

Addison-Wesley, 1998,
122 pages

by David Goodstein

If you go to the science section of your local bookstore, chances are you'll find a shelf full of books by or about Richard Feynman. He seems to be endlessly fascinating to scientists and nonscientists alike. I confess to having coauthored one of those books, intended as a tribute to my friend and colleague at Caltech for more than 20 years. Before I knew him personally, however, in April 1963 he came to Seattle to give three public lectures under the general title "A Scientist Looks at Society," part of a series of guest lectures at the University of Washington known as the John Danz Lectures. I was at the time a graduate student in physics at U-Dub (as we called the U. of W.) and Feynman, although he had not yet won his Nobel Prize, was already a legendary figure. A visit to U-Dub by the great man was a very exciting occasion.

Addison-Wesley has now published Feynman's Danz Lectures under the inappropriate title *The Meaning of It All*. I read through the review copy that was sent to me, eager to find those vivid moments that, even after 35 years, stand out in cherished memory. One was the point at which, much to the delight

of Feynman and the rest of his audience, the entire psychology department stood as one and marched out in a huff (of course it may not have happened that way. This is a 35-year-old memory we're talking about). I found it in the third lecture when Feynman referred to psychoanalysts and psychiatrists as "witch doctors," because all their complicated ideas about ids and egos and so on, accumulated in almost no time at all, couldn't possibly be right. He also said that, if he were a member of a tribe and he were sick he would go to the witch doctor, because the witch doctor knows more about it than anyone else, but, if memory serves, that was after the psychologists were already gone. In the next few pages he also savages professors of English pretty thoroughly, but probably there were none of those present in the first place.

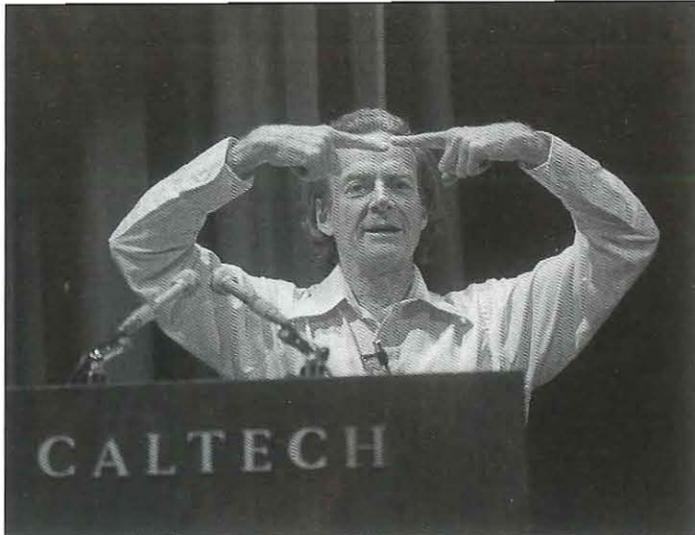
Another zinger I've repeated often (I have spent an entire career shamelessly stealing ideas from Richard Feynman): While making a point, often lost even on scientists, that you can't verify a theory using the same data that suggested the theory (if only epidemiologists would catch on to this!), he suddenly seems to change

the subject and says: "I had the most remarkable experience this evening. While coming in here I saw license plate ANZ 912. Calculate for me, please, the odds that of all the license plates in the state of Washington I should happen to see ANZ 912." So much for a priori probabilities of unlikely events.

Feynman had been invited to give a series of public lectures. In his mind, "public" meant nonscientists, even though most of his audience probably were scientists (like me for example). His general idea was first to try to explain what science and scientific thinking were about, and then to say what a person who thought in that way might have to say about matters like government and religion. So far, so good.

The first lecture, the one that was supposed to explain what scientific thinking is about, he called "The Uncertainty of Science." The uncertainty he had in mind was not that of Heisenberg, but rather that of Karl Popper: that scientists should be skeptical of their own theories, or, in other words, have an open mind. As with most scientists who profess to follow Popper, he consistently refutes himself throughout his lectures.

To Feynman, science has three parts: the facts or body of knowledge, the method or process that we use to establish those facts, and the applications of science, that is to say, technology. To him it's an article of faith that technology follows science. He would regard technology arising on its own as something akin to the Virgin Birth (we'll get to religion shortly). But his real point is that technology is only incidental to the importance of science. He vents his fury on journalists who report (poorly) each new advance in biology, then declare that it



Feynman at Seminar Day in 1978.

He could say more with body language alone than most people can extract from the *Oxford English Dictionary*.

will lead to a cure for cancer.

In the second lecture, called "The Uncertainty of Values," he sets out to apply the scientist's open mind to conventional religion (he swears off "fancy theology"; he's interested in everyday religious belief) and to the Cold War struggle between East and West. In each case, in spite of repeated protestations of uncertainty, he winds up firmly taking sides. For example, on Khrushchev's comment that "modern art" looks like it was painted by the tail of a jackass, Feynman's comment is, "He should know."

