part of her hungered to open it, and part of her hung back with a kind of foreboding. She sat for a long time in the musty armchair thinking, her knees drawn up limberly against her chin.

A chime sounded, and the not quite noiseless carriage of her telefax came to life. It was linked to the Argus computer. Although it reminded her of the old days, there was no real urgency. Whatever the computer had found was not about to go away; π would not set as the Earth turned. If there was a message hiding inside π, it would wait for her forever.

She examined the envelope again, but the echo of the chime

intruded. If there was content inside a transcendental number, it could only have been built into the geometry of the universe from the beginning. This new project of hers was in experimental theology. But so is all of science, she thought.

"STAND BY," the computer printed out on the telefax screen.

She thought of her father . . . well, the simulacrum of her father . . . about the Caretakers with their network of tunnels through the Galaxy. They had witnessed and perhaps influenced the origin and development of life on millions of worlds. They were building galaxies, closing off sectors of the universe. They could manage at least a limited kind of time travel. They were gods beyond the pious imaginings of almost all religions—all Western religions, anyway. But even they had their limitations. They had not built the tunnels and were unable to do so. They had not inserted the message into the transcendental number, and could not even read it. The Tunnel builders and the π inscribers were somebody else. They didn't live here anymore. They had left no forwarding address. When the Tunnel builders had departed, she guessed, those who would eventually be the Caretakers had become abandoned children. Like her, like her.

She thought about Eda's hypothesis that the tunnels were wormholes, distributed at convenient intervals around innumerable stars in this and other galaxies. They resembled black holes, but they had different properties and different origins. They were not exactly massless, because she had seen them leave gravitational wakes in the orbiting debris in the Vega system. And through them beings and ships of many kinds traversed and bound up the Galaxy.

Wormholes. In the revealing jargon of theoretical physics, the universe was their apple and someone had tunneled through, riddling the interior with passageways that crisscrossed the core. For a bacillus who lived on the surface, it was a miracle. But a being standing outside the apple might be less impressed. From that perspective, the Tunnel builders were only an annoyance. But if the Tunnel builders are worms, she thought, who are we?

The Argus computer had gone deep into π, deeper than anyone

on Earth, human or machine, had ever gone, although not nearly so deep as the Caretakers had ventured. This was much too soon, she thought, to be the long-undecrypted message about which Theodore Arroway had told her on the shores of that uncharted sea. Maybe this was just a gearing up, a preview of coming attractions, an encouragement to further exploration, a token so humans would not lose heart. Whatever it was, it could not possibly be the message the Caretakers were struggling with. Maybe there were easy messages and hard messages, locked away in the various transcendental numbers, and the Argus computer had found the easiest. With help.

At the Station, she had learned a kind of humility, a reminder of how little the inhabitants of Earth really knew. There might, she thought, be as many categories of beings more advanced than humans as there are between us and the ants, or maybe even between us and the viruses. But it had not depressed her. Rather than a daunting resignation, it had aroused in her a swelling sense of wonder. There was so much more to aspire to now.

It was like the step from high school to college, from everything coming effortlessly to the necessity of making a sustained and disciplined effort to understand at all. In high school, she had grasped her coursework more quickly than almost anybody. In college, she had discovered many people much quicker than she. There had been the same sense of incremental difficulty and challenge when she entered graduate school, and when she became a professional astronomer. At every stage, she had found scientists more accomplished than she, and each stage had been more exciting than the last. Let the revelations roll, she thought, looking at the telefax. She was ready.

"TRANSMISSION PROBLEM. S/N<10. PLEASE STAND BY."

She was linked to the Argus computer by a communications relay satellite called *Defcom Alpha*. Perhaps there had been an attitude-control problem, or a programming foul-up. Before she could think about it further, she found she had opened the envelope.

ARROWAY HARDWARE, the letterhead said, and sure enough, the type font was that of the old Royal her father had kept at home to do both business and personal accounts. "June 13, 1964" was typed in the upper right-hand corner. She had been fifteen then. Her father could not have written it; he had been dead for years. A glance at the bottom of the page confirmed the neat hand of her mother.

My sweet Ellie,

Now that I'm dead, I hope you can find it in your heart to forgive me. I know I committed a sin against you, and not just you. I couldn't bear how you'd hate me if you knew the truth. That's why I didn't have the courage to tell you while I was alive. I know how much you loved Ted Arroway, and I want you to know I did, too. I still do. But he wasn't your real father. Your real father is John Staughton. I did something very wrong. I shouldn't have and I was weak, but if I hadn't you wouldn't be in the world, so please be kind when you think about me. Ted knew and he gave me forgiveness and we said we'd never tell you. But I look out the window right now and I see you in the backyard. You're sitting there thinking about stars and things that I never could understand and I'm so proud of you. You make such a point about the truth, I thought it was right that you should know this truth about yourself. Your beginning, I mean.

If John is still alive, then he's given you this letter. I know he'll do it. He's a better man than you think he is, Ellie. I was lucky to find him again. Maybe you hate him so much because something inside of you figured out the truth. But really you hate him because he isn't Theodore Arroway. I know.

