

BAD BLOOD

Secrets and Lies

in a Silicon

Valley Startup

John Carreyrou

Bad Blood

| Secrets and Lies in a
| Silicon Valley Startup |

JOHN CARREYROU



ALFRED A. KNOPF New York

2018

THIS IS A BORZOI BOOK PUBLISHED BY ALFRED A. KNOPF

Copyright © 2018 by John Carreyrou

All rights reserved. Published in the United States by Alfred A. Knopf, a division of Penguin Random House LLC, New York, and distributed in Canada by Random House of Canada, a division of Penguin Random House Canada Limited, Toronto.

www.aaknopf.com

Knopf, Borzoi Books, and the colophon are registered trademarks of Penguin Random House LLC.

Library of Congress Cataloging-in-Publication Data

Names: Carreyrou, John, author.

Title: Bad blood : secrets and lies in a Silicon Valley startup / John Carreyrou.

Description: First Edition. | New York : Knopf, 2018.

Identifiers: LCCN 2018000263 | ISBN 9781524731656 (hardback) | ISBN 9781524731663 (ebook)

Subjects: LCSH: Theranos (Firm)—History. | Hematologic equipment industry—United States. | Fraud—United States. | BISAC: BUSINESS & ECONOMICS / Entrepreneurship. | BUSINESS & ECONOMICS / Finance. | TECHNOLOGY & ENGINEERING / Biomedical.

Classification: LCC HD9995.H423 U627 2018 | DDC 338.7/681761—dc23 LC record available at <https://lcn.loc.gov/2018000263>

Ebook ISBN 9781524731663

Cover design by Tyler Comrie

v5.2_r1

ep

Contents

Cover

Title Page

Copyright

Dedication

Author's Note

Prologue

1. A Purposeful Life
2. The Gluebot
3. Apple Envy
4. Goodbye East Paly
5. The Childhood Neighbor
6. Sunny
7. Dr. J
8. The miniLab
9. The Wellness Play
10. "Who Is LTC Shoemaker?"
11. Lighting a Fuisz
12. Ian Gibbons
13. Chiat\Day
14. Going Live
15. Unicorn
16. The Grandson
17. Fame
18. The Hippocratic Oath
19. The Tip
20. The Ambush

21. Trade Secrets

22. *La Mattanza*

23. Damage Control

24. The Empress Has No Clothes

Epilogue

Acknowledgments

Notes

About the Author

For Molly, Sebastian, Jack, and Francesca

Author's Note

This book is based on hundreds of interviews with more than 150 people, including more than sixty former Theranos employees. Most of the men and women who appear as characters in the narrative do so under their real names, but some asked that I shield their identities, either because they feared retribution from the company, worried that they might be swept up in the Justice Department's ongoing criminal investigation, or wanted to guard their privacy. In the interest of getting the most complete and detailed rendering of the facts, I agreed to give these people pseudonyms. However, everything else I describe about them and their experiences is factual and true.

Any quotes I have used from emails or documents are verbatim and based on the documents themselves. When I have attributed quotes to characters in dialogues, those quotes are reconstructed from participants' memories. Some chapters rely on records from legal proceedings, such as deposition testimony. When that's the case, I have identified those records at length in the notes section at the end of the narrative.

In the process of writing this book, I reached out to all of the key figures in the Theranos saga and offered them the opportunity to comment on any allegations concerning them. Elizabeth Holmes, as is her right, declined my interview requests and chose not to cooperate with this account.

Prologue

November 17, 2006

Tim Kemp had good news for his team.

The former IBM executive was in charge of bioinformatics at Theranos, a startup with a cutting-edge blood-testing system. The company had just completed its first big live demonstration for a pharmaceutical company. Elizabeth Holmes, Theranos's twenty-two-year-old founder, had flown to Switzerland and shown off the system's capabilities to executives at Novartis, the European drug giant.

"Elizabeth called me this morning," Kemp wrote in an email to his fifteen-person team. "She expressed her thanks and said that, 'it was perfect!' She specifically asked me to thank you and let you all know her appreciation. She additionally mentioned that Novartis was so impressed that they have asked for a proposal and have expressed interest in a financial arrangement for a project. We did what we came to do!"

