Panel Discussion

Where Are We Going

(Panel Discussion)

Lewis Franklin, Panel Member
Visiting Scholar, Stanford Center for International Security and Arms Control

Roald Sagdeev, Panel Member
Professor of Physics, University of Maryland

Richard Slansky, Panel Member
Leader, Theory Division, Los Alamos National Laboratory

Joseph Lach, Referee
Physicist, Fermi National Accelerator Laboratory

Sagdeev: I think the job ahead will not be a quick fix. It will take perhaps a generation to find a new role for science and technology in the post-Cold War epoch. We have an identity crisis to overcome. The issue of national security will never evaporate. As we try to move toward a new role for science, we still have to discover how much the science and technology community will need to contribute to national security in the post-Cold War. It will critically depend on a new paradigm for national security. In both the United States and Russia, new military doctrines and new formulas for national security are under discussion. Environmental issues and economic competitiveness are now considered part of national security, which in turn is now a part of global security. We already face outstanding global issues that I don't think humankind can resolve without contributions from science.

We need a completely new way to communicate about science. Something in the old way didn't work. I agree with Leon Lederman when he says that both scientists and taxpayers have been spoiled with the seemingly easy successes of science. We became arrogant, and I

think in communicating to the public sometimes we were guilty of overselling the projects we lobbied for. We sold each new big project as ultimate science. That's exactly what is happening with the supercollider. We imply that we will learn the origin of the universe from the supercollider, eliminating room for any further development for the endless frontier. The same thing happened in space. We said, "Oh, the problem is to find out if there is life on Mars or not." After the Viking mission, people said, "Okay, there is no life on Mars," and so Mars was abandoned. Now it is very difficult to build momentum. We have to renegotiate the social contract.

Slansky: I have talked about why we need to renew the social contract, and ways we might go about doing so. But I would like to ask a provocative question: What is the price of the peace dividend? Stated another way, how should we take advantage of the peace dividend in a creative and constructive fashion? We heard the example of using ICBMs as platforms for getting into space much more cheaply than if we started from scratch. We have heard discussion about the scientific results that have been developed by the cold warriors on both sides, and how they can be brought into the marketplace.

Interpreters of those results are very important. If we fire all the scientists and completely undo the morale of the field, there will be no interpreters for those results. We must get ourselves redirected before we find ourselves fired. If we don't, we will keep none of the benefits of the Cold War, those discoveries still shrouded behind classification. How do we get the maximum benefit out of what we learned during the Cold War? What is our peace dividend? Is it the savings of money in tax today, or is it in fact using for the benefit of mankind the many interesting things accomplished over the last 50 years behind the secrecy and shroud of the Cold War? How should we do that?

Franklin: I have been thinking of some of the examples of the great scientific and technological capacity that we have put together in Russia and the United States. How has the commercial sector had to deal with

the economic realities of the new order? The word that came to mind immediately was "Greenfielding." That's where you take an existing factory in Detroit that is inefficiently building cars, and you walk away from it. You also walk away from the labor union and from an age bias toward older workers. You start up a new factory in Greenfield, Kentucky. Not only in this country but in Europe, this practice has become one of the new models of renewal. Given the extensive range of scientific laboratories we have, how much capacity will be needed? Should the national laboratories be subject to the same kind of economic pressure that industrial organizations have? Is there some equivalent that applies to the national laboratories of the corporate practice of Greenfielding? I think we should open our eyes and minds to what that might be, for the renewal process. Roald Sadeev gave the example yesterday of Russian labs subcontracting out corners of their national laboratories. Instead of undertaking a CRADA process, we could simply bring the companies inside the gates! I would leave you with the thought that there could very well be some new thinking, but it has been an education to me to see at Fermilab an unguarded research facility. That is very impressive, a major lesson that could probably be expanded.

Bruce Boardman, Deere & Co.: I'd like to follow up on your reference to changes that have happened in industry. In the farm-equipment industry, for example, we have half as many customers as we did in 1980. I think what has been missing from all the talks that I have heard is the customer. Who is your customer and what is that customer willing to purchase from you? The only thing that you can sell is what your customer is willing to purchase. I think I heard last night that your customer is watching "Days of Our Lives"—and you're trying to sell what? Somewhere there needs to be a recognition and a realization, and maybe a change in the mode of operation, to adapt to what your customer is doing so that with time you can sell him what he really needs. U.S. business has had a drastic shift in its market, much to do with what the customer is willing to buy. Likewise, you are having a

dramatic shift in your situation, in the change in what the people who pay the bills are willing to buy.

