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HIEROGLYPH

Stories and Visions for a Better Future

EDITED BY ED FINN AND KATHRYN CRAMER

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GIRL IN WAVE : WAVE IN GIRL

Kathleen Ann Goonan

When humanity is primarily illiterate, it needs leaders to understand and get the information and deal with it. When we are at the point where the majority of humans them-selves are literate, able to get the information, we're in an entirely new relationship to Universe. We are at the point where the integrity of the individual counts and not what the political leadership or the religious leadership says to do.

—Buckminster Fuller, *Only Integrity Is Going to Count*

MY MANY-GREAT-GRANDMOTHER MELODY IS beautiful. Her eyes are huge, dark, and laughing in her smooth, light brown face, and she is muscular, even a bit wiry, but most fivers (five quarters, 125 years old) are.

She sits cross-legged next to me on the Jump Rock, a coral arc rising like the back of a dolphin in Waimea Bay. Her wings, nearly invisible, overlap smoothly across her back.

Mammoth winter waves rise from the sea and break in perfect translucent curls. No one is jumping off Jump Rock today; those waves crash against and spray up the sides of the rock and swirl around the bottom. The tow skis are busy pulling surfers out to where the curl begins, and thirty or so surfers sit on their boards bobbing up and down. Acres of white foam, with an undertow deep and powerful enough to drag strong men to their death, suck at the beach.

"It was like that, Alia," says Melody. "The change. Like a wave, and we are still on it. We—the entire human world—could have been smashed, like that foam, from a lot of convergent factors."

"Yeah, that's what everybody says. The dark ages." Melody mentions the change a lot, but not much about how it happened. Maybe getting her to talk about it will soften her up. This is one way to go about it, but maybe there is no good way. I've never been able to manipulate her. She has an unfair advantage, being older, smarter, and a Mentor. I'm just hoping she'll understand me, understand why I want to see her, and help me.

I want gills. They're not like fish gills, but that's what everyone calls them.

"You make it sound like a war."

"It was a war. It was even called a war. Back then that kind of language seemed the only way to mobilize people. In the early twenty-first century, we were feeling like a pretty successful species, but we were sowing the seeds of our own destruction. Mass starvation, the breakdown of civilization, the loss of information was a hairsbreadth away, for those who spoke the language of chaos theory and statistics. The history of humanity was the history of war. Most people viewed the idea of world peace with tremendous suspicion. They believed it could only exist in a world where extreme submission was the byword, or if some essential bit of humanity was crushed to dust. Rarely was it seen to be a state of balance in which the highest capability of humans—to be freely creative—would be possible for a huge percentage of people, and if they saw it that way, they saw it as a danger. War defined humanity. We used wealth to amass munitions and armies. It seemed necessary, because nature really is, as Darwin said, 'red in tooth and claw.' War was our peculiar sickness. It always seemed inevitable, something we had to return to despite our horror and reluctance."

"It's hard to believe."

"There's been a fundamental change in how we communicate, and how we see ourselves. Back then, everyone could easily relate to the idea of being

at war. 'The War on Poverty.' 'The War on Cancer.' 'The War on Illiteracy.'"

"What's cancer?"

"Right. What's polio, what's tuberculosis, what's smallpox. If you want to be a physician—"

"I want to be a world-champion surfer."

"You can be both. If you want to be a physician—that was one career you modeled, remember?—you need to study the history of disease, and in the early twenty-first century illiteracy was classified as a public health problem. That freed us to bring a lot of different resources to bear on solving the problem."

Now, she'd roped me in and I had to go along. "What caused it?"

"Lots of things . . . but maybe we were just going through adolescence, as a species. Maybe our stubborn adherence to warehousing children in schools or, in poorer countries, sending them to work, or outright selling them, might not have crashed civilization, but willful ignorance about how humans learn, based on scientific evidence, wasted billions of lives and their potential. World economies were in a tailspin. People were mostly very rich or very poor; very healthy or slated to die young. It just wasn't working. There was an illusion, among the well-to-do, that it was working, but it wasn't."

She caresses the gill pattern I have tattooed, like an ancient Polynesian hieroglyph, on my right cheek, a scream for independence, for control over my own body.

"Your mother says eighteen."

"Why do I have to wait? You need to help me—Mom will listen to you. Look, out there—JJ has gills—see, she's the purple one—wow! Pounded!" I scan the vast undertow and see her pop up, so tiny in that big sea of white foam, about a hundred yards away. "See how much fun it is?"

"I see."

"I'm fourteen, and she's only thirteen. I'm already way behind. Look, what happened to you—you were twelve, thirteen, right? When you got changed? It was radical, eh? Scary as gills. And look at you!"

"So you called me here to advocate for you." Her smile is teasing, and I'm pretty sure that I have no hope. Still, I push.

"I know I could be a champion! I came in second in the Girls' Division, Natural, last year, but to go big you really need gills."

"Gills won't protect you from getting smashed on the reef. Your mother feels they'll let you think you can take dangerous chances. And there's another one of your career models—physics! Tell me: What are you thinking right now, as you look out over the ocean?"

I realize: I'm hypnotized by the way the waves rise up, rush shoreward, curl, and break.

They are mathematically alluring. I study the sea, with its patches of azure, deep blue, shadowy reefs, and swirling foam, for at least five minutes. I always spend a lot of time up here, studying how the waves break in different situations. I can tell if tons of sand have shifted. I know the storm waves. I know when not to go out.

Now, as if the wind has changed, I'm seeing it through new eyes. "With gills, I could get inside the waves. Study them from the inside. Instead of only using the gills to give me an edge."

Melody just smiles. The wind lifts her long white hair in fascinating tendrils, and I want to know, too, about the chaotic yet graceful mechanics of what is happening now, now, now. I want to be able to describe it in a way that is replicable, without words. I have given you a video of what is happening—you can see it in your head, no?—but I want to be able to replicate it in other mediums. I want to study it, and give voice to what I see. Maybe my voice will be a new voice, or maybe my discoveries will have been made before, but I want to be a part of that music.

I realize, suddenly, that I've just learned to think this way—just learned that it is *possible* to think this way—because of Melody's question. I see the potential of entering the phenomena I'm curious about in new ways, seeing them from different angles.

It is a form of love. I gaze at wingsurfers as they dip and fly, tumbling through the air, banzai-style, with this love, and frown.

She is trying to get me off course. She is going to try to make me think I don't need gills to do this. This won't work, of course. It seems obvious that immersion, tumbling in a suit designed to gather information about flow, force, turbulence, is the best way to study waves.

"You have wings. I thought you would understand."

She laughs. "They're fun, but they're mainly dangerous toys. You put yourself at risk." She smiles. "You want to be out there anyway, eh? Even without gills." She pats my knee. "I know."

"If I could stay inside the waves. I could know them. I could learn them. From the inside out."

Even though she sits so solidly, and reaches out from time to time, to touch my knee, she is attending virtually to the twenty or so students, of all ages, whom she mentors around the world and even in space, via holographic avatars and many other not-so-elementary interfaces, depending on the learning style of the mentee. Some, she tells me, require more attention than others—a bit more intensive linking with resources, an encouraging nod, questions that will help them think in a more focused way about the intent of their research, or the process in which they are engaged.

"You *are* inside a wave," she says gently. "In the curl, riding just ahead of the break, at enormous speed. Because you are on the inside, it's hard for you to see. The world has always been this way for you."

"What way?"

"At peace. Most everyone able to be literate in many ways, reading . . ."

I snort. "There's no way *anyone* couldn't learn how to read. No matter how lazy they are. It's like breathing."

"I couldn't read. I couldn't do math. And I was not lazy."

"What?" I stare at her, astonished. "You helped develop *Zebra*!" That's the mudra-language everyone uses now.

