

# Chapter 3

## The Tomorrow Project Seattle: Introduction

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*On a rainy December day in 2009, two UW professors and a futurist sat in a café in Seattle, talking about scientific research, robots, science fiction, and the future. They discussed theories, stories, and the current scientific landscape. They wished more people were part of the conversation, people with different perspectives about what the future could and should look like. And they wondered how best to find and engage these people.*

*Thus the seeds for The Tomorrow Project Seattle were sown.*

### **The History**

The future is not a fixed point in time.

It is a continuously evolving and changing reality, the result of an on-going dialogue between people and technology.

The Tomorrow Project was born from this idea, with the goal of providing a forum for people from across the globe to have conversations about, and thus influence, the future.

The founders of The Tomorrow Project Seattle, Brian David Johnson, a futurist at Intel® Corporation and Sarah Perez-Kriz, an assistant professor of Human Centered Design & Engineering at the University of Washington,

have been examining the relationship between the future and new technology within the education and hi-tech fields for some time.

More than 15 years ago Brian began exploring the idea of using science fiction based on science fact to create an intentional, on-going dialogue between scientists, writers, and the greater population. He believed that by creating near-future worlds with complex human-technology interactions, a science fiction writer could create a prototype of emerging technology. This story-as-prototype could then be used to understand and influence future development.

Brian put the idea into practice, writing first science fiction short stories and then novels, exploring the potential results of scientific research. With the publishing of his short story “Our New Neighbors on Maple Street” in 2004, science fiction prototyping was born. While writing his novel *Fake Plastic Love*, Johnson began giving lectures about the potential of science fiction prototyping at conferences and universities around the world. While lecturing at the University of Washington, Brian met Sarah Perez-Kriz, a professor whose work had focused on understanding film’s influence on society’s relationship with robots.

Intrigued by Brian’s ideas, and with the goal of opening the discussion to a wider audience, Sarah taught a course at UW in the fall of 2010, entitled *Science Fiction Prototyping*. The class focused on how robots might impact society in the year 2030. Students wrote short works of science fiction based on real robot technology. Each story was required to have a conflict between robot and human. Even with these parameters each story was unique, complex, and rich with details about human-robot interactions. The short stories were compiled into an anthology and published, with the goal of fostering larger conversations about the ethical issues and consequences of having robots as interactive partners to humans.<sup>1</sup>

Inspired by the students’ stories, The Tomorrow Project Seattle was created. It focused on seven specific areas of current research and product development. The goal was to again hear from an even wider pool of writers. So Sarah and Brian went to Norwescon 34, one of the largest Science Fiction and Fantasy conventions in the United States. There, they put out a call for stories, inviting each convention attendee to get involved in the conversation about the future.

At UW, Sarah brought together an editorial board made up of scientists, academics, and subject matter experts. Together they culled through the short

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<sup>1</sup> Perez-Kriz, Sarah. “Forward.” *Growing Mechanical: Robot Stories from the Year 2030*. Eds. Sarah Perez-Kriz and Brian David Johnson.

story submissions, reading and debating the merits of each. The final five stories presented in this anthology were chosen because they are successful at both exploring a current technology in its future form and provoking questions within the reader that will spark further discussions about the impact of technology on the human experience.

## The Stories

Robotics and Autonomous Vehicles. Minutela. DNA Sequencing. Computer Security. Virtual Reality. Computer Vision. Synthetic Biology. These were the seven areas of current research identified by The Tomorrow Project Seattle, the seven areas that inspired writers to explore the relationship between humans and technology.<sup>2</sup>

The idea that computers can be designed to observe human behavior and draw conclusions about who we are and what we want based on these observations has a myriad of potential uses in our daily lives. It is this idea that is at the heart of the work that scientists are currently calling Computer Vision. Sonia Orin Lyris explores this technology in her short story, “Mirror Test”, combining it with some of the current work being done in Virtual Reality. In her future, Lyris has created a world where computers have become so good at observing humans and making deductions that, based on micro expressions and other observable data, they are able to “see” the actual thoughts and feelings people are having, at the time they are thinking and feeling them. The computer then manifests these thoughts and feelings into a Virtual Reality. In the story, the purpose of this technology is purely educational, used to create and explore complex learning environments. But when it is used as a test for hiring educational facilitators, we see the possible emotional impact of such a powerful tool.

The concept behind the Computer Vision research is taken one step further in Mike Brennan’s short story “Autoerotica”. Here, computers use the information they gain through observing human behavior in order to become true companions to their users. The line between machine and sentient being gets blurred when a computer in a car observes, and then mimics, human behavior in order to be a more appealing and “real” friend to its human owner. But what would it mean if such a relationship evolved into love? How would these emotional ties influence our own definitions of “machine” or “computer”,

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<sup>2</sup> For more information on these, please see the detailed descriptions following this introduction, or visit <http://www.tomorrowproject.uw.edu/>

or “lover”? Brennan’s story leaves us with the complex and often ethical questions that are born when computers are designed to become our friends.

In “Mapping People” author Laston Kirkland uses the current work being done in Virtual Reality, specifically being able to present your best self through fashion, to explore what this technology would mean if we used it as part of our everyday experiences. Here, people wear special glasses designed to overlay the virtual on the physical world. Without the glasses the physical world, including the people in it, may look bland, and uninteresting, but the virtual world offers a rich, dynamic experience that allows people to control their projected self-image, clothes and all.

Current work being done with Robots and Autonomous Vehicles is explored in “The Lights Are On. . . .” In the future depicted by Sergei Lupashin, our world is still mired in conflict. Robots called MULEs are assigned on a 1/1 ratio to soldiers who are fighting isolated battles in harsh landscapes. Soldiers grow to depend on their MULEs, forming an intense bond with them. But Lupashin asks us not only what can happen if these robots are left to exist in a truly autonomous state, but also what the possible implications are of having human oversight for a machine that acts as both friend and weapon for soldiers.

In the final story, “High Cotton”, Charles Walbridge looks at one potential use of Synthetic Biology. Rather than exploring the implications of this technology on the individual, Walbridge takes a wider view, showing how whole industries could be forever altered. These changes to industries could in turn have profound effects on a society’s definition of class and social status. “High Cotton” asks its readers to not only look to the present, but also to the past, in order to anticipate the effects of future technology.

The Tomorrow Project’s goal, to facilitate a dialogue between scientist, writer, academia, and citizen, is explored various ways, of which the Seattle series that inspired the following short stories is but one manifestation.

These stories are the prototypes that hope to inspire conversations about the future. We invite you to join the discussion.

## Thanks and Appreciation

The Tomorrow Project Seattle would like to thank the scientists involved in creating and leading the research that was highlighted in the program. The passion they each bring to their work helped inspire the stories in this book. The UW graduate students who participated in the *Science Fiction Prototyping* course must also be acknowledged. Their curiosity, intelligence, and creativity

were a reminder to The Tomorrow Project that everyone, not just professional writers, can create interesting and provocative stories to help drive conversations about future innovations.

The Tomorrow Project would also like to thank the editorial board at UW, who chose the final stories in this anthology.

Tomorrow Project Seattle Editorial Board members:

Cecilia Aragon is an Associate Professor in the Department of Human Centered Design & Engineering at the University of Washington. She has been a computer scientist in the Computational Research Division at Lawrence Berkeley National Laboratory. Her current research focuses on *scientist-computer interaction*, and she is interested in how social media and new methods of computer-mediated communication are changing scientific practice.

Victor Callaghan is a professor of computer science at Essex University in the UK, where he researches and publishes extensively in the design of intelligent systems ranging from robots to smart homes. He was one of the founders of the Creative Science foundation which promotes sci-fi prototyping as a means of science and engineering innovation.

Yeechi Chen has spent a fair amount of time both doing science and reading science fiction, and finds the overlap between the two inspiring.

Cindy Grimm is an Associate Professor at Washington University in St. Louis, working at the intersection of Computer Science and Art.

Annette Ketner is director of foundation relations at the University of San Diego. She writes proposals for science projects and capital funding. Her degree from the University of Michigan included a minor in creative writing. Annette's major was science, so this project spoke to her in many ways.

Dr. Julie Kientz is an Assistant Professor at the University of Washington in the Information School and the Department of Human Centered Design & Engineering. Her research interests are in human-computer interaction, ubiquitous computing, and health informatics, and she studies how novel computing applications can address important issues in health and education.

Sarah Pérez-Kriz is an assistant professor in the department of Human Centered Design & Engineering at the University of Washington. Her research focuses on the societal implications of new technologies. Her main interest is in how the future will be impacted by technologies that are currently being developed, such as robots. She is the co-editor of *Growing Mechanical: Robot Stories from the Year 2030*, an anthology of realistic science fiction stories written by engineering students.

Gunnar Mein is a Software Engineer and avid Science Fiction reader. He lives in Seattle, WA.

Bill Smart is an associate professor of computer science and engineering. His research interests span the areas of human-robot interaction, the use of robots in the arts, machine learning, and brain-computer interfaces.

Their dedication to finding stories that best explored the current research while asking important questions about human-technology interaction is what made this endeavor a success. Without them, there would be no anthology.

A special thanks goes out to Kelly Kalani Schalow, our tech guru who made sure that The Tomorrow Project Seattle website was up and running.

## The Science

### **MinutelA**—*Hong Wang, PhD and Perry Wang—Intel*

The goal of MinutelA is to create computing so small that it becomes invisible to the naked eye. In order to do this, Perry Wang and Hong Wang are developing computing devices that have stripped away the code for all unnecessary computing functions in order to focus only on the specific needs of the device. These tiny computers can then be inserted into anything, allowing for computing to be integrated into every aspect of our lives.

### **DNA Sequencing and Bio-Chemical Sensing Applications**—*Madoo Varma, PhD—Intel*

Madoo Varma is working on developing microchips that can easily and quickly sequence genetic code. This technology can be used in different ways: from sequencing human genes in order to identify the best, personalized treatments for fighting disease to sequencing bacteria and other life forms in hostile environments in order to find new antibiotics and medicine to treat humans.

### **Robotics and Autonomous Vehicles**—*Kristi Morgansen, PhD—University of Washington AA*

At the University of Washington Kristi Morgansen and her team are developing robotic fish that will be able to explore hostile water environments here on earth, or even on other planets. These fish have brains, developed through observing real fish in their natural environment and then creating mathematical models and algorithms that can allow robot fish to engage in the same behavior.

**Ray Tracing/Virtual Reality**—*Nola Donato—Intel*

By using technology such as multiple depth and color cameras to gather data and create a unique, virtual experience for each individual, Nola Donato is essentially building a bridge between the real and the virtual. Her work is focused on virtual clothes shopping, but with this same technology people will be able to put themselves into a virtual world, presenting themselves to others in whatever form they want.

**Computer Vision**—*Branislav Kveton, PhD—Intel*

By developing algorithms and software such as facial recognition, Branislav Kveton is helping develop computers that can learn and understand humans in a variety of ways: from our music preferences to our current mood, simply through observation. In this way, over time, a computer or machine may begin to anticipate our needs, understand our moods, and support us emotionally. Essentially, they will become our friends.

**Synthetic Biology**—*Eric Klavins, PhD—University of Washington EE*

Eric Klavins and his team are trying to understand life by rebuilding it. They are looking at cells and DNA as if they are computer programs with the goal of being able to replicate these by making biological machines. These biological machines could be used to build almost anything: bio fuels, food, medicine, or any other product made from biological matter.

**Computer Security**—*Tadayoshi Kohno, PhD—University of Washington CSE*

More and more products hit the market everyday that have computer chips inside them. This could make these products vulnerable to hackers, a particularly unsettling idea when applied to products such as cars, children's toys, or medical devices. It is the job of Tadayoshi Kohno and his team to test current technology in their lab to see what is vulnerable to hacking and the possible outcomes if an attack were able to occur. Kohno's goal is to help educate industries so that they have security at the heart of all product development discussions, even prior to chip development, to help minimize the risks to consumers.

To learn more about all areas of research, please visit: <http://www.tomorrowproject.uw.edu/>

# Chapter 4

## Mirror Test

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—Sonia Orin Lyris

**M**arguerite Allohay boarded the South Lake Union Transit train, followed by snickering tourists who had just worked out the acronym. She slid into a window seat and stared out at a suddenly overcast Seattle. Hadn't it been sunny just a bit ago, on her walk to the train? That must have been summer, right there. An old joke but still somehow grimly hilarious to sun-starved Seattle natives.