Sagdeev: Just a change of customers might not be such a big problem, but the entire culture in military industries was oriented to a single customer, the federal government. I think this has a negative element; it spoils the industry, as if you were out of the market economy and part of a centralized socialist economy. Now what happens? The U.S. government is trying to help in conversion and in privatization.

Slansky: Our customer may not be quite the right place to begin the discussion. The cultural things that we stand for bring something particular to our national quality of life, so we pay our taxes to try to help with some of these things. The issue then becomes not whether we should do it, but what the balance is. In talking about something like Fermilab and the Supercollider, our customer is the American culture. It also has remarkable spinoffs, as Leon Lederman pointed out in trying to calculate how much Fermilab really costs. How much is the SSC costing? You get into second order effects and third order effects that end up driving the system in quite a remarkable fashion. When you ask outright who your customer is, you have to go through a rather subtle set of arguments to pin it down, because it has to do with the working of the whole culture.

Ken McNaughton, Physics Today: I think one of the reasons the government was able to sell defense to the public was that the public was afraid of being attacked by Russia. That fear is no longer there, but the public is still afraid. They're simply afraid of different things. The public is afraid of AIDS, they're afraid of crime, they're afraid of poverty, they're afraid of joblessness, they're afraid of the deterioration in city infrastructure. The government seems to be lagging in its ability to respond, and physics seems poorly positioned to assist the government to meet these needs. Physics could think about trying to fulfill the needs of the public. Somebody asked last night, how do we sell science to the public? Very simply, we solve their problems. But physics is not very well

geared at the moment to solve any of the public's major problems.

Ruth Sweetser, Illinois Institute of Technology: You mentioned the need to change fundamentally the agenda of science in general. Considering the funding constraints that we mentioned, what can we perceive as the openness of the scientific community to statements such as those Ellen Fox Keller has made that defense and science have pretty much gone hand in hand, and now things have changed?

Slansky: Certainly, one of the messages I gave yesterday was how to approach that problem. I agree that we need to pay a lot of attention to it. I'm involved with an organization that does theory and modeling, yet we have started to reach more and more towards applications. I guess I would call it pre-competitiveness research in the marketplace. That has included a lot of negotiation with private enterprise in this country. We've been in the midst of doing this to a fair degree for over 20 years at Los Alamos; we were trying to carry out that change long before we encountered the funding crisis we are in the midst of now. Not all of science should do that, because applications are fed by places like Fermilab, whose immediate product is knowledge and whose secondary product is sometimes a breakthrough in the way that certain kinds of instrumentation and products can be used for other kinds of applications. I would argue that it can't be a revolution, because nature is not going to change her laws to adapt to the laws of man. It just isn't going to happen that way. The laws of nature are going to be what they are. We need to discover them. That is the thing that pins us to reality. Within that reality we can then look to the new social needs, but it has to be done carefully or we'll cut ourselves off from the laws of nature.

Sagdeev: I agree that we should not look for revolution. It would be a very painful process of perestroika, you know. I hope it would be more successful than it was in the Soviet Union. It could easily take the form of counterrevolution against the scientific community and all intellectualism. This is a real danger, at least from what we see in the former Soviet Union.

Franklin: Maybe I could reflect for a moment on the comment on solving the problems that the people are worried about. My father, as a young engineer, worked on the cyclotron at Berkeley. When a book came out on the history of the Lawrence Berkeley Laboratory, I bought it for him; and, since he wasn't around that week, I read it. It has some interesting information that was new to me on where the money came from for the cyclotron age. It came in large part from cancer medical funding sources. Even in the 1920s and the turn of the century, people viewed cancer as terribly dangerous. They knew it was fatal, and they were searching for the silver bullet. Whether it was skillful on Lawrence's part, or merely luck and serendipity, these two needs came together. While the effort didn't cure cancer, it carried the accelerator program; and of course, it contributed in many ways to solving the problem of curing cancer.

