

First Richard Feynman gives the talk; then, 28 years later, an actor who played him on the stage gives it. This is what's called entropy. This is what happens just before the cosmos reaches a temperature of absolute zero.

Finding Feynman

by Alan Alda



Actor Alan Alda spoke at Caltech's 108th annual commencement, on Friday, June 14. Here he is seen with, from left, Professor of Mechanical Engineering Melany Hunt; Marianne Bronner-Fraser, Ruddock Professor of Biology and chair of the faculty; and Trustee William Davidow. Alda is no stranger to science or Caltech, having hosted *Scientific American Frontiers* on PBS for the last eight years. His fascination with Feynman led to the creation of the play *QED*, in which he starred as the late Nobel laureate.

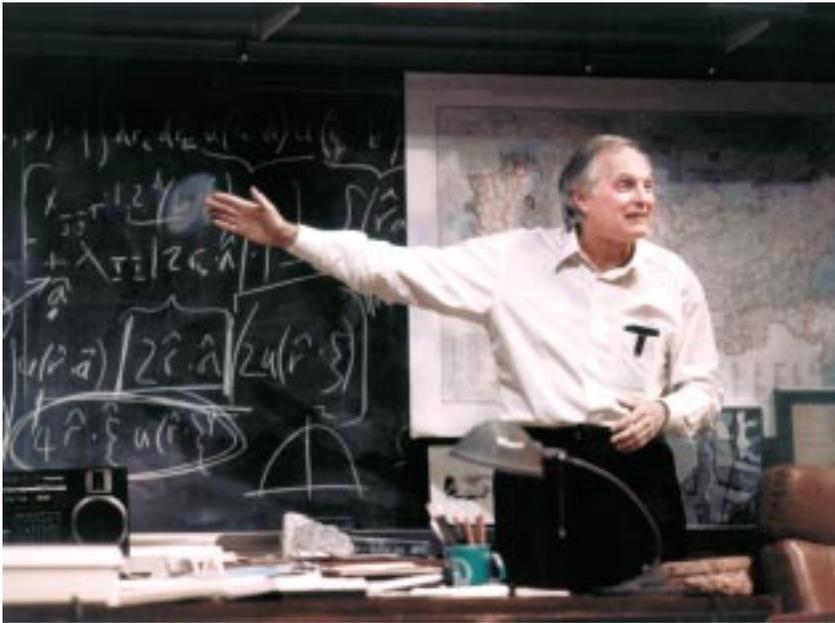
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Twenty-five or thirty years ago, on my days off from the Korean War, which was at that time being waged at Twentieth Century Fox in Beverly Hills, I would often come to Pasadena to visit the Rembrandts at the Norton Simon Museum, or take a walk in the Huntington Gardens. And sometimes I would drive by Caltech and give it a glance and wonder what interesting stuff was going on in there. I had been reading about science avidly for years, and I was immensely curious about how scientists went about what they did. It didn't occur to me each time I passed by that there was one particular man in one of these buildings who at that moment might have been drawing gluon tubes on a blackboard, or playing the bongos, or just standing looking out the window as a young woman passed by—a man in whom, in a few years, I would become intensely interested.

One day, exactly 28 years ago, he was standing right here, giving the Commencement address. This is the way the universe operates. First Richard Feynman gives the talk; then, 28 years later, an actor who played him on the stage gives it. This is what's called entropy. This is what happens just before the cosmos reaches a temperature of absolute zero.

Let me tell you a little about the path that led me here. After I had read several books about Richard Feynman, I brought one of them, a charming, touching book by Ralph Leighton, called *Tuva or Bust*, to Gordon Davidson at the Mark Taper Forum in Los Angeles. I wondered if he thought we might be able to make a play about Feynman. He suggested Peter Parnell to write the play, and the three of us started off on a journey to find out who Richard Feynman was. We thought we'd open the play a year or so later. Instead, it took us over six years.

We had no idea how hard it would be. For one thing, he was an extremely unusual person. Toward the end of his life, he knew he was dying,



Alda as Feynman.

and he knew exactly what the most important questions were, and he knew he had a shot at answering them—and yet he kept to his habit of doing only what *interested* him.

He spent a good part of his time trying to get to this little place in the middle of Asia called Tuva, mainly because its capital was spelled with no vowels, which, for some reason, he found *extremely* interesting. But, just as getting to Tuva was tantalizingly difficult for Feynman, getting to Feynman became maddeningly hard for us.

