APOLLO, CHALLENGER, COLUMBIA

The Decline of the Space Program

A Study in Organizational Communication

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Preface

Perhaps the best way to begin an explanation of how I'm qualified to write this book is to describe my relationship with the two men to whom it is dedicated. I was fortunate to have been recruited by W. Charles Redding to work under him in pursuit of my doctorate at Purdue University. Redding had almost singlehandedly created a new field of study, now called organizational communication. As my adviser he created a plan of study for my graduate work, including classes in economics, the sociology of organizations, inferential statistics, criticism, rhetorical and communication theory.

I was fortunate to be in the first generation of Redding's graduate students in what is now a large and growing field. Our aim then was to understand complex organizations as communication systems. We took as our assumption that organizations cannot function, indeed cannot exist, without communication. We came to believe over time that organizations are *constituted by communication.*

An organization comes into existence when one or more persons recruit others to join them in pursuit of purposes and objectives. Following Chester Barnard (1938), a successful executive and management theorist, we believed that the first function of an executive is to establish and maintain a system of communication, a structure, linking all members, clients, and customers. We studied upward- and downward-directed channels and media, feedback loops, and an enduring concept Redding labeled the "communication satisfaction" of organizational members. Superior-subordinate communication was a hot topic at Purdue and remains today the most heavily researched topic in the field.

Redding's pioneering seminars were enriched by his experiences as a corporate consultant with a major aerospace company. He also testified as an expert witness and consultant to General Electric in an extremely important case heard by the National Labor Relations Board. He taught us, however, that an organizational consultant could do more damage than an inept brain surgeon. He also taught us to avoid the "pro-management bias" of certain business schools. We were to treat all members of an organization as equal in importance, if not in status. In an attempt to demonstrate the even-handedness of his program, he persuaded me to do my Ph.D. dissertation on an international labor union. In the process of my research he guided my attempt to create and measure the concept of semantic-information distance in human hierarchies, a topic that applies to NASA today.

Semantic-information distance is the degree of understanding-misunderstanding among people at different levels of an organization, as well as the degree of knowledge-ignorance of ideas crucial to the organization's purpose and rules. We developed a method of measuring semantic-information distance that combined quantitative and qualitative data. After I completed my doctorate, I was hired as an assistant professor at Purdue and was given the task of teaching the first undergraduate course in organizational communication.

After three years—in 1965—I moved on to Wayne State University in Detroit as an associate professor; I taught graduate seminars and workshops for management and labor unions in the Industrial Relations Center. In early 1967 I received a phone call from a total stranger in Huntsville, Alabama, with a German accent. He introduced himself as Walter Wiesman, the Coordinator of Internal Communication at the George C. Marshall Space Flight Center, then the largest field center in the National Aeronautics and Space Administration (NASA).

Wiesman explained later that he was one of the Germans brought from the German space program to the United States in Project Paperclip. They had surrendered to the U.S. Army and were carefully screened before being brought to Fort Bliss, Texas. They tested their uprated V-2 rockets at White Sands, New Mexico, for scientific and military purposes. Later they were transferred to the U.S. Army's Redstone Arsenal in Huntsville, Alabama. They did the research and development and fabrication of the Army's arsenal of

intercontinental ballistic missiles during the Cold War with the Soviet Union.

Wiesman was the youngest of the 120 Germans brought over and the only one without a scientific or engineering education. He had learned at the German space center in Peenemünde on the Baltic the importance of communication. So had his boss, the legendary rocket wizard, Dr. Wernher von Braun. When many of the Germans were transferred, over the Army's protest, to NASA in 1960, they assumed many of the leadership positions in the new George C. Marshall Space Flight Center (MSFC). Von Braun was the first director of the space center; he had discovered on his own the crucial importance of organizational communication as the Technical Director in Peenemünde.

Von Braun encouraged Wiesman to develop a program in organizational communication for the education of the Marshall Center employees. He was also encouraged to bring in experts to conduct research at the space center. Wiesman had joined several professional organizations devoted to the study of communication and had met W. Charles Redding. Redding gave Wiesman my name as a potential consultant to NASA. Would I, asked Wiesman, be willing to spend the summer of 1967 as a Faculty Consultant to NASA at the Marshall Center? I would be treated as a civil servant, a GS-13, and would have to hurry to get in my detailed application for employment and a security clearance.

I jumped at the chance. NASA's field centers brought in professors in scientific and engineering disciplines from universities around the country to serve as Summer Faculty Consultants. They most often conducted and directed research projects. Someone told me I was the first or one of the first "soft" scientists brought into this program.

Wiesman was willing to place a bet on me despite my relative youth—I was 33 at the time—and then explained what my duties would be. I would work eight hours a day (sometimes longer hours) reviewing and evaluating Wiesman's program in internal communication, including his five-year plan, conducting research at the center, and supervising research done by doctoral students from Purdue at the Marshall Center. Wiesman had also organized a national conference on organizational communication in August of 1967 for interested representatives from aerospace contractors and other businesses and people from government agencies and the aca-

demic world. I was expected to help coordinate the conference and deliver the central paper, or lecture.

The conference was the first of its kind and was a great success. I had by August learned that engineers produced documents with what I thought were ironic titles: "state-of-the-art" papers. And so I gave my paper the title, "Organizational Communication: A State-of-the-Art Review." I organized and summarized the findings from the first approximately 100 empirical research studies done in the field. (Today no one could possibly cover all the research in a single lecture because of the explosive growth of the field.) NASA published the paper as part of the proceedings and later issued it as a separate monograph.

I was, however, learning more than I was teaching. Wiesman put me through a thorough orientation program of visits to the laboratories, the museum—I read von Braun's correspondence with Albert Schweitzer about the possibility of afterlife for humans—and the test facilities. I watched a test of the mighty F-1 rocket engine, described below, one of five on the Saturn V rocket that would launch the Apollo space capsule. The atmosphere at the Marshall Center that summer was electric with excitement and anticipation. They had done the research and development of the moon rocket there, and the first test flight was scheduled later that year—1967. Its first flight to take astronauts to the moon was due to take place in 1969, only two years in the future. I got caught up in the excitement like everybody else.