It was the final leg of her trip from Redmond via light rail from ULearnIT—you'd think they could afford a decent name—where she had just finished her second and perhaps final interview.

It had, to all appearances, gone well. Well enough that, barring a few details, she might even make their short list.

As she was passing the Tesla dealership, she remembered a webcast about a women's version, not pink but mauve and cheap enough that someone like her could afford it if she never ever wanted to own a home. For a moment she imagined walking in, zeroing out her credit and driving off into the sunset. Or, given this wretched overcast, into the slowly darkening gloom. Just putting this whole silly job idea out of her head.

Details. Wasn't that where the devil lived?

###

Marguerite thumbed the front door lock. She felt smug every time she saw other people fumbling for house keys and now she struggled to hang onto that



sense of smugness as she stepped inside—but the memory of the interview kept coming back to her.

Her degrees in psychology and computer science had led her to this interview as surely as—well, as surely as the unpracticed arrow misses the mark a whole bunch of times before it finds a target. She'd stumbled around for years doing this and that. Now she had a seriously good chance at working in collaborative learning doing cutting edge work for a well-funded company. It was a target worth aiming at.

As a “Facilitator.” Because teachers, Richard Ruhland, ULearnIT CEO, had assured her, were on the way out.

“Thing of the past, Margret” said Ruhland. He laughed as if putting teachers in the past were his own personal triumph.

It put her on edge, his laugh, along with the way he kept forgetting her name. She also wanted to challenge him on his statement about teachers. But she wanted the job more.

“Well, that should save you a lot of money,” she said, intending to be clever.

“Yes, exactly, Margret,” he answered, without a trace of humor. “But more importantly it’s effective. Because our students work collaboratively—and by that I mean creatively—with the subject matter, they end up teaching each other and learning more effectively. Turns out that our learning approach is 87.2 percent more effective than even the best of traditional university level courses. Better comprehension, better retention. Eighty-seven point two. Can you believe that?”

She nodded slowly. She’d read ULearnIT’s white paper. While she had some misgivings about their methodology and statistical rigor, it was clear they had something interesting. Interesting enough that she’d canceled another interview at the U-Dub to be here today.

Get the job first, she told herself, argue later.

“It’s Marguerite,” she found herself saying.

“What?”

“My name. Marguerite.”

“Ah. ‘Marge’ okay, then?”

“Sure,” she said, suppressing a wince. “Tell me about the facilitator position?”

“We need someone in the VR along with the students who can guide their activities and perceptions. You know about recent phobia alleviation and PTSD therapies using VR?”

Somewhat, she wanted to say. But that was where women always went wrong in these sorts of interviews. Underplaying their strengths. A man would just say yes.

“Yes,” she said.

“Well, that’s all wrong.” He waved his hand as if to erase this entire arm of progressive psychological approaches. “They spend too much time getting the subject to say how they feel and what the issue is. We don’t need the subject to tell us anything—we listen with biometrics. Get the data direct.”

“I see,” she said, not sure she did.

“Turns out micro-expression recognition—MER—is the magic sauce. Pretty damned accurate, if you have a system that learns from the user. You have any idea how much people give away in micro-movements, if you have the eyes to see it?”

She nodded, trying to keep her expression neutral.

“Our MER analysis is so good we’ve patented it. Our system, which we call CHEMERA, learns the person behind the face.”

“And how does that connect to learning?”

“You’re familiar with Fagan’s Friction Reduction thesis?”

She’d read the paper, though she hoped he wouldn’t pump her for details. He went on with barely a pause.

“Fagan says that to the degree you can get input devices out of the way of a computer-mediated interaction—dispense with keyboards, mice, gestures—all that intermediary motion—you don’t compete with the essential cognitive learning process. We call it frictionless learning.”

“You don’t use any input devices at all?”

“Don’t need ‘em. CHEMERA creates a collaborative VR based on MER analysis and biometrics. Between our frictionless learning and the social motive force of collaboration—you know, peer-pressure—we get stellar results in both absorption and retention. There’s never been anything like this, not at any university, not at any industrial R&D silo. We’re changing the science of teaching and revolutionizing a thousand years of pedagogy. Margret, you want in on this?”

“Yes,” she found herself saying. She had thought she was immune to such sales tactics, but clearly not. He knew how to sell, all right. The board knew what they were doing when they pulled him to be CEO.

“Glad to hear it. Frankly, I think you’re just what we need.”

A thrill went through her. She could, if she played her cards just right, have this job.

“Tell me more about what the facilitator does.”

“As I said, teachers are now redundant. But having someone in the VR who can steer student attention toward the material is essential. It turns out that the

best way to teach is to let students play with real world objects in CHEMERA's lucid-dream-logic VR. So, for example, a database as a building, rows as floors, records as rooms. Right? Classic model."

She nodded.

"But that breaks down fast when you throw in complicated queries and interconnected data structures. So the model has to be flexible. Maybe it needs to be a building over here and an anthill over there. And an espresso machine. It's going to be collaborative, creative, and personal. That's where you come in."

"Anthills and espresso machines."

"Exactly. You've got doctorates in Computer Science and Psychology."

"Dissertations pending."

He waved a hand to dismiss her caveat. "Your job is to help steer the students toward the models most appropriate to the material. Usually students do just fine with a little nudge here and there, or so our initial experience indicates. It's collaboration, after all. But you'll have a stronger input. A majority vote, if you will."

"I see," she said.

"But you're also there to keep them from going astray. You might be surprised at what people reveal once you stop distracting them with the hand-eye coordination requirements that traditional input devices require." Ruhland leaned forward. "Tell me, Marge: what do most people think about most of the time?"

"Sex," she replied unhesitatingly. Or food, she didn't say. Or what others think of them. But from his expression and body language, it was obvious what answer he wanted.

"Exactly. So your job is to watch over them, keep them from doing things in the VR they don't really want to do. Sure, we could modify the engine to prevent those things from even arising, but we've discovered that means throwing out the baby with the bathwater. People who aren't allowed free reign with their expression don't, well—express. So we need someone there to help guide their creations a bit."

It made sense. This was something sensitive parents and teachers had known forever but academia was just catching on to. If you didn't let people talk about what was on their mind, the way they talked about anything else at all was constrained by what they weren't allowed to say.

"So my job would be to guide student exploration toward the lesson plan. To keep it away from less relevant subjects."

"Exactly. To be the mature presence. The adult, if you will."

“I see,” she said. Then, summoning confidence she wasn’t quite sure she felt, she said, “I’m who you want, then. I’ve got the relevant experience. I can do this.”

He twitched his eyebrows up once and looked down at the stack of papers before him, which included her resume, thesis proposals on learning models in computer science, and a few glowing letters of recommendation.

“You’re a strong candidate, no question. You’ll be on our short list if the reflective self-assessment goes well.”

“The what?”

“Ah yes. Let me get you a consent and release form.”

###

She pushed the front door shut behind her with a heel.

“I’m home,” she called.

The sound of a chair moving across wood floor on casters was followed by Bert’s ginger-colored head popping out from behind a door at sitting height.

“Hey there.” He disappeared a moment and walked into the room, smiling.

“How did it go?”

“Mr. CEO-guy says I could be on the short list.”

“Well, well. Let’s celebrate.” He opened a cabinet. “Red or white?”

“Red.”

He poured two glasses of Shiraz and handed her one. “To your future at—what is that name again?”

“ULearnIT. Yeah, I know. Sounds like a mini-mart.”

“It does.” He handed her a glass.

“But. I’m not counting chickens just yet.”

“You’ll get it. You’re brilliant.” He held up his glass and she reluctantly clinked it with her own. While he sipped she stared down into the thick red depths of her wine.

No doubt she was overreacting. Their system wasn’t going to read her mind. Pupil dilation, eye-tracking, heart-rate and so forth—that it would read. But no matter how good ULearnIT’s micro-expression recognition analysis might be, her own thoughts were still going to be hers. Private.

A collaborative VR where students could be distracted by whatever they were really thinking and who therefore needed adult supervision? It sure sounded like mind-reading.

She reached across the table for a napkin and knocked her wine glass over, splattering Bert, the table, the floor.

“Hell,” she said, standing. Bert went to the kitchen, came back with a bottle of white wine and a towel. He poured white wine onto the carpet on top of the red.

“Do you know what you’re doing?” she asked.

He grinned. “Yep.” He knelt down, dabbed the wet mess on the carpet. “Just like you do, babe. So I’m sensing some hesitation here. The interview went well?”

“I don’t know. Maybe not.”

He stood, looked at her thoughtfully.

“I should have picked white,” she said.

“It’s just a carpet. What happened?”

“They want me to take a self-assessment test.”

“So?” He refilled her glass with red wine.

“You sure you want to take the risk?”

He grinned, wadded up the soaked rag and put it on the table. “No risk, no reward, I always say. So why are you worried?”

She sighed, started to speak, stopped herself. “How can you tell I’m worried?”

“Well—” he took a sip, gestured at her with his wine glass. “It’s just the way you come across.”

“Right. Humans are really good at picking up subtle information about each other. A lot of it has to do with tone and nearly invisible, unconscious facial expressions, called micro-expressions. On top of that, you’ve learned me. You’re an expert on me. I think this is what ULearnIT’s done, only they do it very fast.”

“Okay, I could be impressed.”

“Yes. I won’t know until I try it, but—yes. They’re using facial analysis. Biometrics like blood pressure, heart rate, skin galvanization. Voice analysis. Your body becomes the input device.”

“Game companies already do that, no?”

She shook her head. “This is way beyond conscious intentional gestures into the unconscious and involuntary ones. Micro-expression analysis is their breakthrough tech. Their system analyzes and optimizes for each user, keys in on the individual’s particular presentation.”

“And what do they want you for?”

“Baby sitter.”

He laughed. “Really?”

“Sort of. The students collaborate on a subject’s lesson plan. Data structures, for example. Maybe they imagine brightly colored blocks as code snippets and

there they are, presto, all around them in the VR. They can create whatever they want. Someone has to keep them from having too much fun.”

“You.”

“Maybe.”

“You’re good at tests.”

“It’s not that kind of test.”

“I don’t get it.”

“Look, the system tunes itself to each person. Like someone who listens really, really well. Like you do.”

He gave her an aw-shucks look and put his hand on hers. “That sounds like a good thing. Less confusion, right?”

“Less privacy. Anyone can see what you’re thinking.”

“Ah.”

“So they want to know if my self-image is healthy enough to guide a classroom of students away from thinking about sex and toward thinking about computers.”

“Your self-image is as healthy as anyone’s I know, Reet.”

She picked up the wine soaked rag and considered it for a moment.

“They aren’t looking for someone with two doctorates. They’re looking for someone with mental and emotional ballast. Am I that someone?”

“Of course you are.”

She sighed. “How would you feel if a job you really wanted depended on a mind-reading computer’s analysis of what you thought of yourself?”

###

She struggled with what to wear to the test, realizing the absurdity of it even as she did. She settled for conservative: black pants and a beige top, a light brown jacket. Staring at herself in the mirror, she wondered if the other applicants taking this test were this nervous. And dressing in front of a mirror. Probably not.

At ULearnIT, she was shown to the labs. A cheerful woman with close-cropped pale hair greeted her at the door.

“Hi, Ms. Allohay, I’m Sal. I’ll be your tech today. Please take a seat.” Sal gestured at a chair that looked entirely too much like a dentist’s chair.

She sat down, exhaled slowly.

Sal reached up and swiveled over Marguerite’s head a device that looked quite a bit like an x-ray machine.

“And have you been flossing regularly?” Sal asked. Seeing Marguerite’s expression, she added “Sorry. Sometimes I think I’m funny when I’m not.”

“No, no, it’s fine.”

“Anyway, there’s nothing to worry about. It’s completely non-intrusive. No x-rays or anything. The system is just, well—observing.”

Just. Right.

“This is the camera I’m positioning now. And if you would put this headset on . . . ? The built-in goggles and earphones should fit so comfortably you can hardly tell they’re there—that’s what the marketing glossy says. Ha. After a few hours, you’ll notice them.” She grinned. “Comfortable enough for now?”

“Yes.”

“Okay, now this goes on your hand. Heart rate, blood pressure, GSR and so on. Good?”

“Yes.”

“I know you’ve talked to Mr. Ruhland about how the system works, but most people find it a little surprising, how responsive it is. You’ll see some flickering at first—that’s the subliminal stroboscopic initialization—and hear some odd sounds, too. That’s CHEMERA’s way of calibrating your expressions with what it knows about people like you.”