She throws her head back and laughs until tears come to her eyes, then looks at me with a grin. "You know that I *changed,* but you have no idea how or why. It wasn't at all what you think. You need a history lesson a lot more than you need gills! Let me show you how different it was. Okay?"

I look with longing at the perfect shorebreak, just this side of deadly, glance at my short board, and feel tricked. But intrigued.

"So what happened? What was it like? Was it fun? As much fun as surfing?"

"Not at all," she says soberly. "I guess it was just as thrilling, because it was scary. We—*I*—didn't know what would happen. But once the incalculable power of creativity was released, and evenly distributed, it was like an atomic reaction: we could not put the genie back into the bottle."

She is silent for a moment, hands moving this way and that, choosing, plucking, and assembling from her Immanent Library the stories she wants for the lesson I know is coming.

I am actually excited. And honored, really. Melody's stories always change me, somehow—I feel stronger afterward. They are precious; I don't get them often. I can barely remember the last time she visited me in person.

"You always seem to know exactly what I need. Like medicine."

She holds my gaze with hers. "I'm a Mentor. It's my job. I listen to my students, I see gaps, I figure out, from an array of possibilities, how best to show them information that might be useful in that particular time on their journey. Learning is all about timing, and understanding what media will most entice any particular person: which stories—and stories can be in words, numbers, Zebra, pictures, music—might draw them into the neuroplastic state of learning, of changing their brain in focused ways. You are right about medicine, in a way, but it seems more like food to me. This is your first grok, right?"

"A *grok*?" I've been biologically ready for a year, but a grok is a serious thing, and I hadn't been sure when I should try it. It's kind of like gauging whether to go over or under a wave, judging break.

I look at the waves and think, *Now.*

When I look back, I see that Melody has assembled spheres, which glow in the air like juggling balls, unaffected by the wind. She tosses me a golden sphere, a green sphere, and one that looks like Jupiter, pulsing with many dark swirling colors. I catch them—they feel like nothing but a slight tingle—and press them to my chest, where they melt into the interface on my skin. I smile and nestle into a smooth curve of volcanic rock as wind and sun wash my bare skin. I close my eyes and grok.

A VIOLENT WRENCH. IT is dark. I seem to be looking at the pages of a book, but the letters dance and mock me, writhing like animated dream-creatures, and I feel bound up, like a prisoner.

When grokking, you can maintain awareness that you are separate from the grok. I know that I can end it whenever I choose, that I cannot be trapped in a bad nightmare. That is what I know, but I need to test it. I need to know I can get out.

I open my eyes and see luminous blue sky, a few white wisps of cumulus, the old clock tower across the bay, and a kind of sideways view of Melody, her eyelids at half-mast, gesturing in graceful Zebra to one of her students. She has implants that record and transmit that three-dimensional language, and, again, I feel a powerful urge to think of ways to describe it mathematically.

She stops gesturing and glances at me. "Pretty hard to believe, right?"

"I was looking right at the screen—through your eyes—and I could only kind of . . . catch the tail end of things, or . . . I don't know. It was kind of weird."

"It was called dyslexia. I had dyslexia, dysgraphia, and dyscalculia. Couldn't read, write, or do any kind of math, even though I knocked myself out trying. But—keep going. Call me if you need me, but I think you can handle it. I've waited a long time to show you. Okay?"

"Sure."

She smiles at someone who I can't see and returns to gesturing.

I am confused. Back then she couldn't even read or write, but she learned how to do all this?

It's weird to be back over a hundred years ago—immersed in it, although I can leave at any moment. I would definitely like to avoid feeling Melody's emotions—they seem too personal—but that's what I'm in for. I guess it's like reading words, where you feel what the characters feel, but a lot more powerful. She thinks I'm strong enough, though. Maybe it will get me my gills, but I suspect the issue has been reframed, and that she even thinks it will change my mind.

If I can drop down the face of a four-ton wave, I can stand this. And that's about what it takes. I close my eyes again.

I grok.

I am Melody Smith. It is 2121, and I am thirteen years old.

I WAS BORN IN the days when *terror* was a byword, a fear to which everyone in the world relinquished rights, and, in the case of many, blood and life.

I think it surprised everyone when infinitely plastic OPEN ROAD was introduced to the world in one bright flash (so it seems now, despite the years of violence, marches, demonstrations) by a globe-spanning group of people.

No one person pushed a button. It emerged, evolved, changed as connectivity increased, with bottom-up feedback. All kinds of people—neurologists, biologists, cognitive scientists, artists, computer scientists, musicians, and visionaries—had been working on aspects of it, first separately, and then connectedly, for years.

It was an offshoot of research on how the brain works, what consciousness is, what makes a brain healthy, how human children link to and explore the environment, explorations that lay down specific neuronal pathways. Research on what makes people mentally ill, criminal, violent, and otherwise challenged, and how to change that.

It was a time of chaos and glorious growth, a watershed as important as the printing press. How much more dangerous than the atomic bomb the release of universal literacy seemed to the settled, privileged way of doing things. You would have thought that it would be the end of the world, and, indeed, it was a war of power and money that permeated the entire structure of society.

It was the removal of mind-blindness. Literacy enhanced empathy, because it makes people able to experience what being someone else might feel like and stretches the range of emotions.

I was there.

I *AM* THERE.

On the morning of the day that everything changed, I wake in my bedroom, my oasis, in early-morning dark, ready to brave the daily nightmare.

No, that's not right. I'm never ready.

The night before had been very unpleasant. I lie there in the darkness and decide not to bother with going to school today.

I hate to leave my room. I hate even to go into the living room. My two older brothers are always there, sprawled in front of the television—an old-fashioned screen-viewing device, where car crashes and murders pop out into the room in front of it—ready to say something nasty.

When I was six, my parents gave me my room, and paints, all the paints I could want, a big shelf with gallons and quarts and pints of bright hardware-store paints and stiff hardware-store brushes, spray paints, an industrial-strength fan to vent the fumes, a laundry sink, and boxes of rags. It was an act of desperation for them. They gave me all that because it kept me happy. I had my own world.

I repaint my room all the time. My bed is painted. My dresser is painted. My walls are painted. Layers of other years, other parts of me, peek through; it's an archaeology of me. I paint patterns I see in my head, zigzags and dots, like that. I lie in bed, see a picture or colors in my head, jump up, and get started. Or I'm in school, and think of what I'm going to

paint when I get home—what colors and brushes to use, how I'll blend this or that.

Sometimes I just get a rage on and start splashing paint around.

When I try to paint people, they come out funny, their arms too long, their faces crazy, but that's okay, I tell myself, and I tell myself that all the time. Sometimes I wrap my arms around my knees and put my head down and say it's okay, it's okay, it's okay.

Last night I was screaming "It's okay! It's okay!" out loud and Dad ran into the room and said, "Melody, what's going on?" And I saw that I had thrown the can at the wall and made a big yellow cartwheel of paint across the floor that he had run through, leaving yellow sockprints. He grabbed me and held me tight, and I stopped screaming and trembling. "Look!" He pried open a red can of paint and mixed to orange and made more footprints on the floor until we were both laughing.

Then Mom opened the door and yelled, "I'm working two jobs for this?"

My father's face moved from laughing to fixed, like a statue, like he was a different person, in a blink. He said, "Come on out and do your homework now, you have to let that dry," and I felt trapped. We opened the windows, left our painty socks on the floor, and closed the door on my kingdom.

I sat at the dining room table with my tablet and pulled up my assignments. I looked at the wall of my mother's books, all neatly arranged and never pilfered, never leaning into the gaps as they used to be: she had no time to read anymore. I closed my eyes and remembered myself nestled next to her, an open book spanning our laps, and she was trying to make me say the words on the page when one of her tears fell and shimmered, a delicate hemisphere magnifying one spoke of a wheel in a picture of a train.

