

# Reflections on Technology and Society

ROBERT W. LUCKY

Thank you for coming out to hear me this morning. I appreciate your attendance, and I hope to make it worth your while. This is a marvelous setting—it makes me want to be reincarnated as a basketball player and hear the cheers of the crowd as I dunk the ball. But I'm afraid that wasn't to be my lot.

I grew up in Pittsburgh, Pennsylvania, and as a child you often wonder what adults do. You form opinions based on those adults you see around you. On my street—I lived on a dead-end street at the outskirts of the suburbs—they kept building new houses. I would see carpenters working, and when they'd leave at night, the house would have come up that much more and you could see what they had done. At the end of my street was a farm, and I saw the farmer growing things. I saw him harvesting what he had grown. And I came to believe that adults made things and they grew things.

One day, as an adult, I looked around and I realized that I don't know a single person who makes a single thing. I don't know a single person who grows anything. Everybody I know makes their living exchanging information. It is marvelous that it is all possible. We're living in an information world.

When I was in high school I worked in the U.S. Steel mill outside Pittsburgh. It was the

largest steel mill in the world, and the experiences that I had in that summer were overwhelming to the senses. Molten ingots would flow by on automated rails, glowing orange. Then, a few seconds later, you would feel the wave of heat sweep over you. There was clamor constantly—near the auditory threshold of pain. There was soot in the air and in my nose, and the taste was in my mouth. My senses were overwhelmed.

Last year I visited the Microsoft company store in Redmond, and I looked at the company products—all in a line about twelve feet long, cardboard boxes filled with almost nothing. That was their entire product line. I looked at those boxes and thought, "That company is worth more than any company in the world right now, and their sole product weighs nothing, consumes no space—it's just those bits." At the company store, by the way, everything was \$10—every software program that they had. I said, "I wish I were an employee and I could buy these things for this price."

One of the executives was telling me, "Do you know we still make a profit at \$10?"

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*Robert W. Lucky was corporate vice president of applied research at Bellcore when this forum address was given on 26 November 1996.*

It's a frightening thought, but those cardboard boxes are worth more than General Motors, more than U.S. Steel. The steel mill I worked at so many years ago is now a deserted place, a junk pile.

Well, the world is getting changed into bits. Now there are two effects and their implications that I want to talk about here. One is the world changing from atoms into bits: the atoms of that steel mill to the bits of Microsoft. The other is that the world is becoming very connected.

These two effects are profoundly changing everything that the world is all about. And there are two laws here that I want to mention. When we look at the technology side of this, the most fundamental law is Moore's Law. Probably a lot of you have heard of Moore's Law, but some of you have not.

Gordon Moore is a retired engineer. He's a very soft-spoken, mild man. I think you'd like him a lot. You would never realize that he founded Intel and became a giant of industry. He's a very self-effacing individual. About 25 years ago he founded Intel, and about 20 years ago he proclaimed what has become known as Moore's Law. It's not a law at all; it's actually an observation. The observation is that digital technology, electronics technology, gets twice as good every 18 months. Now that means that transistors shrink, they get half the size, they get cheaper, they work faster, they cost less. That is an exponential thing, compounded. So in 15 years it's a factor of a thousand. Moore's Law tells us something about the way the world works. The transistors and all of the electronics technology get more and more and more powerful. So the laptop computer you buy this week will be obsolete next year, and you'll have to buy another one. Hey! That's great, isn't it—for the industry. This is a fundamental observation, and it has held exactly true over this long period and will go on for some time into the future.

This guarantees you that your life is going to get more complex. The complexity is

mounting. The things we are doing are going to be more and more powerful—and more and more complex. This will be a burden to you in many ways. I remember when VCRs were very simple, and I used to laugh at the joke about the flashing 12:00. But now I've got two in my house that are flashing 12:00. You know, they've made them simple, yet somehow they've made them almost unworkable. But you're guaranteed that they'll become more complicated as time goes along, because that is the way the world works.

