Figure 12.3 A Clearer Picture of Satellite Images

Spy satellite photography has come a long way since the first Corona mission was launched in 1960. Here is a chronology showing some highlights.

1960: The first Corona satellite, KH-1, is successfully launched in the U.S. after many failed missions. These satellites allay fears that the Soviet Union has developed a large fleet of advanced intercontinental missiles.

1963: After four versions of Corona, the new KH-4A satellite drastically improves resolution. It is followed by the even better KH-4B. All are developed by Lockheed.

1972: The final Corona mission is launched, completing a program that covered 750 million square miles of the earth. It still takes several days to view the image after it is taken

1976: The Crystal Kennan becomes the first digital imaging spy satellite, allowing real-time transmission of images.

1980: Reconnaissance satellites allow the U.S. to see the Soviet military buildup along the Polish border before the declaration of martial law in Poland in 1981.

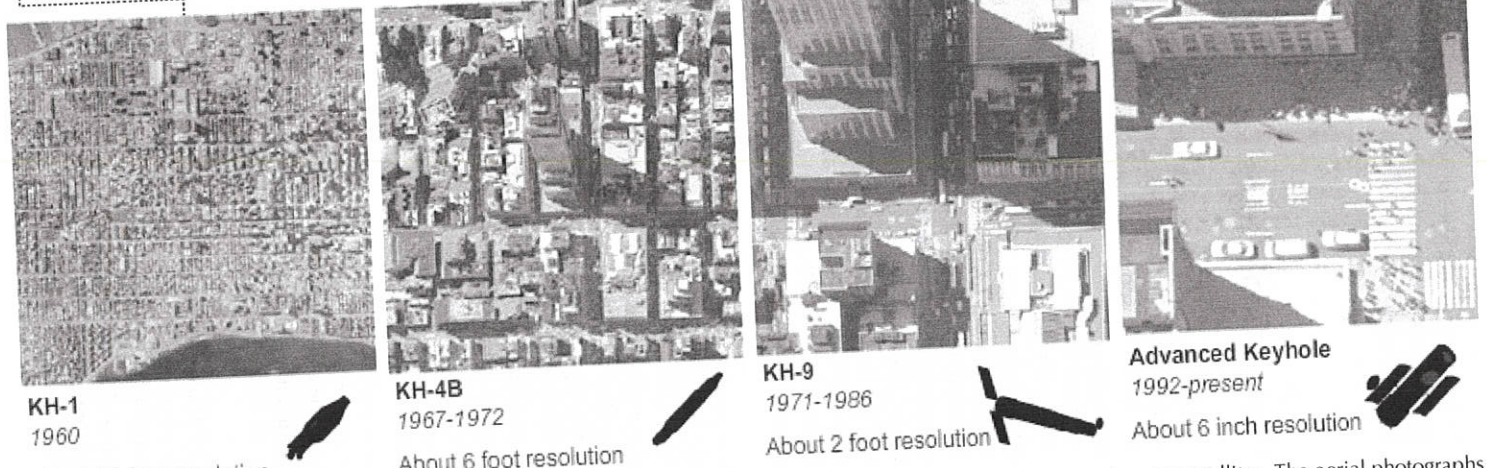
1980s: There are fewer advances in photo satellites, but the first successful radar-imaging satellites are launched.

1995: President Bill Clinton signs an executive order declassifying all the Corona images, making 860,000 images of the earth's surface publicly available.

2003: The U.S. government uses satellite imagery extensively for planning the war in Iraq.

2005: The Future Imagery Architecture program is killed after a series of budgeting and manufacturing missteps.

1960s 1970s 1980s 1990s 2000s



KH-1
1960
About 40 foot resolution

KH-4B
1967-1972
About 6 foot resolution

KH-9
1971-1986
About 2 foot resolution

Advanced Keyhole
1992-present
About 6 inch resolution

How close satellites could clearly zoom in on Midtown Manhattan

The resolutions used are estimated ground resolutions used by various reconnaissance satellites. The aerial photographs above were not produced by a satellite, but are meant to illustrate the kinds of resolution available over the years. The actual images may have varied widely.