This was a pivotal moment for Theranos. The three-year-old startup had progressed from an ambitious idea Holmes had dreamed up in her Stanford dorm room to an actual product a huge multinational corporation was interested in using.

Word of the demo's success made its way upstairs to the second floor, where senior executives' offices were located.

One of those executives was Henry Mosley, Theranos's chief financial officer. Mosley had joined Theranos eight months earlier, in March 2006. A ruffled dresser with piercing green eyes and a laid-back personality, he was a veteran of Silicon Valley's technology scene. After growing up in the Washington, D.C., area and getting his MBA at the University of Utah, he'd come out to California in the late 1970s and never left. His first job was at chipmaker Intel, one of the Valley's pioneers. He'd later gone on to run the finance departments of four different tech companies, taking two of them public. Theranos was far from his first rodeo.

What had drawn Mosley to Theranos was the talent and experience gathered around Elizabeth. She might be young, but she was surrounded by an all-star cast. The chairman of her board was Donald L. Lucas, the venture capitalist who had groomed billionaire software entrepreneur Larry Ellison and helped him take Oracle Corporation public in the mid-1980s. Lucas and Ellison had both put some of their own money into Theranos.

Another board member with a sterling reputation was Channing Robertson, the associate dean of Stanford's School of Engineering. Robertson was one of the stars of the Stanford faculty. His expert testimony about the addictive properties of cigarettes had forced the tobacco industry to enter into a landmark \$6.5 billion settlement with the state of Minnesota in the late 1990s. Based on the few interactions Mosley had had with him, it was clear Robertson thought the world of Elizabeth.

Theranos also had a strong management team. Kemp had spent thirty years at IBM. Diane Parks, Theranos's chief commercial officer, had twenty-five years of experience at pharmaceutical and biotechnology companies. John Howard, the senior vice president for products, had overseen Panasonic's chip-making subsidiary. It wasn't often that you found executives of that caliber at a small startup.

It wasn't just the board and the executive team that had sold Mosley on Theranos, though. The market it was going after was huge. Pharmaceutical companies spent tens of billions of dollars on clinical trials to test new drugs each year. If Theranos could make itself indispensable to them and capture a fraction of that spending, it could make a killing.

Elizabeth had asked him to put together some financial projections she could show investors. The first set of numbers he'd come up with hadn't been to her liking, so he'd revised them upward. He was a little uncomfortable with the revised numbers, but he figured they were in the realm of the plausible if the company executed perfectly. Besides, the venture capitalists startups courted for funding knew that startup founders overstated these forecasts. It was part of the game. VCs even had a term for it: the hockey-stick forecast. It showed revenue stagnating for a few years and then magically shooting up in a straight line.

The one thing Mosley wasn't sure he completely understood was

how the Theranos technology worked. When prospective investors came by, he took them to see Shaunak Roy, Theranos's cofounder. Shaunak had a Ph.D. in chemical engineering. He and Elizabeth had worked together in Robertson's research lab at Stanford.

Shaunak would prick his finger and milk a few drops of blood from it. Then he would transfer the blood to a white plastic cartridge the size of a credit card. The cartridge would slot into a rectangular box the size of a toaster. The box was called a reader. It extracted a data signal from the cartridge and beamed it wirelessly to a server that analyzed the data and beamed back a result. That was the gist of it.

When Shaunak demonstrated the system to investors, he pointed them to a computer screen that showed the blood flowing through the cartridge inside the reader. Mosley didn't really grasp the physics or chemistries at play. But that wasn't his role. He was the finance guy. As long as the system showed a result, he was happy. And it always did.

—

ELIZABETH WAS BACK from Switzerland a few days later. She sauntered around with a smile on her face, more evidence that the trip had gone well, Mosley figured. Not that that was unusual. Elizabeth was often upbeat. She had an entrepreneur's boundless optimism. She liked to use the term "*extra-ordinary*," with "extra" written in italics and a hyphen for emphasis, to describe the Theranos mission in her emails to staff. It was a bit over the top, but she seemed sincere and Mosley knew that evangelizing was what successful startup founders did in Silicon Valley. You didn't change the world by being cynical.