Now, another law about connectedness, about how the world is becoming more intertwined and connected. It's known as Metcalfe's Law. Actually, I'm a little jealous because I was talking about it long before it became Metcalfe's Law—probably so were a lot of other people. But a journalist, George Gilder, wrote about it in terms of Metcalfe's Law, and that's what it came to be. Metcalfe's Law is that the value of a network increases with the square of the number of users. This is why the Internet and the Web have suddenly become so important because their value is exploding as the size grows.

To give you a feel for that, I remember when it first became very clear to me that this is what was going on. I was on a federal advisory committee for the Internet quite a few years ago. We were asked to rule on the issue of whether Brazil was to be allowed to use the Internet, which at that time was subsidized by the U.S. government.

I said, "Of course not. It's paid for by U.S. tax dollars. Why give Brazil a free ride on this?"

Then we started arguing and I started realizing that when Brazil comes onto a network, they don't just use the network, they bring themselves. They bring what they know. They bring their culture. They bring value. They bring connections. They bring themselves. And that's the way a network works. Every time someone joins a network, they bring value to

the network. And so the value of the network to everybody tends to explode.

By the way, as an aside, I had lunch with Bob Metcalfe (who this law is named after) earlier this year. I said, "Bob, you know, you've done a lot of things in your life that I've admired, and mostly you invented ethernet." Ethernet is a local area network that most of your computers are connected to here.

Then I said, "That's great, but the thing that you've done that I'm most jealous of is that you named a stadium." That is 3Com Park in San Francisco. Metcalfe started the company 3Com, and he picked the name out. Very few people know what the name stands for: Computers, Communication, and Compatibility. That's the 3Com—the stupidest name you could imagine, especially for a stadium. But, as we know, Candlestick Park is now called 3Com Park. And so I said, "Bob, you know, I can't imagine what it's like to have named a stadium."

He kind of laughed and said, "Well, you know, last week I went to a famous restaurant. They have a world-famous chef. When I ordered my dinner the waiter came over to me and said, 'Sir, I understand that you're Mr. 3Com. Our chef would like to meet you.'"

"I said, 'Well, that's fine, but your chef should understand that I don't own that ball-park. We just paid for the use of the name.'

"So the waiter says, 'Oh, just a minute.' A few minutes later he came back and said, 'Sir, the chef doesn't want to meet you.'"

But back to connectedness: The world is becoming so connected that you can sit here at your computers in Provo and reach out to the world in a way you've never done before. It's so fantastic. I have a little cubbyhole in my attic where I have my computer. The idea that I can reach out and touch the whole world from my little attic is so thrilling to me, and it's something new.

I got a call a week ago from a professor at MIT who is working on a project. He wants to

prove the six degrees of separation. Now, you all have heard this theory about how we're all separated from everybody else by six people. I could get to any of you, or any of you could get to me, by reaching out to six consecutive people that you know. You reach out to someone you know, and they reach out to somebody they know, and in six or fewer people you get to me. This guy wants to prove it by looking at telephone records. Well, he's not going to be able to do that because he's not going to be able to get those records, and I don't think that would prove it anyway. But the concept is very interesting, as well as whether or not that is in fact shrinking as time goes along so that the world is becoming more tightly linked. As you go to faraway, exotic places and see McDonald's and other U.S. culture everywhere—you realize how connected the world is. As they say, when a butterfly flits its wings in Brazil, there is a snowstorm in Provo. That connectedness is happening.

In the Internet today on the Web we are seeing the emergence of a new group consciousness. It's not understood, as it is only shaping before us right now. We're getting such phenomena as Pierre Salinger's claim that TWA Flight 800 was shot down by a U.S. missile—and that actually came through the Internet. You see how these ripples of rumors from the Internet go out and explode across the world. It happens very quickly. We are getting the phenomenon of what is now known as "flash crowds": crowds that suddenly appear in a particular place in cyberspace. For example, on election night 50 million people tried to get to CNN and failed, of course. I was one of them. These flash crowds move around in cyberspace looking for the hotspots, where they are, and where the people will be.