Feynman on religion is interesting mainly because he clearly feels the need to tread very carefully for fear of offending too many people. He divides religion up into three parts (he seems to like dividing things into three parts): the metaphysical (creation myths, etc.), the ethical, and the inspirational. His analysis is that science undermines the metaphysical part, but has no effect at all on the ethical, because, in fact, scientists have pretty much the same ethical values as everyone else. He laments the fact that the undermining of the metaphysical takes a lot of air out of the sails of the inspirational part, but his

view is that the picture of the universe presented by science is pretty inspirational itself. On the delicate question of whether we are justified after all in believing in God, he gives us the one paragraph in the entire book that justifies the title *The Meaning of It All*:

"It is a great adventure to contemplate the universe, beyond man, to contemplate the universe without man, as it was in a great part of its long history and as it is in a great majority of places. When this objective view is finally attained, and the mystery and majesty are fully appreciated, to then turn the objective eye back on man viewed as matter, to see life as part of this universal mystery of greatest depth, is to sense an experience which is very rare and very exciting. It usually ends in laughter and a delight in the futility of trying to understand what this atom in the universe is, this thing—atoms with curiosity—that looks at itself and wonders why it wonders. Well, these scientific views end in awe and mystery, lost at the edge in uncertainty, but they appear to be so deep and so impressive that the theory that it was all arranged as a stage for God to watch man's struggle for good and evil seems inadequate."

He starts the third lecture, "This Unscientific Age," with the announcement that he had used up all his organized ideas in the first two. There are a number of other points that bother him, however, and those he will discuss here. This is the lecture that had in it both of the moments I remembered, and along the way another that I don't know how I could have forgotten. He tells the story of a snake-oil salesman he heard speak in Atlantic City, selling bottles without the legally required warning labels. By the end of his talk he's gotten his gullible audience to affix the labels to the bottles. "This," Feynman announces, "is what I did in the second Danz lecture." He had started out by claiming an open mind on, for example, politics, but by the end, there was a label on his bottle.

There are, then, some nuggets of pure Feynman gold in this book. So why did it take so long to get published? The answer is that, according to the University of Washington Press, they tried strenuously at the time to get Feynman to permit them to publish, but he wasn't having it. And he was right. Feynman in person was electrifying, no matter

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what he spoke about. He could say more with body language alone than most people can extract from the *Oxford English Dictionary*. But on paper, dealing with matters far from his comfort zone, Feynman is quite another matter.

The book is badly dated and atrociously edited. Many pages make the reader squirm with embarrassment. Sometimes he's just a little off the point. He trashes those English professors not for the relentless banality of most literary criticism, but for not producing a rational scheme of spelling for the English language. At other times it's just not the right stuff. Feynman doing battle with the earnest ladies of the Altadena Americanism Center has some of the same spirit as the famous stories he liked to tell about himself, but it's neither racy nor funny, just quaint and somewhat silly. And there are many references to names or things that had meaning in 1963 but not anymore. Who was Mr. Nakhrosov? Mr. Anderson? (He was somehow mistreated by the American military). Do you remember what "the farm problem" was? The editors do nothing to help us in these matters. Addison-Wesley's attitude is, clearly, take the money and run.

The publication of this book now, with Dick Feynman no longer here to defend himself, does not honor his wishes, and it does not honor his memory. You'll find this book on the Feynman shelf in your bookstore. Don't buy it.

This review first appeared in the July–August 1998 issue of American Scientist. David Goodstein is professor of physics and applied physics, the Gilloon Distinguished Teaching and Service Professor, and vice provost at Caltech.

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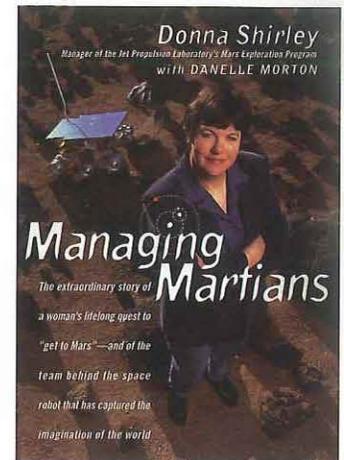
by Al Hibbs

"We have a signal!" the flight engineer yelled.

"The team exploded in cheers and hugs and impromptu jigs. Even though I was in full view of the CNN audience, broadcasting live, I did my own modest victory dance. Pathfinder hadn't crashed or burned! It was on the surface of Mars—and alive. My Christmas package had arrived. I restrained myself from hugging the nearest available person—the CNN reporter.

"Did I just see you wipe away a tear?" he asked with astonishment."