I also attended the Fifth Annual Summer Lecture Series in Aerospace Science and Engineering sponsored by NASA, the Marshall Center, and the U.S. Army Missile Command. A certificate proclaiming P. K. Tompkins had successfully completed the lecture series (20 hours) hangs proudly in my study today. I am forever grateful there wasn't a final exam! The only lecture I can remember was on the "Third Body Problem." It was about a mathematical riddle of what would happen if a third body entered the gravitational field of two other bodies. I'm told the problem has since been solved by a supercomputer; the reason I remember the lecture is because the mathematician delivered the entire lecture standing on one leg, the other crossed at the knee, all the while tempting the law of gravity.

A big event was my first interview with Director von Braun. He was 55 years old then and larger than life. I had seen Hollywood's film biography of him. Born in Wirsitz, Germany, in 1912, he re-

ceived his Ph.D. in physics at the age of 22 in 1934 from the University of Berlin; for reasons of military security his dissertation title was somewhat misleading: "About Combustion Tests," but it contained a theoretical investigation, supported by experiments, of a rocket engine. He immediately went to work for the German Ordnance Department and by 1934 he and his group had launched successfully two A-2 liquid-fueled rockets; they reached altitudes of about one and a half miles. He became the technical director of Rocket Center Peenemünde in 1937, developing and launching the V-2 rockets during World War II. When the Soviet Army was nearing the Rocket Center at the end of the war, von Braun led the majority of his rocket specialists from the eastern part of Germany to Bavaria. There they surrendered to Western Allies and were taken to Fort Bliss, Texas, and eventually to Huntsville, Alabama.

In Chapter Four of this book I summarize that first interview, explaining his philosophy of organizational communication. We decided in that meeting that I would spend the rest of the summer conducting a diagnostic study of the Marshall Center as a communication system, finding out what worked well and what didn't. Von Braun wanted to discover whether there were problems in the system connecting the 7,200 employees at the Marshall Center with the total of 200,000 people in the agency and in contractor organizations working on the Apollo Project.

First Data Point

During the rest of the summer I was given complete access to the organization, interviewing in depth about 55 top rocket scientists and managers at the Marshall Center, the Michoud Assembly Plant near New Orleans, Louisiana, and the Mississippi Test Facility in Hancock County, Mississippi. I discovered much that worked, ingenious communication techniques detailed in the fourth chapter of this book. I also found some problems—blockages and barriers—and worked to come up with recommendations for overcoming them. I also worked on action items for von Braun. He was curious, for example, about the Saturn V Control Center, a management facility to coordinate all activities having to do with the moon rocket. NASA headquarters had built it and thought it would be a major contribution. (I found that it was not working well; briefings were thereafter rescheduled in another room von Braun preferred.)

At the end of the summer I briefed von Braun in his office. He was delighted to hear about some powerful effects of a reporting system he had created; he was concerned, however, with some of the serious problems I had unearthed. At the end he jumped up from the conference table to get a calendar from his desk. He looked up the dates of his staff and board meetings in the fall, and we selected one on which I would return from Detroit to brief the center's top management. I did so in the room where von Braun preferred to get briefings, the very room where I had sat in on briefings for him on such complex topics as the possible trajectories for a spacecraft to take in a trip from the Earth to Mars. (An engineer sitting next to me leaned over and said, "You can't hardly get there from here.")

I still have an audiotape of the two-hour briefing I gave the top rocket scientists of the world. They interrupted me, challenged and questioned me, some with German accents. They were clearly worried about some of the problems, illustrating an openness of communication about problems I've rarely seen in other organizations. There was also considerable laughter, sometimes at their expense. They invited me to come back the next year, 1968, again as a Summer Faculty Consultant in Organizational Communication.

Second Data Point

In the winter and spring Wiesman kept me informed about how my recommendations were being implemented. When I returned in 1968, von Braun and Wiesman both had projects for me to pursue. NASA headquarters had ordered a deep Reduction in Force, or RIF in the inevitable acronym, which would mean layoffs for many Marshall employees now that the Saturn V's first test flight had been a success. The Marshall Center would have fewer employees to work on more projects, a diversification in which they would do the research and development for what was called the Apollo Applications Program, including projects such as Skylab and the Apollo Telescope Mount.

Von Braun asked me to help him with a needed reorganization of the center. He also had a list of action items for me to research. Again I was given complete access to documents (many of which were classified) and to interviewees. Coming up with a new organizational scheme—which von Braun regarded as the formal communication system—was the most complex problem I ever faced. But I

was helped by the people who would have to implement it and live within it. After I briefed von Braun about my preferred scheme, he whipped out a copy he had been working on and compared it to mine: "We're close," he said.

I had now become an insider with two data points on the space center, 1967 and 1968. The experience had an enormous impact on my subsequent teaching and research. I had noticed during those two summers how NASA employees worked long hours at half the money the contractor personnel made. They nonetheless had the deepest sense of identification with the organization I've ever seen, the deepest sense of commitment to their projects I've seen. I felt it myself. That realization led me to engage in a career-long research program into the phenomenon I call—without notable creativity—organizational identification.

I also watched how the engineers and scientists, out of their identification with the organization and its projects, created working groups and teams not specified by the organization chart of this government bureaucracy. They often functioned without a formal leader, caught up in "automatic responsibility" for problems they perceived. They shared control of the group's deliberations. Later I would come to call this "concertive" control, a group of people working together in concert to solve organizational problems. I'm probably best known in my own field for my theoretical and empirical work on organizational identification and concertive control—with help from associates at three different universities. The seeds for these programs were found in the Marshall Space Flight Center during my experience of what is now regarded as the glory years of NASA.

I was invited to return as a Summer Faculty Consultant in 1969, but I had become a professor of communication at Kent State University in 1968; Kent State gave me a travel grant allowing me to spend part of the summer doing research on the great Irish novelist, James Joyce, in Dublin and London. I expected to return to the Marshall Center in the summer of 1970 to continue my research. On May 1, 1970, however, a tragedy occurred on my campus. Four students were killed and nine wounded by the Ohio National Guard during a demonstration against the U.S. incursion into Cambodia. I was asked to serve that summer on a commission to investigate the causes of the tragedy and chair a task force on communication. Out of that came a book: *Communication Crisis at Kent State* (Tompkins

and Anderson 1971). In addition, we reversed the consulting process by bringing Walter Wiesman to the campus as a speaker and consultant to our administration and faculty about the tragedy.