"Melody?" I opened my eyes. The homework words leaped around on the screen; I had an instant headache, a dark hole in the center of my chest, and a stomachache.

"Honey," said my father, who had pulled up a chair next to me. "What's wrong?" He knew what was wrong. We both did.

"I can't read with all that noise." I pointed to the TV.

"Turn it off," said Dad. Alex flipped me the bird behind Dad's back. He and Jake slunk back to their rooms. "Okay, try again."

Mom's shadow fell across the tablet. "Go on," she said. "Sound it out."

"Wh . . . wh . . . when!"

"Good guess," Dad told me. He pushed the screen and it said, "*Where.*"

"Why do you coddle her?" snapped Mom, and walked away.

He went to the next screen, which had three words on it. "Which one is 'what'?" asked the voice.

I had no idea, but pointed to one of the words.

"Think about it," said Dad.

Those words were always like a slap in the face. I burst into tears, ran back into my room, slammed the door, and dove into bed. Outside the door, I heard Mom and Dad fighting: his quiet words; her screams. I put pillows over my head and cried myself to sleep. Again.

SO I OPEN MY eyes the next morning, when everything was about to change, remembering all that, and like a robot getting shorted out, my arms heavy and my eyes aching, I finally get dressed.

When I emerge from my room, Alex is in the kitchen getting his breakfast soda. He and Jake, eighteen and nineteen, are unemployed layabouts who do nothing but play video games and eat potato chips. They do not help our parents around the house, and our parents seem powerless against their combined indolence, against the dronelike lifelessness of their pale faces drifting from computer to television to refrigerator. They somehow suck money from the Internet, and Jake won a ragged-out old car while online gambling, but they kept that secret from Mom and Dad and made me keep it secret too.

On my way to the bus stop, I glance down the block at the house Mom and Dad used to own, a pretty bungalow with trees in the yard and tulips, in spring, that Mom planted. They lost it in the crash. Growing up in that house gave my brothers a sense of entitlement I don't have. I'd been a baby when it happened. Dad had been an artist then, but after that took what jobs he could get. Right now he's managing a fast-food restaurant. He's a nice man; he never yells, but he never seems to be able to keep a job for long. Mom works in an office.

A thin, pasty boy on the bus makes quiet, nasty-sounding remarks behind me. I don't know what they mean but I know they're nasty and there is no other seat. He always seems to sit behind me. I endure him every day, my stomach in a knot.

When we pass the Supreme Court, I focus on the sign wavers to keep

my mind off other things. Today, I hear, muffled through the window, "NO TRANSGENIC HUMANS! STOP PLAYING GOD!" "Transgenic," I whisper to myself to cement it in my mind. I like new words, and I can remember them if I repeat them to myself. I open my tablet and say it, but close it instantly when the guy behind me bats me on the back of my head with his open palm and says, "Try 'idiot,' bitch."

I imagine swirling around like a tornado, using the superpowers my brothers are always trading in their games, and ripping his head off. I know there is more to me than anger and sadness. I know that if I could read, I could go anywhere and do anything.

I ask the kid next to me, "What do the signs say?"

"'BAN BIONAN. NO TO NANO-NORMALIZATION.' That other group's signs say 'HELP OUR KIDS LEARN. FREE HUMAN POTENTIAL.'"

"Thanks." Both groups are now chanting "SAVE! OUR! CHILDREN!," which about sums up all these protests: everybody likes kids.

I stick in my earpod. "Oona," I say, holding my hand over my tablet to block out the noise on the bus, "tell me about nano-normalization."

"Sure, honey," Oona begins, in my aunt's voice, who reads about fifty pages of stuff out loud to train the device and whips me to a website. Oona reads, "Humans are born to learn. We have taken over the world because we are curious and we explore. We take things apart and build new things. We invent . . ."

"Okay. So?"

I think I hear Oona sigh. "So all the little things you do from the time you're born train your neurons. They grow really, really fast and develop dedicated neural pathways for all of your senses. Your brain is self-organizing when you're an infant, and you start to see the edges of things, you start to hear subtle differences between the sounds of your native language, you start linking things together, but then—"

"Then things go wrong," I say. "Like with me, right? Go ahead, you can tell me. You won't hurt my feelings."

"The neurons are pruned."

Pruned. An ugly word. "Yeah! Like I said!"

"Melody, it happens to everyone when they're infants. Calm down. I'm going to shut down—"

"No! I won't smash you. I promise!" Social Services had given me Magic Man, Oona's predecessor, and I'd had anger issues with him. Aunt

Oona bought this one for me, but the main program remembers being Magic Man.

Oona starts talking again. "It says that there is an international coalition of neuroscientists, educators, and governments—all kinds of vectors are involved, actually—working on improving education for people like you and for everyone, but that business interests keep them from moving forward. This Supreme Court case is about whether or not new medical strategies can be used in education. Next week, they will consider whether the patents on a learning neurobiologic called OPEN are legal. But some kind of business bots are stopping me from further exploration."

"How can they?"

"Education is all about business, not people. Not teachers, and not children. Testing companies rake in billions every year administrating the mandatory testing program . . ."

Oona stutters and the screen freezes. Alex is good for one thing: adept with computers, he told me that was what happened when business, or government, which controls the Internet, television, everywhere we get information, does not want you to know something. But what you want to know is usually there, somewhere. My fingers do the little dance that he taught me to reach the more radical sites and Oona is back. She shows me a video of a woman talking.

"Everything is upside down. All scientific evidence points to a model of the most efficient human learning as being completely individual. Humans, from infants to the elderly, learn in their own style, in their own time, driven by curiosity. February tenth is not the day that every third-grader in the country is ready to learn their four times table, and but that's how it's been taught for a hundred years. Without teachers' unions, it was easy to replace teachers with teacher-technicians. They only know scripts; they don't know anything about *how* children learn. They have a few layers of how to keep everyone on the same page; that's all. If that doesn't work, then they fail the children, hold them back to go through the same fruitless exercises. So one key move is to take education out of the hands of business and put it into the hands of kids and of educators, in that order. We call the people who will help coordinate the learning process Mentors. Mentors will have to know a lot about neuroscience, about learning styles, about their subject matter, and they will take their cues from the children, instead of the other way around. The child will show them what . . ."

We pull into the school parking lot. Just as we step into the milling crowd the pasty kid whispers in my ear once more. In my mind, I turn and knee him in the crotch, leaving him groaning, but really, I slide through the crowd fast as a pixel trace and enter the long, low building: East Side High.

Jarring sounds: slamming locker doors, kids shouting. Every room is full of different people at different times of the day. A gray window of dread falls between me and everything around me. I don't know what's worse—spending every day with the same unpleasant kids or being constantly among strangers. No one stops the kids from being mean. It's too much work. I'm in the principal's office a lot, because of my anger issues, but it's restful. Mr. Beadley is a kind, quiet man who lets me listen to music and chill.