What was odd, though, was that the handful of colleagues who'd accompanied Elizabeth on the trip didn't seem to share her enthusiasm. Some of them looked outright downcast.

Did someone's puppy get run over? Mosley wondered half jokingly.

He wandered downstairs, where most of the company's sixty employees sat in clusters of cubicles, and looked for Shaunak. Surely Shaunak would know if there was any problem he hadn't been told about.

At first, Shaunak professed not to know anything. But Mosley sensed he was holding back and kept pressing him. Shaunak gradually let down his guard and allowed that the Theranos 1.0, as Elizabeth had

christened the blood-testing system, didn't always work. It was kind of a crapshoot, actually, he said. Sometimes you could coax a result from it and sometimes you couldn't.

This was news to Mosley. He thought the system was reliable. Didn't it always seem to work when investors came to view it?

Well, there was a reason it always *seemed* to work, Shaunak said. The image on the computer screen showing the blood flowing through the cartridge and settling into the little wells was real. But you never knew whether you were going to get a result or not. So they'd recorded a result from one of the times it worked. It was that recorded result that was displayed at the end of each demo.

Mosley was stunned. He thought the results were extracted in real time from the blood inside the cartridge. That was certainly what the investors he brought by were led to believe. What Shaunak had just described sounded like a sham. It was OK to be optimistic and aspirational when you pitched investors, but there was a line not to cross. And this, in Mosley's view, crossed it.

So, what exactly had happened with Novartis?

Mosley couldn't get a straight answer from anyone, but he now suspected some similar sleight of hand. And he was right. One of the two readers Elizabeth took to Switzerland had malfunctioned when they got there. The employees she brought with her had stayed up all night trying to get it to work. To mask the problem during the demo the next morning, Tim Kemp's team in California had beamed over a fake result.

—

MOSLEY HAD a weekly meeting with Elizabeth scheduled for that afternoon. When he entered her office, he was immediately reminded of her charisma. She had the presence of someone much older than she was. The way she trained her big blue eyes on you without blinking made you feel like the center of the world. It was almost hypnotic. Her voice added to the mesmerizing effect: she spoke in an unusually deep baritone.

Mosley decided to let the meeting run its natural course before bringing up his concerns. Theranos had just closed its third round of funding. By any measure, it was a resounding success: the company

had raised another \$32 million from investors, on top of the \$15 million raised in its first two funding rounds. The most impressive number was its new valuation: *one hundred and sixty-five million dollars*. There weren't many three-year-old startups that could say they were worth that much.

One big reason for the rich valuation was the agreements Theranos told investors it had reached with pharmaceutical partners. A slide deck listed six deals with five companies that would generate revenues of \$120 million to \$300 million over the next eighteen months. It listed another fifteen deals under negotiation. If those came to fruition, revenues could eventually reach \$1.5 billion, according to the PowerPoint presentation.

The pharmaceutical companies were going to use Theranos's blood-testing system to monitor patients' response to new drugs. The cartridges and readers would be placed in patients' homes during clinical trials. Patients would prick their fingers several times a day and the readers would beam their blood-test results to the trial's sponsor. If the results indicated a bad reaction to the drug, the drug's maker would be able to lower the dosage immediately rather than wait until the end of the trial. This would reduce pharmaceutical companies' research costs by as much as 30 percent. Or so the slide deck said.

Mosley's unease with all these claims had grown since that morning's discovery. For one thing, in his eight months at Theranos, he'd never laid eyes on the pharmaceutical contracts. Every time he inquired about them, he was told they were "under legal review." More important, he'd agreed to those ambitious revenue forecasts because he thought the Theranos system worked reliably.

If Elizabeth shared any of these misgivings, she showed no signs of it. She was the picture of a relaxed and happy leader. The new valuation, in particular, was a source of great pride. New directors might join the board to reflect the growing roster of investors, she told him.

Mosley saw an opening to broach the trip to Switzerland and the office rumors that something had gone wrong. When he did, Elizabeth admitted that there had been a problem, but she shrugged it off. It would easily be fixed, she said.

Mosley was dubious given what he now knew. He brought up what

Shaunak had told him about the investor demos. They should stop doing them if they weren't completely real, he said. "We've been fooling investors. We can't keep doing that."