There you are, still sitting out there. You haven't moved since I started this letter. You're just thinking. I hope and pray that whatever you're seeking, you'll find. Forgive me. I was only human.

Love,
Mom

Ellie had assimilated the letter in a single gulp, and immediately read it again. She had difficulty breathing. Her hands were clammy. The impostor had turned out to be the real thing. For

most of her life, she had rejected her own father, without the vaguest notion of what she was doing. What strength of character he had shown during all those adolescent outbursts when she taunted him for not being her father, for having no right to tell her what to do.

The telefax chimed again, twice. It was now inviting her to press the RETURN key. But she did not have the will to go to it. It would have to wait. She thought of her Fa . . . of Theodore Arroway, and John Staughton, and her mother. They had sacrificed much for her, and she had been too self-involved even to notice. She wished Palmer were with her.

The telefax chimed once more, and the carriage moved tentatively, experimentally. She had programmed the computer to be persistent, even a little innovative, in attracting her attention if it thought it had found something in π. But she was much too busy undoing and reconstructing the mythology of her life. Her mother would have been sitting at the desk in the big bedroom upstairs, glancing out the window as she wondered how to phrase the letter, and her eye had rested on Ellie at age fifteen, awkward, resentful, rebellious.

Her mother had given her another gift. With this letter, Ellie had cycled back and come upon herself all those years ago. She had learned so much since then. There was so much more to learn.

Above the table on which the chattering telefax sat was a mirror. In it she saw a woman neither young nor old, neither mother nor daughter. They had been right to keep the truth from her. She was not sufficiently advanced to receive that signal, much less decrypt it. She had spent her career attempting to make contact with the most remote and alien of strangers, while in her own life she had made contact with hardly anyone at all. She had been fierce in debunking the creation myths of others, and oblivious to the lie at the core of her own. She had studied the universe all her life, but had overlooked its clearest message: For small creatures such as we the vastness is bearable only through love.

• • •

The Argus computer was so persistent and inventive in its attempts to contact Eleanor Arroway that it almost conveyed an urgent personal need to share the discovery.

The anomaly showed up most starkly in Base 11 arithmetic, where it could be written out entirely as zeros and ones. Compared with what had been received from Vega, this could be at best a simple message, but its statistical significance was high. The program reassembled the digits into a square raster, an equal number across and down. The first line was an uninterrupted file of zeros, left to right. The second line showed a single numeral one, exactly in the middle, with zeros to the borders, left and right. After a few more lines, an unmistakable arc had formed, composed of ones. The simple geometrical figure had been quickly constructed, line by line, self-reflexive, rich with promise. The last line of the figure emerged, all zeros except for a single centered one. The subsequent line would be zeros only, part of the frame.

Hiding in the alternating patterns of digits, deep inside the transcendental number, was a perfect circle, its form traced out by unities in a field of noughts.

The universe was made on purpose, the circle said. In whatever galaxy you happen to find yourself, you take the circumference of a circle, divide it by its diameter, measure closely enough, and uncover a miracle—another circle, drawn kilometers downstream of the decimal point. There would be richer messages farther in. It doesn't matter what you look like, or what you're made of, or where you come from. As long as you live in this universe, and have a modest talent for mathematics, sooner or later you'll find it. It's already here. It's inside everything. You don't have to leave your planet to find it. In the fabric of space and in the nature of matter, as in a great work of art, there is, written small, the artist's signature. Standing over humans, gods, and demons, subsuming Caretakers and Tunnel builders, there is an intelligence that antedates the universe.

The circle had closed.

She found what she had been searching for.

AUTHOR'S NOTE

Although of course I have been influenced by those I know, none of the characters herein is a close portrait of a real person. Nevertheless, this book owes much to the world SETI community—a small band of scientists from all over our small planet, working together, sometimes in the face of daunting obstacles, to listen for a signal from the skies. I would like to acknowledge a special debt of gratitude to the SETI pioneers Frank Drake, Philip Morrison, and the late I. S. Shklovskii. The search for extraterrestrial intelligence is now entering a new phase, with two major programs under way—the 8-million-channel META/Sentinel survey at Harvard University, sponsored by the Pasadena-based Planetary Society, and a still more elaborate program under the auspices of the National Aeronautics and Space Administration. My fondest hope for this book is that it will be made obsolete by the pace of real scientific discovery.

Several friends and colleagues have been kind enough to read an earlier draft and/or make detailed comments that have influenced the book's present form. I am deeply grateful to them, including Frank Drake, Pearl Druyan, Lester Grinspoon, Irving Gruber, Jon Lomberg, Philip Morrison, Nancy Palmer, Will Provine, Stuart Shapiro, Steven Soter, and Kip Thorne. Professor Thorne took the trouble to consider the galactic transportation system described herein, generating fifty lines of equations in the relevant gravitational physics. Helpful advice on content or style came from Scott Meredith, Michael Korda, John Herman, Gregory Weber, Clifton Fadiman, and the late Theodore Sturgeon.