"The model of a public school has not changed in over a hundred years." Right. I believe it. Mine was built in the 1960s and is rectangular, full of rectangular rooms. I am really interested in learning Thai, because I have a cousin who speaks Thai and English and I'm jealous, but they told me that I could only learn Spanish or Latin. I am in remedial math and reading, which is why Alex always calls me Loser and says I should just give up and flip burgers, but I don't want to. It's like there's a beautiful picture in my head of me reading a book and using all those weird symbols I sometimes glimpse in my math program. I'm up on a high mountain peak, where the wind blows hard and the air is clear and I can see forever, but I can't even find the beginning of the trail that leads to the top. I work hard. I just don't get it, despite my meds. I love my special teachers, but all day I'm yanked from class to class, from world to world, expected to keep track of multiple fragments of tenth-hand information. I have a great memory, and I know I have good questions, but when I ask them, the teachers say we all have to get through the day's lessons and don't have much time, and I suspect that they don't even know the answer or how to find it or how to even think about it. Being in school is like being on a conveyor belt in a cafeteria. I'm whisked past smells that might be tantalizing as new-baked bread or as sour as overcooked cabbage, but, whether it's good or bad, there's never enough time for me to put food on my plate and eat it. Maybe I can, they tell me, sometime in the future, if I play my cards right, the cards that everyone assures me exist but that I have never seen. What cards?

My first class is Math for Idiots. I sit at the back of the room, so I can

paint on my tablet, but the teacher looks at me from the front of the room, where she's monitoring everyone, and the math program breaks through my fix and takes over. "Melody, here are six groups of two ducks. Write a multiplication problem that will tell you how many ducks there are." The ducks are swimming in a pond, but they may as well be flying over Antarctica. I try to touch one with my finger and stop it from moving, but my finger hits the empty screen. I try to return to my art program. "Melody," says a male voice behind me and I look up. It is Mr. Beadley. "Come to my office, please."

I am very surprised to see my parents there, my mother in an impeccable suit and my dad in his manager's uniform. I can't believe that they both took time off work. Something must be terribly wrong.

We sit around a big round table like grown-ups and Mr. Beadley says, "This is a very sensitive issue, and I apologize if I am out of bounds, but I have been looking over some data and I believe that Melody is the perfect candidate for the OPEN ROAD project at NIH. I would like to recommend her as a participant."

"You mean she could be an experiment. Like a lab rat," says my mother. She looks tired, as usual; her dark brown hair curves perfectly around her chin and her mouth is a thin line.

"She would be part of an experiment, yes, but let me give you my thoughts. I am probably the only person who has observed her steadily over the years. I have all her records here; I've printed them out for you." He kindly gives us all a copy. I catch a few words in mine before they dance away, but I know what the evidence shows: I'm a mess. This is, basically, my picture: I am in seventh grade and cannot read, have no symbolic numeracy skills, and can't write worth beans. I can talk, though. That's something, isn't it? A program changes my spoken words to writing. What more do they want?

"She is gifted in several areas, as you can see," says the ever-kind Mr. Beadley.

My mother presses her lips together more tightly, which means, *none that matter.* She bows her head and flips the pages.

My father says, "We know she has challenges. What kind of experiment are you talking about?"

THE NEXT MORNING DAD and I are in a beautiful glass building in a room looking out over the National Institutes of Health campus. Dr. Campbell, a research scientist with long red hair, explains to us that I probably have an unusual brain that keeps me from being able to focus. I can't correctly process what I see and hear, or organize and use that information. She says they might have a cure. They might be able to tweak with my brain, make it like the brains of everyone around me.

Might. Still, my heart beats faster.

"We are actually in the last stages of our research, and we are getting ready to put this through the FDA approval process. This process has been approved and used in Europe and other countries for the last six months. It's called OPEN. Operational, Procedural, and Educational Neuroplasticity. Perhaps you've heard of it?"

"I don't know," says Dad. "Maybe on the news?"

I ask, "What is it?"

"I will show you some pictures. Here is a picture of a normal brain in a functional MRI machine. A ten-year-old boy whose brain is normal—that is, pretty much the same as 90 percent of all brains—is reading silently. In this one, the boy is reading out loud. See how these regions light up?" She defined the different areas—Wernicke's, Broca's, the motor cortex, and others—and explained what they did.

"This is an image of a dyslexic boy trying to perform the same task. And here are images of that same dyslexic boy who was given an earlier generation of the therapies we propose to administer to you, if you qualify, and if you wish."

It gives me a simple picture: parts of my brain are not connecting to other parts the way most people's brains do.

And shows me that there is a way to fix it.

My father says, "There are many, many creative people who are dyslexic. Steven Spielberg . . ."

You, I suddenly think, surprised by the word as it pops into my mind and then understanding its truth as if I had snapped a puzzle piece into place. *You, and me. Maybe Alex.*

"*Dyslexia* is a blanket word that describes a very broad spectrum of disabilities. Melody's tests show that she has all the symptoms of dyslexia and dyscalculia, which we can confirm or discard as a diagnosis with fMRI studies. We are now able to break these challenges down into more finely

defined pictures. Reading takes place in different parts of the brain; if these locations do not connect, it is difficult to read. When pathways between these areas are naturally lacking, they can be developed through genetic and bionan interventions, combined with hands-on exercises. Together the eyes, the hands, and the brain build pathways. We predict that by using OPEN, many people who now have trouble reading can master the processing skills from which reading springs. There is nothing wrong with these people—they are just different. If most brains were like this boy's brain, we would all be communicating in different ways, and I would be the odd person out."

She looks at my father. "I know it may be difficult to come to terms with this, but the way your daughter processes information will make it hard for her to do what she wants to do. She may indeed develop creative responses and strategies, but why deny her the opportunity to communicate with the rest of society? You can find hundreds of fascinating and successful people who were and are, supposedly, dyslexic, but you will not hear about the billions of other dyslexics who were not able to overcome their problems despite all their truly remarkable creative ways of dealing with it."

My father says, "Neurodiverse individuals make important contributions to humanity. Think of Darwin. Leonardo da Vinci. Einstein. Winston—"

I'm looking at the pictures of the brains. You can see the difference. My brain is "before."

I interrupt. "I want my brain to connect."

Dad becomes agitated, urgent. "You're a creative person, Melody. Maybe a genius! You've won art awards—you can maybe get scholarships. You don't have to be the same as everyone! You can be unique!"

"I will always be unique," I shout, though I have no idea why I believe this. "The only thing I'll lose is being so miserable!" He looks very sad at that. I lean over and hug him. "It's okay, Dad, it's okay. I love being able to paint. I always will. I want to know how to read, too."

His arms tighten around me. He pats my back. I hear him swallow hard. "Do it, then."

Dr. Campbell nods. "Good. It is up to your parents to agree to this, and I want all of you to know everything there is to know. I'm sorry your mother couldn't come."

"She had to work. She already took one day off."

"I will get in touch with her and discuss any questions she might have."
"She already said yes," says Dad.
"Still, I need to engage with her. This is a family endeavor."

I ENJOY BEING IN the Connectome MRI, which maps my brain and the changes as I perform tasks on a very fine level. I am safe: no one can bully me. I can relax completely and respond to questions knowing that I will not be judged harshly for wrong answers: I'm giving information that will help heal me. Yes, my father keeps telling me that there is nothing wrong, and that I don't need healing, so I change that word to *enhance* and somehow it makes him happy.

I love the deep, harsh sounds the machine makes; the odd rhythms; the silences. They're like music for me. I do some research on how the machine works and why it makes these sounds, using videos, and realize: soon, when I can read, I will be able to take in information a lot faster than I can when I'm listening to someone talk. I'm thrilled!

After the fMRI—which, I learn, is by now almost primitive—I move through many more advanced ways of looking at my brain. The data, rendered in pictures, in sounds, in graphs, astound me: I'm looking at myself. The tests finely target my learning challenges and their causes.

I return to school while an international team, a keen and fascinating group of people, the members of which I meet online, readies my therapies. Soon, they say, studies like the one that I am in will make this process swift. One man envisions international kiosks in which people will be evaluated and receive therapies in a matter of minutes.

After a month, they call us back with the assembled information. We meet with Dr. Campbell and some of the team in person: a neurogeneticist, a nanobiologist, and two educators, all from OPEN ROAD. It's fascinating to see how information moves through my brain, and the model of how the pathways will grow and strengthen.