In 1971 I became a professor and department chair at the State University of New York at Albany and organized a research project with colleagues on organizational identification. In addition, I published two articles about my NASA research in a journal, *Communication Monographs* (Tompkins 1977; 1978). Wiesman read these articles in manuscript form, and reprints of the publications are in the archives of the space center today. Wiesman and I were close friends by then (and remained so until his recent death), and I continued to be a proud NASA watcher over the years. Then came word about the tragic *Challenger* disaster of 1986. By then I had returned to my alma mater, Purdue, as a professor and associate dean of Liberal Arts. Purdue had a close connection with NASA; astronauts Gus Grissom and Neil Armstrong, the first man on the moon, were both graduates of Purdue.

The Marshall Space Flight Center (MSFC) had responsibilities for the space shuttle despite having been forced by the Nixon administration and NASA headquarters to accept a complicated and compromised design involving liquid and solid rocket fuels. (Von Braun once told me we shouldn't ever put astronauts on top of a rocket with solid fuels because such fuels couldn't be tested adequately and couldn't be turned off once they had been ignited.)

Third Data Point

As I followed the news reports about the *Challenger* accident, I couldn't believe my eyes and ears. The media reported some communication practices at the Marshall Center that wouldn't have been tolerated during the Apollo days. Ronald Reagan appointed a presidential commission, the Rogers Commission, headed by former Secretary of State William P. Rogers. As I read the commission's report I came to the conclusion that NASA had forgotten much of what we knew and learned in the 1960s. I formulated a theory of organizational forgetting and tested it by visiting the Marshall Center for two days of interviews in January of 1990.

The results confirmed my hypothesis. Von Braun had resigned in 1970 to take a job in industry and died in 1977. Wiesman had long been retired as well. The workforce had been cut in half. Too few

people were trying to manage too many projects. Few of my interviewees could remember the communication philosophy and techniques of the Apollo era. I agreed with the Rogers Commission that, ironically, miscommunication had been a factor leading up to the tragic accident. I planned to write journal articles about this research, my third "data point," but, as I explain in the Introduction to this book, Claude Teweles persuaded me to write an academic book for his publishing company: *Organizational Communication Imperatives: Lessons of the Space Program* (Tompkins 1993). Someone from NASA who read it e-mailed me about its implications for an agency program called "lessons learned," but the interaction was superficial and short.

Fourth Data Point

I continued to study NASA. In the summer of 1987 I studied NASA's Aviation Safety Reporting System (ASRS) and visited the facilities of its contractor, the Battelle Memorial Institute's office in Mountain View, California. They allowed me to interrogate their huge data base of reports about near accidents among airplanes. The ASRS is an interorganizational communication system for the entire aviation industry. Input is provided by controllers and pilots and other observers. Those who write reports about the "incidents" are given immunity from prosecution. The reports are read by analysts—former pilots and air traffic controllers—who store them in the computer by categories. By the time I visited the computer in 1987 they had accumulated 70,000 reports involving 50,000 incidents (there may be more than one report per incident). All of these had been processed and cross-checked by a second analyst without a single breach of the promise of anonymity and immunity.

The system worked effectively, even brilliantly, to prevent aviation accidents. As of 1987, NASA had issued more than 835 alert bulletins, time-critical notices about hazards such as overgrown trees blocking approaches to an airport runway and faulty navigation lights and runway markings. My questions put to the data base had to do with human factors. I was not surprised to discover that between 60 and 70 percent of the reports in the data base included a reference to obstacles to human communication (sometimes coded as problems of "information transfer") as a contributing factor in the incidents considered to be serious threats to aviation safety. In a

third of these miscommunication problems somebody—perhaps a controller—forgot to say something to someone else—a pilot, for example. In another third, incomplete or inaccurate information was communicated by one to another, leading to incorrect decisions about controlling and piloting airplanes. One-eighth of the incidents involved communicating in a tardy manner. In one-tenth of the reports, the receiver either didn't get the word or misunderstood the message.

I was invited to present my findings to a conference in Boulder, Colorado, on man-made risks sponsored by the National Science Foundation. It was published as a book chapter edited by the organizer of the conference (Tompkins 1990). A different version was published under the title "Organizational Communication and Technological Risks" (Tompkins 1991). The paper was released to the press, and I suddenly found myself on radio talk shows from coast to coast. An airline pilot on the way to O'Hare called in to a talk show in Chicago to confirm my conclusions. The study was summarized in *Popular Mechanics.* An interview with a Denver television station was picked up by CNN and I heard from friends around the country about it and from one colleague who saw it while in Australia. It seems that most people naïvely underestimate the importance of communication and miscommunication, and it is newsworthy when evidence to the contrary is introduced. In that book chapter I reviewed my research with NASA in the first three data points, hoping that lessons from the Apollo Program and NASA's own Aviation Safety Reporting Program would help reduce technological risks. This was the fourth "data point" in my relationship with NASA.

I continued to follow other studies of the *Challenger* accident. In 1997, for example, I wrote an essay-review about all of the books about the tragedy for an international journal, *Organization* (Tompkins, Heppard, and Melville 1998). I gave lectures trying to reconcile the conflicting interpretations of the causes of the accident, a project carried forward in the present volume.

Fifth Data Point

Then the sky fell. *Columbia* broke up on February 1, 2003; seven astronauts were killed. Although again depressed, I decided not to pursue the case. And yet I couldn't stop reading about the accident

and the investigation of it. In April I was invited to give a lecture via telephone to students in an organizational communication class at Michigan State University. As I prepared for it, I heard what Dr. Sally Ride called an "echo" of the *Challenger* accident. The analysis in my book about the first shuttle accident seemed to fit or apply to the evidence in the second shuttle accident.

When I agreed to write this book, it became my fifth "data point" on one organization. This time, however, it would be different. I had to concentrate on NASA-as-a-whole, not a field center. The evidence this time would come from newspaper accounts and the Report of the Columbia Accident Investigation Board (CAIB). I was no longer an insider. In the end that became a positive factor because it gave me the needed perspective given by distance.