What part of him do you focus on? He helped create the atomic bomb; he helped figure out why the *Challenger* blew up; he understood the most

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puzzling questions in physics so deeply they gave him the Nobel Prize. Which facet of him do you let catch the most light? The one who was a revered teacher, a bongo player, an artist, a hilarious raconteur, or a safecracker?

We wanted to make a play about Feynman, but *which* Feynman?

A mathematician friend of mine suggested that a central image for a play about him could be Feynman's own idea of a sum over histories. Just as Feynman saw a photon taking every possible path on its way to your eye, Feynman himself took every possible path on his way through life. He was the sum of *all* his histories.

Well, nature may be smart enough to know how to average all the paths of a photon. But we three

theater people couldn't figure out how to add up all the histories that made up Feynman.

At one point, I said: "You know what we ought to do? We ought to write a play about three guys sitting around in a hotel room, trying to figure out a play about Feynman. They never figure it out. They just drive themselves crazy."

We researched him like mad, of course. The people who knew him and worked with him and loved him here at Caltech opened their doors and their hearts to us. They were extremely generous and helpful, as we struggled to reduce this irreducible person to an evening in the theater.

I think one of the things I most hoped would come through was his honesty. He never wanted to deceive anyone, especially himself. He questioned his every assumption. And when he was talking to ordinary people with no training in physics, he never fell back on his authority as a great thinker. He felt that if he couldn't say it in everyday words, he probably didn't understand it himself.

I was fascinated by this in him. He knew more than most of us will ever know, and yet he *insisted* on speaking our language.

Like Dante in *his* time, he could say the most exquisitely subtle things in the language of the common people. He was an American genius, and like many American artists, he was direct and colloquial—not afraid to take a look at the ordinary, and not afraid to go deeply into it to reveal the extraordinary roots of ordinary things. And yet, he recoiled from oversimplification. He wasn't interested in dumbing down science—he was looking for *clarity*.

If he left something out, he always told you what he was leaving out, so that you didn't get a false picture of a simplicity that wasn't there. And, later when things got more complex, you were prepared for it. He treated you, in other words, with respect.

But there was something else about him that fascinates me.

I was reading a book by Freeman Dyson the other day and a paragraph about Feynman jumped off the page at me.

"Dick was ... a profoundly original scientist. He refused to take anybody's word for anything. This meant that he was forced to rediscover or reinvent for himself almost the whole of physics.... He said that he couldn't understand the official version of quantum mechanics that was taught in textbooks, and so he had to begin afresh from the beginning.... At the end he had a version of quantum mechanics that he could understand."

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I think I saw something in this paragraph for the first time; something suddenly clicked into place. The fact that he wouldn't take anybody's word for anything wasn't new to me, or that he needed to go through every step himself in order to understand it. A phrase of his has been on the blackboard behind me every night as I've played Feynman: "What I cannot create, I do not understand."

(People have asked us why that phrase is given so much prominence in the play. It's because the blackboard on our set contains pretty much everything that was on the final blackboard left by Feynman in his office when he died. And "What I cannot create, I do not understand" was right up there at the top.)

But what did jump out at me the other day was the phrase "he couldn't understand the official version of quantum mechanics that was taught in textbooks." Now, this is *Feynman* we're talking about. I suddenly had this picture in my head of Feynman going through the same experience the rest of us do—meeting that same blank wall half way up the mountain. I wondered. Did that give him the ability to remember what it was like to *start* that climb?

So, maybe it wasn't just that he could visualize these little particles and their interactions that made him able to communicate it to the rest of us. Maybe it was also that he could remember what it was like to feel dumb.

Now, here's why I'm going on about this. It may not seem *important* how Feynman did it. Maybe we should just be glad he could do it and let it go at that. But I think it *is* important. Because I think we have to figure out how *we* can do it, too.

For one thing, we live in a time when massive means of destruction are right here in our hands. We're probably the first species capable of doing this much damage to our planet. We can make the birds stop singing; we can still the fish and make the insects fall from the trees like black rain.

And ironically, we've been brought here by reason, by rationality. We cannot afford to live in a culture that doesn't use the power in its hands with the kind of rationality that produced it in the first place.

But right now, instead of reason, a lot of people are making use of wishes, dreams, mantras, and incantations. They're trying to heal themselves using crystals, magnets, and herbs with unknown properties. People will offer you a pill made from the leaf of an obscure plant and say, "Take it, it can't hurt you, it's natural." But so is deadly nightshade. Interestingly, they expect the plant to have active properties to cure them, but they're certain it has no active properties that can harm them. How do they know that?

I mention this, not to denigrate anyone's beliefs (I feel strongly that we're all entitled to our beliefs, just as we're entitled to our feelings), but I bring it up to point out that we're in a culture that increasingly holds that science is just another belief.