With excitement and pride, the team shows me around the Neuroplasticity Lab, equipped with all kinds of specially developed hands-on equipment that seems oddly simple—large sandpaper letters glued on boards, for instance—but intelligent. When I traced the *W*, for instance, it says, "Wah. As in white, water, willow . . ." I remember my mother doing those things long ago, and, as then, the associations fly out of my head as soon as I stop

hearing them. In a cabinet hang chains of small, grouped colored beads to show what multiplication is. The five-bead chain, for instance, has five groups of five beads each, and when you fold it up it makes a square of twenty-five beads. That is weird. I never knew what the word *squared* meant before. Just being able to make a square with my hands makes me understand it. There are also little arrows with numbers on them that speak their names when touched—5, 10, 15, 20, and 25—but I can't read them.

The educators have developed a personalized program for a computer that is kind of like a brain prosthetic/stimulator, which they give me. It is a portable analog of the physical lab and projects 3-D images I can move with special gloves. They watch me put it through its paces. I count the five-square bead chain and when I say "five," the number 5 manifests next to the fifth bead. I forget what it looks like as soon as the projections vanish, but it's cool.

I pick up objects—a sphere, a cube, a dodecahedron—and take them apart in various ways, reassemble them, play with them in any way I choose, and as I do so, verbal and the corresponding written information—usually equations—appear in the air. I can move those numbers around, too, and fly through different kinds of mathematics that explain, in their various ways, what I am doing and seeing.

They confer off to one side, heads bowed, come back with smiles and say that they will tweak and continue to tweak. They are as exuberant as kids let loose on a playground. I can almost see them jumping up and down and clapping their hands.

ON THE MORNING I am to get the shot containing the nanobots and genetic information that will bestow upon me a finely calibrated neuroplasticity for a limited time, I wake up sweating. Do I really want to go through with this? Will I really still be myself? Will I die? They told me that developing leukemia from genetic therapies is a thing of the past, but they are not superheroes, just humans. Will it go wrong and make me worse?

Perhaps the bravest and at the same time the most stupid thing I ever did was get into the car with my dad. On the way to NIH, we listen to a pep talk from a boy in Brussels and a girl in Amsterdam and another girl in Libya who have taken the shot. They are all ecstatic. I asked for negative reports too, so I listen to one girl from Rio who says it did nothing, and

to parents who blamed their boy's subsequent tic on it. My father, who is driving, holds my hand the entire time. He tells me repeatedly that I can change my mind.

We enter a cubicle and Dr. Campbell swipes my arm with alcohol, talking all the time in a low, soothing voice. "Someday soon this will be something you can drink. We're working on developing a reset, or, really, a going-forward process that would restore one's previous mental environment if the client prefers it. Some people who are blind and gain vision, or who are deaf and gain hearing capability, have a difficult time learning how to process that new information and are unhappy. We want to make everything as smooth as possible for you."

"Science," murmurs my father, as the needle goes in.

The injection is very, very expensive—so expensive that few people in the world can afford it, so radical that use of the individually tailored cocktail is illegal in much of the world, and so controversial that I have been afforded—quite annoyingly to my brothers in particular, whose shady activities, I discovered later, ceased abruptly—round-the-clock security.

"Now," says Dr. Campbell, "I'd like you to meet Glinda. She had the shot a few weeks ago. She'll be your Mentor." She ushers me into the lab.

Maybe it's my imagination, but everything seems brighter, more sharply defined. "I feel a bit nauseated," I say, and Dr. Campbell gets me a ginger ale and some crackers. I am opening the package when an African American girl about my size bounces into view.

"Hi! I'm Glinda!"

She sticks out her hand and I shake it. "Nice to meet you. I'm Melody."

"Okay!" Her eyes are merry and she has a big smile on her face. "I had my shot about a month ago and I'm going to be your guide here. Yeah, I felt kind of woozy for an hour or so. Want to lie down?"

I finish my crackers. "No, I'm fine. So what's this over here?"

"You left-handed?"

I nod.

"Okay, get on your gloves and let's get started." She notices me staring at her long dreads.

"Cool beads."

"Step back," she says, and gives her head a shake. Her dreads swirl; the beads clack together in a kind of music. "Hair as a weapon. Once people get a smack of beads in their face, they don't bother me. Okay. All these

exercises look simple, but you know they're tough. And even with all the fancy help, English is a joke. It doesn't make any sense. Well, it makes sense sometimes, and that tricks you into thinking it makes sense all the time. You just have to learn a whole lot of rules and, sometimes, just the way a bunch of words look. It's a lot easier in phonetic languages, like Italian. You're not stupid—English is. What do you do?"

I know immediately what she means. "I paint."

"I play the saxophone. Now I can actually read music! I learned how to play by ear, and I'm an ace at memorizing—y'know?—but wow! Now I can play what I see on the page. When I see a score, I hear it in my head. It's like magic."

The first thing I have to do, she tells me, is connect each letter to a sound and to a motion. "Making the motion with your hand, or your finger, wires it into the brain." She laughs. "Not that there are wires in your brain."

"It seems more like a light show."

We even sleep in the lab—there are cozy little bedrooms there—so we won't miss a second of our enhanced developmental time. Grad students drift around, taking notes and making videos, and everything I do is recorded, somehow, by a light cap that I wear with sensors in it. I forget about it after the first day. Being able to concentrate is such a change that all distractions vanish. I'm climbing a trail up a steep, windy ridge, the trailhead far below me.

I dream the things I'm learning—sounds, pictures—and sometimes I wake at night, remember where I am, dash out, and start where I'd left off. I'm beginning to be able to sort out letters, because they stay solid, but also because I'm doing a lot of tracing work with my fingers and just simple writing of sounds on paper. "Ssss," I say, as I write a sinuous *s* over a dotted line. There is a set of letters in a partitioned box, and when I pick one up it says its sound, "mmm," and I begin playing with them—there is no other word for I'm doing; it is not work; and soon I'm putting together words that sing at me—"ffaassst!" It's crazy. I'm doing preschool things, and I'm thirteen. But it's the most fun I've ever had.

I'm laughing and crying the day when, after a solid two weeks of work, the lights come on. "Cat! Sun! We went to the park!"

Glinda is sitting cross-legged on the floor, holding up cards, and she tosses them into the air. We jump up and down, hugging, crying, and screaming.

The days go by. We play spades, gin rummy, Scrabble, all kinds of

games I couldn't play before. We're like a big family, the whole lot of us, a dozen kids of all ages who have had the shot. I feel as if I've been asleep my whole life and now I'm awake. There's a whole new world around me—a world I can participate in, and change. I run around reading everything I see out loud, and then the words are in my head, silent, giving me pictures, feelings, information. Thanks to the bots in my brain, which transmit information to a screen, I can see that solving a puzzle releases a cascade of pleasure-giving chemicals. I can hear the names of the chemicals, even see a statistical rendering of how many neurons are changed. The amazing thing is that it was just tiny little bleeps of stuff that woke me.

Over the next few weeks, the lab—it is a cold word for the warm, inviting world we have, with its cushions, its books, its bright colors, and the incredibly gifted helpful people, adults and children, in our learning environment—fills with other children who had had their shot, and it is a great thrill to find that I can actually help *them*. Mom and Dad visit every few days. Both seem satisfied in their own ways about what's going on—even Dad, when he sees how happy I am. A great weight lifts from me: I hadn't known that my inability to please them had been so much a part of my life.

Too soon, it's time to go back to the real world, to integrate back into my school.

I am supposed to be subject A4957, a closely guarded secret, a bit of data, like Glinda and the other kids in the lab. Like the other kids in the world. No interviews allowed.