I saw no reason to interview anyone this time because I saw no evidentiary holes in the voluminous newspaper articles, the CAIB Report, and in November of 2003 a long article about *Columbia* that appeared in the *Atlantic Monthly.* The author had gained access to CAIB and NASA. His work confirmed that additional interviews by me were unnecessary. My contribution would be to give pictures of NASA over time so that the reader could follow the dramatic decline of a once-proud institution. In addition, I was able to accept the evidence presented by CAIB and the press and make a somewhat deeper interpretation of the mechanisms underlying what is now the conventional explanation. Finally, I have placed NASA in the context of other contemporary American organizations and institutions in an attempt to find a more general explanation in Chapter Eight. In that chapter I present eleven of what I call "communication transgressions" that are common to most of them and that appear to be correlated to individual and organizational failures. Ethical issues emerge in the narration and analysis, from start to finish. Only a careful reader can determine whether these new interpretations have traction in helping us understand our organizational environment. Whatever the decision of that careful reader—James Joyce thought the perfect reader is an insomniac—I remain a Professor Emeritus of Communication and Comparative Literature. *Emeritus* is a Latin word for more time to play golf and to write books. ✦

Chapter One

The *Columbia* Accident

More than a dozen people read this book in manuscript form, most of them professors who are concerned greatly about how their students learn. Most of them advised me that it was their experience that a lot of students don't bother to read Prefaces and Introductions, preferring instead to get to the action immediately by starting with the first chapter. Such students, they said, and perhaps other readers as well, would find it difficult to get oriented to the unusual organization of this book. Some of the professors themselves had trouble getting oriented; they needed a forecast, a kind of roadmap of the book. So at the risk of repetition, I will restate some of what is in the Introduction and Preface to help the reader follow my format.

Forecast

I think of this book as a story, a nonfiction novel, the outcome of which is known to most if not all of my readers. That is similar to a crime novel in which newspapers and other media report a murder. The suspense is created by curiosity about *why* and *how* the murder was committed. Although there was no murder, no crime, in the case of the *Columbia* accident, there was a dreadful accident with loss of life. How did it happen? Why did it happen? Rather than summarize what the final investigators discovered, I have chosen to present the information as it came in immediately after the disaster. I relied on press reports of NASA news conferences, first-hand accounts of the debris falling from the sky, and interviews with observers published in the Archives of the *New York Times* and other

newspapers. I also consulted NASA's website. All of this is important to an understanding of how to analyze organizational catastrophes.

By coincidence, a friend and neighbor, Gregory Williams, was at NASA's Kennedy Space Center on February 1, 2003, waiting to watch the shuttle *Columbia* land. I begin this chapter with an interview I later conducted with him; from there I summarize the news and "evidence" as it became known and reported, a method used in the mystery genre known as a "police procedural," in which the reader learns along with the police and detectives. We see what hypotheses are developed and how the incoming data tend to confirm or disconfirm them. We also see how television was not able to cover the story the way they did the *Challenger* accident in 1986. This chapter describes what evidence was gathered and reported during the day after the accident and ends with a list of possible technical causes of the accident.

Chapter Two continues this narrative process for the week following in a frenzied attempt at sense making. Members of the press realized early on that they were dealing with a mystery—rather, two mysteries. The first mystery is the technical or technological one; what went wrong with the shuttle? The second mystery is about communication, organization, management; what, if anything, did NASA do wrong to create the technical failure? Reporters following the investigation talked about clues and even mentioned Sherlock Holmes, the famous English detective created by Sir Arthur Conan Doyle. The reader learns, for example, of a tension between the official investigating commission, the Columbia Accident Investigation Board (CAIB), and the agency being investigated, the National Aeronautics and Space Administration (NASA). This is an important lesson to learn: *Large organizations invariably try to protect and defend themselves from outsiders.* Journalists who were not seeking to protect and defend the organization began to compare this accident with the earlier shuttle accident. They began to recall that NASA had been less than open in discussing the *Challenger* accident 17 years earlier—a communication transgression; some said NASA had tried to cover it up. This introduces a theme that will be developed throughout the book: the important but infrequently examined topic of the *ethics of communication.* I introduce my own tentative hypothesis about how language could have led to a mis-

understanding that contributed to the accident. The narrative of this chapter concludes at the end of the next day, February 2, 2003.

Chapter Three takes a break from the narrative format to introduce a brief history of NASA and concepts from the field of communication such as organizational culture, the Ideal Managerial Climate, and superior-subordinate communication, which will become central to the investigation and analysis of the *Columbia* accident. That chapter presents a detailed description of the original "strong" technical culture. Chapter Four continues this analysis by concentrating on the biggest field center of NASA, the Marshall Space Flight Center (MSFC), during the glory days of the space program: the Apollo Project, which sent Americans to the moon and safely brought them back home to Earth. That chapter reports some of the research I did as a Summer Faculty Consultant at the Marshall Center in the 1960s on communication-as-culture, linking it to the success of the organization.

Chapter Five looks back at the *Challenger* accident of 1986. Not long after the *Columbia* accident a lot of people, including me, saw some similarities between the two shuttle accidents. It is necessary, therefore, to move backward in time to understand how various scholars and a Presidential Commission analyzed the first accident. My analysis is presented along with several others so that the reader can decide whether my synthesis of them makes the best sense. Organizational communication is one of the best, if not the ultimate, perspective on this national tragedy; returning to it helps one understand, by analogy, the second shuttle accident.

Chapter Six returns to the narrative of the unfolding mysteries of *Columbia* with the press coverage until the release of the Columbia Accident Investigation Board (CAIB) Report in late August. Quoted in that chapter are e-mail messages among NASA employees relevant to the accident that were released to the press. They show that some members of NASA suffered from misunderstanding, from a form of miscommunication. Some central NASA figures were reassigned from their posts so that they would not appear to be investigating themselves. CAIB began to issue recommendations.

Chapter Seven is a close reading of the CAIB Report. It came out seven months after the accident, on Tuesday, August 26, 2003. I consider it the final chapter in the police procedural, in which the mystery is solved. By means of a technique called fault-tree analysis,

certain hypotheses, called "branches" of the tree, are eliminated one by one. The remaining branch was deemed to be the technical cause of the accident. But there is a remaining mystery—what were the organizational causes of NASA's failure? Communication and culture, more or less synonymous, are examined in careful detail. Using CAIB's evidence and observations, I provide my own analysis. Mysteries solved.

These first seven chapters are an in-depth case study, the analysis of one organization over nearly forty years. It is my belief that by getting to the heart of one organization, one gets to the heart of all organizations. But rather than assume that is so, Chapter Eight looks at other organizations that were in decline at the same time NASA had its failure. I present evidence in the cases of Enron, the Catholic Church, and other troubled organizations, showing that their difficulties are similar to those of NASA. These organizations suffered from forms of unethical communication practices, miscommunication, and other mistakes made by NASA.