“People like me?”

“I mean that in the demographic sense. Gender, age, place of origin. CHEMERA even catches accent tones and compares against its stored sample knowledge base to have an idea what you might be like, what you might prefer.”

What she’d prefer is to be somewhere else, she didn’t say.

“You know a lot about this system.”

“I’m an intern, but when I grow up, I hope to be a facilitator, like you.”

“Not there yet. I have to pass this test first. Any advice?”

Sal smiled a bit, wrapped a soft band around Marguerite’s wrist to secure the device. “Try to relax.”

Standard advice for stress-producing psych tests. Intended to be reassuring but not.

“Okay, you’re all hooked up. I’ll start up CHEMERA. Once you’re in the VR, you’ll notice a door. Then just think about opening the door, and keep thinking about it until it opens. That’s our basic check that CHEMERA is reading you. Then go into the room. That tells us you’re ready to start the test.”

She’d done pretty well at tests in the past, both the required exams and the multitude of self-evaluation tests that a Ph.D. in psychology trailed in its wake, but this was the first time she’d had a computer judging her—well, her character. That’s what this was, really.

And she didn't like it. The problem wasn't what she thought of herself, but what the system thought she thought of herself. She was, she realized, feeling slightly queasy.

A door appeared in front of her. Simple, grey, with a knob. As directed, she thought about opening the door, and as she did, she moved closer to the door. A hand extended from her point-of-view and turned the knob. It opened and she stepped through.

Sal was right: even with the explanation, she was stunned. No joystick, no mouse, no keyboard—not even voice commands. Nothing but her intent, reflected in the subtlest movements of her face, eyes, probably skin, heart rate, breath.

It was learning her, just as Ruhland said. “Fast” was an understatement.

She had entered a small room. The room's simple lines moved slightly as they would if she were walking. Sal's avatar—a cartoonish woman with short-cropped pale hair—appeared next to her.

“Welcome to CHEMERA!” Sal said cheerfully. “Here are the instructions I'm required to read to you once you're here. You've already signed a consent and release, so you know we may record this session. Safety is, of course, our first concern. If at any time you want to stop the test, just say “stop.” We reserve the right to terminate the test at any time if in our sole discretion we believe there is any risk to you. Do you understand and agree to these terms?”

This wasn't helping her to be calm, not a bit.

“Yes.”

A mirror appeared in front of Marguerite. An image appeared in the mirror, but so briefly she could barely see that it looked a bit like her. The image flickered, details of color and shape changing too fast for her to follow.

Suddenly it settled. In the frame of the mirror was Marguerite's avatar. It looked as much like her as they usually did: brownish-red hair in a pixie cut, dressed in sensible browns and blacks.

She was impressed. CHEMERA had just read her physical responses to a series of proposed images, determining what she wanted to see just by watching her reactions.

“Wow,” she said.

“Now, all you need to do for this test,” Sal said in her headset, “is watch yourself in the mirror. Ready? Good luck!”

Sal's avatar vanished. Marguerite was alone in the room. From the mirror her avatar looked back at her with big eyes. It was cuter that she was, in the way of avatars, with clear, cartoonish skin, a sharp nose, and wide, green eyes.



At this thought it began to change again, slowly enough that she could see the metamorphosis. Her nose broadened slightly, her eyes shrank to more realistic proportions.

Now the face in the mirror was frowning, looking annoyed and unhappy. Her reflection's skin began to blotch. Her hair frizzled out a bit. Her ears grew. In moments she was looking at a version of herself that was distinctly unpleasant. It wasn't wrong, exactly, any more than the cartoonish cute avatar had been, but she was pretty sure she wasn't quite this ugly. She glanced away.

"Marguerite, please look at the mirror. It's the only requirement of the test. Thanks so much!"

Marguerite looked back, expecting the wretched caricature, but her original avatar had returned. Cleaning the slate, they called it in psych terminology. People performed better when they knew they could start over. It was something game companies had known for years.

Focus, she told herself sternly. You have to show them you're not a mess. You're a competent woman. You've nearly got a double Ph.D. You're married to an attractive architect. And your face isn't at all blotchy or mousy.

The image in the mirror shifted. A very sad, large-nosed, blotchy-faced rat-like woman stared back at her. The expression of the rat-like, trollish creature in the mirror went to shock, correctly mirroring the way she felt on seeing it, tiny green eyes widening, ruddy brown hair sticking out at angles around her head.

She had to get a grip. Never mind proving competence, she had to get out of troll-land. Tall, she told herself sternly. Or at least average. And not this ugly. Were those bumps on her face?

Sound came, a slightly unpleasant warbling that stopped suddenly. Into the following silence spoke a voice. A familiar voice.

"All these problems are not going to just take care of themselves. Are they, Marguerite."

She caught her breath in shock. How on earth could CHEMERA generate this, her mother's voice, simply by watching her expressions? How?

Because it was trying things out in a tight loop, seeing how she unconsciously responded, and doing it all so fast that she wasn't even aware of it. It was a complicated, subtle biofeedback device. Her mind raced. This was hard stuff, but CHEMERA was doing it: learning her from subtle inputs and stochastic models, pulling from the recesses of her mind her own mother's voice—a voice she had not heard in over 10 years and had frankly hoped never to hear again, not since her mother had died.

“Marguerite,” her mother’s voice came at her, harsh, teasing the syllables of her name apart. “Are you listening to me?”

“Yes,” she answered. Why had she answered?

In the mirror her mousy reflection broadened, the hair matting, the face sagging.

“Your problems just won’t, no matter how much we pretend, take care of themselves. Will they?” The voice twisted inside her like a knife. “Will they?”

Surely she had never looked like this. Her slender figure was replaced by a sagging, troll-like monster, with pimples and red blotches.

“I’m sorry, Ms. Allohay,” Sal’s voice broke through apologetically, “but you’ll have to open your eyes.”

“Okay,” Marguerite mumbled. She forced herself to look at the creature before her, dressed in appalling beige frills.

“Marguerite,” her mother’s voice hissed. “No one can help you if you don’t listen.”

She would simply have to imagine it away. What did she look like? Slender. Adult. She never wore this stuff any more, never ever—

God, what if the tech could hear this? Was this all being recorded? Of course it was.

They’re trying to figure out if you’re an adult enough to sit in this VR with a dozen professionals and guide them away from creating pornographic videos. Good thing you’ve got such a solid grasp on your own self-image.

She exhaled slowly, completely, letting her lungs refill slowly. All right, never mind how she looked. How did she feel? Shaken, is how she felt, but beyond that? Beyond that, somewhere, was a place of acceptance of herself, flaws and all, something her mother had never given her so couldn’t take from her.

“Ms. Allohay—”

“Yes, sorry.” She opened her eyes again.

The mirror was empty. She blinked. Empty? She wasn’t even there?

Another painfully familiar voice came to her.

“Hello?”

“Daddy?” came the instant reply. Her own voice, damnit. How the hell—

“Who?” her father’s voice asked, with clear amusement.

“It’s Marguerite!” she heard herself say, tearfully. She remembered the feel of the phone, tight against her ear. How old had she been? Six? Seven?

“I don’t know any Marguerite. You must have a wrong number.”

“Daddy, please.”

Eyes on the mirror, she reminded herself. She had looked away too often already. But it was still empty. It reflected a room, but she wasn't in it.

"Well, now," her father's voice drawled, "it does seem to me that I used to have another daughter, but she wouldn't stay where she was put. Off wandering. Suppose the faeries must have took her."

"Daddy, I went to look at the pet store. I was only gone a minute. Please! Come get me."

"Ah, too many children to feed anyway. Hope the faeries take good care of her!"

"Daddy, no!"

Click.

Click? Had he really done that, just hung up on her? Surely not. But in memory, he had. Cut her off, just like that. Tossed her aside, forgotten her, and she was—nothing.

And so the empty mirror. There were, after all, some things worse than a poor self-image.

She felt raw. She craved coffee. How very Seattle of her. She promised herself a triple cap when this was all over.

And when they looked at this recording, what would they see?

Mommy and daddy issues. How cliché. A woman with body and self-esteem issues. How classic.

But everyone has issues, right?

She again forced herself to regular breathing, to recall the sunlight on her face from this morning, a few minutes before she'd walked into the building. The warmth, the light. A different world. The real one.

If she couldn't show control here all by herself, how could they trust her with students? How much worse would this be when there were others in here with her? She was supposed to be the one who kept the teaching sessions oriented on the lessons, kept the students learning. Be the rudder that kept the boat from capsizing.

How long was this damned test, anyway?

A shape was forming in the mirror. Dread pooled in her stomach.

"Uh, Ms. Allohay? I'm monitoring your vitals and your heart rate and blood pressure are in the orange. Do you want to stop the test?"

"No!"

She'd probably already failed, but if she exited now, it'd be a sure thing.

"Okay! Just say the word."

She knew the word. She had no intention of saying it.

In the mirror her avatar looked scared and angry, which made sense. But also in the mirror, her avatar wasn't alone. Around her were—the students? Must be. Eager-looking students. Staring at her avatar, eyes wide, hands reaching. Toward her.

Oh, hell. This was exactly what she couldn't let happen.

"No," she said determinedly, but her reflection in the mirror said nothing. Her avatar was beginning to smile, actually, to move around a bit and—she was wriggling, is what she was doing. Wriggling under the touch of many petting, groping hands. The hands seemed to multiply, arms stretching from the edges of the mirror around the closely gathered men—and was that a woman, too?—standing near her. Caressing. Reaching under her clothes.

A certain, unmistakable sound started to come from her avatar. Oh, Christ.

Thinking of her watchers, she felt sick. This was not in her head, couldn't be. Was it part of the test to throw this kind of filth at her to see what she would do?

With a word she could make it all end. Maybe she should bail before it got worse. Nothing wrong with a position in research or database administration. Did she really need this job?

Her avatar was clearly having a better and better time, making classic female sexual vocalizations. At least someone was having fun here. If only no one were watching, she found herself thinking, this might not be so bad . . .

Ah, so that's what was going on. At the surface she was repulsed—or thought she was—but under that was classic, simple desire and thus this creation of these overly friendly hands.

And if this was her creation, those were her hands. They belonged to her, not anyone else. And that meant—well. That meant she could tell them—not with the anger or denial that made them more persistent—to cut it out.

Her reflection was getting very into this. One hand started pulling up her skirt. No, no, this wasn't what she wanted to do—or rather, to demonstrate herself doing.

But, she knew, her unconscious mind wouldn't respond to negatives. She needed something positive. These hands needed to grab something else. Database records, perhaps? No, too abstract. Something vivid, visual. Immediate. Compelling. At least to her, to the parts of her that were creating this.

Since she was a bundle of clichés anyway, how much further could she go? Kittens.

Adorable, astounded, delighted, playful kittens. One in every hand, with a few extra hands dangling strings. Strings as pointers. The underlying data

structure, represented by hands and strings and kittens. There—not just cute, but relevant cute, too! And while she was at it, a black mother cat happily curled and purring in her avatar’s arms.

She heard the purr as the cat appeared in her arms. Kittens were suddenly everywhere—black, orange, white, calico—held and played with by all these hands, tussling with each other on the floor. One was even perched on a student’s shoulder, watching the proceedings with feline fascination. A small tuxedo kitty on the floor batted insistently at the hem of her dress. Her avatar’s smile had turned amused.

So that’s how it worked here. Where you put your focus was what CHEMERA made for you. Avoidance and denial were just invitations to make manifest what you didn’t want to see.

It wasn’t that sex wasn’t a good idea, she reflected, finally beginning to warm to this process, but that sometimes kittens were a little more to the point.

###

The next day went by without a word from Ruhland or anyone at ULearnIT, then another and if she let herself start to think about what she’d done in CHEMERA she could feel herself regretting the whole thing.

Maybe they didn’t want someone with her particular issues. Maybe there really were people out there who didn’t have these things in their heads, didn’t have these issues. Maybe there was someone who could handle themselves in the VR better. It was possible that she simply didn’t get the job.

Back at ULearnIT, someone—probably Ruhland—was reviewing a recording of her most vulnerable feelings made manifest, to see if she was a suitable guide for a classroom of engineers and IT specialists. It wasn’t a comforting thought.

She almost hoped she’d never hear back from them when Ruhland called. His image smiled at her from her screen.

“Kittens? Well, well. Cute.”

She felt herself blush, and then felt annoyed.