But someone had leaked the news.

I'D BEEN COMPLETELY SHELTERED at NIH, but Dr. Campbell warns me about it and says that it is perfectly all right to say "no comment." A dark limo takes me out the back entrance, but I get a glimpse of picketers at the front gate of NIH. To the delight of my brothers, they've been staying at a hotel for the last week. Unfortunately, they hadn't been shy about giving interviews; Mom and Dad couldn't be with them all the time.

"This is crazy," says Alex, looking out the hotel window. "There are people who are afraid of you learning how to read!"

"They're afraid that it might be forced on them and their children," says Dad.

"But if it works, what's so bad about it?"

"What if it works today and not tomorrow? What if it has some kind of terrible side effect that they don't know about? What might happen when people denied education because of their gender, their religion, their race, or their social strata learn about the world, about science, about history, about how other people live? What will happen to the way things are if the thinking of a lot of people changes?"

"Doesn't everybody already know?" I ask. "We have television. We have the Internet."

"As you know," says Alex, "both are edited."

"And not equally distributed," says Jake. "I heard that somewhere."

I peek out the window. We're on the fourth floor, and when the crowd glimpses me, signs pump up and down in the air. "Dad, I can read the signs now! I can read the signs!" I dance around the room. "And I can read *complicated* words!" I'd raced through lists of words and their definitions and usages, thrilled at the depth and complexity of my language skills. I already knew a lot more words than most kids my age, because I worked so hard at memorizing them for so many years.

"Like what?" asks Jake.

"Like . . ." I look out the window and a woman with long black hair scowls and waves her sign. "'Harbinger of Doom,' for instance."

"Yeah? What's a harbinger?"

"Like an avatar," I said, smugly. "Like a signal of the future."

"Yeah, right." But he looks impressed despite himself.

I'd been looking forward to seeing my room again, and everyone was feeling pent-up. But it didn't look like we could leave yet; the house was too insecure. Mom asked me if I wanted to go back to school and I was able to edit "Hell" out of my "Yeah!" response. But yeah. Hell yeah.

THE NEXT DAY, PAPARAZZI follow the black Suburban that takes me to school. I feel like I'm in an unpleasant movie. They treat me like a bomb: streets are cleared for a two-block radius. My bodyguards open a path for me to get into the building. It's really annoying. I can hardly concentrate and show off like I'd planned, though I whiz through a few segments of math and get out of the Math for Idiots screen. I hear that the principal got a few death threats, but he refuses to send me home.

It's all pretty unsettling, so around lunchtime I tell my bodyguards that I want to give an interview. Maybe that will make them go away.

I choose the place in the front of the school where I'd pretend-kneed bully-kid in the crotch.

"How do you feel about being an experiment?"

"Like a rat," yells someone in the crowd.

"Great," I say into the microphones. "I hope that it helps other kids like me."

"How do you feel about being the first?" That's a hard one. Should I throw the other kids I know about to the wolves? Finally I say, "I think everyone knows I'm not, and I wish you would leave me alone to get on with my life."

"Read this." That woman with the long black hair thrusts a piece of paper with writing on it into my hand. It's crystal clear: "I am the harbinger of deadly change." Must be their script. I hold it up for the videos, feeling an instant's thrill of knowing I hold a trump card. I crumple it up and toss it to the ground.

"I *am* a harbinger. I am a harbinger of free literacy for millions of people, all around the world. It is a radical change. It is as radical a change as the polio vaccine, as the smallpox vaccine, only this liberates people from the disease of illiteracy. Thank you. That's all."

Next day, the picket signs read ILLITERACY IS NOT A DISEASE. What makes the news is the one that says ILLITERACY IS NOT A DISESE.

WITHIN THE GROK, I move back into myself: Alia. Melody's narrative shifts to a stream of images, narrative, songs, music, poems, that move through my mind in a particular cadence. As soon as I discern a pattern, that pattern shifts, and I feel like a living fractal, a meta-human, a big music flashing with color, intensity, emotion that clamps shut my chest or makes me join with others, briefly, in strange new song.

LONG WALK. FLIES. DAB of goo in eye, don't rub it! Zahrą screams for food. Sea of long white tents. Soldiers with candy. Missionaries; lentil soup. Mind your manners, now. Water warm and muddy. Drone of distant trucks.

A mob of kids runs past. *Candycandycandy!*

Back doors of trucks burst open. Out come people, tables, boxes, chairs. A Sheng-man shouting, "English line! Cold Nehi! Take your shot!"

I push up front; a fast bright sting, cold! Orange Nehi pop.

Beneath a tree we get rough lines and circles stuck to cardboard. I try to peel them off. Big hands lead mine: **ssss ssss** for **sss**nake! **sss**un! **sss**assy, **sss**oon, and **sss**illy! We all laugh. She tries to take my card back: No! No! No! It's mine! She trades for **aaaa**, like **a**apple, **caaa**t, and **haaa**ppy. Then tah! tah! tah! Like tick and time and tummy!

Soldiers drive up. Shouting. Then they leave. We sing fast songs of words. I feel a loud excitement in my head.

SILHOUETTES OF BOBBING HEADS in a tunnel. Burst of light ahead: emerge to soldiers clubbing people down; young men rise and rush them shouting LET! US! READ! LET! US! READ!

AN INTERVIEW AROUND A lighted table, earnest talking faces, all else in dramatic shadow.

"Research has yielded conclusively that normal brains are not damaged, as many claimed they would be, by use of OPEN. It accelerates the process of learning to read for everyone."

"But people want this for their babies."

"It is not presently recommended for use until the age of four, but it won't hurt them. It doesn't accelerate normal developmental milestones. When natural stages of plasticity occur, the responses of the babies are optimized."

The interviewer leans forward. "So there is a potential for them being smarter than children who don't use it."

"Possibly."

"Which may lead to a two-tiered society."

"If it is limited, of course. That is why many groups are working to prevent that from happening."

"But it's expensive."

The woman shakes her head. "It was at first, but the fancy labs and computers we once used are rapidly becoming obsolete as the number of Mentors increases. They know how to create learning tools from the

environment—so cheap and simple it's laughable. And tragic. Beans for counting. Sitting next to someone and helping them sound out words. Most people who have had the shot, or the serum, are thrilled to be able to pay it forward by taking time to mentor."

The interviewer turns to a man in a tweed suit. "Dr. Eltor, the education system is in great flux, is it not?"

"Indeed. It's almost as if we have been stultifying as many children as possible, based on ancient models that probably worked well in smaller, more intimate populations, or models that worked well for homogenization of immigrant populations slated for factory work in the early twentieth century. That a good portion of children were able to succeed in old-style schools was used as proof that it was the best way for children to learn, for it was assumed that a certain percentage of children were unable to master what we wished them to learn. But without that framework, and with new information from the field of neurology about how learning really occurs, and with new, universally available computerized learning tools, children are learning more, and faster, so much faster that it seems that they are all geniuses compared with children just five years ago.

"It is causing social upheaval in many sectors. Everything is affected. Business and trade, political structure, science, the arts, religion—everything. Universal literacy might seem like a simple change, but even American slaveowners knew the power of reading would not lead to simple results."

The interviewer remarks, "It is anything but simple. I'm going to turn to our legal expert. Can you help us understand yesterday's UN mandate that calls for governments to support free distribution of OPEN to all children in the world?"

"It is indeed . . ."

LEARNING TO READ: An Anthology. Read by people of many ethnicities—girls, boys, women, men—translated into English by the grok:

How language
Feels in my hand:
Sharp

Sinuous
Like cutting into rainbows
With my brain.

Pathways arise
I follow them
As if up a rope,
Pulling myself up
Hand over hand.