Chapter Nine tries to wrap up the book. It explains how *Spiderman*—the film, that is—fits into the larger picture of the book. It also asks what a student should do in preparation for an organizational life. It will be hard to avoid a career that doesn't involve organizational communication. What practices should one look out for? In what situations should the individual resist the demands of an organization? How can one recognize when the cultural force of an organization—a mighty power—must be disobeyed or at least ignored?

Now, I suggest you get into position to dive into the mysteries. If you have difficulty with any passages of the book, you can reach me via e-mail at <Tompkinp@Spot.Colorado.Edu>. Enjoy.

The Mystery

Gregory Williams, 51, was born in Detroit, Michigan, and received a degree in civil engineering from Michigan State University in 1975. He now works as a project engineer in Denver, Colorado, specializing in the renovation and restoration of high-rise buildings. He describes himself as a Black American; his success in a technical career led him to create a Foundation, The Real Me, by which, in cooperation with the Denver Public Schools, he identifies minority students and girls with scientific or technical aptitudes and links

them via e-mail with mentors at the state's private and public colleges, universities, and business organizations. Once a year he rounds up his charges, buses them to meet their mentors on campus and in other organizations. In addition, the pupils meet with admissions advisers so that they can prepare for moving on to higher education and a technical career. His cousin from California was going to be spending a couple of weeks in Orlando, Florida, at a seminar in late January and early February of 2003, and asked Gregory to join him for a few days of vacation.

Williams had never spent any time in Florida other than in airports, so he accepted the offer, arriving in Orlando Thursday night, January 30. The next day, Friday, January 31, he and his cousin read the local newspapers over breakfast to find out what was happening and learned that the *Columbia* space shuttle would be landing the next morning at Kennedy Space Center (KSC), a drive of about 90 minutes from their hotel in Orlando. As an engineer, Williams was interested in the space-shuttle-as-machine, as well as the process of space flight. The cousins agreed to make the trip; his cousin's co-worker from California, also attending the seminar, asked to join them.

They arrived at the Visitors Center at KSC the next morning at about 8:15 Eastern Standard Time. There were only about 150 or 200 people, Williams told me (our formal interview was conducted on Monday, August 11, 2003). That was because landings are not as spectacular as launches. Local residents pay little attention to them—except for the sonic boom produced by the shuttle's descent. The Center had movies about the space program and souvenirs, but the three men walked outside to look over the facilities. The Center was placed in such a way that the spacecraft would come down directly over it on its flight path toward the landing strip.

The first announcement over the public address system came at approximately 8:45; the content was, as Williams remembered six months later, that *Columbia* had reached California at about 20,000 miles per hour and at about 200,000 feet. The next announcement, five minutes later, said the craft was flying at about 18,000 miles per hour at about the same altitude over Texas and should be landing in about 15 minutes. That was the last official announcement Williams and the others heard.

After 15 minutes passed, everyone began to peer into the skies. Birds and a surveillance plane gave false hopes. After 20 minutes of

silence the crowd became "inquisitive," Williams said, curious about the delay. People had pulled out their cell phones to share the moment with friends and relatives. Some of them were told that the shuttle would not be landing, that there was "a problem or an incident." These people quickly spread the word among the 200 people or so at the scene. "Somber" was the word Williams used to describe that moment. It was also, as he later added, "suspenseful."

People rushed to the souvenir shop. The three men joined them. Their thinking was that this was a moment of History—with a capital H—and that they needed a memento of the momentous occasion. Williams bought a cap embellished with a shuttle emblem and the names of the seven astronauts. "In fact," said Williams, "I intended to bring the cap with me today as a gift for you, but I forgot it." After they bought their souvenirs, the three men walked back outdoors to see the huge NASA buses, like "Greyhounds," said Williams, head down to the landing strip to pick up the VIPs, the relatives and friends of the seven astronauts. Williams could only speculate as to how difficult that scene would be—notifying the loved ones—but took it as a strong "indicator" that something bad had happened. They thought the scene might become "hectic," so they walked to their car.

"As we drove away the television crews were coming in the opposite direction like a flock of vultures." They turned on the radio for news, "mesmerized and in shock." Williams said, "My vacation was null and void," and he wondered, "What made us come here today?" He paused and said: "Things happen for a reason—even if you can't figure them out—and you have to live with them." He paused to reflect and then added that the experience "was like a bad dream. It wiped out our whole day. I didn't want to do anything but listen to the radio and watch TV. Then sporadically we would start talking to each other about it." He also said they did some drinking while they talked.

Williams has a placid demeanor and an easy smile but is not otherwise easy to read in regard to his emotions; still, he seemed to be somewhat irritated when he complained that NASA was so "secretive." The only information they got at KSC was via cell phones. "They [NASA] didn't have a news conference for several hours," complained Williams.

It seemed as if our interview was about to die of a lack of energy; suddenly Williams remembered something he thought was impor-

tant: "We began calling people like crazy from the hotel room. You're part of history so you want to tell people; it sucks you into the moment."

Q: Who did you call?

A: The four most important people in my life.

I had another question. In my reading about the accident I had learned that if NASA had realized there was a problem with the left wing they could have brought *Columbia* in at a different angle, one in which the right wing would have handled most of the load and the heat, temperatures between 2,000 and 3,000 degrees Fahrenheit. Williams said there were two other possibilities as well. The second was to send up a second shuttle to earth's orbit, rescue the astronauts, and destroy the *Columbia*. The third was to send *Columbia* to the International Space Station where it could wait for another spacecraft to rescue them.

(But you would have had to have known that the left wing had been seriously damaged.)

Debris Rains on Nacogdoches, Texas

While Gregory Williams and the others at KSC were experiencing shock, David M. Halbfinger and Richard A. Oppel, Jr., were filing an article with the dateline Nacogdoches, Tex, Feb. 1, with this title: "LOSS OF THE SHUTTLE: ON THE GROUND; First the Air Shook With Sound, And Then Debris Rained Down." The article would appear in the *New York Times* the next day. The article begins with four one-sentence paragraphs, the first three of which are:

> It sounded like a freight train, like a tornado—like rolling thunder—and then a gigantic boom.
>
> It fell from the sky in six-inch chunks and seven-foot sections of steel, ceramics, circuit boards and who-knows what.
>
> It tore holes in cedar rooftops, scorched front lawns, ripped a streetlight from its pole and littered the parking lot behind the Masonic hall downtown.

Miraculously, despite the pieces of the space shuttle *Columbia* that fell to the ground on hundreds of square miles of eastern Texas and western Louisiana, no one was injured—on the ground that is. A hospital worker in Hemphill, Texas, was horrified to find the

charred torso and skull of an astronaut near some pieces of debris on a rural road. Human remains were also found in Sabine County, Texas.