Elizabeth's expression suddenly changed. Her cheerful demeanor of just moments ago vanished and gave way to a mask of hostility. It was like a switch had been flipped. She leveled a cold stare at her chief financial officer.

"Henry, you're not a team player," she said in an icy tone. "I think you should leave right now."

There was no mistaking what had just happened. Elizabeth wasn't merely asking him to get out of her office. She was telling him to leave the company—immediately. Mosley had just been fired.

A Purposeful Life

Elizabeth Anne Holmes knew she wanted to be a successful entrepreneur from a young age.

When she was seven, she set out to design a time machine and filled up a notebook with detailed engineering drawings.

When she was nine or ten, one of her relatives asked her at a family gathering the question every boy and girl is asked sooner or later: “What do you want to do when you grow up?”

Without skipping a beat, Elizabeth replied, “I want to be a billionaire.”

“Wouldn’t you rather be president?” the relative asked.

“No, the president will marry me because I’ll have a billion dollars.”

These weren’t the idle words of a child. Elizabeth uttered them with the utmost seriousness and determination, according to a family member who witnessed the scene.

Elizabeth’s ambition was nurtured by her parents. Christian and Noel Holmes had high expectations for their daughter rooted in a distinguished family history.

On her father’s side, she was descended from Charles Louis Fleischmann, a Hungarian immigrant who founded a thriving business known as the Fleischmann Yeast Company. Its remarkable success turned the Fleischmanns into one of the wealthiest families in America at the turn of the twentieth century.

Bettie Fleischmann, Charles’s daughter, married her father’s Danish physician, Dr. Christian Holmes. He was Elizabeth’s great-great-grandfather. Aided by the political and business connections of his wife’s wealthy family, Dr. Holmes established Cincinnati General Hospital and the University of Cincinnati’s medical school. So the case could be made—and it would in fact be made to the venture capitalists

clustered on Sand Hill Road near the Stanford University campus—that Elizabeth didn't just inherit entrepreneurial genes, but medical ones too.

Elizabeth's mother, Noel, had her own proud family background. Her father was a West Point graduate who planned and carried out the shift from a draft-based military to an all-volunteer force as a high-ranking Pentagon official in the early 1970s. The Daousts traced their ancestry all the way back to the *maréchal* Davout, one of Napoleon's top field generals.

But it was the accomplishments of Elizabeth's father's side of the family that burned brightest and captured the imagination. Chris Holmes made sure to school his daughter not just in the outsized success of its older generations but also in the failings of its younger ones. Both his father and grandfather had lived large but flawed lives, cycling through marriages and struggling with alcoholism. Chris blamed them for squandering the family fortune.

"I grew up with those stories about greatness," Elizabeth would tell *The New Yorker* in an interview years later, "and about people deciding not to spend their lives on something purposeful, and what happens to them when they make that choice—the impact on character and quality of life."

—

ELIZABETH'S EARLY YEARS were spent in Washington, D.C., where her father held a succession of jobs at government agencies ranging from the State Department to the Agency for International Development. Her mother worked as an aide on Capitol Hill until she interrupted her career to raise Elizabeth and her younger brother, Christian.

During the summers, Noel and the children headed down to Boca Raton, Florida, where Elizabeth's aunt and uncle, Elizabeth and Ron Dietz, owned a condo with a beautiful view of the Intracoastal Waterway. Their son, David, was three and a half years younger than Elizabeth and a year and a half younger than Christian.

The cousins slept on foam mattresses on the condo's floor and dashed off to the beach in the mornings for a swim. The afternoons were whiled away playing Monopoly. When Elizabeth was ahead, which was most of the time, she would insist on playing on to the bitter end, piling on the houses and hotels for as long as it took for David and

Christian to go broke. When she occasionally lost, she stormed off in a fury and, more than once, ran right through the screen of the condo's front door. It was an early glimpse of her intense competitive streak.

In high school, Elizabeth wasn't part of the popular crowd. By then, her father had moved the family to Houston to take a job at the conglomerate Tenneco. The Holmes children attended St. John's, Houston's most prestigious private school. A gangly teenage girl with big blue eyes, Elizabeth bleached her hair in an attempt to fit in and struggled with an eating disorder.