On the Internet, though, it's not so much the crowds as it is that individuals can find each other. You can find people like you out there that you've never been able to get to before. Do you ever feel that you have a clone

out there that you've never met—that there's someone just like you out there, but your chances of meeting them are zero? On the Internet you can find people like you, whatever you are like, out there. And so it's been said that on the Internet conspiracies can happen. People can get together and form conspiracies on the Internet, but you can't do propaganda on the Internet because propaganda is a broadcast phenomenon. You have to be able to talk to a crowd like I am doing right now. I could do propaganda now, but I couldn't do conspiracy. On the Internet you could do conspiracy but not propaganda, because the model on the Internet is pull rather than push. You choose what you want.

In finding people like yourself, there are various things taking place that take advantage of what we call collaborative filtering or the group consciousness. The group has a great deal of wisdom about it—like the stock market: it just seems to know things that individuals don't know. There is great wisdom somewhere in groups, and that wisdom can exist on the Internet in groups. As a simple example of this, we did something at my company that is now actually done by another company on the Web. If you want to look it up, it is Firefly Network, Inc.: [www.firefly.com](http://www.firefly.com). They do movie, music, and restaurant recommendations based on groups of people like you.

Let me give you an example of this kind of thing. I was getting on an airplane a year or so ago, and the passenger in front of me as we were filing on the plane asked the stewardess what the movie was on that flight. The stewardess said that the movie was *Sommersby*. *Sommersby* was a remake of the movie *The Return of Martin Guerre* but set in the American South. This guy asked the stewardess, "Well, is this movie any good?"

She said, "I don't know."

I was standing right behind, so I said, "No, the movie is no good at all."

The stewardess turned to me and said, "Now just a minute, sir, let me calibrate you. Did you like 'Enchanted April?'"

I said, "Great movie."

Then she started listing other movies, and I said "I don't like that" or "I like that."

Finally, after these questions she turned to the other gentleman and said, "This gentleman knows what he's talking about. Our movie is no good."

You can extend this example out to the Internet: Firefly does. What you do is give your personal ratings of all these movies that you've seen, and people love to do that. Then Firefly cross-correlates all your ratings against everybody else's ratings. They find somebody out there in the world who liked the exact same movies that you liked and hated the same movies that you hated. They've got somebody who represents you out there. They've got a small group of them. And now, when that somebody just like you sees a new movie and says it's great, you ought to see that movie because you're going to like it, too. Those ratings are much better for you than those of Siskel and Ebert, because you may not like the movies that Siskel and Ebert like. But you like the movies that this other, unknown person out there likes. So you can do the same thing with restaurants, with music, and with other things using the wisdom of the group to guide you. This group consciousness is happening out there.

An explosion of information is happening. There are about 60 million pages on the Web, and that number is doubling every 53 days. The interesting thing to me is that the number of pages on the Web is growing faster than the number of users. If this continues, what it means, basically, is that, statistically, nobody will ever see any page. The pages are increasing like an expanding universe, and faster than the number of users grows. That means the pages are the trees that fall in the forest and don't make a sound. I don't know exactly how

this works, but we all know that 90 percent of everything is junk. How do we ever find our way through all this junk? This is a sudden new phenomenon that has happened. As you all know, the search engines, the AltaVistas and Excites, are not able to keep up with this. What happens is that you put in certain key words and you get 40,000 matches for your word. You say, "Ah, forget it. This is useless." So we need better ways to get at the information.

The people I know who work on indexing, library sciences, and so forth are trying to find ways to index the material out there. Yahoo!, by the way, is a site that does indexing, as you might know. It tries to do a Dewey decimal system for the Internet and classify everything so that you can find things by classification. But it's growing totally out of control. The information is not pure information. The quality varies greatly. One of the problems we have is that when you put in key words for a search in AltaVista, it won't tell you that what it's giving you is junk. There are no consumer reports for the Internet.