NASA and local officials warned people to stay away from the debris because of the dangerous and deadly brews of chemicals, even carcinogenic substances, on the shuttle. Law enforcement officers from all levels of government tried to find and cordon off the largest pieces. At the center of Nacogdoches itself, a crowd gathered around a large piece of roped-off metal, placing bouquets, praying in circles, and some treating the event as an "alien crash." And there were unconfirmed reports that people were offering bits of debris as souvenirs on eBay. The FBI was to take jurisdiction; they warned that scavengers would be prosecuted.

John Anderson, 59, said, "We heard this low-frequency, high-energy sound, an enormous release of energy, sort of a ragged boom." He found over 70 pieces of debris on his 14-acre lot of grass and trees. The first piece that landed on his porch got his attention; he remembered that a shuttle was scheduled to land that day and feared the worst. He ran in to turn on the TV. "We had the TV on, and by that time they were reporting there had been no communication. But we already knew."

Mr. Anderson knew much more than the people on television or those watching television: "One remote television image, small globes of light trailing plumes of smoke across the sky, said everything that could be said in the minutes and hours after NASA reported a mysterious emergency with the space shuttle *Columbia*'s return to earth." So wrote Alessandra Stanley in the *New York Times* on February 2, 2003. Her article about television coverage that Saturday is one of nearly two dozen articles about the tragedy appearing in that newspaper the day after the accident. Stanley gives credit to CBS's Dan Rather for being the first anchor on the news set, going live just one hour after the shuttle disintegrated.

Saturdays are usually slow news days; journalists and reporters and correspondents like to take a weekend off as much as anyone. Rather got to work before the others, but with few facts he and the other correspondents were at a loss for words, depending on memory, experience, and their ability to improvise. Taking a call from a man who said he was an eyewitness, Rather asked the caller to describe what had landed on his property. The man said it was the teeth of an astronaut, adding that the broadcaster was an "idiot."

CBS cut the caller off quickly; Rather explained there was no way to avoid crank calls, and as an afterthought said, "I am an idiot, but that is beside the point." Mr. Rather, a native Texan, also spoke of Nacogdoches, Texas, as "an old Indian trading post" located behind "what is called the Pine Tree Curtain," before reporting that a considerable amount of debris had landed there.

Brian Williams appeared on NBC an hour later. Bill Blakemore took the desk at ABC until Peter Jennings went on the air at about noon. Blakemore was quicker than others to raise such important questions as the effect of a loss of a shuttle on the International Space Station, dependent as it is on the space shuttles for supplies for the two astronauts and one cosmonaut aboard. (Aaron Brown, anchor of CNN for eighteen months, was playing golf in the Bob Hope Celebrity Tournament in Palm Springs, California, and he didn't make it to work until the day after the accident.) Tom Brokaw of NBC broke off his vacation in the Virgin Islands and was able to anchor the evening news on Saturday. CBS announced at 10:57 a.m. that flags were flying at half-staff at NASA Headquarters. The networks were understandably reluctant to say that the shuttle and the seven astronauts were lost. They did, however, raise the possibility that what NASA was calling a "contingency" might be an act of terrorism. The Fox network interviewed Dan Gillerman, Israeli delegate to the United Nations, about the Israeli air force officer on board the *Columbia*; Gillerman said Colonel Ilan Ramon was the child of a Holocaust survivor and the leader of an attack on a nuclear reactor in Iraq in 1981. It was hard work for the television commentators because they had so little hard news and so few images to pass along to viewers. They knew that NASA had lost all signals, all communication from *Columbia*, and that debris was scattered over eastern Texas and western Louisiana. Later we would learn the last voice message from the spaceship was "Roger, uh. . . ."

The Internet

John Schwartz contributed a contrasting picture of the television coverage with his article in the *New York Times* titled: "LOSS OF THE SHUTTLE: THE INTERNET, A Wealth of Information Online." Not only did it provide people with information, it also provided them with a medium in which to disseminate it:

> That was nowhere more clear than on the high-tech community known as Slashdot, at <www.slashdot.org>, where members posted more than 1,100 messages by 5 p.m. that included links to NASA pages, first-person accounts of hearing or seeing the breakup, the text of Ronald Reagan's 1986 elegy [sic] to the *Challenger* astronauts, arguments over the future of space travel, and the usual exchange of insults that crop up in any online discussion.

Within hours of the disaster, a man named Don Drake had downloaded images of the orange trail of debris across Texas from the radar website of NOAA, the National Oceanic and Atmospheric Administration. He combined and animated these images so they moved every second or so for anyone on the internet to see. He was interviewed by Schwartz by phone and said that this was something that the conventional media do not do very well, that they don't have the variety of technical talent to be found on the internet. Using the jargon of journalists, he spoke of the thousands of technical "stringers" out there online. According to another of Schwartz's sources, one could see the story of the accident develop by reading through the postings in the order in which they appeared.

The President Speaks

A silent confirmation that the astronauts were lost came when the White House lowered its flag to half-staff at about noon. President George W. Bush, informed at Camp David of the disaster by his Chief of Staff, Andrew H. Card, Jr., sped down the mountain and through the Maryland countryside to the White House in a motorcade. He looked "drawn and stricken" as he spoke on television at 2:00 p.m. from the Cabinet Room: "The *Columbia* is lost. . . . There are no survivors." Echoing President Reagan's remarks after the loss of *Challenger,* he said the space program would continue, and to honor the five men and two women, he added: "The same creator who names the stars also knows the names of the seven souls we mourn today. . . . We can pray they are safely home."

A NASA News Conference

A news conference was held in the afternoon by Ron D. Dittemore, Shuttle Program Manager, and James M. Heflin, Jr., NASA Mission Operations chief flight director at the Johnson Space Center (JSC) in Houston. The *New York Times* published excerpts from it the

next day. They expressed their shock at losing seven family members. It was a great day to land in the Florida area, they said, because the weather was cooperating with the landing. They had had nothing but positive signs until a few minutes before 8:00 a.m. Central Standard Time. Mr. Dittemore said the first sign was the loss of temperature sensors in the left wing, followed by the loss of tire pressure on the left main gear, and then indications of excessive structural heating: "I have to caution you that we cannot yet say what caused the loss of *Columbia*. It's still very early in our investigation and it's going to take us some time to work through the evidence, the analysis, and clearly understand what the cause was."