Source: GlobalSecurity.org; Photographs by Sanborn, via Google Earth

an agency official read a brief statement awarding both satellites to Boeing.

"The room was momentarily silent," Mr. Nowinski recalled. "We hadn't really expected to win the whole project. We figured we'd be lucky to get the radar system. I was stunned."

They threw open the door and informed a crowd of colleagues waiting in the outer office. The room erupted in cheers.

The final decision had been made by Keith R. Hall, who became the satellite agency's director in 1997 after serving as a senior intelligence official and deputy staff director of the Senate Intelligence Committee.

Mr. Hall, now a vice president of the consulting firm Booz Allen Hamilton, recalled in an interview that, though both bids claimed to fall within the spending cap, an agency evaluation team had calculated that only Boeing's actually would. Its plan was also deemed the more technologically innovative.

Even a former Lockheed Martin executive vice president, Albert E. Smith, acknowledged that "Boeing wrote a better, cheaper proposal than we did."

The upshot, Mr. Hall said, was that there was really "no choice in the source selection." He added that he considered the Boeing proposal executable, if moderately risky.

The award announcement had barely been completed, though, when dissenting grenades started landing at the satellite agency.

Lockheed Martin, infuriated by the decision, filed a protest, which froze the project for several months as the agency reviewed its decision.

Eventually, Lockheed Martin withdrew its protest. Dennis R. Boxx, the company's senior vice president for corporate communications, said he could not comment on classified projects. But government and industry officials said the company stood down after the agency awarded it a consolation prize, a relatively small piece of the project.

Within a few months, two cost-estimating groups, one operated by the Pentagon, the other by the office that coordinates work among intelligence agencies, determined that the Boeing plan would bust the budget caps.

By then, Mr. Hall said, it was too late to reopen the bidding.

Nor did the cheering last long at Seal Beach. As Boeing moved from writing its proposal to building the hardware, assembling a work force of thousands, outside engineers questioned the photo satellite's intricate optical system.

"There were a lot of bright young people involved in developing the concept, but they hadn't been involved in manufacturing sophisticated optical systems," said one military industry executive familiar with the project. "It soon became clear the system could not be built."

The design was eventually supplanted by a more conventional approach, partly to accommodate added intelligence collection requirements from Washington, Mr. Nowinski said.

Expectations about relying on the commercial satellite industry for parts and know-how proved wrong, since those companies curtailed production and laid off experienced technicians after the dot-com collapse.

Soon, defective parts began showing up in critical components, forcing costly delays at Boeing and some subcontractors.

"The No. 1 problem that killed us on this project was substandard parts," Mr. Nowinski said.

One of the electro-optical satellite's most important components—a set of oversize gyroscopes that help adjust the spacecraft's attitude for precision picture-taking—was flawed, said engineers involved in the project. The problem was traced to a subcontractor that had changed its manufacturing process for a crucial part, inadvertently producing a subtle but disabling alteration in the metallic structure that went undetected until Boeing discovered it, three years into the project.

Several kinds of integrated circuits for the electro-optical satellite also proved defective. Even rudimentary parts like electric cabling were unfit for use, several engineers said. Customized wiring did not conform to the orders and in some cases was contaminated by dirt.

As for the sister satellite, Mr. Nowinski said, "We thought the radar system would be a piece of cake."

But the plans were impeded by unexpected difficulties in increasing the strength of the radar signals that would be bounced off the earth. The problem, among other things, involved a vacuum-tube device called a traveling wave tube assembly. Perhaps most surprising was the appearance of parts containing tin, forbidden because it tends to sprout tiny irregularities, known as "tin whiskers," in space. One military industry executive said he was astounded when, several years into the project, he got a form letter from Boeing telling suppliers not to use tin.

"That told me there had been a total breakdown in discipline and systems engineering on the project," he said, "and that the company was operating on cruise control."