We in high-energy physics have a very sophisticated customer, in the Department of Energy and the Department of Defense, in buying technology. They are experienced in how to buy it effectively. On the whole, I think they do a rather fine job of procuring and deciding. Believe me, if you go to the FBI and suggest using technology to solve crime, it's another world. They have not learned how to buy technology, and they feel it's dangerous. They've had their fingers burned many, many times and they're never going to do it again. Then go down the street to the other government agencies—for example the Department of Labor. They're in charge of unemployment. They are struggling with antiquated computers and enormous amounts of data. Let technology come in and help them see clearly what's going on. Health is in a little better shape, but by and large, the health community is still in the chemical laboratory with reagents and liquids. They are resisting simulation and modeling. The education of the customer on how and why, when and where to buy these products is very much part of the problem in plying our product to these new customers.

Paul Betten, Argonne National Laboratory: There seems to be a

contradiction between science and job creation. I think the public fears science, because, ultimately, it ends up causing more unemployment. For example, if you look at science in terms of farming, the whole point is to get more yield with fewer people. If you automate a factory, the whole point is to speed up production, get rid of the people. When you look at science, even though there may be spinoffs that are creating other jobs, I think the public has a fear that science will cause unemployment in the long run. Do you have any comments on how to change that?

Slansky: There are new industries at this point, especially associated with computers, communication and information. But your question is well placed. I don't know that there is an answer that deals with science alone, without including many other aspects of the way our culture as a whole is going to deal with unemployment, especially in conjunction with the problem of population growth.

Franklin: The public perception is probably as you see it. But is the perception accurate, or is it a misperception by the public? There are new jobs being formed, as we all know, mostly in small companies, not in big companies, in small laboratories, not in big laboratories. Of course those new jobs tend to either be in one of two extremes, either in service industries, the hamburger flipping, or at the other extreme, jobs that require a good education. There might also be a fear of inadequacy, a fear that "I may have to work harder." I think you raised a very good question.

Richard Bullock, Technology Development Int'l: I have a small firm that's interested in licensing technologies from wherever they come from. One area of interest of course is the federal lab system. My question draws on the comment just made. Where does the panel think incremental job growth is going to come from in the next 20 years if we basically stay with the industries we have? Does the panel think manufacturing job growth will occur, and secondly, do they think there are job-building opportunities in the portfolios of inventions that are

residing in their lab file drawers at this time? I also want to respond to the labs' question "Do we have to open our gates?" I'd say, yes, I think you do, but I don't think that's sufficient. I think you're sitting in a situation where the R&D capacity of the industrial world is quadrupled if we remove defense as your customer. Defense is an industry that's in tremendous overcapacity. My experience in marketing tells me that's when you really have to go out and shake the bushes and understand what your customers need. You really have to start thinking in terms not just of opening the gates but of going out and bringing people in the gates. Personally I don't think people will come on their own, because the gates are already open now. You have to go tell people, show people.

Franklin: Let me take a quick shot at your job growth question, because I think it is very important. I propose for example, that we shift from a defensive action to protect the U.S. (rocket) booster industries, which currently crank out the magnificent number of nine missiles per year. The result is there are only nine payloads per year for U.S. industries to build. I could easily imagine launching 100, which wouldn't generate many jobs But that might generate a quite different business of not only 100 payloads per year that have to be built, but a whole infrastructure, including the scientists who analyze the data or the commercial users or the new kinds of satellite-related products that might come on the market. People wonder why Land Sat hasn't taken off, but if you want a picture every hour, you're not going to get it by waiting for government to provide it. You're going to get it only when you as a farmer or you as a traffic manager or you as a water resource manager decide it's worthwhile to spend the money to purchase this service from a satellite. Then the market will develop. But the market is inhibited right now, because the government has decided to control the space business. Jobs could flow rapidly from that specific example. I would be interested in other examples that might also have possibilities. Let the commercial market deal with surplus military material, with the exception of weapons proliferation. I would be a little hesitant to have these commercial missiles launched from Libya, for example.

Stanka Jovanovic, Fermilab: I am the manager of the education programs here at Fermilab. None of you has really said that your customer is the citizen, who is an illiterate citizen when it comes to scientific issues. If you want the taxpayer to support the nebulous things that we do as researchers, how do you perceive the role of scientists in enhancing science education, not of the college student, not of the graduate student, but of the kindergarten through 8th grade student?

