CHAPTER 8

“Copy It”

Around the same time that Nikita Khrus hchev declared his support for building Zelenograd, a Soviet student named Boris Malin returned from a year studying in Pennsylvania with a small device in his luggage—a Texas Instruments SN-51, one of the first integrated circuits sold in the United States. A thin man with dark hair and deep-set eyes, Malin was one of the Soviet Union’s leading experts on semiconductor devices. He saw himself as a scientist, not a spy. Yet Alexander Shokin, the bureaucrat in charge of Soviet microelectronics, believed the SN-51 was a device the Soviet Union must acquire by any means necessary. Shokin called Malin and a group of other engineers into his office, placed the chip under his microscope, and peered throug h the lens. “Copy it,” he ordered them, “one-for-one, without any deviations. I’ll give you three months.”

Soviet scientists reacted angrily to the suggestion they were simply copying foreign advances. Their scientific understanding was as advanced as that of America’s chemists and physicists. Soviet exchange students in the U.S. reported learning little from lectures by William Shockley that they couldn’t have studied in Moscow. Indeed, the USSR had some of the world’s leading theoretical physicists. When Jack Kilby was finally awarded the Nobel Prize in Physics in 2000 for inventing the integrated circuit (by then the co-inventor of the integrated circuit, Bob Noyce, had died), he shared the prize with a Russian scientist named Zhores Alferov, who’d conducted fundamental research in the 1960s on ways semiconductor devices could produce light. The launch of Sputnik in 1957, the first space flight of Yuri Gagarin in 1961, and the fabrication of Osokin’s integrated circuit in 1962 provided incontrovertible evidence that the Soviet Union was becoming a scientific superpower. Even the CIA thought the Soviet microelectronics industry was catching up rapidly.

Shokin’s “copy it” strategy was fundamentally flawed, however. Copying worked in building nuclear weapons, because the U.S. and the USSR built only tens of th ousands of nukes over the entire Cold War. In the U.S., however, TI and Fairchild were already learning how to mass-produce chips. The key to scaling production was reliability, a challenge that American chipmakers like Morris Chang and Andy Grove fixated on during the 1960s. Unlike their Soviet counterparts, they could draw on the expertise of other companies making advanced opti cs, chemicals, purified materials, and other production machinery. If no American companies could help, Fairchild and TI could turn to Germany, France, or Britain, each of which had advanced industries of their own.

The Soviet Union churned out coal and steel in vast quantities but lagged in nearly every type of advanced manufacturing. The USSR excelled in quantity but not in quality or purity, both of which were crucial to high-volume chipmaking. Moreover, the Western allies prohibited the transfer of many advanced technologies, including semiconductor components, to Communist countries via an organization called COCOM. The Soviets could often bypass COCOM restrictions using shell companies in neutral Austria or Switzerland, but this pathway was hard to use on a large-scale basis. So Soviet semiconductor facilities regularly had to work with machinery that was less sophisticated and with materials that were less pure, producing far fewer working chips as a result.

Spying could only get Shokin and his engineers so far. Simply stealing a chip didn’t explain how it was made, just as stealing a cake can’t explain how it was baked. The recipe for chips was already extraordinarily complicated. Foreign exchange students studying with Shockley at Stanford could become smart physicists, but it was engineers like Andy Gr ove or Mary Anne Potter who knew at what temperature certain chemicals needed to be heated, or how long photoresists should be exposed to light. Every step of the process of making chips involved specialized knowledge that was rarely shared outside of a specific company. This type of know-how was often not even written down. Soviet spies were among the best in the business, but the semiconductor production process required more details and knowledge than even the most capable agent could steal.

Moreover, the cutting edge was constantly changing, per the rate set out in Moore’s Law. Even if the Soviets managed to copy a design, acquire the materials and machinery, and replicate the production process, this took time. TI and Fairchild were introducing new designs with more transistors every year. By the mid-1960s, the earliest integrated circuits were old news, too big and power-hungry to be very valuable. Compared to almost any other any type of technology, semiconductor technology was racing forward. The size of transistors and their energy consumption was shrinking, while the computing power that could be packed on a square inch of silicon roughly doubled every two years. No other technology moved so quickly—so there was no other sector in which stealing last year’s design was such a hopeless strategy.

Soviet leaders never comprehended how the “copy it” strategy condemned them to backwardness. The entire Soviet semiconductor sector functioned like a defense contractor—secretive, top-down, oriented toward military systems, fulfilling orders with little scope for creativity. The copying process was “tightly controlled” by Minister Shokin, one of his subordinates remembered. Copying was literally hardwired into the Soviet semiconductor industry, with some chipmaking machinery using inches rather than centimeters to better replicate American designs, even though the rest of the USSR used the metric system. Thanks to the “copy it” strategy, the USSR started several years behind the U.S. in transistor technology and never caught up.

Zelenograd might have seemed like Silicon Valley without the sunshine. It had the country’s best scientists and stolen secrets. Yet the two countries’ semiconductor systems couldn’t have been more different. Whereas Silicon Valley’s startup founders job-hopped and gained practical “on the factory floor” experience, Shokin called the shots from his ministerial desk in Moscow. Yuri Osokin, meanwhile, lived in obscurity in Riga, highly respected by his colleagues but unable to speak about his invention with anyone who lacked a security clearance. Young Soviet students didn’t pursue electrical engineering degrees, wanting to be like Osokin, because no one knew that he existed. Career advancement required becoming a better bureaucrat, not devising new products or identifying new markets. Civilian products were always an afterthought amid an overwhelming focus on military production.

Meanwhile, the “copy it” mentality meant, bizarrely, that the pathways of innovation in Soviet semiconductors were set by the United States. One o f the most sensitive and secretive industries in the USSR therefore functioned like a poorly run outpost of Silicon Valley. Zelenograd was just another node in a globalizing network—with American chipmakers at the center.