During her sophomore year, she threw herself into her schoolwork, often staying up late at night to study, and became a straight-A student. It was the start of a lifelong pattern: work hard and sleep little. As she excelled academically, she also managed to find her footing socially and dated the son of a respected Houston orthopedic surgeon. They traveled to New York together to celebrate the new millennium in Times Square.

As college drew closer, Elizabeth set her sights on Stanford. It was the obvious choice for an accomplished student interested in science and computers who dreamed of becoming an entrepreneur. The little agricultural college founded by railroad tycoon Leland Stanford at the end of the nineteenth century had become inextricably linked with Silicon Valley. The internet boom was in full swing then and some of its biggest stars, like Yahoo, had been founded on the Stanford campus. In Elizabeth's senior year, two Stanford Ph.D. students were beginning to attract attention with another little startup called Google.

Elizabeth already knew Stanford well. Her family had lived in Woodside, California, a few miles from the Stanford campus, for several years in the late 1980s and early 1990s. While there, she had become friends with a girl who lived next door named Jesse Draper. Jesse's father was Tim Draper, a third-generation venture capitalist who was on his way to becoming one of the Valley's most successful startup investors.

Elizabeth had another connection to Stanford: Chinese. Her father had traveled to China a lot for work and decided his children should learn Mandarin, so he and Noel had arranged for a tutor to come to the house in Houston on Saturday mornings. Midway through high school, Elizabeth talked her way into Stanford's summer Mandarin program. It was only supposed to be open to college students, but she impressed

the program's director enough with her fluency that he made an exception. The first five weeks were taught on the Stanford campus in Palo Alto, followed by four weeks of instruction in Beijing.

—

ELIZABETH WAS ACCEPTED to Stanford in the spring of 2002 as a President's Scholar, a distinction bestowed on top students that came with a three-thousand-dollar grant she could use to pursue any intellectual interest of her choosing.

Her father had drilled into her the notion that she should live a purposeful life. During his career in public service, Chris Holmes had overseen humanitarian efforts like the 1980 Mariel boatlift, in which more than one hundred thousand Cubans and Haitians migrated to the United States. There were pictures around the house of him providing disaster relief in war-torn countries. The message Elizabeth took away from them is that if she wanted to truly leave her mark on the world, she would need to accomplish something that furthered the greater good, not just become rich. Biotechnology offered the prospect of achieving both. She chose to study chemical engineering, a field that provided a natural gateway to the industry.

The face of Stanford's chemical engineering department was Channing Robertson. Charismatic, handsome, and funny, Robertson had been teaching at the university since 1970 and had a rare ability to connect with his students. He was also by far the hippest member of the engineering faculty, sporting a graying blond mane and showing up to class in leather jackets that made him seem a decade younger than his fifty-nine years.

Elizabeth took Robertson's Introduction to Chemical Engineering class and a seminar he taught on controlled drug-delivery devices. She also lobbied him to let her help out in his research lab. Robertson agreed and farmed her out to a Ph.D. student who was working on a project to find the best enzymes to put in laundry detergent.

Outside of the long hours she put in at the lab, Elizabeth led an active social life. She attended campus parties and dated a sophomore named JT Batson. Batson was from a small town in Georgia and was struck by how polished and worldly Elizabeth was, though he also found her guarded. "She wasn't the biggest sharer in the world," he recalls. "She played things close to the vest."

Over winter break of her freshman year, Elizabeth returned to Houston to celebrate the holidays with her parents and the Dietzes, who flew down from Indianapolis. She'd only been in college for a few months, but she was already entertaining thoughts of dropping out. During Christmas dinner, her father floated a paper airplane toward her end of the table with the letters "P.H.D." written on its wings.

Elizabeth's response was blunt, according to a family member in attendance: "No, Dad, I'm not interested in getting a Ph.D., I want to make money."

That spring, she showed up one day at the door of Batson's dorm room and told him she couldn't see him anymore because she was starting a company and would have to devote all her time to it. Batson, who had never been dumped before, was stunned but remembers that the unusual reason she gave took some of the sting out of the rejection.