Mr. Heflin took his turn after Dittemore to say that when they noticed the abnormalities they sent an alert to the astronauts, an alert to check their displays. He then had difficulty articulating whether the crew knew that something was wrong: "I can't—I've asked a couple of people. I haven't heard the tapes myself. I'm not sure what they said at the time, but they were acknowledging, we believe, that indication that they'd seen." Then they lost all data from the vehicle at around 8:00 a.m. Central Standard Time; the craft was at 207,135 feet, traveling at a Mach of about 18.3. "And the flight control team during this time—again, we lost the data and that's when we clearly began to know that we had a bad day."

A reporter at the press conference stated that he had heard reports that some debris hit the wing during the launch and then asked if that was true and a cause of concern. Mr. Dittemore acknowledged that a piece of foam used as insulation on the external fuel tank (ET) hit somewhere on the left wing; they weren't sure where it hit, he added. Given their experience with tile on the wing, he said, "It was judged that that event did not represent a safety concern. And so the technical community got together and across the country looked at it, and judged that to be acceptable."

Houston, Texas, Loses Heroes

The press conference was held at the Lyndon Baines Johnson Space Center (JSC) in Houston, about 200 miles south and a bit west of Nacogdoches. Houston is also the home and training center of the astronauts. In an article for the *New York Times* with the dateline Houston, Feb. 1, reporters expressed a NASA-wide theme that would be repeated many times by many people—death in the fam-

ily. The city was in mourning because Houstonians were proud to say they lived in the same city or same neighborhood with an astronaut's family. They were heroes, even though the current crop lives a quieter life style than the earlier generations, who held keg parties the night before a launch. Perhaps this indicates a cultural shift in the astronaut corps, a change from a cowboy culture and the "right stuff" into, well, more like an accountant's culture.

At Frenchie's Italian Restaurant, off NASA Road 1, pictures of the crew hang on the wall near the cash register. There is a photograph of a recent birthday party held for the pilot of the lost flight, Commander William McCool. The owner of the restaurant, Frankie Camera, was sad for several reasons, one of which was they died over Texas, "so close to home." Reporters Bragg and Yardley described the disbelief and resignation and numbness and sadness in Houston: a funereal atmosphere. They also described the press conference at JSC, how the two administrators spoke with cracking voices; they wrote about the speakers' "precise language about failed sensors and damaged tiles on the left wing of the shuttle." Mr. Heflin was also quoted as articulating another long-time NASA theme: when something breaks, we fix it.

Reactions at the Cape

An article with a dateline from Cape Canaveral, Florida, Feb. 1, by Dana Canedy had this headline the next day: "LOSS OF THE SHUTTLE: CAPE CANAVERAL; Keenly Felt Grief in a State Entwined with the Space Program." The reporter interviewed tourists at KSC, local residents, and officials. A woman from Alexandria, Virginia, was quoted as saying about the *Columbia* crew: "You hope that somehow these lives were spared." Tourists were no longer in the mood for recreation, some deciding to cut their vacations short. Much like Gregory Williams, people felt they had lost their vacation; some visitors said they were "stunned," and a woman from West Virginia said, "You feel kind of hollow inside."

Canedy's article moves from the effect on tourists to description of the unique relationship between Florida and the space program. After the explosion of *Challenger* on January 28, 1986, the Florida legislature remembered the seven-person crew with a special license plate, one that turned out to be among the most popular ever.

Senator Bill Nelson, a Democrat, took a ride on the *Columbia* itself in 1986 when he was a congressman representing Brevard County, in which the space center is located. Public officials said they were shocked and saddened over the loss of *Columbia*.

At the runway, where NASA officials, reporters, and relatives were awaiting the spacecraft, "panic" took over as the shuttle failed to appear. The Administrator of NASA, Sean O'Keefe, in office only a year, "fighting back tears, addressed the news media a short time later: 'This is indeed a tragic day for the NASA family, for the families of the astronauts, and, likewise, tragic for the nation.' "

* * *

Unlike the *Challenger* accident, which appeared on live television with a huge nationwide audience of schoolchildren, in this case people were more likely to hear the news in anxious telephone calls and radio broadcasts and cell phones and the internet. Dean E. Murphy's article in the *New York Times* on February 2 has the subtitle: "Sorrow, Memories of *Challenger* and a Will to Move Ahead," based on the responses of citizens around the country. Some citizens told Murphy they were already apprehensive about a possible war with Iraq, memories of 9/11, and the *Challenger* accident. Others linked *Columbia*'s fate with fears about the accident's effect on the economy. Many thought it might be a terrorist attack. Sympathy for Israelis was expressed by many. A pediatrician in Grosse Pointe, Michigan, hoped the loss might cool the "fiery rhetoric" toward Iraq. A store manager in Buchan, Michigan, said she watched President Bush's speech on television with tears in her eyes.

Readers of the Sunday *New York Times* and other newspapers were able to sense the outline of the event the following day, February 2, 2003. In an overview article, one of the many pieces in the paper that day about the accident, David E. Sanger in a dateline from Washington, D.C., explained that *Columbia* had broken up during re-entry into the atmosphere of the earth, killing all seven astronauts and raining fiery debris across Texas and Louisiana. The loss, he said, would revive the long-term debate about the space program in Congress and would renew questions about management problems at the agency.

The Crew and Its Mission

Best known among the astronauts was Ilan Ramon, 48. He was selected as an astronaut candidate in 1997 following a science agreement between President Bill Clinton and Shimon Peres, then the Israeli foreign minister. The son and grandson of Holocaust survivors, Ramon felt he represented Israelis and all Jews as the first of his ethnic identity to fly in space. On the shuttle he was in charge of an Israeli project to gauge the effect of dust storms on climate. He carried a special symbol onto the spaceship: a small Torah scroll used in the bar mitzvah of the project's principal investigator, Dr. Joachim Joseph, nearly 60 years earlier while he was in a Nazi concentration camp. Security surrounding the flight was extraordinarily tight because of Ramon's status as a national hero in Israel. Experts on terrorism, wrote Sanger, thought it was highly unlikely that *Columbia* had been hit because it flew at such a high altitude, beyond the reach of conventional weapons. Mr. Bush called Ariel Sharon, Prime Minister of Israel, and the two friends "grieved together," as did their two nations. Ironically, we would later learn that the shuttle broke up near a small town in east Texas named Palestine.