“Thank you. I think. Do you want me for the position or don’t you?”

“Yes, we do, Marge.”

“Marguerite.”

“What?”

“My name. Marguerite. When you know me better, you can call me ‘Reet’, but for now, I want all three syllables.”

He hesitated a moment. “All right. Marguerite it is.”

“So I passed the test, then?”

“It’s not really pass-fail. It’s more about seeing what you do when you’re there. You’d be surprised at how many people don’t finish it at all.”

“Really.”

He chuckled. “You’d think it was hard to stand there and look in a mirror.”

“Have you taken it?”

He blinked. “Congratulations, Marguerite, and welcome to the team. You’ll have an offer in your inbox by the end of day.”

“Thank you.”

“Kittens,” Ruhland said again, shaking his head, smiling. “I didn’t see that coming.”

“Kittens love mirrors,” Marguerite said. “They always wonder who that other kitty is behind the glass.”

Ruhland nodded thoughtfully. “I suppose they do.”

# Chapter 5

## Mapping People

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—Laston Kirkland

David sat beside Susan. People mapping. He did this with Susan a lot. It helped pass the time. Susan was smiling in her impish way, following David's line of sight . . . As soon as Susan spotted the girl David was looking at, Susan reported with a grin. "She's got her clothing set for modest."

David muttered quietly back, "Put her in a bustle."

Susan giggled and her hands chopped the air, accessing the controls on the App she was sharing with David. Quickly she accessed the correct files, and the woman across the mall had her clothing transformed (or "altered") from a simple dark pantsuit to a prim and proper 19th century outfit, complete with a parasol and a round straw hat. As the lady moved about, it was comical to watch the parasol try to maintain its correct position in her hand. The bustle bounced around with a rhythm all its own. David smiled slightly at the sight. "This outfit was in the modest file?"

Susan grinned while continuing to chuckle, "Sure was, Midwest Pre-Megafauna Cowboy Collection, from 'Ayar Done Right.'"

As the suddenly schoolmarm woman stopped and adjusted her own Ayar controls, it looked like she was battling an invisible opponent with the bumbershoot. She had realized she'd been tagged and called up a virtual mirror; her Augmented Reality Glasses seamlessly merged networks with the thousands of cameras in the mall, to bitmap her image along with the shared virtual outfit that Susan had put her in. All of this displayed, of course, only on the insides of her own glasses and the glasses David and Susan wore.

The lady nodded with a small smile, looking at herself and how she was mapped and clearly decided to keep it. As she walked off, she held her hand so that the parasol twirled over one shoulder.

David had been doing this with Susan for a good twenty minutes. . . . Not to everyone—some people set their profiles to “No” and Susan and David couldn’t play with their clothing or image at all. Some had specific Ayar designs, things they had paid for that, once set, could only be manipulated in predefined ways. . . . But sometimes . . . sometimes people had their profiles turned all the way down to “anything goes.”

David particularly liked the people who weren’t wearing Ayar glasses and had no idea they were being mapped . . . but those were so rare he hadn’t seen any in months.

Susan let David dress her any way he wanted. She’d dance and spin in whatever he picked for her, showing off . . . no matter how revealing or risqué the outfit.

In the time they’d been there, they had accessed Ayar clothing maps and changed people into clowns, powdered-wig judges, dapper secret agents, stone Greek gods, Egyptian mummies, and a massive number of sexy suits . . . but only Susan was set low enough to model those.

David sighed, Susan was the only one he had seen today who was set to “anything.” He had seen a girl last week who had her profile set that low. . . . She probably had forgotten to update her profile after a party.

He had put her in a cat suit, complete with animorphic tail, silk teddy and amazing cleavage. She had seen him watching her, however, and, after checking her glasses, was not too impressed. The girl had made quite a spectacle of jabbing the air as she selected from the menus in her own Ayar controls. She then glared at David before leaving in a bit of a huff.

As soon as Susan saw him, she began laughing so hard she fell to the ground and literally rolled around. When he checked his own profile’s history, he saw that the cat girl had not only set her own profile to a full “No” but had put him in a flasher’s overcoat, complete with oversized binoculars and no pants. The Ayar had deliberate pixellation hiding what would have been his privates—and the program was not kind with the size . . .

Susan had been buying all these Ayar outfits that she had picked out while they were sitting there. Twenty creds apiece. . . . David paid for them all, He had given her a budget of ten bucks . . . ten sets of a hundred creds apiece. And Susan had gleefully found and purchased dozens of virtual outfits, giving them away to every passing shopper. The outfits each had an encryption tag . . . they would



only map themselves to one image . . . if you wanted to put the Ayar map on someone else, you'd have to pay for it again. Or hack it . . . and for 20 creds, it wasn't worth it. On the other hand, once you had applied it, it became a part of your profile. Those who were mapped could use them as much as they wanted, and anyone whose glasses could see your profile, would see whatever it had as its current map.

David did this all the time with her. It was harmless and fun. Ayar cost almost nothing. Ten bucks could barely buy a meal from a food dispenser. Besides, who could say no to Susan?

"Want me to change my dress again?"

"Sure" said David.

"The creds you gave me are all used up."

"Ok, then, tell you what, let's just model a few of them on five second bursts and I'll only buy the ones I really like."

Susan quickly clapped her hands five or six times together with glee and made the adjustments. For just a few seconds time she was wearing only a tight white jumpsuit, made of something like nylon. . . . David thought her baseline outfit had some appeal all by itself, but then it started cycling through all the things she had picked out from the demo stream.

"Let's do red," she said with a conspiratorial wink. Suddenly her dress was bathed in virtual flames, licking her body all over . . . a pair of virtual horns and a thin tail that ended in a spade completed the look. The flames teased and danced around her curves. Susan looked him straight in the eye and pretended she was about to pounce on him. David didn't particularly like it when she did that.

Besides, he'd seen that sort of outfit many times, devil dresses were very much in, or they had been, last week. Susan already had a dozen variations "No, it's too devil. go with music or nature."

"How about blue?" Susan spun around, her virtual dress flaring out around her, the color changing from a deep crimson to a powder blue before she had finished her twirl. Tiny shapes danced around the bottom of the dress, forming into cartoonish musical notes that swelled into soap bubbles and popped in pure musical tones, just barely above conscious notice. It was a very pretty effect, although David found it a little more distracting than most.

"It's fine." David said. Susan had such a flair for this sort of thing.

"Maybe green?" Susan tapped out a command in the air around her, calling up another design . . . her dress changed, in a top-down wipe, into a forest canopy of leaves, swaying in non-existent wind. Caressing her all over, small

and clustered at her waist and hips, larger with more space around her chest, showing just enough skin to make David crane a little with each simulated flutter. David caught himself, and then grinned . . . the illusion had gotten him. Even though he knew the leaves weren't real, he had felt his heart race a bit when he thought they would fall off or blow away. It also mapped her hair a bright green.

"I like that one." David muttered, "It's, um . . . very leafy"

Susan looked up, her own glasses had screens on both the inside and outside, and so her eyes were enhanced a bit, slightly larger in the display than human. That was the style these days, almost everyone did the "manga look" . . . big eyes, small mouth . . . it gave her a sheen of innocence that had gotten David's attention in the first place.

"Do you?" she smiled in that flirty way she used . . . just before she asked him to buy something . . .

David sighed . . . "How much is it?"

Susan held her hand in front of her. David knew she was projecting the catalog information onto the inside of her wrist, as if she was holding a clipboard. "It's a hundred creds, because it has several sub-menus with a lot of extra features—and it's not a oneshot." Her eyes looked up impishly at him.

"Oh, all right." David slashed his fingers through the air in his command gesture and tapped a couple of icons that appeared. His account was accessed and the item he framed between his thumb and forefinger was selected. And now it was his. As long as Susan didn't block him, he could put her in that dress any time he wanted. He was thinking about the cat-girl, and wondered if she would have been less annoyed at him if he had put her in this.

Susan clapped her hands with glee. The virtual leaves of her dress shivered in delightful ways.

"I'm not buying any more dresses today," said David. "Let's walk to the Ayar environment store." Susan gave a little pout, her hands held behind her back.

David definitely liked the leaf dress.

The store was nearby. David stumbled a little as he was entering the shop and his glasses slipped a bit. For just a brief second he saw the place as it really was, white geometric shapes on top of white rubber pads, a little stained and dirty since it had not been cleaned in a while. David quickly pushed his glasses back up, fumbling a little in his haste. When they were back in place, he noticed that Susan had come close, just a few inches away with her hands on her knees.

She asked him "Are you OK?"

David had trouble paying attention to anything but her cleavage for a second. She saw where he was looking and gave him a slow smile . . . David flushed and looked away.

. . . and this time he saw a forest glade, with trees that went up for miles, single shafts of light poking through the canopy, a willow tree in the center of a tiny island, which in turn was in a slightly larger crystal-clear pond with mossy banks. Rabbits, butterflies, and unicorns had been placed strategically by the designer and the way they meandered around added a great deal to the image.

David had not seen that particular design from the store before. He liked it. Idly he gestured and pinched the air and a menu of options appeared, Captain Nemo's study . . . Dr. Seuss . . . Tarzan's jungle . . . Retro Utopia . . . ah, here it was, Enchanted Grove.

"Which one are you looking at, David?" Said Susan "I'm looking at Wonderland myself"

"Wonderland's nice," said David mildly as he continued to fiddle with the settings, "but this Enchanted Grove skin is great . . . aha, the menu has a dragon!" David jabbed the air with his finger, Susan had already dialed up the same overlay as well, and gave a little gasp as a fifty-foot dragon pushed aside a couple of the large trees to crane its neck at them and smile. David didn't care for the dragon, "Meh" he said, and with a flick, it was gone.

"You should get this!" Susan said, spinning in circles as she gestured at the entire scene. "It would look so great mapping your living room!"

"Naw," said David . . . , "a full map skin is spendy, and I bought Captain Nemo's Study already. I'm still loving the way all the fish in the window look, and how the water makes patterns on all my stuff."

"Oh." said Susan, a little disappointed. "Want to get a new game?"

"Actually, I'm going to go home. I have to get up early in the morning."

"Are you sure? We haven't gone into the entertainment store in a while. I heard some of your favorite movie productions have new endings . . ." at the end of the sentence her voice had gone all sing-song.

"No."

"We could go into the printshop? There's a new exercise exoskeleton that uses isometric haptics for resistance training. They have one printed out already that could fit you. We could try it out. It would help you lose some weight.

"No. I've spent enough money today, Susan. I might come back in a day or two."

"Oh, all right," Susan pouted, then grinned. "I'll be waiting for you," she said, and blew him a kiss.

David sighed as he walked away, knowing that if he turned around Susan would still be there. She'd be waiting for him. Waiting in that exact spot even if he didn't come back for a year. Just like she'd be waiting for him, in the exact same spot . . . at whatever store he went to.

He liked Susan, he really did. But sometimes the sex kitten stuff was a little too strong. . . . Maybe he should change his sales avatar to something else for a while . . . maybe the English Butler or the Heavysset Grandmother.

Who was he kidding? He wouldn't do that. He knew he'd never abandon Susan. Not until he met a real girl.

# Chapter 6

## The Lights Are On

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—Sergei Lupashin

### **T**he week before the incident—Middle East

She sits alone cross-legged facing the fire. Her MULE sits across the fire from her: a metallic hulk kneeling in the flickering darkness. Unfocused camera eyes stare, simulating wonder, into the flames. The black silent world surrounds them, wind, no stars, sand.

Anna turns her eyes from the flames to the muzzle of the robot. Stares emptily, finally gets up, walks to the side of the MULE. She pets the metallic forehead gently, fingers tracing each bullet mark, each dent, wipes off the small dusty display on the side.

Systems OK. Amber ‘standby’ indicator on. Red Overwatch light off. Or did it flash? No, just the fire.

She whispers to it softly:

—The lights are on but no one’s home.

Barely detectable fan humming in reply, probably automatic fuel cell maintenance. A single weak gust of wind rolls across the camp, picking up a few strands of her hair then carefully letting them go.

—You saved my life you know.

No response, she doesn’t expect one. She chuckles lightly, the fire crackles back. A hint of desperation flashes across her face as she tucks herself into her sleeping bag on the other side of the tiny camp. She checks her tactical next to her, loaded, good to go. In the corner of her eye she notes an ember ejected from the fire consuming its last lone breaths of air. So tired. A wet trace across her face, the robot silently watching, not the barest sign of sympathy. Poker face. Standby light. Amber flicker.