Now, librarians generally don't like to do quality evaluation. I once gave a keynote talk at the annual meeting of the Library of Congress. I told them that they had too many books, and they did not appreciate this at all. I said, "If you took 99 percent of your books and put them somewhere in the basement where no one could see them, I'd be better off because I might be able to find the good stuff."

You never see in the card catalog "This is good" and "This is no good." But if you pick the book off the shelf and see that it is dog-eared, that a lot of people have scribbled notes in it, and that a lot of people have checked the book out, you might say, "Well, there must be something to this." There is a certain wisdom in group behavior. We need to incorporate this kind of knowledge. This is implicitly incorporated today when you go out and search for something and you find links. The things that you most find links to are the things that other

people thought were good. So, as you follow other people's links, statistically you actually are guided to the good stuff. You're not exactly following a card catalog in a library, you're following other people's recommendations to steer you where you might want to go.

So this self-organization is a phenomenon that is helping us right now. I don't know how it will work out in the long run, but we face a meltdown of information if we can't find better ways to organize it and to guide our own searches toward it. The critical factor in all of this, the one thing that is in short supply, is human attention. We only have 24 hours in a day, and there isn't enough time ever to explore even a tiny corner of this universe. I never felt this way before, but I started getting up really early Saturday morning because I'm afraid that I'll miss out on something. Time is ticking, and there isn't enough time. Somehow, as all this expands in front of you, you realize that the one essential is time—and you don't have enough of it.

It isn't just information out there. I hate to even mention its name in this setting, but there is a site on the Internet that was the most popular site earlier this year. I don't know whether it is anymore, but it's called the Peeping Tom Homepage. Probably if I asked for a show of hands of how many people have been to the Peeping Tom Homepage, no one would raise their hand here even though probably some people have been there. It's not in any way related to the Peeping Tom that you normally think of. The site merely guides you to all the cameras currently set up around the world and connected to the Internet. If you go to Peeping Tom Homepage, it will just give you a listing geographically by country. You can check a place out before you go there, as I did recently. If you want to check out what it looks like on the French Riviera right now, there are lots of cameras there. You can look at the beach and see what's happening. There is a camera in my

hometown—Red Bank, New Jersey—on the main street, so I can see what it’s like.

I have a camera, and I’m thinking of putting it out in my front yard so that when I’m on a trip like this I can just go on the Internet and see if my house is still there. That would give me a comforting feeling. You know, if you’re driving home and you see a fire engine going the other way, you sort of wonder, Did they come from my place? Or better yet, I could have my camera actually right inside, focused on the inside of my front door, because that’s where my two little dogs lie. I could see if the dogs are okay. If the dogs are there, I would know that my wife is out because the dogs wait by the door.

The number of cameras on the Internet now is certainly in the tens of thousands. We’re heading toward the time when there will be millions of tiny, cheap cameras all linked together on the Internet. Everything will be visible from everywhere. These cameras are getting down to button size. It isn’t even just cameras. Cameras are passive devices; they look. But more and more we’re starting to get actuators out there, things that can move at your command. There is a cute little site called Tele-Garden at USC. They have a garden with a robot arm over the garden. You can log onto the site and register. They will let you work the garden. There’s a camera, and you can move the camera around. You find a spot in the garden that no one else has taken, and you can plant seeds and water them, and watch them grow and stuff. It’s a collaborative garden for people.

The author Douglas Adams, who is a friend of mine, says he gets a thrill out of there being such a lot of Coke machines on-line now. It’s great because the companies can check when they’re empty. But there are a number of Coke machines, particularly at universities, where you can actuate them and drop a Coke can. You can have an account that lets you do this, and Adams says he gets a thrill by paying

some money and actually dropping random Coke cans in different places. A student will be walking by and a Coke can will drop. This gives him a great thrill to be able to reach out and do things, to actually affect things out there. More and more, as the world becomes connected and visible and actuated, you’ll be able to see and check the traffic and the temperature on every street and every building, the elevator movements—everything. It is all going to be out there.