And I guess it's easier to believe *something*—anything—than not to know. We don't *like* uncertainty, so we gravitate back to the last comfortable solution we had—no matter how cockeyed it is.

But Feynman was *comfortable* with not knowing. He enjoyed it. He would proceed for a while with an idea as if he *believed* it was the answer. But that was only a temporary belief in order to allow himself to follow it wherever it led. Then, a little while later, he would vigorously attack the idea to see if it could stand up to every test he could think of. If it couldn't stand up, then he simply decided he just didn't know. "Not knowing," he said, "is much more interesting than believing an answer which might be wrong."

You're graduating today partly as Feynman's heirs in this gloriously courageous willingness to be unsure. And just as he was heir to Newton, who was in turn heir to Galileo, I hope you'll think about devoting some time to helping the rest of us become *your* heirs.

I'm assuming you're here at Caltech because you love science, and I'm assuming you've learned a great deal here about how to *do* science. I'm asking you today to devote some significant part of your life to figuring out how to share your love of science with the rest of us.

But, not just because explaining to us what you do will get you more funding for what you do—although it surely will—but just because you *love* what you do.

And while you're explaining it, remember that



Feynman's commencement address—"Cargo Cult Science," on science, pseudoscience, and learning how not to fool yourself—appeared in the June 1974 issue of *E&S*.



dazzling us with jargon might make us sit in awe of your work, but it won't make us love it.

Tell us frankly how you got there. If you got there by many twists and turns and blind alleys, don't leave that out. We love a detective story. If *you* enjoyed the adventure of getting there, so will we.

Most scientists do leave that out. By the time we hear about their great discoveries, a lot of the doubt is gone. The mistakes and wrong turns are

Bethe says, "That's interesting, Feynman, but what's the importance of it?"

And Feynman says, "It has no importance, it's just fun!" ...

Of course, what Feynman was looking for was *serious* fun. It was the awe he felt when he looked at nature. And not just the official great wonders of nature, but any little part of nature, because any little part of it is as amazing and beautiful and complicated as the whole thing is.

left out—and it doesn't sound like a human thing they've done. It separates us from the process.

Whatever you do, help us love science the way you do.

Like the young man, so head over heels about his sweetheart, he can't stop talking about her; like the young woman so in love with her young man, she wants everyone to know how wonderful he is—show us pictures, tell us stories, make us crave to meet your beloved.

Don't just tell us science is good for us and, therefore, we ought to fund you for it; don't tell us to trust you that your fancy words actually mean something; don't keep the tricks of your trade up an elite sleeve. Don't be merchants, or mandarins, or magicians—be lovers!

Look, in our culture we know when a commercial is coming. We know how to turn it off. But love we can't resist.

You may be swayed by people who insist they're only interested in hearing about the practical applications of science. You may be tempted to bend over backwards, telling them what they want to hear.

When Feynman stood here and spoke 28 years ago, he cautioned scientists against going too far in telling laypeople about the wonderful everyday applications of their work, especially if there weren't any. He felt it wasn't honest to pretend there *was* such a benefit—just to get funding for your work.

It's a powerful urge, but it's possible to resist it.

Robert R. Wilson resisted it beautifully. Bob Wilson was a physicist whom Feynman had known well. He had helped recruit Feynman for the Los Alamos project. Wilson was also an accomplished sculptor. He had a foot in each of C. P. Snow's "two cultures."

Wilson built Fermilab, the giant atom smasher

in Illinois. But at a congressional hearing in 1969, he was grilled by Senator John Pastore, who wanted to know what an atom smasher was *good* for. Does it in any way contribute to the security of the country?

Wilson said, "No, sir, I do not believe so."

"It has *no value* in that respect?" the senator asked.

Wilson looked at him and said, "It only has to do with the respect with which we regard one another, the dignity of people, our love of culture.... In that sense this new knowledge has all to do with honor and country. But it has nothing to do directly with *defending* our country—except to help make it worth defending."

Like Wilson, I don't think Feynman needed to justify his curiosity about nature.

Pure science was pure pleasure. It was fun.

It's like the story of the plate.

The one thing I was certain of from the beginning was that we had to have the story of the plate in the play. It was central. The author, Peter Parnell, would do draft after draft. And I would look at it and say, "Where's the plate?" I drove him crazy.