A rough tongue licks my brain
Vision ripples; re-forms. Once
Small, I ride the wave,
Made huge
By just
A word.

I am made Other
I am made Past
I am made Future
I am the stranger
Walking past me in the street;
I am the cat
Asleep at my feet.

Word-lightning zigzags;
Inner.
No other hears
When I hear
Each thought
So private
Yet utterly public.

I read my great-grandmother's letters.
She is dead
Yet her voice speaks to me
As if she were alive. She rings in my mind;

She sits next to me
On this summer afternoon in Cairo.

Words leap through mind like wild gazelles, their flight
A bright path etched on air.
Meaning strikes like sunlight: story feeds me.

When my mother went to the protest in Kabul,
She wore her brave blue burqa.
She did not come back.

My video flies to YouTube:
The million-colored scarves
Of women chanting in the street
Light spills across them
They are like ridge beyond ridge
Of mountains, transparent
In the sunrise

They are thoughts! They are thoughts! They are thoughts!

Reading my first novel:
I do not finish so much as
Let it fall
And move amazed
Through a changed day
Where all seems hushed and new

I was like a red horse
With a sun in my heart
Running through the woods
Of northern Michigan
And I could write it down for other kids
To be that horse
To be that day.

Reading was like a stranger
Who came to town and stayed.
Some said she was dangerous,
But that seemed so unlikely.
She pitched in where she was needed.
Helped with the kids and cooking, built web pages, organized yard sales,
Set up carpools, organized like-minded people
Soon we could not live without her
After a year she started her own business.
Now she owns the town.

Learning speech sounds: letters
Stand out, flamed with color
A fleeting stage, they tell me.
They flip and mirror: my brain follows
And soon they settle; normal.

But now I know their ancient selves
Stretch far back in time.
Once things, *before they changed to sounds*
And then sounds changed to lines
Stood on their own feet, walked through time,
Omnipotent
Taking on local color
In neighborhoods of minds.

WAVES OF PEOPLE MARCH down Wilson Boulevard, their chant "O-P-E-N" a roar. Their signs read RADICAL LITERACY FOR ALL.

Camera pans to coming clash: BAN BRAIN MEDDLING. KEEP OUR CHILDREN FREE.

A MURMURING UNDERTONE THROUGHOUT the flashes, like words a running brook makes when you listen without thinking: What does it mean what does it mean to be what does it mean to be human?

DO WE WANT TO be human, or not?

I DISCOVER A SEARCH function and follow the bright ping of Melody.

Melody's twenty-year-old voice, low in my head; her bright face above a podium: "All the *with* words. Com-munication. Com-plete. Com-munity. We kids glimpse this vision"—a short, lilting laugh—"I know, I'm an adult now, but when I chose this path I was a child and became part of a network that is actually growing younger, as more children—nearly a billion, now—are reading fluently, with understanding, by age seven, because more of us are reading than ever in history. We are also producing our own literatures—trading them, learning about other cultures and also learning how universal some problems are. Just as there is a natural 'sensitive period' for laying down language skills, which OPEN replicates, we are finding that there may be a 'sensitive period' for incorporating and practicing one's ethical and moral framework. When loyalty is freely chosen, based on conscious decisions, we find it is fluid and dynamic. When loyalty is fear induced, as in many repressive regimes, it is deeply damaging. We are learning the kinds of strengths and skills we may need to determine the difference between the two for ourselves, so that we can make positive decisions about our own commitments as we mature. I may find out I am wrong when I am older, but in my personal experience I have found that most very young children are idealistic. They can tell the good from the bad, and, mostly, want to emulate the good, to be good people. But when we are children, we are powerless, and, being plastic, we emulate the behavior of those around us and mirror their emotions. Thus, even in families where you might expect a happy result, unhappiness and resulting unpleasant behaviors are a part of life. Perhaps the gray areas of human behavior—lying, cheating, stealing—and most definitely the black areas of psychopathology—may be deviations from the norm that are actually sicknesses, illnesses that can be healed by the proper application of OPEN and optimal experience of empathic states, so that it will become almost physically impossible to hurt others and look on without feeling remorse, pity, sorrow. However naive it may be, most children believe that a perfect world is possible—that their parents will once again love each other and remarry, for instance. Unlike earlier children, we have a new power. With the invisible power of literacy we can put ourselves in the place of

others. We can't help it. We feel deeply the power of anger. The anguish of injustice. We can rejoice in our own individuality and in the group with which we identify without needing to do away with others. We are far too addicted to the joy of learning and life to have time to contemplate the destruction of others.

"The religious instinct, at its best, builds vast cathedrals and motivates people to be empathic, to help others, to share, to do no harm. At its worst, it is a means of creating sharply defined classes of people—those in power, who can bully with impunity, and those without power, without human rights, who must submit or be hurt, ostracized, or even killed. This is the history of all religions through all time. In an initiate, pathways of thought are established in the mind that, in some cases, claim to obviate the need for deep thought regarding morally complex issues. We have seen both escape from cults through the use of OPEN and the paradoxical establishment of new cults. It takes strength and help to leave a cult, where all of one's important relationships exist, and seek a more healthy life. No one can predict what effect OPEN will have on religion, though it is interesting to try.

"These issues are, of course, far more complex than any one person can fathom. Systems and philosophies from religions to economic treatises to legal and governmental frameworks and science have proposed cures for the ills that so visibly plague humanity. Some even claim that human nature is itself to blame and that we cannot change what is worst in us without losing what is best in us.

"I think that is an empty, morally bankrupt approach. When we look around and become aware of human suffering, all of us must think of how best we can improve matters. Perhaps new ways to manage resources will bring an end to war. I don't know.

"But I do know that universal literacy, however radically it comes about, will be part of the solution." Applause. A woman approaches from the right side of the stage, smiling.

IT IS SUDDENLY A new world.

MY BROTHERS GET THE shot and grow up, to my great surprise, to be great guys.

A STUTTERING RUSH OF sound, pictures, words, sharp and colorful feelings, then Melody's voice and pictures cease.

I am Alia again, and the tang of salt water, the rush of wind, and the roar of surf bring me back to my surroundings.

I open my eyes. The blue sky and the sparsely populated landscape (I'd been spun across the globe, into classrooms, threaded through history with tremendous speed), and the random cries of the children on the beach below take me by surprise, as when you stop moving suddenly and the world surges forward.

"Do you still paint?"

Melody seems surprised. It takes her a moment to answer, and her voice is slow and thoughtful. "I stopped painting for some years. I was too busy, too happy. I think my painting came from anger. I've painted now and then over the years, in spurts. But it's not the same, and I think that my father was always sad about that. He thought I'd lost my genius. I certainly lost my anger, and that was what propelled my painting, back then. I had no other way to express myself. Dead ends inspire creativity. I've found new challenges, though, that give me the same deep satisfaction as painting once did."

She touches her fingers to her thumbs in a certain combination, and her body glows with complex bioluminescent patterns. "I still love to explore color, pattern, and form. To create these, I studied bioluminescence for two years."

My eyes widen. "Can you give me some?"

She laughs. "See? Design your own! Figure out how to do it!"

I gaze back out at the sea and breathe in sharply at the wonder it now, quite suddenly, contains—a new wonder that wells from all that I see and hear—coordinated, strident, almost as if it is shouting at me, a complex combination of forces and properties, chemistries and habitats, no longer a toy but an astonishing field of information and relationships, some, probably, unknown. Some that I might discover.

LIFE BURSTS OPEN.

I SAY TO MELODY, "This is your art. Opening minds."

Still sitting cross-legged, hands clasped in her lap, Melody lowers her head and nods fiercely, so that her whole body rocks. When she looks up again, her face glows with quiet satisfaction. "I think that's true. I never realized that." She leans over and gives me a long, strong hug, whispers in my ear, "Thank you, Alia."