Elizabeth didn't actually drop out of Stanford until the following fall after returning from a summer internship at the Genome Institute of Singapore. Asia had been ravaged earlier in 2003 by the spread of a previously unknown illness called severe acute respiratory syndrome, or SARS, and Elizabeth had spent the summer testing patient specimens obtained with old low-tech methods like syringes and nasal swabs. The experience left her convinced there must be a better way.

When she got back home to Houston, she sat down at her computer for five straight days, sleeping one or two hours a night and eating from trays of food her mother brought her. Drawing from new technologies she had learned about during her internship and in Robertson's classes, she wrote a patent application for an arm patch that would simultaneously diagnose medical conditions and treat them.

Elizabeth caught up on sleep in the family car while her mother drove her from Texas to California to start her sophomore year. As soon as she was back on campus, she showed Robertson and Shaunak Roy, the Ph.D. student she was assisting in his lab, her proposed patent.

In court testimony years later, Robertson recalled being impressed by her inventiveness: "She had somehow been able to take and synthesize these pieces of science and engineering and technology in ways that I had never thought of." He was also struck by how

motivated and determined she was to see her idea through. “I never encountered a student like this before of the then thousands of students that I had talked” to, he said. “I encouraged her to go out and pursue her dream.”

Shaunak was more skeptical. Raised by Indian immigrant parents in Chicago, far from the razzle-dazzle of Silicon Valley, he considered himself very pragmatic and grounded. Elizabeth’s concept seemed to him a bit far-fetched. But he got swept up in Robertson’s enthusiasm and in the notion of launching a startup.

While Elizabeth filed the paperwork to start a company, Shaunak completed the last semester of work he needed to get his degree. In May 2004, he joined the startup as its first employee and was granted a minority stake in the business. Robertson, for his part, joined the company’s board as an adviser.

—

AT FIRST, Elizabeth and Shaunak holed up in a tiny office in Burlingame for a few months until they found a bigger space. The new location was far from glamorous. While its address was technically in Menlo Park, it was in a gritty industrial zone on the edge of East Palo Alto, where shootings remained frequent. One morning, Elizabeth showed up at work with shards of glass in her hair. Someone had shot at her car and shattered the driver’s-side window, missing her head by inches.

Elizabeth incorporated the company as Real-Time Cures, which an unfortunate typo turned into “Real-Time Curses” on early employees’ paychecks. She later changed the name to Theranos, a combination of the words “therapy” and “diagnosis.”

To raise the money she needed, she leveraged her family connections. She convinced Tim Draper, the father of her childhood friend and former neighbor Jesse Draper, to invest \$1 million. The Draper name carried a lot of weight and helped give Elizabeth some credibility: Tim’s grandfather had founded Silicon Valley’s first venture capital firm in the late 1950s, and Tim’s own firm, DFJ, was known for lucrative early investments in companies like the web-based email service Hotmail.

Another family connection she tapped for a large investment, the retired corporate turnaround specialist Victor Palmieri, was a longtime friend of her father’s. The two had met in the late 1970s during the

Carter administration when Chris Holmes worked at the State Department and Palmieri served as its ambassador at large for refugee affairs.

Elizabeth impressed Draper and Palmieri with her bubbly energy and her vision of applying principles of nano- and microtechnology to the field of diagnostics. In a twenty-six-page document she used to recruit investors, she described an adhesive patch that would draw blood painlessly through the skin using microneedles. The TheraPatch, as the document called it, would contain a microchip sensing system that would analyze the blood and make “a process control decision” about how much of a drug to deliver. It would also communicate its readings wirelessly to a patient’s doctor. The document included a colored diagram of the patch and its various components.

Not everyone bought the pitch. One morning in July 2004, Elizabeth met with MedVenture Associates, a venture capital firm that specialized in medical technology investments. Sitting across a conference room table from the firm’s five partners, she spoke quickly and in grand terms about the potential her technology had to change mankind. But when the MedVenture partners asked for more specifics about her microchip system and how it would differ from one that had already been developed and commercialized by a company called Abaxis, she got visibly flustered and the meeting grew tense. Unable to answer the partners’ probing technical questions, she got up after about an hour and left in a huff.