What about the societal impact of all this? This imagery sometimes captures my imagination. I’m sure that many of you saw the movie *Independence Day*. In *Independence Day* you’ve got this powerful image of giant flying saucers that look like 15-mile-wide Scooter Pies coming over the cities. They come very slowly of course, because that’s much more effective. The shadow comes across toward you, and everyone’s eyes are riveted on the darkening sky. That’s what I think about sometimes in the Internet. You see it coming and you know it’s inevitable, but you look up at that thing and you think, “Is that thing friendly?” That’s what we worry about. There are a lot of implications here. People used to ask in the early days, “What’s cyberspace?” I said the more interesting question is “Where is cyberspace?” because it doesn’t exist in any particular geography. This is giving governments a great deal of difficulty. I’m often on government committees, and I feel this strange power—when you go and you get associated with any of the governments, you want to reach out and control things. It just happens to you when you sit in Washington, D.C., or in any seat of government power. You feel like you want to control. And the governments want to control this.

There are worries about the kinds of things that can happen when we see that bomb-making information is distributed on the Internet. People say, “Well, let’s close down the Internet.” Never mind that you can go to a library and get the same information. The fact

that it was on the Internet makes it bad. Porn on the Internet is, as you know, an issue that's going to the Supreme Court and has given a great deal of difficulty. I like the wisdom of a good friend of mine, John Perry Barlow, who says that the Internet is actually self-policing. "Every time I get anywhere near pornography, there's so much traffic I can't get through," he says. It is an issue that probably can't be resolved. China today and Singapore are prime examples of countries that control the content on Internet. In those countries, the only access to Internet is through proxy servers that have censored the sites. China has a list of a 100 forbidden sites on the Internet, and they include *Playboy* and the *Wall Street Journal*. That information cannot get into China. However, I've met with the person who runs the Internet in China, and he says that you really can get it. The list is just for show, to tell people that that's a policy. And the same thing may be happening in Singapore. But the issue of control of content here is an almost unresolvable one that isn't going to go away.

Earlier, when I was talking to the electrical-engineering and computer-engineering students about how things happen, I mentioned a friend of mine at Stanford about 20 years ago who told me about this idea he had for public-key cryptography. This is a cryptography where you have two keys: a public key and a private key. It's as if you have a mailbox that anybody can put letters into, but the mailbox is locked and only you have the key to open it. I have to tell you a little story about this. My son-in-law was on a ski trip last year in Vermont, and his car had a big problem. He had to leave the car in Vermont at a repair place and then come home another way. But he realized when he got home that he had left his key ring in the car. One of his difficulties was that he has one of these mailboxes in the apartments where the postman puts the mail in the top of the box, and you have a key to open your particular box. That's just like public-key

cryptography—the same kind of metaphor. He immediately called the car repair place in Vermont and asked them to send him the key ring, which they did. And then he realized: his key to the mailbox was now locked inside the mailbox! He asked me not to tell anybody any of this. So if you ever see him, please, I didn't tell you this. So, the key to your mailbox has been mailed to your mailbox. This isn't going to work. Anyway, my friend at Stanford, Marty Hellman, invented this public-key cryptography. I told him, "Marty, you know, people like you and me don't know about this stuff. There are people in Washington, D.C., who worked for years in the field. There are thousands of people who know all about the secrets of cryptography. But you and I, we don't know about this stuff."

Marty said, "I know. It's just my idea." Well, 20 years later, this idea of Marty and his friend Whit Diffie has changed the world. They've unleashed something on the world that the world doesn't know what to do with, and that is unbreakable secrecy. I've been in meeting after meeting, forum after forum, and nobody has a solution. The FBI, in particular, doesn't want there to be complete secrecy. So the U.S. has tried to impose a policy on the rest of the world. France was ahead of us—they just outlawed all cryptography for their citizens. But aside from France, we're probably the most vociferous on this point in not wanting this privacy to happen. The civil rights groups, on the other side, say that it's a right to have privacy. I see no resolution. The government comes up with policy after policy that won't fly; there are unresolvable demands of individual privacy on the one hand and the government's worries of how this will be misused on the other hand. There seems to be no relief.