This excerpt is from the first chapter of Donna Shirley's memoir—a chapter that gives a fast-reading account of the development of the Mars lander at Caltech's Jet Propulsion Laboratory (JPL), and the climactic events of July 4, 1997, when the spacecraft, called Pathfinder, completed its seven-month journey from the surface of Earth to the surface of Mars. Pathfinder was carrying a small roving vehicle named Sojourner Truth. (In a later chapter we learn how and why it got that name.) This rover, although firmly strapped down to the Pathfinder for its interplanetary trip, was developed as a completely separate project—



a project managed by Shirley, the first female spaceflight project manager at JPL, and, I believe, for all of NASA. In the rest of the book we learn how this came about and what some of the consequences have been.

At the age of 10 she found her career goal—aeronautical engineering. In high school she got out of a home economics requirement in order to take a mechanical drawing class, wherein she was looked upon as a sort of joke by both her fellow students (all male) and her teacher. (An aside: I have known Donna for many years and worked with her from time to time at JPL. On more than one occasion one of our colleagues has quietly assured me that, as a woman, she shouldn't be taken seriously as an engineer.) But she kept to her goal of engineering and her interest in aeronautics. She learned to fly and soloed at 16.

The brief story of her early life carries us through her college years, sometimes difficult, but including winning a hometown beauty contest and becoming Miss Wynnewood (Oklahoma). Her early professional career brought her eventually to JPL. Here she was involved in a number of study and analysis projects. The main

body of the book describes these activities and the engineering challenges they involved. Although she does a pretty good job of avoiding jargon (not a perfect job: for example, "six-degree-of-freedom equations" goes by without comment), we still get a heavy dose of technical explanations. If you're an engineer, you'll probably enjoy it.

For Donna, JPL seemed to offer the hope of fulfilling a dream held since childhood—flying into space, particularly to Mars; and, if not going personally, at least with a piece of machinery she could truly call her own. This required getting on a flight project, where the engineering requirements are much stricter than for study projects. But that goal was elusive. She had worked on studies of Mars missions and even the development of Mars-rover prototypes. When it was decided to turn prototypes into flight hardware, she applied for the job of running the project and was turned down with the Catch-22 excuse that, because she had no experience in delivering flight hardware, she couldn't get a job delivering flight hardware. When she finally did get the assignment, she suspected that it was because all the experienced candidates believed it would never be successful.

The Pathfinder spacecraft, which carried the rover to Mars, was developed and operated under the project management of Tony Spear, an engineer with many years of flight-project experience. It was inevitable that Donna and Tony would have a difficult relationship. Every project manager wants everything that might affect the success of his project under his control, so Tony was understandably dismayed at the setup with Donna and tried to get the rover either canceled or

placed under his management. Donna recounts a meeting with Tony and his senior staff in which he demanded that she turn over her budget allocation to him. Of course she refused, and the ensuing shouting match was ended only when an engineer from an adjoining office complained that they were interrupting his meditation.

And how did Sojourner Truth get its name? After developments were pretty well started, Donna had her "bright idea," which was destined to get her in trouble: She would have a naming contest. Young students were asked to propose the name of a woman who had done much for humanity, and back up their choice with a 300-word essay. When a NASA bureaucrat got wind of the contest, he ordered it stopped, but it was too late. Essays were already pouring in. A few months later, the project got an official NASA reprimand for the undignified contest that had not "followed proper procedures." Four years later the same bureaucrat was publicly praising the young contest winner for her choice of the name!

Sojourner Truth was well along in development but still a couple of years from launch when Shirley was offered the job of Mars Program Manager for JPL. This meant responsibility for planning all the projects intended to explore Mars. In describing this job she reveals a certain lack of historical perspective, saying, "Certainly no one at JPL had any experience building a program." To the contrary, program plans were a regular output of JPL—and NASA. In 1959, shortly after joining the newly created space agency, JPL published a plan for the exploration of the solar system, including Mars. In 1976 NASA published a massive plan called "Outlook

for Space" that involved program planners from every NASA center, including JPL. A planetary exploration plan was described therein, including a plan for Mars. This was followed two years later by the publication of a plan called "Exploration of the Solar System," put together at JPL. In 1983, NASA published "Planetary Exploration Through the Year 2000," again with a plan for Mars with inputs from JPL planners. Indeed, there has never been a lack of plans for exploring Mars and the rest of outer space. What has been lacking is consistent funding

for this piece of the space program, and the determination of the NASA bureaucracy to stick to any plan. Perhaps Shirley's plans will be more successful. To quote the last line of her book, "Stay tuned."

Al Hibbs, BS '45, PhD '55, is retired from a long career at JPL, where he was senior staff scientist and manager of program planning and coordination. In his capacity of public spokesman for JPL, he was known as the Voice of Surveyor, the Voice of Mariner, the Voice of Viking, and the Voice of Voyager.

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