MedVenture Associates wasn’t the only venture capital firm to turn down the nineteen-year-old college dropout. But that didn’t stop Elizabeth from raising a total of nearly \$6 million by the end of 2004 from a grab bag of investors. In addition to Draper and Palmieri, she secured investments from an aging venture capitalist named John Bryan and from Stephen L. Feinberg, a real estate and private equity investor who was on the board of Houston’s MD Anderson Cancer Center. She also persuaded a fellow Stanford student named Michael Chang, whose family controlled a multibillion-dollar distributor of high-tech devices in Taiwan, to invest. Several members of the extended Holmes family, including Noel Holmes’s sister, Elizabeth Dietz, chipped in too.

As the money flowed in, it became apparent to Shaunak that a little patch that could do all the things Elizabeth wanted it to do bordered on

science fiction. It might be theoretically possible, just like manned flights to Mars were theoretically possible. But the devil was in the details. In an attempt to make the patch concept more feasible, they pared it down to just the diagnostic part, but even that was incredibly challenging.

Eventually they jettisoned the patch altogether in favor of something akin to the handheld devices used to monitor blood-glucose levels in diabetes patients. Elizabeth wanted the Theranos device to be portable like those glucose monitors, but she wanted it to measure many more substances in the blood than just sugar, which would make it a lot more complex and therefore bulkier.

The compromise was a cartridge-and-reader system that blended the fields of microfluidics and biochemistry. The patient would prick her finger to draw a small sample of blood and place it in a cartridge that looked like a thick credit card. The cartridge would slot into a bigger machine called a reader. Pumps inside the reader would push the blood through tiny channels in the cartridge and into little wells coated with proteins known as antibodies. On its way to the wells, a filter would separate the blood's solid elements, its red and white blood cells, from the plasma and let only the plasma through. When the plasma came into contact with the antibodies, a chemical reaction would produce a signal that would be "read" by the reader and translated into a result.

Elizabeth envisioned placing the cartridges and readers in patients' homes so that they could test their blood regularly. A cellular antenna on the reader would send the test results to the computer of a patient's doctor by way of a central server. This would allow the doctor to make adjustments to the patient's medication quickly, rather than waiting for the patient to go get his blood tested at a blood-draw center or during his next office visit.

By late 2005, eighteen months after he'd come on board, Shaunak was beginning to feel like they were making progress. The company had a prototype, dubbed the Theranos 1.0, and had grown to two dozen employees. It also had a business model it hoped would quickly generate revenues: it planned to license its blood-testing technology to pharmaceutical companies to help them catch adverse drug reactions during clinical trials.

Their little enterprise was even beginning to attract some buzz. On

Christmas Day, Elizabeth sent employees an email with the subject line “Happy Happy Holidays.” It wished them well and referred them to an interview she had given to the technology magazine *Red Herring*. The email ended with, “And Heres to ‘the hottest start-up in the valley’!!!”

The Gluebot

Edmond Ku interviewed with Elizabeth Holmes in early 2006 and was instantly captivated by the vision she unspooled before him.

She described a world in which drugs would be minutely tailored to individuals thanks to Theranos's blood-monitoring technology. To illustrate her point, she cited Celebrex, a painkiller that was under a cloud because it was thought to increase the risk of heart attacks and strokes. There was talk that its maker, Pfizer, would have to pull it from the market. With the Theranos system, Celebrex's side effects could be eliminated, allowing millions of arthritis sufferers to keep taking the drug to alleviate their aches and pains, she explained. Elizabeth cited the fact that an estimated one hundred thousand Americans died each year from adverse drug reactions. Theranos would eliminate all those deaths, she said. It would quite literally save lives.

Edmond, who went by Ed, felt himself drawn in by the young woman sitting across from him who was staring at him intently without blinking. The mission she was describing was admirable, he thought.

Ed was a quiet engineer who had gained a reputation in the Valley as a fix-it man. Tech startups stymied by a complex engineering problem called him and, more often than not, he found a solution. Born in Hong Kong, he had emigrated to Canada with his family in his early teens and had the habit common among native Chinese speakers who learn English as a second language of always speaking in the present tense.

A member of Theranos's board had recently approached him about taking over engineering at the startup. If he accepted the job, his task would be to turn the Theranos 1.0 prototype into a viable product the company could commercialize. After hearing Elizabeth's inspiring pitch, he decided to sign on.