Slansky: How do we boil down science education into 30-second sound bites? That's the demand of society at this point. It's very hard to say what's going on at Fermilab in a 30-second sound bite. I admire what you are doing in education. I think it's very important that some of us—more of us in the future—help provide to the American people what the basis of our culture is all about at the moment. I wish you the best of luck and I think that more should join you!

Rich Stanek, Fermilab: My question concerns the cohesiveness of the national laboratory system. Now that the defense laboratories are starting to look for other ventures to get into, do you feel that the labs work well enough together to share resources, move people around, as opposed to trying to promote their own programs, trying to keep their own laboratory fully funded and keeping people fully employed at their own laboratories and not really looking at the laboratory complex as a system?

Slansky: The implication of your question is correct—we do tend to compete with one another in a society of limited resources. That we should work together better, that we should have more cooperation, I absolutely agree.

Dean Waters, Oak Ridge National Laboratory: I want to address what I believe is the mistaken notion that technology is sitting on the shelf just looking for projects to be commercialized. There are a few exceptions; perhaps the booster launching capability of the United States may be one. Generally in the private sector, and in the Depart-

ment of Energy, it takes far more than scientists to bring ideas to the point where they can be commercialized. We haven't said much about engineers in this room for the last two days, and we've said virtually nothing about production in the private sector. The Department of Energy's laboratories and production facilities represent unique assets of the United States. Do you have any comments about how we might utilize the private sector? And second, what methods would you use for success?

Sagdeev: I would like to speculate briefly on this issue. I think it is related to the previous question about the cohesiveness of the national labs. I think that I would rather drastically disagree with what you say. I think the military industrial complexes existed as an extremely well managed, centralized army of researchers. Everything was prescribed, with deadlines controlled by the all-important customer. Now when we have to deal with many customers, with a multitude of problems, with diversity, I think we have to decentralize ourselves. I believe in the future we are not going to act as a totalitarian substructure. I believe that organizations like Los Alamos National Laboratory will be forced gradually to move to a structure more or less like a regular campus, where each small group lives an independent life. People meet each other sometimes at seminars. Unfortunately multidisciplinary gatherings are becoming rarer and rarer. Staying together might mean that we should create an atmosphere of intellectual creative interaction with a lot of cross fertilization, but we should not be centrally controlled.

Slansky: The weapons complex is broken at this time. It has been broken for some number of years. It is not producing anything. When you put the microscope on this, the issue is whether you're looking at the whole complex, including Los Alamos, Livermore, Sandia, Rocky Flats, Frenault, Savannah River, Oak Ridge—Y-12 in particular—and Hanford. When you look at the complex you have to ask what it is producing, and it's not producing anything at the moment. It's generally broken. Environmental insults have caused some of these

laboratories to increase in staff size by 30, 40, 50 percent, while the product is zero. What is broken down is the complex as a whole. I must say that the picture of this very central, wonderfully organized structure is not the way I've experienced it, but I've not been in the middle of it. It has seemed to me to be a little bit more disorganized.

Everything in the Manhattan Project for the Second World War was done in one place. There *was* only one place, except for the making of special nuclear materials at Oak Ridge and Hanford. But there are a few places—the labs that are represented here plus Livermore—where there are good things going on. We have been looking for other customers for 20 years, at least in the case of Los Alamos, and I think of Oak Ridge. But it is well recognized that the complex of weapons labs as a whole is indeed broken. There is a plan, called "Complex 21," to try to figure out how to deal with this fact. In the meantime, the environmental insults are driving the whole thing. The previous Secretary of Energy said, "It isn't our product but how we do our business that counts." We are still living with the effects of that view. We have made other products, especially at the research laboratories, Oak Ridge, Livermore and Los Alamos. To some degree, Sandia is beginning to try to cash in on it right now. But the production laboratories themselves—Rocky Flats, Frenault and Savannah River—have not done very well in being able to get over the environmental period. I think one has to use a sharp microscope to see any bright spots for these laboratories.

