CHAPTER 6

"I... WANT... TO... GET... RICH"

The computers that guided the Apollo spacecraft and the Minuteman II missile provided the initial liftoff for America's integrated circuit industry. By the mid-1960s, the U.S. military was deploying chips in weaponry of all types, from satellites to sonar, torpedoes to telemetry systems. Bob Noyce knew that military and space programs were crucial for Fairchild's early success, admitting in 1965 that military and space applications would use "over 95% of the circuits produced this year ." But he always envisioned an even larger civilian market for his chips, though in the early 1960s no such market existed. He would have to create it, which meant keeping the military at arm's length so that he—not the Pentagon—set Fairchild's R&D priorities. Noyce declined most military research contracts, estimating that Fairchild never relied on the Defense Department for more than 4 percent of its R&D budget. "There are very few research directors anywhere in the world who are really adequate to the job" of assessing Fairchild's work, Noyce explained confidently, "and they are not often car eer officers in the Army."

Noyce had experienced government-directed R&D while fresh out of graduate school when he worked for Philco, an East Coast radio manufacturer with a big defense unit. "The direction of the research was being determined by people less competent," Noyce recalled, complaining about the time he wasted writing progress reports for the military. Now that he was running Fairchild, a company seeded by a trust-fund heir, he had flexibility to treat the military as a customer rather than a boss. He chose to target much of Fairchild's R&D not at the military, but at mass market products. Most of the chips used in rockets or satellites must have civilian uses, too, he reasoned. The first integrated circuit produced for commercial markets, used in a Zenith hearing aid, had initially been designed for a NASA satellite. The challenge would be making chips that civilians could afford. The military paid top dollar, but consumers were price sensitive. What remained tantalizing, though, was that the civilian market was far larger than even the bloated budgets of the Cold W ar Pentagon. "Selling R&D to the government was like taking your venture capital and putting it into a savings account," Noyce declared. "Venturing is venturing; you want to take the risk."

In Palo Alto, Fairchild Semiconductor was surrounded by firms that supplied the Pentagon, from aerospace to ammunition, radio to radar. Though the military bought chips from Fairchild, the Defense Department was more comfortable working with big bureaucracies than nimble startups. As a result, the Pentagon undere stimated the speed at which Fairchild and other semiconductor startups would transform electronics. A Defense Department assessment from the late 1950s had praised radio giant RCA for having "the most ambitious microminiaturization program underway" while dismissively noting that Fairchild had only two scientists working on the company's leading circuit program. Defense contractor Lockheed Martin, which had a research facility just down the road in Palo Alto, had over fift y scientists in their microsystem electronics division, the Defense Department reported, implying that Lockheed was far ahead.

However, it was Fairchild's R&D team that, under Gordon Moore's direction, not only devised new technology but opened new civilian markets as well. In 1965, Moore was asked by *Electronics* magazine to write a short article on the future of integrated circuits. He predicted that every year for at least the next decade, Fairchild would double the number of components that could fit on a silicon chip. If so, by 1975, integrated circuits would have sixty-five thousand tiny transistors carved into them, creating not only more computing power but also lower prices per transistor. As costs fell, the number of users would grow. This forecast of exponential growth in computing power soon came to be known as Moore's Law. It was the greatest technological prediction of the century.

If the computing power on each chip continued to grow exponentially, Moore realized, the integrated circuit would revolutionize society far beyond rockets and radars. In 1965, defense dollars still bought 72 percent of all integrated circuits produced that year. However , the features the military demanded were useful in business applications, too. "Miniaturization and ruggedness," one electronics publication declared, "means good business." Defense contractors thought about chips mostly as a product that could replace older electronics in all the military's systems. At Fairchild, Noyce and Moore were already dreaming of personal computers and mobile phones.

When U.S. defense secretary Robert McNamara reformed military procurement to cut costs in the early 1960s, causing what some in the electronics industry called the "McNamara Depression," Fairchild's vision of chips for civilians seemed prescient. The company was the first to offer a full product line of off-the-shelf integrated circuits for civilian customers. Noyce slashed prices, too, gambling that this would drastically expand the civilian market for chips. In the mid-1960s, Fairchild chips that previously sold for $20 were cut to $2. At times Fairchild even sold products below manufacturing cost, hopin g to convince more customers to try them.

Thanks to falling prices, Fairchild began winning major contracts in the private sector. Annual U.S. computer sales grew from 1,000 in 1957 to 18,700 a decade later. By the mid-1960s, almost all these computers relied on integrated circuits. In 1966, Burroughs, a computer firm, ordered 20 million chips from Fairchild—more than twenty times what the Apollo program consumed. By 1968, the computer industry was buying as many chips as the military. Fairchild chips served 80 percent of this computer market. Bob Noyce's price cuts had paid off, opening a new market for civilian computers that would drive chip sales for decades to come. Moore later argued that Noyce's price cuts were as big an innovation as the technology inside Fairchild's integrate d circuits.

By the end of the 1960s, after a decade of development, Apollo 11 was finally ready to use its Fairchild-powered guidance computer to carry the first human to the moon. The semiconductor engineers in California's Santa Clara Valley had benefitted immensely from the space race, which provided a crucial early customer. Yet by the time of the first lunar landing, Silicon Valley's engineers had become far less dependent on defense and space contr acts. Now they were focused on more earthly concerns. The chip market was booming. Fairchild's success had al ready inspired several top employees to defect to competing chipmakers . Venture capital funding was pouring into startups that focused not on rockets but on corporate computers.

Fairchild, however, was still owned by an East Coast multimillionaire who paid his employees well but refused to give them stock options, viewing the idea of giving away equity as a form of "creeping socialism." Eventually, even Noyce, one of Fairchild's cofounders, began wondering whether he had a future at the firm. Soon *everyone* began looking for the exit. The reason was obvious. Alongside new scientific discoveries and new manufacturing processes, this ability to make a financial killing was the fundamental force driving forward Moore's Law. As one of Fairchild's employees put it in the exit questionnaire he filled out when leaving the company: "I... WANT... TO... GET... RICH."