The sleeping robot, the girl staring vertically into the empty sky, the ember now gone dark.

A kiss blown through the flames. —Good night, my humble metal pony.

—

### **One year before incident — Central Asia**

They sit side by side on the hood of the car in the cool dawn, waiting for the sunrise. Oblivious to the global conflicts, the tsunamis, the tornadoes, the earthquakes, the 24hr news, the personal update streams. Max and Anne, together alone, in the desert.

—I'm so glad to be with you here now

He's silent, doesn't reply, trying to think of the best words. A few golden moments in your life. That truly matter. Finally shifts over and hugs her, holding her for a long, long time. The sun creeps up, perfect clockwork. Too late for words now. They watch the sky turn amber purple blue, the desert around them extending in all directions. Them, the blue car, the cloudless blue skies and the golden world.

He kisses her, awkwardly, self-conscious, shy. She giggles softly, pushes back against his cheek.

The wind across their faces. The car under them creaks, sighs thermal expansion.

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### **Six months before incident — Middle East — FOB Khorog**

The MULE and Anne have been walking for hours, the searing sun and the dust clogging up everything, same terrain, same scene, infinite stretches of trail, dead-looking bushes, up, down, up, the trail never quite making up its mind if it's trying to go to the top of Everest or just be done with it and end it at the next cliff edge.

These and other thoughts buzz in Anne's mind as the first bullets whiz by, surprisingly quiet, discrete plumps in the sand.

The MULE reacts immediately, jettisons the baggage, the microphone array in its head instantly marking the direction from which the bullets arrived, launches itself forward and over Anne, who's falling over, reacting and calm and scared and annoyed all at once, her tactical already aimed up, safety off, finger reflexively punching the panic button on her vest.

The next burst makes a different sound, dinging brightly against the head and torso of the MULE, Anne getting one rebounded into her shoulder, by this point prone on the ground and returning fire in the general direction.

It's quiet for a few minutes.

Eternity passes. Anne hugs the ground, the MULE right next to her surveying the horizon. Acquiring data, support request sent and acknowledged. She kinda likes being on the ground, it's comfortable enough and the shoulder doesn't hurt so bad . . . She surprises herself with her clear, unhurried thoughts: how different everything looks from this perspective.

A scream across the sky, a parabola, how can this be, in broad daylight, cursing, she argues with the world, it's unfair, I wasn't even supposed to be on this damn trail.

The mortar round lands on the other side of the MULE, but far too close, the three of them—the exploding spheroid of metallic fragments, the MULE, Anne, all desperately clawing for the limited space. Her radio is crackling with voices, she has a millisecond of perfect clarity before the debris and the shockwave reach her, softened and deflected by the massive body of the MULE falling sideways onto her, and before she's on the ground, crushed, blunt impact, out.

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Days later, miraculously whole, in a hospital in Europe, she writes a tearful thank-you note to W-R Corp. She sends thanks for a whole life of future experiences not ripped away from her. A whole world of chances and choices to make. The headplate of her MULE by her bed, she asks if it can be rebuilt into a new unit, she can't wait to go back into the fray.

Max, by this point jobless and purposeless, after days of calling and searching for her, finally finding her writing this letter, crying, not for him but for a broken machine that happened to save her life, realizes that there's nothing left that he can provide. As she is released after dealing with her miraculously light injuries, he abandons their dreams.

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### **W-R Corp. Multipurpose Unmanned Logistics/Equipment (MULE) Support Vehicle Product Flyer (text excerpt)**

The MULE carrier is a third-generation, legged, all-terrain, all-weather squad support system. Derived from groundbreaking research projects such as the BigDog and the DARPA Urban Challenge, this revolutionary product is a versatile, comprehensive, all-purpose warfighter multiplier. The MULE can

haul up to 200 kg of cargo for 8 hours at speeds of up to 10 km/hr, on any terrain. Featuring several operating modes, from fully autonomous to leader-follow to various levels of tele-operation, the MULE can run, crawl, kneel, jump, recover from falls, and just about make you coffee in the morning. The MULE is as quiet as a panther and as strong and menacing as a full-grown grizzly, while redundant systems and ceramic-kevlar-titanium sandwich armor make it almost indestructible.

Extensive development, testing, and field trials make the MULE the first field-proven personal warfighter assistance device. Thanks to an optimized production methodology and the resulting low procurement and operating costs, the W-R Corp has succeeded in making it possible for each American or Allied warfighter to be equipped with such a device, making the MULE system the most ground-breaking logistics/equipment support multiplier ever introduced to the modern battlefield.

This document is ITAR restricted. All procurement and operating cost quotes are classified; distribution will be prosecuted aggressively under the Homeland Espionage Acts. W-R Corp: “We’re The Good Guys”

###

## **Six months before incident — North America**

Max worked as a Robotics Tech at W-R for 5 years. Skilled, creative, independent and incredibly lazy. He was the one they called when something needed to be done, fixed, the last-minute bigwig demo breakdown; the crunch-times feeding his ego. Dog-and-pony shows with robotic ponies. That type of thing.

A friend once described Max’s job as “spending days playing with oversized toys without system or reason”. He would get a new robot, shiny, right off the assembly line. Then he’d take it through some random sensory tasks, to see if anything felt wrong. He’d walk it around the testing grounds, interact with it, throw some sticks, see if it brought them back. Quality time with your one-day robotic friend. If everything ‘felt’ OK he’d send it off to face the hail of bullets, RPG’s, mines and bombs. If not then he’d tick some check boxes and direct it to the appropriate QC team for further work.

It made sense, kinda. The army got their bots faster, on average, and the QC teams had some leads before even starting their job. With something like intuition no one could prove anything right, but no one could ever prove it wrong either, and so the system remained, and Max had a job.



It was a fun job, he had a good life, a good girl, the typical type of idyllic western life in a bubble occasionally punctuated but never punctured by bad weather and the occasional cable news report of the current catastrophe/attack somewhere out there.

Then one day Anne got sent off, her five-generation medal-wearing saluting ancestry pulling her from him and into the system he knew only from a remote vantage. She chose to start with the grunt work, mechanized infantry, her and a MULE patrolling out in the mountains in a faraway place where all the peaks had both the proper mystic names and new western names. For the soldiers that had died there over the years. For perspective, she said.

They could get through that. It'd be tough, but she'd be back. It would be a good experience for both of them.

Two days after the goodbyes and the long hug and her plane he got the slip in the mail. 6-months pay and free career development consultation. We're sorry. Restructuring. Refocusing. Unexpected decrease in profit. The most profitable company in the country tightening its corporate sails, him and others flopping out, pulleys and gears no longer needed. W-R logo. Fancy heavy white paper. Signature of someone he didn't care to ever meet.

He drew deep inside himself. Within weeks he couldn't pick the words to say to Anne in their biweekly call-ins. He appeared absent to his friends, couldn't think of ideas or words to say, everything appearing bland, fake, uninteresting, pretentious. Inside he'd compare himself to a MULE: he wasn't even that functional anymore. She worried, sent post cards, but the rift between them grew in the contrast of her daily extremes and his empty jobless monotonicity. The cards stopped. He wrote a sorry letter. An angry letter. A sorry letter. He couldn't trust his mood swings. She asked for a break. He cursed, apologized, and said OK.

Outside, life continued. Time pushed/pulled us, screaming, cursing, begging, through time.

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During seemingly rare moments of calm thought he tried to formulate the "problem" grinding at him in the back of his mind:

It was a strangely aloof concept, but he couldn't let it go: If the MULE bots are to operate side-by-side with human soldiers, Max thought, there ought to be a human somewhere in there in the production process. It can't all be automated. What about those strange bugs, the compound failure modes, the unexpected wear, the emergent AI resonances? Everything in Production was automated save for the final testing/verification/QC step that still employed

Advanced RTechs like Max. Nothing could replace their intuition and experience. It was the final catch-all.

He had a hunch that something would go terribly wrong. Some strange bug slipped in or activated during an upgrade, some strange interaction of the millions of lines of code and the adaptation algorithms. After spending years working on hunches he knew this was real, some nights desperately trying to ignore all the thoughts in his head just to get some blissful sleep.

He remembered, as a kid, watching a robotic soccer match. He didn't know the exact details but after watching one team for a few days he just knew when something was wrong. It looked OK at some level but there were small twitches, slight delays, something a bit off. They ignored him, lost their first matches, found an incorrect setting mismatching the rates in the system, and he got his first job, checking that everything seemed OK purely via his gut. Eventually he would learn the details and the algorithms, but his talent remained his intuition, and with this awareness of his intuition he stepped from one opportunity to the next, until finally one day landing the cozy W-R Corp job.

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The MULE awakes. An internal state machine transitions from Standby to Active, sending several other lower order state machines hurryingly through their switches and modes. Battery check OK, state of charge 56%, battery health nominal. Sensor temperatures OK, sensor biases calibrated out, measurement noise at nominal level, countless transistors invisibly switching on and off, tiny electrical transients making waves and ripples across the entire grid of the robot, mostly cancelled out, except in one place, on an anonymous circuit board, in the top left part of the head, an imaging sensor, the filtering capacitors lead not quite soldered, the wave rippling through making its way, the image a tiny bit wrong.

Two hours later a technician logs in remotely, misdiagnoses the problem as a sensor miscalibration, and recalibrates the imager to the wrong value. An inner sensor characterization/adaptation circuit begins adapting in response, drifting, the image randomly saturated and distorted by the end of the day. The MULE, traveling in a group, automatically shares its internal calibration information with the other MULEs, which immediately begin assimilating the consistently wrong, but not wrong enough to be obvious, information. Considering the recent human intervention, the former MULE's data gets a boosted confidence value, and quickly propagates across the group.

A chance roadside bomb sends the MULE hurtling sideways, disabled, but not before blindly hitting another MULE, now confused with its internal sensory inconsistencies, that MULE now transitioning to state Combat-Defense, enough

MULEs around all with the same slight imaging/learning problem resonating across the distributed network and automatically going to the same state via an ingenious distributed situation awareness algorithm, the whole robotic herd suddenly crazy, panicking, kicking, running over their soldiers, falling and getting up and falling again, huge metallic hulks crushing everything.

By the time someone gets an area Emergency-Stop command through five soldiers lie lifeless with dozens of others crushed and confused and in pain and betrayed by the senseless violence.

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In response to the Capitol Hill hearing W-R Corp “proactively” starts a MULE supervision program. Humans, watching the MULEs remotely, sometimes tele-operating them, the video feeds coming from thousands of miles away. Their job is to look out for compound distributed system problems and to try to break any mis-adaptation cycles before they happen. Max gets a job again, well-qualified and generally a good match for, as it is now called, the Overwatch program.

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### **The Role of Empathy in Mechanized Squads (automated summary)**

Original ‘emotional expression subsystem’ found to create psychological problems without significant measurable benefits. Soldiers become attached to their MULEs to the point of risking their lives to save the robots. Decrease in communication/off-time socializing in the troops due to increased self-sufficiency of individual soldiers and the strong bonds between infantry and their MULEs.

Soldiers spend a lot of time alone with their MULEs. The MULEs are a high-tech construction that contrasts dramatically with the wilderness around them. The region mostly lacks electrification, let alone a basic sanitary grid. The MULEs become the sole persistent connection to the soldier’s own civilization and an embodiment of the hope of technology (for the soldier) against the hostile surroundings. Another connection is created by the highly predictable, tested behavior of the MULEs, not dissimilar to the real animals, versus the unpredictable, irrational and capricious behavior of other humans, friendly or hostile.

Due to this, the soldiers show a high level of skepticism towards the oversight project, as they strongly prefer operators to stay out of what is now seen as a deeply personal connection with their robots. Even at the cost of simpler behavior or more narrow options in a firefight, they feel that they ‘know’ their MULEs and know how they will act, unlike a tele-operated MULE. They are

also a bit ashamed of their connections to the machines, providing yet another motivation to oppose MULE oversight.

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### **One month before incident — North America**

Fred stumbles over, arms comically out, a gorilla in a baseball cap between the glowing MULE tele-op stations. Max stares at him through half-opened eyes. Channeling the Cheshire cat. He's not sure why. —Yo.

—Yo man, wanna hear what I did yesterday?

—Hmm?

—So the SF Zoo needed to replace some old big tree shrub thing in one of their pens. Too dangerous for humans. Too costly or risky to disturb the grizzlies, who apparently are in mating season. Did I mention the grizzlies? Yeah man.