So far, not a lot of other things have happened. In many things cryptography is helpful, such as with absolute authentication in time and signatures, for signatures that are unforgeable, and electronic money, money that

is unforgeable. But here's a difficulty: money is for the first time profoundly anonymous; it cannot be traced. So we have, as I said, something that perhaps we're not ready for. But money is in the end a belief system more than anything. Money is what you believe it is, and as for the difficulties with money, it will be interesting to see what happens.

Finally, there is the whole societal thing of how media shapes what we are. As Neil Postman, who is today's version of Marshall McLuhan, says, "The structure of media alters what we are." We have a new medium in the Web, and it's going to alter what we as people are. Postman says that "all media represents a Faustian bargain. They have their pluses and all of them have their minuses." He says, "Technology giveth and technology taketh away. There are no unmixed blessings. There are always unforeseen consequences." The author of *Silicon Snake Oil*, Cliff Stoll, who is kind of crazy anyway, says, "Get a life. Get away from your computer." On the other hand, when you sit at your computer, you can reach out and touch the world. Which is the life here?

One of the prime examples, of course, is television. Now I often wonder about television. It has certainly changed what we are. It changed everything about us, but it was not an unmixed blessing. Now, by the time we are 20 years old, we have likely seen almost a million television commercials. Our minds are used to flashing images changing every three seconds, to sudden shifts of the world similar to a surfing entity going through the MTV world.

Some years ago I gave a talk to an organization called People-to-People. They are individuals in various countries who get together and find friends in other countries. Then they network through their friends. They had their annual meeting in Washington, D.C., and I talked to them. I was talking about digital television, how wonderful it was. You know, the idea of television is wonderful from a technical standpoint. I could feel from the crowd that

they didn't like television. So I suddenly stopped and asked the crowd, "If you could go back and disinvent television, would you do it?"

Basically everybody said, "Yes, we would. We would stop this from happening. We think it's bad and it has hurt mankind."

I'm not going to resolve that. Postman says that Socrates opposed writing, which was just starting to be used in his time. He said that writing was going to have negative effects, that writing would cause us to lose our memories. And it did. You know people in those days memorized entire books; *The Iliad* and *The Odyssey* were passed down orally. People had marvelous memories because it was an oral culture. With writing you didn't need to memorize stuff, and they did lose their memories. Furthermore, Socrates said that writing would take away the dialectic. Writing, when you read it, forces you to follow an argument rather than participate in it. Once you've written something down, you can't change it. You lose the flexibility, and he said that these are all bad things about writing. Of course, writing, you'd have to say, is good, but it did, indeed, have those effects. And the Web will have unforeseen consequences in the way we live our lives. I don't know what those are going to be. I don't know whether it's going to make us better people or worse people, but it will change everything.

Now, speaking of change, all of this has happened so suddenly that there are no experts here. I wrote a column recently based on a remark a friend made. He said, "We're all bozos on this bus." I like the analogy because you just feel like you're a clown. You don't know anything about this, but you're being driven somewhere on some bus that is out of your control. You don't know where the bus is going, you don't know who is up front driving, and you're just a bozo on the bus. A lot of people wrote me e-mail after my column came out asking if I knew where that expression came from, and I didn't know actually. (Just for the record, it came from a *Firesign Theatre* radio

show in the '70s, I guess, but I didn't know that.) Anyway, I just feel that we are all bozos on this bus, and there's a good side and a bad side. The good side is that everybody else is a bozo just like you. The bad side, of course, is that you are a bozo. I see everybody suddenly hanging out their shingles: "I Am a Web Consultant."