She stands, spreads her wings, leaps, and dances with the wind, furling, diving, spinning, and gliding, until she is another pixel of blue in the distance, indistinguishable from sky and sea. A dot of infinity.

Leaving nothing resolved, I think, with slight vexation, watching my friend take yet another pounding in the surf below.

Except: everything has changed.

I pick up my board and carefully make my way down to the swirling surf.

STORY NOTES—Kathleen Ann Goonan

I was intrigued by the *Hieroglyph* project when I was asked to participate by editors Kathryn Cramer and Edward Finn and began thinking about what might lead to meaningful change in our future.

I have read widely in the field of neuroscience for many years and had just finished a story about a girl with a particular form of synesthesia (*Arc Magazine,* 2014), and another about the possible effects of a neuroplasticity drug on PTSD victims (*TRSF,* 2013). My novel *This Shared Dream* (Tor, 2011) draws heavily on the fast-changing field of memory research and on the much more slowly implemented field of education research.

Therefore, I asked Joey Eschrich, senior coordinator for the Center for Science and the Imagination at ASU, and my bridge to ASU researchers, to introduce me to someone working in neuroscience. Stephen L. Macknik, Ph.D., is director of the Laboratory of Behavioral Neurophysiology at the Barrow Neurological Institute in Phoenix, Arizona, and Susana Martinez-Conde, Ph.D., is director of the Laboratory of Visual Neuroscience at BNI. We had several e-mail exchanges, and I read their book, *Sleights of Mind: What the Neuroscience of Mind Reveals About Our Everyday Deceptions* (Henry

Holt & Co., 2010). It is a fascinating book but did not particularly yield a focus for my story.

Through Joey, I was eventually able to Skype with Ruth Wylie, Ph.D., at ASU's Chi Learning and Cognition Lab in the Learning Sciences Institute. The lab engages in the kind of hands-on research and development that interests me. Fellows investigate how children learn and how they interact with various materials, and develop and test teaching/learning strategies. In our Skype chat, we talked about Dr. Wylie's particular research, which engages in developing strategies to expand computer-enhanced and computer-tracked learning.

By the time I spoke with Dr. Wylie, I had decided to focus on the process of learning to read, and how future education based on what we are discovering about how we learn might facilitate universal literacy.

Our present U.S. educational system is not science based; instead, it has become business based as the dehumanizing loop of frequent, expensive standardized testing, and targeted materials developed and sold to enable school systems to focus on testing success, have become government mandated. Though this method of teaching and evaluation might not be detrimental to students who are able to learn in this manner, many normal students might fall outside the effective parameters of this method of teaching. Additionally, all bodies are slightly different. Some of us have brains that process information in ways that do not meet the norm, such as children who fall under the broad definitions of dyslexia and dyscalculia, and who are therefore unnecessarily challenged and frustrated by our public schools.

Despite fits of reform enthusiasm, the teaching methods used in our public schools, even in this age of science, are not based on scientific information about how children learn. They are, instead, still based on models developed to homogenize large groups of multiethnic immigrants—to teach immigrant children to be good factory workers by learning English, obeying bell-regulated time signals, and receiving information in boring formats without questioning it rather than participating in shaping their own learning process.

My interest in neuroplasticity springs from my long experience as a Montessori teacher. When young children learn, they go through finely delineated periods of neuroplasticity, several of which, as an example, make learning to speak one's native language effortless and accent-free.

I began Association Montessori Internationale training, in 1975, as a skeptic. I planned to be a writer, but I realized, after finishing my degree in English, that I would not be able to support myself as a writer for some time. Having my own preschool seemed a good way to spend time with young children (not everyone's idea of fun, but it is for me), have my own business, and write in my "spare time." Spare time did not materialize, of course, because within a year of opening my school I had a hundred students, an elementary school, two locations, and many employees. But for fourteen years, I closely observed how well a science-based approach to learning works, and this fostered a great curiosity about neuroscience and the ways in which learning occurs. I learned a lot about early childhood development, observing firsthand how effortlessly most of the four-year-olds I taught could read, write, add, subtract, and multiply. In fact, I had to discourage parents from having their children labeled as gifted. They were, for the most part, normal children in a very good science-based learning environment, doing what normal children are able to do.

The underlying tenets of this approach to early childhood learning, developed in the early twentieth century, have been borne out by science. This is not surprising, for Maria Montessori was a scientist. The first woman to graduate from the University of Rome with a medical degree, in 1896, she became an instant worldwide celebrity when she spoke at the first International Congress for Women's Rights in Berlin that same year. During the next few years, she established herself as an advocate of children with learning difficulties. Being a scientist, she took nothing for granted and developed her educational philosophy and materials using the tool of dispassionate observation. The challenged children in the first learning environment she established, for the City of Rome, passed the city's tests in normal range, which made Dr. Montessori wonder why normal children were not learning at a higher level.

One reason I wanted to teach preschoolers instead of high schoolers, as I could easily have done with my English degree, was that, despite being in one of the best school systems in the country from the time I was in seventh grade, I found it stultifying. I knew there had to be a better way. And there is. In fact, there are many different ways. All of them depend on becoming literate, and the best and most effortless age to become literate is in early childhood, when children are naturally learning language,

numeracy, and spatial skills; when children's growing motor skills can be engaged in learning through their exploration of an environment that holds finely targeted learning materials. However, early childhood education, or for that matter, public education in general, is not held in very high esteem in the United States. Perhaps that is the reason it consistently ranks average in international measurements of student mastery of science, math, and reading.

Finland, and various Asian countries and locales, including South Korea and Taiwan, consistently rank very high in tests administered annually by the Program for International Student Assessment. In 1963, Finland made a decision to make education its number one economic priority, and the highly effective educational system that emerged is the result. To find out more about it, I read *Finnish Lessons: What Can the World Learn from Educational Change in Finland* by Pasi Sahlberg (Teachers College Press, 2013). I also investigated educational methods used in the Asian schools that top the list and learned that Finnish and Asian methods differ greatly. However, they both work. It seems that wherever good education is a cultural priority, as it is in all the top-rated countries, teaching is a highly respected profession. I also read a number of books that offer alternatives to the way education is usually handled in the United States, such as *Who Owns the Learning? Preparing Students for Success in the Digital Age* by Alan November (Solution Tree Press, 2012) and *World Class Learners: Educating Creative and Entrepreneurial Students* by Yong Zhao (Corwin Press, 2012).

When I finally decided to focus on writing science fictionally about helping dyslexics learn to read, I found one of the best books I have ever come across about the neuroscience of reading, *Reading in the Brain: The New Science of How We Read* by Stanislas Dehaene (Penguin Group, 2009). I also read books about dyslexia, such as *Living "Lexi": A Walk in the Life of a Dyslexic* by Shelly Trammell, and other first-person accounts of dyslexia. I also read quite a lot of research about some of the causes of dyslexia.

The process I went through in researching the facets of this story, and of writing it, is similar to my process when writing any fiction. I thank ASU for putting me in touch with some of the top researchers in the field. I hope that the result is interesting enough to spur individual interest in the importance and possibility of literacy for everyone in the world.

RESPONSE TO "GIRL IN WAVE : WAVE IN GIRL"—Erin Walker

Erin Walker, a researcher in the field of personalized learning technology at Arizona State University, responds to "Girl in Wave : Wave in Girl" at hieroglyph.asu.edu/grokking.

FORUM DISCUSSION—Mad Scientist Island

Kathleen Ann Goonan, Bruce Sterling, and other Hieroglyph community members consider the prospect of a radically deregulated "Mad Scientist Island" at hieroglyph.asu.edu/grokking.