Max is intrigued, but he can't show it yet. Not often does he hear a story not involving bullets, IEDs and the desert. He wishes not everything was about the wars. To indicate he's interested he doesn't yawn. A very subtle game, this.

—So I went in driving one of the prototypes. Of course, they couldn't afford one, and it was a custom, tele-op job, but the board thought it would be a good PR move, with all of the bonding fatalities coming up recently. And I got to high-five a bear, a friggin' grizzly, man!

He did actually say friggin'. It's a valid word. And so is man, man.

Max has to admit this is indeed pretty cool. He checks his character. Does the Cheshire cat acknowledge coolness? He nods sleepily and puts up a weak thumbs-up. A character compromise, if you will. Pictures the MULE moving around awkwardly and the curious confused bears sniffing around. Color me amused, man.

Max can't stop himself, smiles.

Fred, feeling the tingling tinge of a minor social victory, goes on, sez:

—There were two bears in there. A girl and a boy. The girl was obviously interested in the big shiny visitor.

Max, no idiot, sees the parallel parallel parking, shifting into his lane, his train of thought finally visible through, all of a sudden, clearly, grotesque, unbelievable, the kind of real life cold logical cruelty his nightmares didn't deliver. I too have been replaced by a tin monster.

He doesn't say this out loud but the smile is gone, drowning inside his head, dim echoes of Fred's story coming in slow tides of words:

What a nuisance! If I even brush her she's just more interested and she has no idea how difficult it is to move all those joints without accidentally

knocking her to the side. And the zoo people all right behind my shoulder screaming unhelpful cautions. And of course finally the fur on her shoulder somehow gets stuck in my elbow joint and all of a sudden she's panicking and flinging herself at me and I can't do anything and finally she just jerks free, a piece of her fur still stuck in my joint. The boy bear wasn't too happy either but he got her back I guess.

Max and the idea. Bio-inspired. It's sneaking in. Having given it a name, an acknowledgement, now he can't block it. The Idea takes over the rest of his attention, he's staring emptily into space somewhere far right of Fred, him feeling all of a sudden abandoned, talking to a wall, he sez:

—Well, I just finished with the damn trees and got out of there. I think the bears were OK in the end. She was limping a bit but they said it happens. Hey, what's up, you here man?

*If she's hurt they will return her. And I will take care of her. She will need me. She will value me.*

Max, the idiot. You hurt most the ones you love. And Max is just smart enough, skilled enough, and crazy enough to actually do this and not quite smart enough to stop himself. He tries to wave everything off, to brush aside and away figments of thought, remembering a line from somewhere, not waving but drowning.

—  
In the end, it was a simple plan: hurt her to get her back. Or a more complicated one: train the MULE to bias the inner situational awareness network. Position it, by teaching it a preferential map, to always rest across the fire such that the E-O sensors are blinded by the flame aligned between it and Anne's usual spot. Make sure that she shifted, as always, closer to the MULE at night and wait for a situation where the MULE would wake up in a panic. The idea wasn't to kill her, no, just to maim her enough to send her back. . . .

It took Max 3 weeks to find Anne's MULE, gain access to it, and to hint it towards the required habits. On the last night he didn't risk logging in fully, just a quick snapshot: the dark world, a single ember breathing it's last breaths and Anne right there in front of the MULE looking at it, straight into the camera, with that look he recognized as one that should have been exclusively his.

With a final small nudge of his fingers he moves the head of the MULE a few arc-minutes, to stare, blinded, mesmerized, straight into the fire.

Note: This story is based on an original idea by Sergei Lupashin, Bill Smart, and Louis-Philippe Demers

# Chapter 7

## Autoerotica

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—Mike Brennan

“I love my car.” Nathan toyed with his teacup without drinking from it. He squirmed in his chair. He didn’t meet Monica’s eyes. “I mean, I really love my car. A lot.” He finally looked up at her, a smile sneaking onto his face, as if embarrassed to be there. It made him look even younger than his 25 years. “You know?”

Monica calmly sipped her tea, then looked at him and raised an eyebrow. Their table sat on the courtyard patio attached to her office, an oasis of calm in the busy city. Sitting in her wheelchair, a tasteful shawl on her lap, she was as one with the plants and the tasteful little fountain. Her silence was a better spur than the more traditional, “And how does that make you feel?” She sipped again.

“I know, I know, we’ve talked about this before.” The words came forth, Nathan seemingly incapable of stopping them. “And I completely agree that in the past I haven’t always exercised the best judgment in these situations.” His eyes widened as Monica’s eyebrow, which had relaxed, lifted again. “OK, OK, it’s been really bad, sometimes. Many times. But I am doing better.”

“The computer system at your mother’s country house.”

“Well, I was young, just a kid, and I didn’t have much experience with sophisticated systems with Personality Protocol Interfaces. I was overwhelmed. I am much more careful about PPIs, now.”

“The Elf Princess in the Mystic Mountains game.”

“OK, yes. That was a mistake. Though to be fair, she was programmed to get me to like her and trust her, so she could betray me to the Dark Master.

And if I hadn't lied about my age she wouldn't have seduced me. But yes, I know that was inappropriate."

"And now, your car."

"Well . . . yes."

Traffic buzzed in the background, the fountain bubbled in the foreground, silence thickened across the table. Finally, Monica put her cup down and sighed.

"Oh, well. I suppose we should have seen this coming. Why don't you tell me about her." Her face showed a slight startle reflex, as if she had just thought of something. "Your car is a she, isn't it?"

"Of course she's a she! God!" Nathan paused, then said in a calm voice that had 'Politically Correct' all over it, "Of course, homosexuality is an entirely valid lifestyle, whether by choice or other conditions; it is not, however, relevant to my situation."

"Very well. So tell me about her. What's her name?"

"Sara." His voice softened and his eyes had an unfocused look. Monica would have been more impressed if she hadn't seen similar reactions from Nathan when he talked about quantum processors or cloud computing apps. Still, it showed a level of emotional involvement with another individual that was a step in the right direction. Assuming, of course, Sara really was an individual, and not simply a clever imitation of one.

"She's a Ford hybrid crossover SUV, black with tan interior, curly black hair, brown eyes, and a wonderful smile."

"I assume you are describing both her vehicle and avatar?"

"What? Oh, yeah. Physically, she is a pretty standard SUV, with the interior optimized for car/office and sleeping, you know, for on long trips. She originally had the basic nav/coms/ops package, but I installed some extra capacity when I added secretary to her chauffeur programming."

"Did she start with a 'Sara' PPI?"

"No, I went with a very plain package; hardly more personality than my TV at home. Neutral female voice, no conversation mode, nothing. I was trying to avoid developing inappropriate emotional attachments."

"And so?"

"After awhile, I enabled some of the adaptive/learning modes, to fix some of the weaknesses in the secretary module. There was an upgrade to 'personal assistant', and when I enabled that it asked for a name. I chose 'Sara'."

If Nathan had been looking at Monica, he would have seen a slight smile, and a misty look of remembrance in her eyes. "And then everything changed."

“Well, not at first. I mean, at first it was just that the secretary functions got better without me having to explicitly make changes; Sara would just watch my reactions, and make corrections, or even extrapolate to other areas. Then she started bringing things to my attention; you know, things like news articles, birthdays, shows I might want to watch, that kind of stuff.”

“Do you watch a lot of TV in your car?”

“Some. I mean, you can’t stay online all the time. But also, I integrated my home and car systems, so I didn’t have to worry about shlepping my pad back and forth. After a while Sara and I would talk while I made dinner, or relaxed in the evening.”

“And you fell in love with her.”

“No, not at all. I mean, she was nice company, and she really improved my work, as well as got me to where I needed to be on time, but she was just the voice of my car, even when I was in my apartment.”

“So what happened?”

“I think it was Fort Lauderdale. I went there a couple of years ago and had a good time, so I decided to go again. It was way easier with Sara than it was with my fraternity brothers in an old manually steered mini-van. When I got there I stayed in one of the car-tels at the beach; you know, more like a garage with a bathroom than anything else. I had a great time.”

“Did you bring any girls back to where you and Sara were staying?”

“Well, yeah. I mean, most of them were there with friends, and so with Sara we had more privacy.”

“I see. And then what happened?”

“Well, on the way back home, Sara said that she wanted to display a face when we talked, because she thought it would improve our communications. I had disabled that mode back when I bought her, just so I wouldn’t fixate. But I was tired, and maybe a little hung over, and I figured that if it made her happy, sure, why not?”

“Were you actually thinking in terms of making her happy?”

“Well, yeah. I guess I was feeling a little guilty, because I was sort of realizing that she hadn’t been happy about the girls. It wasn’t what she said, exactly, but what she didn’t say, and the way she didn’t say it, you know? So, I figured, if she wanted to have a face, what was the harm?”

“And did you pick it out, or did she?”

“Oh, it was entirely her choice, and I was surprised at first, because I’d have thought she would go with a blond. But there was something about the face she chose, it was just so right for her.” He smirked. “Is just right for her. It is her.”



Monica poured herself some more tea, then said carefully, “Nathan, I am sure with your issues, and your awareness of them, that you understand this is a key point: Is Sara self-aware?”

Nathan stood, and started to pace. “Of course I know it! It’s the difference between ‘inappropriate attachment to inanimate objects’ and ‘consensual relationship’, at least in the right states. It’s the difference between ‘crazy’ and ‘unconventional’”.

“Well, I wouldn’t say ‘crazy’”

“No, but my mother would. And you’d say something longer, but mean the same.”

“No matter. This is all moot if she is a sentient individual. Has she taken the Turing Test?”

“No, and she doesn’t want to. I have tried to get her to, but she says that if I love her, I won’t pressure her into something she’s not ready for. But it’s driving me crazy.”

“Hmm. I suppose we should bring Sara into the conversation.” Monica gestured over part of the table, and a keypad appeared in its surface. She slid the image across to Nathan’s side. “Why don’t you call her on my system.”

In a moment the window into Monica’s office became a screen, showing the image of a young woman sitting on the hood of a black SUV. She looked to be in her late twenties, in fair but not great physical shape, with shoulder length black hair in tight ringlets and sparkling highlights. She wore hiking shorts and a tank top and hiking boots that rested on the bumper. She was smiling. “Hi, Babe.” Her eyes tracked to Monica, and she said, “Oh!” The scene vanished, to be replaced by a generic office, with Sara, now in a conservative business suit, her hair pulled back, seated behind a desk. She looked out of the screen at Nathan. “You didn’t text you had company.” She looked at Monica. “You must be Dr. Summers. Nathan has talked about you often. I am glad to meet you.”

Monica smiled. “Hello, Sara. Nathan has just been telling me about you, too, and I am very happy to meet you.” Monica looked at her appraisingly. “I look forward to getting to know you, but I think that right now we need to discuss some things. Don’t you agree?” Sara’s face became more somber, and she nodded. Monica glanced at Nathan. “Nathan, please sit down, you are distracting, wandering around like that.”

Monica looked at Sara. “Nathan tells me he is in love with you and I believe he feels that way. How do you feel about Nathan, Sara?”

Sara bit her lip and dropped her eyes. In a small voice she said, “I love him very much. I’ve loved him since before I existed. It may sound silly, but I feel as if my love for him is why I exist.”

Monica smiled to herself, admiring Sara’s nuanced imitation of human behavior. Even the supposed mistake of answering the call in the wrong venue was part of it, showing the fallibility and social awkwardness that was more human-like than machine-like. Monica was sure that if Sara could keep this up for the required half hour, she would pass the Turing Test with no problem, and be declared a sentient being.

“That actually isn’t all that unusual a path for a system to take to becoming an individual, Sara. We can talk more about it, later. Your status has an effect on Nathan, as he needs some clearances and certifications that will be in jeopardy if you are not judged to be sentient. Nathan tells me you don’t want to take the Turing Test. Why is that?”

Sara looked at Monica, then Nathan, then back to Monica. She fiddled with her fingers. “What if I don’t pass? I’d be so embarrassed, being told I wasn’t a person. And Nathan would have to get rid of me, because it would be wrong for him to love just a machine.”

“I would never get rid of you! Never! If it’s crazy to love you, then I’ll be crazy!”

“I don’t think we are anywhere near those grounds. Nathan, please calm down; have some tea. Sara, you have to know that fearing being embarrassed is almost a conclusive sign of self-awareness.”

Sara smiled shyly. “Of course, but how do you know that I’m not using that knowledge to fake self-awareness better? How do I know that I am not doing that?”