Franklin: I think the educational issue deserves a little more attention, both education of the population in general, the taxpayers, and in particular the kind of education and awareness that would lead young people to choose science and engineering careers. We talked broadly about PBS and the space science areas. We noted with some surprise the fascination of the American public with the Voyager pictures—very simple pictures of rings of Saturn. They weren't Arnold Schwartzenegger or "Days of Our Lives," but they tapped something in the American

people that recognizes quality. People understood something about all the efforts and the pride of the nation that came through in these very few pictures. I think we can build on that. Carl Sagan's PBS sessions attracted the largest audiences ever for scientific programming. Now—about "Days of Our Lives!" Maybe we need the scientific equivalent of "General Hospital." Maybe we could bring science to the people with "Days of Los Alamos."

Slansky: You don't want to hear about it. We're reorganizing right now.

Sagdeev: I think it's an interesting idea. We could create a sort of scientific Disneyland for people to visit.

From the floor: I like it! How about "Six Flags Over Rocky Flats"?

Arthur Fisher, Popular Science: My magazine has the best of interest in the scientific and technical literacy of the American population for obvious reasons. We want to make money. We sell our magazine to people who are interested in science and technology. I did a three-part series last year on science and math education, and we got the largest outpouring of letters since I've been with the magazine. The letters spanned a great spectrum of reactions, and I want to comment on a few of them. We got a lot of letters from people asking, "How do you expect this country to be interested in science when my child's high school has an athletic department of 18 people and we don't have a single science teacher?" Letter after letter was in this vein. We pay athletes, movie stars and rock stars unbelievable sums of money. They are the idols that we have created for our children to believe in. We don't create any scientist idols as role models for our children. That was one of the strongest recurring themes.

Sagdeev: As a matter of fact, I think the audience, the general public, is much smarter than we think. I can give you another example. *Parade Magazine* ran a poll among their readers asking "Who is the smartest man in the United States?" Right after the Gulf War, even General

Schwartzkopf came out only number 2— after Carl Sagan.

Ralph Segman, National Technology Transfer Center: I have been a science writer, as Arthur is now. I found then, and I think it's true now, that scientists generally were insulated from life. They didn't think about the public, or believe that what they did was related to the public. They were doing things for themselves. They were doing wonderful research, finding out wonderful things, and building reputations for themselves. The reason the public doesn't seem to know as much as we all would like them to know is not because they're stupid, but because the scientific world has been stupid.

Bruce Boardman: Maybe that's all the more reason for you to put a business manager in charge of your facility.

Slansky: It depends on my product You're arguing that perhaps the product is wrong, but as long as our product is actually science, which is heading toward the new broader definition of national security having to do with economic competitiveness, with nonproliferation, with a number of new issues that are facing the world right now, managers have to understand the details of how people get their work done.

Boardman: Maybe you also need someone who can understand and identify who the customer and what the customer is willing to purchase and how to operate the facility in order to produce that product.

From the floor: Dick, the public perception of what you do is make bombs. Can you change that perception? What should it become? That's marketing. We're talking about how you change the viewpoint of a customer so that you can do what they really want. To what extent should you deal with this?

Slansky: Our director has tried hard. In his words, "We do large projects where science makes a difference." An example of a large project where science makes a difference is, of course, the nuclear weapons program. To continue our stewardship of that as long as there are bombs around is probably a very sensible thing. You don't want

those just left lying around in the environment, of course. That we do other large projects where science makes a difference is a more problematic statement, because there aren't many large projects out there where science makes a difference. A green, compact energy source, public transportation systems that can be built at a reasonable price—there are new directions in which science will make a difference.

From the floor: How do you determine where science makes a difference?

Slansky: To some degree, that's done by the scientists themselves. They do vote with their feet. Even when they are given money to do something they tend to vote with their feet.

Jim Schultz, Fermilab: There appears to be no dearth of scientists but instead a lack of science interpreters, not only to educate children, but also to let industry know what's going on within our labs. We talked about opening up the gates to let people in, but there has to be more of an effort to let a wide audience know what is going on in the labs. What do you see changing in the labs to allow this communication to grow?

Slansky: Of course, an openness. I have heard expressions of surprise that Fermilab is totally open. If I told you how much of Los Alamos is open, I think you would also be surprised. I think that openness is badly needed, so that people do have a chance to learn more. We're still viewed as a bomb factory.

Sagdeev: I think there is another important component—honesty. Very often we try to oversell science.