The plate story is this: After the war, Feynman became depressed. His first wife had just died of tuberculosis, and the realization of the awful destructive power of the bomb he had helped make had finally sunk in. He was teaching at Cornell, but he had no taste for it. He couldn't concentrate. Then, one day, he's in the school cafeteria and some guy starts fooling around, tossing a plate in the air. Feynman watches the design on the rim of the plate as it spins and he sees that as it spins, the plate wobbles. He gets fascinated, and he tries to figure out the relationship between the spin and the wobble. He spends months on this, and finally comes up with this complicated equation, which he shows to Hans Bethe.

And Bethe says, "That's interesting, Feynman, but what's the importance of it?" And Feynman says, "It has no importance, it's just fun!"

But, see, that's the thing—it not only brought him out of his slump, but that playful inquiry, according to Feynman, eventually led in a circuitous way to the work that won him the Nobel Prize.

But no matter *where* it might have led him, he made up his mind that day in the cafeteria never to work on anything that didn't interest him—that wasn't fun.

Of course, what Feynman was looking for was *serious* fun. It was the awe he felt when he looked at nature. And not just the official great wonders of nature, but any little part of nature, because any little part of it is as amazing and beautiful and complicated as the whole thing is.

So, this is interesting. I'm urging you to be like someone who I admit I've found to be pretty elusive.

Here I am, seven years later. And, just as Feynman never got to see Tuva, I never really found Feynman. Not really. I came close; but he was too many things. He had too many histories.

We came up with a play in *QED* that was immensely satisfying. It was beautifully written and beautifully directed, and it gave the audience a Feynman that was as close an approximation as we could come up with. But part of me feels that a large chunk of the man is still beyond our reach—probably beyond the reach of anyone. He's just out of sight, smiling at us. Laughing at how he put one over on us, letting us think he was just an ordinary guy. A guy we could *get*.

It turns out, though, that the old thing about the destination not being as valuable as the journey really *is* true.

Because, when we began, *finding* Feynman seemed important, and I guess it was—but, as it

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turned out, *looking* for Feynman has been the fun.

Every once in a while, though, I can feel Feynman looking over my shoulder, and he's *not* smiling. Like right now. I'm at the end of my talk and I feel the pressure of the words he closed *his* talk with 28 years ago. "One last piece of advice," he said. "Never say you'll give a talk unless you know clearly what you're going to talk about and more or less what you're going to say."

In other words, where are the brass tacks?

Okay, let me be more or less practical. I'm going to propose something to you today. I realize it's a childish idea, something only an unschooled layperson would come up with—but it's specific enough that it might get you thinking.

What if each of you decided to take just one thing you love about science and, no matter how complicated it is, figure out how to make it understood by a million people? There are about 500 of you taking part in this ceremony today. If just a few of you were successful, that would make several million people a lot smarter.

How you do it is up to you. You're clever people, and I bet you come up with some ingenious solutions. On the other hand, you may be thinking, "*WHY?* Why should I do this impossible thing?"

Well, I don't know; maybe for the same reason that the birds sing.

If it does for you what it does for birds, there's a lot to recommend it:

- 1) It's a good way to improve your chances of having sex.
- 2) It feels good to sing.
- 3) Singing is the music nature makes when it dances the dance of life.

You are the universe announcing itself to itself. You open your mouth and a little muscle in your throat makes a corner of nature vibrate. You're one part of the forest saying, "This is what I think I know," while another part of the forest is saying, "Yeah? Well this is what I think *I* know!" Your chirpings are the harmony of all knowledge.

You've learned so much in this place about how nature works. Is there anything more beautiful than that? Is there anything greater to sing about?

So *sing*. Sing out. Sing. Out.
Thank you, and good luck. □



Alda and Feynman finally meet in this montage by Caltech graphic artist Doug Cummings, presented at the post-Commencement luncheon by President David Baltimore.

*Alan Alda, of course, played Dr. Hawkeye Pierce in the classic TV series M*A*S*H. He also knows a thing or two about writing—during the show's 11-year run, he became the first person ever to win Emmys as actor, director, and writer. (M*A*S*H netted him five Emmys and 25 nominations.) A native New Yorker and son of the distinguished actor Robert Alda, his first regular television gig was on the groundbreaking political satire That Was the Week That Was, in 1964.*

He has appeared in movies too numerous to mention, the most recent being What Women Want, and wrote, directed, and starred in The Four Seasons, Sweet Liberty, A New Life, and Betsy's Wedding.

His Broadway credits include The Owl and the Pussycat; Fair Game for Lovers, which won him a Theatre World Award; and The Apple Tree, which earned a Tony nomination. QED had its world premiere at the Mark Taper Forum in Los Angeles on March 22, 2001, and concluded its New York run at Lincoln Center's Vivian Beaumont Theater on June 10.