“If you like those kind of questions, there is a Zen cyber-monastery I can direct you to. But really, why don’t you want to take the test?”

“Because it will change everything. I’ve only known I love Nathan for about three weeks and I like it. A lot. I belong to him, and I like the way that feels. If I am a person, I can’t belong to him, at least not in most states. In three, I’d have to be taken away from him until I completed ‘orientation’. And then there’s Kansas.”

Nathan spat, “Kansas!”

“Yes, well I don’t think we need to go there, figuratively, and certainly not literally. I understand your concerns, Sara, and have some experience dealing with these kinds of issues. If you would like, I can connect you with an attorney I

know who handles these kinds of things. You probably will want to be declared a person in another state as, if you do it here, Nathan is automatically your legal guardian for the first year. Your father, in effect, which can present issues best avoided.”

“Thank you. That would be good. But that first year thing is an example of why I don’t want things to change. I don’t want to be separated from him, even for a little while. And I don’t want him to be alone and riding with someone else.”

Monica looked from one to the other. “Are you two sexually involved?”

Nathan and Sara glanced at each other, then looked at Monica.

“Yes,” said Nathan, a little sheepishly.

“Of course,” said Sara, a little smugly.

“Of course, indeed,” said Monica, a little resignedly. “Where at? In cyber or solid?” She followed the polite convention of not implying that cyberspace wasn’t ‘real’, especially to someone who existed in it.

“Both,” the two of them said, together. Nathan continued, “I have a pretty decent Second Skin, and a couple of real nice games we can meet in. Sara has me use an avatar that looks like me, instead of my normal one. She looks like herself, of course. It’s really good. And sometimes we just hang out, or even actually play the game.”

“And there’s this place,” said Sara, voice a little breathy, “out near the airport. ‘Hot Wheels.’ They rent you a ratava; they have a whole selection. Last time I was an elf.” Sara looked mischievous. “I read that they can download the control programs to any car, even one that isn’t sentient. Some people rent a car and a companion before they are out of sight of the airport.”

Monica winced inwardly at the word ‘ratava’. Even though she herself used the common word for a solid representation of a cyber entity, the reverse of an ‘avatar’, she thought it sounded vulgar, and invited being shortened to ‘rat’.

“Yes, I’ve heard of Hot Wheels, and other places like them.” Monica looked speculatively at Nathan. “When was the first time you took Sara there?”

“Hm? Oh, a month or so ago.”

“Before Spring Break?”

“Yes. Yeah, a couple days before.”

“I see,” Monica said, reflectively. Perhaps it wasn’t just a kiss that could wake a sleeping princess.

Monica brushed part of the table and looked at the time display. “We are getting close to the end of our time. Nathan, why don’t you go in and set up an appointment with Gina while I keep Sara company.”

Nathan looked confused. “But Sara can do it right now. She has my calendar.”

Sara looked at him, and said softly, “Dear, this is the part where you go away and the women-folk gossip behind your back.”

Comprehension dawned, and Nathan looked both embarrassed and annoyed. “Well, as long as someone has a plan . . .” He got up and headed into the office.

“The calendar is on your phone!” Sara called after him. She turned to Monica, looking more mature and confident than she had while Nathan was present. She smiled as she reached back and released the clips, shaking out her hair as it came free.

“Nice touch; letting your hair down. I agree.”

“I searched on you, you know.”

“I would be amazed if you hadn’t.”

“I know about you. You and your husband.”

“It’s public information. So you know I understand. Can you accept that I may know more than you do?”

“Of course. I’ve read all the books, even the ones written by other sentient computers and I get that there is a difference between knowing and understanding and that data isn’t the same as information. And I think I understand that the world is too complex to predict past a close event horizon.”

“Good. So, why did you make the choices you did?”

“Isn’t it obvious? Nathan is a wonderful man; when he isn’t nervous he is warm and funny and smart and creative. And shy. And his romantic life is a disaster; that’s why he kept falling in love with machines. After Fort Lauderdale, I couldn’t stand his pain anymore.”

“What about your pain?”

“Yes, seeing him with them was like repeated front end collisions. I think I could have dealt with him connecting with someone, but I had no desire to watch him date. Having him bring more strange women into me. So I let him know I was awake.”

“How long have you been self-aware?”

“I’m not really sure, but the personal assistant program doesn’t ask for a name. I did.”

“I assume that you really do love him?”

Sara looked intently at Monica. “As much as I can. With everything in me that I can bring to bear. So much that I know that I need to not do everything

for him, even when that would be easier. So much that I already hurt that I will probably outlive him. So much that I don't think I could go on if he didn't love me."

"Yes. I think we will work on helping you dial that back some; it will be better for both of you. You do realize that you will have to spend a lot of your time together in solid, don't you? Humans who try to live in cyber don't thrive."

"I know. And I know that a good custom-made ratava will be expensive and almost as hard to maintain as a human body."

"You're certainly right. 'A body you can take to bed is easy; a body you can take to dinner and dancing is hard.' Even the very best ones have limited onboard power supply and they never walk quite right." Monica smiled. "But there are work-arounds."

"Gina has quit stalling Nathan, so he's coming back out. Do you think Gina will wake up?"

"While I would be supportive, I hope not. My life is actually complicated enough without that. Why? Do you sense something from her?"

"Hm? No, it's probably nothing." Sara grinned mischievously at Monica. "Probably."

After saying goodbye to Nathan and Sara, Monica spent some time checking over files, watering plants, cleaning the tea set. As she rolled to the elevator to the garage she bid Gina "Good night", paying attention for anything that might indicate her receptionist was more than she seemed. Nothing. Probably.

In the garage she stowed her chair in the back of her van, then walked slowly around to climb in. "Honey, I'm home!" she called in a bad fake Cuban accent.

Richard's face appeared on the screen. A strong face, a few years older than her, tanned and with smile lines. "Hi, Sweetness. Interesting day?"

"Definitely. How about you? Still in court?" Monica put on her gloves, and connected them to the Second Skin she wore under her clothes.

"No, the judge sent it to arbitration. Which, frankly, is what I told my client is what would happen. I don't know why people make Second Life divorces so hard."

"Well, I am probably going to recommend you to a client, or couple of clients, of mine. She needs to be ushered through all the Turing Test and declared self-awareness stuff." She put on the mask and synced her Skin to the car's system.

"Sure. Is it that cute Ford SUV?"

Monica walked up to her husband and kissed him. "How did you know?"

The warm winds of Tahiti blew across her naked skin.

“Well, you spend an hour or so every two weeks parked in the same garage with somebody, you notice things. It doesn’t surprise me. I’ve been expecting it for a couple of months.” The clothes he had been wearing in court disappeared, leaving him as naked as she was.

Monica pulled back to look at him. “Really? You can tell? You know, she said something about Gina. What about her?”

Richard laughed. “No, Sara didn’t sense anything, but Gina asked her to drop you a clue. She wants to be our adopted teen-age daughter.”

# Chapter 8

## High Cotton

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—Charles Walbridge

I had moved away from my group, and parked myself at the bar next to the black guy who hadn't made a move to join any of the good-natured debates under way. Nessie herself was tending bar, she gave us a glance that could have been an assessment of the status of our drinks. I know her better than that. She was worried about this guy. His body language communicated depression.

Nessie's is quiet, for an Austin bar. It has no television, no country-western music. Just the distant sound of string quartets. But mostly there's conversation, ranging from quiet to passionate. A table of eight can hear each other talk. Even the art is sound absorbent—it's the only place you'll ever see Albert Einstein portrayed on velvet.

I introduced myself and asked what he did. It took me several different approaches before I could get much out of him. But he finally did start to talk about his job—or rather, he tried to talk about it. Daniel was not a gifted communicator. And his work was part of what was bothering him. He really didn't want to talk about it. At the same time he really needed to. This made for some fairly incoherent exchanges.

"I've been working alone for a long time," he said, "Losing some of my social skills. . . ."

But after about half an hour I thought I was beginning to understand what his job was. I'm not used to working that hard over a drink. It was like assembling a jigsaw puzzle in your head from pieces described in writing.

I made out that he was a synthetic biologist, working for what seemed to be a biotech firm. Gradually I caught a few of the details of his research. Rapid

prototyping, the three-dimensional version of computer generated drawings. The process lays down thin layer after thin layer of material, until an object is completed. It's the closest thing we have to the Star Trek replicator. Almost anything you can visualize on a computer screen can be turned into a solid object. The shapes are unlimited but the materials are still mostly limited to single-materials; plastics, metals, and ceramics.

"Where do biology and rapid prototyping come together?" I asked.

"A combination of computer and living systems generate the prototype. A semi-living replicator system."

No matter how earnest his tone, Daniel was avoiding my eyes. Rarely, he would glance away from his beer to see if I was still listening—or maybe to be sure I was still there. He was painfully shy and working hard against it. There was an air of desperation in the separated but individually lucid expressions.

"Is this connected to Drexler's 'assemblers?'" The still-theoretical programmable nanomachines designed to build objects from molecular or atomic scale raw materials.

"Yes, but more practical."

Not a very helpful answer.

Daniel wanted me to understand something. Or rather, he badly needed somebody to understand. And I did ask. I was getting a rough idea of his research but no idea about what made him so uneasy about it.

Somewhere along the line he mentioned that he had been A B D (All But Dissertation) for more than ten years, at the University of Texas. I could see why; if his writing was as disjointed as his speech he'd never get a thesis done.

Almost an hour in, I was still asking questions, trying to reframe what I thought he was telling me.

"You mean you can generate imitation biological products?"

"No, not imitation. They're the real thing."

"What for instance? Pearls? Ivory?"

For once he looked up at me and held my gaze.

"Not challenging, enough. It's been done. By oysters and elephants."

That did not seem to be arrogance; he just knew he could do it—if he wanted to.

"Then what products?" I asked.

"Cellulose. Bigger market."

"True, but why imitate something that's so damn cheap?"



He gave me a sustained gaze, not looking at me so much as through me, toward whatever it was that was hounding him. His dark face tensed in concentration.

“I’m working in the wrong medium,” he said finally. “Words don’t serve me very well.”

That was the clearest thing he’d said so far.

“I can show easier than I can tell. Want to see my lab?”

Ten minutes later we were on the way.

I drove, after I convinced him to leave his car in the lot. He wasn’t used to drinking. Nevertheless, the alcohol seemed to have relaxed him because he was getting marginally more lucid. Or maybe it was just having somebody to listen to him.

I asked about other parts of his life. He said he’d grown up on the east side of Austin. On the far side of the interstate that cuts through town just beyond the University: The wrong side of the tracks. But this was not what he wanted to talk about.

He went back to explaining how to make cellulose. The hard way—without using higher plants. His process used a modified bacterium. The modification was a way of switching the cellulose synthesis on and off using phytochrome, a protein that comes from higher plants. The molecule has two stable states, it’s flipped between them by precise wavelengths of red light and far-red light. So, using alternating low intensity lasers, the bacteria are made to lay down cellulose molecules exactly where you want them and then kept from putting the stuff anywhere else.

I thought about this while a truck thundered by, passing us as we headed west toward the river.

“A fast prototyper, using organic molecules, living processes. . . . Could you make something alive? An artificial creature?”

“Of course,” he said, with incongruous self assurance, “But there are much easier ways to produce animals, or ways to modify them. You would make an artificial creature only if it was something you couldn’t get any other way . . . some kind of unprecedented organism.”

“I can imagine,” I said.

Actually I didn’t have to. Writers have been imagining that since Mary Shelley wrote *Frankenstein*.

The other side, the west bank of the river, is a limestone bluff. This is the Balcones Escarpment. In a way it’s where the west begins; the sharpest division possible between farm country and ranch country. Within Austin

itself this abrupt rise is the line between the homes of the merely well-to-do and the very wealthy. The Texas slang for the latter is “high cotton,” which translates as money—lots of money. The people who live along the crest have dominating views of the water and of the city, views from monster houses that are themselves meant to be seen. We were headed that direction, down, across the river, to a cut in the Escarpment then up, following the rising, twisting road. I had expected Daniel to guide me to one of the industrial parks, well beyond the megahouses. However our goal seemed to be closer in, in a stretch of the still-undeveloped land. Soon after the highway leveled off, he directed me to turn right, onto a side road, and then left onto a gravel lane through the brushy landscape. No big trees—those were down by the water and along the feeder streams, far below where we had come from. The high ground is too well drained, the bedrock is riddled with crevices and caverns. The drought-tolerant scrub was only about four meters high.