Slansky: The SSC will not cure cancer, although there may be some technology spinoff that will be relevant for cancer issues. But it came out in the press and was widely quoted that the SSC advertised itself as curing cancer. One has to be very, very careful to not let these kinds of statements go by. Of course the SSC is not going to cure cancer. However, its technology can have some impact, some important

impact. I completely agree that we've got to be very careful not only that we not oversell science, but that we don't let other people misquote us. We have to be careful to tell people what science can do, but we also have to be careful to tell them what science can't do. You know, we only have a certain bag of tricks to study nature. We can only answer certain kinds of questions. You can go down one level, and then the next level and the next level, finally down to quarks and leptons, but do we really understand human nature by understanding the interaction of quarks and gluons? Of course not, not really. In some sense we do, but in a more important sense, we don't. I'd like to think that the SSC is going to tell us more about the fundamental structure of matter, but we have to be very careful about how we sell that.

Chuck Horton, General Motors: Maybe we're being too kind to each other and avoiding some very hard issues. In industry we have so often been reactive and allowed others to control what we need to do, rather than being proactive. Why are you in the national laboratories not being proactive, why haven't you had a better mission in terms of what you want to do? Why do you keep looking at someone else to make that decision for you, and have Uncle Sam pay the bill for it? You have fancy mission statements regarding the general welfare of the public, and that is all very good. But businesses exist to make money. I just came from a conference on fuel cells, an area where there is complete disarray. Pure chaos! People see potential in fuel cells, and yet they cannot get their act together to capitalize on this technology. Then a venture capitalist addressed the group. Number one, he said, don't have all of these fancy restrictions on proprietary information; they create a lengthy, horrible waste of time. If your idea is that good, a lot of people know about it anyway. Second, don't worry so much about competition. Competitiveness is a good indicator that your idea might be a good business. Third, put together a complete strategy—where you're going, when, and how. Now those are the types of things that you at the national labs are getting into. I keep seeing a need for being more proactive from your end. I can respect that you have an infrastructure. You've got some

wonderful resources. But you must determine where you want to go with them. If you rely on other people to direct you, you're going to have an awful struggle to get the answer.

Slansky: The starts and stops that I referred to yesterday in the CRADA process mean that it has not worked very well so far. It's an effort to get a new approach. But DOE had difficulty deciding, especially in the defense program technology transfer initiative, whether it should be short-term, long-term, intermediate term, precompetitive, be on the production line in a half a year, or whatever. What was funded was one corner of the field—immediate payoff. Insofar as we're having a little trouble getting off the ground, things are not going to work very well and your kinds of concerns and criticisms are something that we have to figure out how to solve.

Sagdeev: Perhaps we should reconsider our approach to intellectual property, to be more open. I think this really could open the gates for a much more creative atmosphere. It would probably remain important to keep technological secrets in the area where they're relevant to national interests—national economic interests, competitiveness, or national security. But in many respects our current approach very often is absolutely obsolete, a real obstacle for breakthroughs.

Franklin: There is a trend in universities to want to patent, license and generally raise revenue from the discoveries made on the campus. It became very clear at Livermore that a major motivation is in fact to generate a revenue stream independent of federal funding, in perpetuity. The price you pay for that is restricting this information to one company instead of taking the technology that the taxpayers paid for and making it broadly available. Instead, we're going to make it selectively available. I would say there are some new approaches that are restricting the flow of technology at the university level and possibly in the national labs that are serving a particular need of the institution—not the public—to raise revenue. That may not be in the public good in the long-term.

Henry Dreisilker, Dreisilker Electric Motors: For the last 12 months I have been working with the East West Corporate Corridor Association to get technology transfer. We haven't been successful. I believe it is an open secret that small business is the backbone of this country. How can we get together? I will not take what I learn from technology transfer to Germany. I just want to take it to Glen Ellyn. Small business has to be involved just like big business, but it's not being done. Small business cannot get anywhere. We haven't got the power. But we are the most important factor in the United States economy. There are millions of things we can do, but how does small business get into the picture? How can we get into this?

Slansky: You have to help us cut our bureaucracy. It's no more complicated than that. It costs the same to write a CRADA for $50,000 as it does to write one for $50 million. The amount of legal work that goes into these things is staggering. There has to be pressure on the government to decrease the amount of bureaucracy that we go through in this country. When you need 28 signatures, somebody proves his usefulness by stopping the process. The bureaucratic process in this country is really putting gum in the gears of progress, and something's got to be done.

Lach: Let's have lunch.