The flight was commanded by an Air Force Colonel, Rick D. Husband, 45, and the pilot was a Navy Commander, William C. McCool, 41. The scientific payload was coordinated by Michael P. Anderson, 43, a Lieutenant Colonel in the Air Force, the third African American to die in the service of the space program; Dr. Kalpana Chawla, 41, a woman born in a province of India where girls are often aborted, who had a doctorate in engineering from the University of Colorado and had become an American citizen; and two Navy doctors, Captain David M. Brown, 46, and Navy Commander Laurel Salton Clark, 41. The mission of this flight was unusual, being completely dedicated to scientific experiments, some ninety of them, including eleven from schools worldwide and, as mentioned, the Israeli study of dust storms. A more typical mission for the shuttle is the transport of people, equipment, and supplies to the International Space Station and the support of military operations, but *Columbia*'s cargo bay could carry less mass than other shuttles because, as the first one built, it had less-advanced structural materials. Like all shuttles, *Columbia* got her name from a ship, in this case a Boston-based sloop that discovered the Columbia River on the

Left to right: David Brown, Rick Husband, Laurel Clark, Kalpana Chawla, Michael Anderson, William McCool, Ilan Ramon (CAIB Report, Vol. I, p. 29).

coast of Oregon and was the first American vessel to circumnavigate the world. This was the 113th shuttle mission, the 28th for *Columbia*, the oldest of the Orbiters. That means, of course, that the rate of catastrophic failure for the shuttle is two in 113.

Early theories of accidents are often disproved, wrote Sanger, but he couldn't resist recalling that a few days earlier NASA had revealed that a piece of foam insulation had hit the left wing during the launch. A similar incident had been observed in a previous launch but without inflicting any major damage. All theories would be reviewed by NASA itself and by an independent board chaired by Admiral Harold W. Gehman, Ret., who was one of the two chairmen of a commission that investigated the terrorist attack on the U.S. destroyer *Cole.*

Then Sanger made the inevitable comparison to the *Challenger* accident, observing that whatever had happened to *Columbia,* it was different from what caused the first shuttle disaster. The infamous O-rings of the *Challenger* were part of the solid-fuel boosters; the *Columbia* problem seemed to be centered in the left wing. The first disaster happened on ascent, the second on descent, on re-entry into the earth's atmosphere where it is subjected to temperatures in excess of 2,000 degrees. *(It seemed to me, however, that both shuttles might have been doomed during the launch.)*

Turning to the problem of the International Space Station, Sanger stated that the two Americans and one Russian aboard were scheduled to be picked up and returned to Earth by *Atlantis,* set for a launch on March 1. The station, he wrote, had a large stock of water, food, and other supplies, enough to support the three for several months. The Russian Space Agency was also scheduled to send a robotic cargo ship, *Progress,* to the station, but the building materials to be used to expand the station could only be hauled by one of the three remaining shuttles.

The latter part of Sanger's overview article skipped, in journalistic style, from topic to topic, mentioning in random order how communication was cut—"It's as if someone just cut the wire," quoting Mr. Dittemore. NASA had declared a "mission contingency [anomaly]," when anyone on the ground could see that the spacecraft had broken up. There was none of the drama of *Challenger* because the shuttle was not in full view of the television cameras. Debris was scattered over hundreds of square miles of Texas and Louisiana; in Hemphill, Texas, a driver "came across what appeared to be parts of

the remains of an astronaut." The space program had lost the political import it had during the Cold War. There was another Colonel Ramon story:

> [H]e had little room to take personal items on the flight, but he did lift off with a piece from the Holocaust-era: a small black-and-white drawing called "Moon Landscape" that he had borrowed from the Yad Vashem Art Museum in Israel. The drawing, by Peter Ginz, a 14-year-old Jewish boy killed at Aushchwitz in 1944, was a picture by a child who dreamed of faraway places and sketched what he thought the Earth would look like from the mountains of the moon. This morning, nearly 60 years later, it was incinerated over the skies of Texas.

Possible Causes of the Disaster

The subtitle of another article appearing in the *Times,* on February 2, written by William J. Broad and James Glanz, was "Inquiry Putting an Early Focus on Heat Tiles." NASA had experienced trouble with the tile heat shields on the wings in the past, and although NASA officials discounted the effects of a piece of foam insulation shed by the solid rocket tank, they had to admit the loss of sensors in the left wing would necessitate study of that possibility. Broad and Glanz listed five other possible causes; the six possibilities, in order of decreasing likelihood:

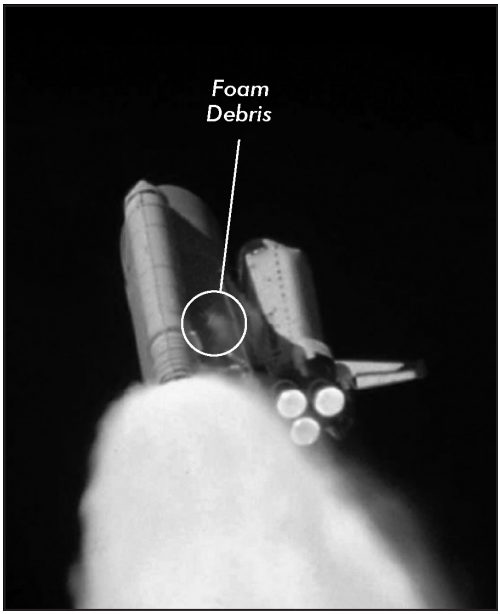

Figure 1-1. *A shower of foam debris after the impact on* Columbia*'s left wing. The event was not observed in real time (CAIB Report, Vol. I, p. 34).*

1. Damage to the protective tiles on the left wing.
2. An explosion of the ship's fuels and oxidizers, which were kept under high pressure.

3. Collapse in the shuttle's structure, which was aged.
4. Faulty navigation setup for the fiery re-entry, caused perhaps by a computer problem.
5. A collision with a speeding meteoroid or piece of space debris.
6. Terrorism, perhaps by a technician at the launching site.

As we shall later see, research and analysis would proceed by an attempt to reject faulty hypotheses and seize upon the hypothesis that would explain most of the facts. Although it would take some time to prove, the answer would be that none—not one—of these original hypotheses would turn out to be the complete answer.

There was another question: Could NASA have saved the astronauts?

These questions would remain a mystery for months to come.

We can now move to Chapter Two and pick up the narrative of what was learned in the following week. ✦