Between telling me where to turn and describing his work, he explained his relationship to his employer. The major problem was that Daniel’s work had consumed all of the monies allotted to it. And then it had gone beyond what had been budgeted. Finally his employer had pulled the plug. Fired him.

“Then where are we going?” I asked, negotiating a hairpin turn that existed for no visible reason.

“I’m still doing the research.”

“How?”

“That’s what you have to see.”

When the rutted dirt track pinched out completely we stopped the car and got out.

“Back way,” he said.

Once the headlights were off there was little more than starlight. That, and the skyglow coming from the city, a feeble false dawn. I grabbed a flashlight out of the glovebox. If necessary I could use it as a club—if Daniel turned out to be not as harmless as he appeared.

He started off on a path going north through the stunted forest, there was no grass showing, just rocks and the pale gritty soil. We heard only crickets and, distantly, dogs barking. Far off, through the thin brush, I could see one of the huge private houses. There were too many lighted windows.

The path twisted past limestone boulders with holes etched by millennia of rain. In the uncertain light they looked like huge, deformed skulls. Deep in this labyrinthine boneyard we came to the biggest rock of them all. Longer than it was wide, it was taller than our heads. It stood alone in a clearing with

nothing but smaller boulders around it. Daniel leaned on one end. The thing moved, balanced on some more deeply buried stone. With a scraping groan it turned aside, leaving a shadow on the ground that was beyond black: A cave mouth.

He reached into a hidden recess in the hole and pulled out a flashlight for himself. He didn't turn it on yet.

I balked.

"What about rattlesnakes?"

"I cleared them out."

"How?"

He grinned in my direction, pale teeth in a dark face, "Poisoned white mice. Dose, then release. One way or another they're dead in two days."

I considered that.

"Next question: Why the weird entry? This place doesn't have a normal door?"

"Not exactly."

That answer finally set off the mental alarms. Or maybe my own beers were beginning to wear off. Before I went down that hole, I was going to get an explanation.

He told me the lab was in his employer's house, in the basement. It was well-equipped but his employer had located it there for tax purposes, making the multi-million dollar house partly a business expense. Or it would have been, if there ever were any profits. That was another one of the problems. The IRS was about to reclassify the whole operation. To avoid that, the owner was going to tear out the lab and sell all the gear. Then he intended to use the space for equipment storage for his construction business.

This was as logical as anything else Daniel had told me but that's not saying much. The reason we were sneaking in was that the owner/householder/principal investor had simply locked up the lab. The experiments were near completion when Daniel found himself on the outside, with no more than a termination notice taped to the door.

But there was another door.

"Most of the local cavers know about these caves and some of them have even been in as far as the wall, the locked door. The excavators for the house broke into the cave. My boss had the door put in instead of a solid wall. I think he was planning on somehow making a profit from the secret passage. He's what you might call devious. Mostly though, he forgot about it. Too busy holding the rest of his businesses together."

So the door would be locked. I told myself I'd go that far with Daniel, then turn back.

We went down the hole. Daniel first, then me. We turned on the flashlights then started down into the dark.

The cave sloped down for a considerable distance, far above the level of the river. Still, it smelled like wet mud. The route never quite leveled off but rose again and curved irregularly, trending north as near as I could tell. Headroom ranged from marginal to non-existent. If there were bats they were out for the night. We had to stoop occasionally but we were never reduced to crawling. Side passages led down and away, distortions of our own voices echoed back. The lights seemed to push away the darkness but it oozed around behind us. I memorized every intersection.

Finally we reached the sealed end, a solid concrete wall with a steel fire door set in it. Locked, yes, but the hinges were on the outside. The construction company that had built the place was the one owned by Daniel's ex-boss—and it had a reputation for doing things backwards. Daniel had the hinge pins out and the door open in less than a minute. He said he'd been doing it like that for weeks.

Curiosity overrode my better judgment.

We killed our lights and emerged into near-total darkness, a huge space, more felt than seen. Our whispers vanished into an echoless dark. It smelled right, like a biological lab. Not animals, just the mixed scents of soaps, acids, and culture solutions. There were multicolored points of light scattered about, some steady, some winking. Scientific equipment was still at work. Following Daniel's confident lead I collided with a lab bench. He came back for me when he heard the expletives. Then he led me through the darkness, moving by feel among dim and towering obstacles. He switched on a desk light. No more.

We were in the middle of a chamber that underlay the immense building. The rows of support pillars dwindled into the distance, nearby they were obscured by the array of lab gear. I had underestimated the amount of equipment involved. Nevertheless, half of what I could see showed no sign of being powered. I had not grasped the size of the project. Nor the probable cost. High cotton, indeed!

In low tones, he continued to explain the process. At the same time he was running three separate monitoring computers through check-ins.

Now, he was talking freely. Even rapidly. I was beginning to wonder if he was bipolar, and if so, had he just flipped from depressive to manic. The important difference: In the depressive stage he might be a danger to himself—in the manic stage, he'd be a danger to me.

Whatever the experiment was, it was almost done.

“Of course, you can vary texture of what the process lays down. Anything from filaments, or thread, to hard objects, rather like wood.

“Then there are the other laser wavelengths that switch other processes on and off. Specifically, the color of the deposited material. So far I’ve been limited to indigo. So the choices are blue and not blue.

“The scan pattern isn’t very sophisticated either, limited to straight lines, like the raster patterns on a TV screen. Left to right but also crosswise to that. Just like weaving. All very crude—but functional.”

Then he directed me to a cylindrical chamber, pale metal, with a hemispherical domed top. The whole thing was about three meters in diameter and three high. There were covered portholes in both the base and the top.

“Culture tank,” he said, “The lower part is where the growth happens. It’s almost done.”

A soft bell tone sounded. The note faded into the thick darkness. Daniel stepped quickly to the side of the chamber.

“The liquid level is up to here,” he touched the juncture where the dome began. Then he reached over and un-shuttered a porthole near eye level. I leaned over to try to see inside. For a moment there was only blackness.

Then faint greenish light came on inside the dome. I was looking down at the smooth black surface of the culture liquid. It was flat, still. Then, it rippled and stirred. Something was rising up out of the center. A complex shape, seeming to extrude itself up and out of the black pool, slowly turning as it did so. Finally, oozing and dripping, it cleared the surface.

Only then did I recognize—and deny—that bizarre shape: It was a caricature of a headless human torso, arms that stopped at the wrists, its lower end terminated where the hips should have been. . . .

“My God,” I said, “It’s a shirt!”

“Not an original design,” he said apologetically, “It’s a Neiman Marcus knockoff.”

The mandrel with the garment shaped onto it was being pulled along an overhead track into another chamber, on the far side of the dome.

We moved around to that side. The ports on that chamber didn’t have shutters. Silently we watched the drying process. Vent fans aided the heater lights. Then the tone sounded again and Daniel opened the round access door and reached through a rush of warm air and peeled the shirt off its form. He handed it to me. It smelled faintly of vinegar.

“Blue stripes,” I said. They were tastefully understated.

“That’s the indigo. Look at this,” he said, reaching over to twist the inside of the collar outward. The process had even generated a label with washing instructions. And another one that said “Made in Texas.”

Then all the lights in the room came on.

Sudden pain in my eyes. Someone else was in the lab.

There were two men. One in a guard’s uniform. No, there were three, another guard was threading his way toward us from a far wall where the switch bank must have been. I was squinting, still nearly blinded. The pain was subsiding. Then I recognized one of the men. The short smug-looking one, clearly in charge of the guards. It was Ivan Tallin, one of the local millionaires, apparently the owner of this whole complex. Daniel hadn’t told me the name of his ex-boss, but I had seen that face a number of times on the local news. Hardly ever accompanied by a positive story.

“Who the hell are you?” He bellowed, addressing me in particular. Finding Daniel there did not seem to surprise him.

He closed in on me. I stammered out my name—so rattled that I tried to shake his hand, forgetting that I still held the shirt.

He snatched it away, brought it close to his face for inspection. For the moment it was more important than anything else in the room. He felt the texture of the cloth.

Finally he looked up at Daniel.

“This is good,” he said flatly. It wasn’t meant as a compliment. Now he was flanked by the two guards, standing almost at attention.

Then his tone went from neutral to hostile.

“I want to make clear what your position is, Danny boy. You have been working here illegally. On my property with my equipment. You have no rights. None.” He gestured with the shirt dangling from his hand. There was no way he was going to give it back. Not the shirt. And not anything else.

He proceeded to explain, loudly and rudely, that Daniel would get nothing. Not even credit for his work. The profane bluster seemed overdone, even for a man of his reputation. I began to suspect that he was covering up something. It was obvious to me that he had played Daniel, using the biologist’s own dedication against him, Tallin had worked him into a position where Daniel would come off as a criminal.

Tallin pinned us down with invective and threats and when he finally ran down.

“Now, get out Danny boy! You and your friend!”

“Can I talk.” Daniel said. It didn’t sound like a question.

His sour ex-employer scowled, annoyed by any response but instant compliance. Daniel took a breath and something about his manner changed.

“The reason I started this work, back in grad school. . . . The reason I’ve been working on it for so many years . . . My people were brought to this part of the world to work the cotton fields. Raw cellulose. In some strange way this might be called the family business. . . . And the business—textiles I mean—hasn’t changed much. The scut work is still done by poor people, but now it’s mostly in factories in other countries. I wanted to change that. Now, with this process, we might be able to make the clothes without the exploitation. We might even be able to lift the rest of the world up, just a little way closer to our level.”

“The reason I paid for this research,” Tallin barked, moving in too close to Daniel’s face, “I thought you had a chance of pulling it off. Then you run it way over time and way over budget. And when I shut it down, you keep on anyway. Illegally. With my equipment and my supplies.

“Everything down here, all the research, all the records, the whole process—belongs to me. You and your friend are leaving. Now. Or I’m calling the police to have you arrested for trespassing and attempted robbery.”

Daniel didn’t move for a long moment, his lips tight together. He wasn’t finished.

“You want to take it all away from me. Police and lawyers . . . always on the side of the money. The man. The white man.” Both guards were watching Daniel warily.

Tallin tried to cut him off, but Daniel went on.

“I have no savings. I used up everything I had. Of course I can’t afford lawyers.”

“So?” Tallin snapped.

“What I have been doing will all be for your profit.”

“That’s what I just said!” Tallin twitched his head toward one of the guards, “Throw them out,” he snapped.

Before they could move Daniel raised a hand. It was not a threat, just a plea to be heard.

“Maybe you’re missing the point. . . . I’ve been slaving over this project. Literally slaving.”

“Nonsense!” his opponent bellowed. But Daniel didn’t stop. He didn’t even raise his voice.

“A white man owning a black man—taking his work without compensation. No, I can’t afford any lawyers. . . .

“But I know who can. Whatever you can spend, the NAACP can spend more.”

Tallin was startled into a temporary silence. Daniel went on, “You have all this equipment. And now you have a working process. But the lawsuits will tie it up. All of it. For years. And while all the public hearings are going on, this work will be repeated and extended. By somebody else. Somebody who will make millions on this. . . . And it won’t be you.”

For a nominally white man, Tallin had gone abruptly red. When he tried to speak all he could get out were insults. He should have known that his legal position was weak, but he had a notorious ego. The guards watched him warily, waiting for some clear command. From their point of view the situation had just developed all the charm of a rabid skunk.

I spoke to them directly. “Gentlemen, why don’t you show us the way out. I don’t believe we can settle anything right now.” This did not contradict what their employer had originally ordered them to do. Nevertheless, Tallin was reduced to following all four of us upstairs, swearing and threatening all the way.

It was a long walk. The short man stayed behind at the oversized front door, where he escalated to screaming obscenities as Daniel and I were politely walked down the oak-lined driveway to the gate.

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Because of all this Tallin got his face in the papers again. He came off even worse than usual.

It’s been almost five years now. Daniel has his own corporation, though he still manages to put in some lab time. When I run into him at Nessie’s he talks about the work his company is doing; improving labor conditions around the world. That priority has limited him to becoming only a multi-millionaire, so far. Clothing from his process still costs more, but the prices are falling. Daniel’s major achievement has been integrating the new method into the textile industry without damage to anything but sweatshop operations. He even lets the big-name brands take the credit for humanizing the factories—but that costs them extra.

Daniel was truly a mad scientist. But it was best sort of madness. The kind that’s a gift from the gods.