I heard a great ad on the radio the other day. I was driving in New Haven, Connecticut. This is the honest truth—this was an ad on the radio. It said, "Be an Internet consultant. Earn up to \$2,000 a day. No previous experience required." I'm serious. When you're all bozos on a bus, that works. This is an important lesson to you students, though. We're bozos on a bus because all of this technology and everything here is so new that there are no preexisting experts. You are as good as the next person in this. The other part of this is that this is true of life in general. When you're in school you have this mistaken idea, speaking for myself here, that the world is full of geniuses out there. When you're in high school you read about a person who can multiply 15-digit numbers in their head and stuff. You think, "I'll never be like that. I'll never be a genius like that." You get this warped view of the world, that there are these fantastic geniuses out there. And there aren't. There aren't. When you grow up, you look around as an adult and you ask, "Where are these geniuses?" Where are these kids that could multiply 15-digit numbers in their heads? You don't see them as adults. But somehow, when you're very impressionable as a child, you think that this is what the world is like. And you worry.

I was at a meeting years ago—I was on an advisory committee for the Star Wars program. This group had some very famous people on it, and we heard this talk by an engineer from Boeing. I won't say what the talk was about because it's irrelevant. Besides, the talk was incomprehensible to me. I thought, I don't understand this because I'm stupid.

So afterward, this person who gave the talk stopped and asked, "Are there any questions?"

I thought, no way am I going to ask a question. I don't understand this stuff, but I'm keeping my hand down because I would just reveal my own stupidity. Finally one hand went up in the audience. Everyone turned and saw that the hand belonged to Edward Teller, the father of the H-bomb, arguably the most famous physicist in the world. Not only is he famous, but he carries a persona. He has a Bela Lugosi eastern European accent and talks like Dracula. He whispers so that everyone has to be real quiet and turn their attention to him. He's kind of old and infirm now, so he has a cane. But it's not a regular cane—it's a biblical staff, a gnarled tree trunk that he carries. Picture this: When he talks, he moves his head back and forth and his jowls joggle out of sync with the rest of his face—sort of like Richard Nixon's. When Teller raised his hand, everyone was quiet and turned to look at this world-famous physicist. I just couldn't wait to hear what he was going to say. In his Dracula voice he said, "I have understood nothing of this." I realized that I was not the only dumb one there. This guy's provably not dumb, so therefore the speaker didn't do his job. That's the way the world really is. But you do worry.

There's a little skiing story I want to tell you. I was skiing in Saint Moritz. You people are all skiers, so you'll know about this stuff. I'm not very good, but I was getting used to going down the groomed trails, down the front of the mountain where this resort was. I was pretty proud of myself; I hadn't killed myself yet and was doing okay. My friend kept accusing me of having no courage and urging me to go off the back of the mountain where there aren't trails, where you can ski 26 miles to a railroad station. I thought, no, this is the life I know. I can go down the front of the slopes. But finally, the last day, my manhood was being challenged. I had to do this. The thing is that the snow isn't groomed, and you don't know what's ahead,

but you take the plunge and you go off the back of the mountain. I only got about a 100 feet when I crashed and burned. My skis flew off, and there I was, floundering in the heavy snow trying to get back up. I looked up; there were these two skiers standing over me. Blond, blue-eyed, with the sun and the blue sky above their heads, it was obvious that they were expert skiers. They were pointing at me and laughing and talking in German. I said, "I'm okay. I'm okay. Please go away." They stood there while I got my skis back on and started off again. They kept watching me. Now I was under a lot of pressure. I only got about 70 feet and I crashed. They came over to me again, standing there and looking at me and talking in German and laughing. I said, "Please, I'm okay. I'm not hurt."

And then one of the men turned to me and, in perfect English, said, "It's not that. It's harder up ahead, and you're not good enough."

He was right, it was harder ahead, and I wasn't good enough. Sometimes life is that way, but more often the converse is true. People tell you that it's harder ahead and you're not good enough, but that's not the case.

Now, as I look ahead, technology is shaping this world—it interacts with society. And there are going to be mega-events, probably in your lifetime. I think that we will do such things as actually create life in the laboratory. I think that we will engineer humans. I think machines will think. And these are mega-events that are going to change our understanding of the world. But I truly believe that we will still have wars. The wealth of the world will still be concentrated in a small number of people. There will be haves and have-nots and societal problems that all of our technology and all of our power are unable to solve. And that's where we need your help. Thank you very much.