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California's Role in the Commercialization of Space

Joint Committee on Science and Technology

CALIFORNIA LEGISLATURE

JOINT COMMITTEE ON SCIENCE AND TECHNOLOGY

SENATOR JOHN GARAMENDI, CHAIR

Interim Hearing on

CALIFORNIA'S ROLE IN THE COMMERCIALIZATION OF SPACE

November 16, 1989
California Institute of Technology
Pasadena, California

ACKNOWLEDGEMENTS

The impetus for this hearing was two-fold. The Joint Committee on Science and Technology has monitored the process by which science and technology related research activities are funded in California. Over the past several years, the committee has been concerned with the failure of the state to secure major research projects and the lack of coordination for science and technology activities at the state level. Out of this process have come a series of bills which established the Office of Competitive Technology within the Department of Commerce, the Competitive Technology Program and the Council on Science and Technology.

The interest of the committee in the commercial uses of space was spurred by a chapter in the 1989 volume of California Policy Choices, "Does California Need a Space Policy?" The chapter's author, Dr. Christopher Bellavita of the University of Southern California asked a series of provocative questions that formed the basis of this hearing.

HEARING

STATE OF CALIFORNIA

JOINT COMMITTEE ON SCIENCE AND TECHNOLOGY

CALIFORNIA'S ROLE IN THE COMMERCIALIZATION OF SPACE

Thursday, November 16, 1989
10:00 a.m.
BAXTER LECTURE HALL
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CA

CHAIRMAN: HONORABLE JOHN GARAMENDI

MEMBERS:

Senator Rebecca Morgan
Senator Art Torres

Assemblyman Sam Farr
Assemblyman Charles Quackenbush
Assemblyman John Vasconcellos

STAFF:

Masako Dolan
Principal Consultant
Karen Thiel
Senior Consultant
Gladys Ikeda
Senior Consultant
Fusha Hill
Secretary

HEARING TRANSCRIPT

CHAIRMAN JOHN GARAMENDI: Good morning. I want to welcome all of you to this hearing. This is the first in what will probably be a series of hearings on a very important part of California's economy and a very important part of what is the image of California. The aerospace industry is an extremely important one here in California, and California is always considered to be on the forefront of that whole endeavor.

The purpose of this hearing is to investigate whether the State of California ought to have a policy of assisting the space industry. We're conducting this hearing at Caltech, and I'm particularly pleased to be here because this is where the aerospace industry was developed and nurtured. The synergy between the Theodore Von Karman's School of Aeronautics and California's pioneering aircraft companies developed the aerospace industry into one of the driving forces in the economy of Southern California. Today, aerospace in California is a $30 billion industry employing over 257,000 people. It is of vital importance to this state. Yet, at the state level we really have not developed a policy to maintain, to foster, or encourage the growth of this critical industry. For example, we don't have an office of aerospace even though we've long had a Department of Agriculture.

Fostering collaboration between our research institutions and the private sector for the economic development of our state has been a major focus of this committee, the Joint Committee on Science and Technology. The competitive technology program was developed to provide state funding to encourage the transfer of technology from research institutions to the private sector in order to promote the creation of new products, services, and jobs.

The purpose of this hearing is to hear from the people who are interested in space, to hear testimony on what the State of California's role should be in the commercialization of space, as well as the maintenance of the space industry in California. Other states, such as Florida, Hawaii, Virginia have developed state policies to encourage the commercialization of space in their states by taking steps to develop commercial space ports, and other activities. These states, plus Texas, have increased their research infrastructure and are developing major programs to support the commercialization of space. Thus far, as a state, we have done little to support our aerospace industry and much less seriously reviewed the commercialization of space.

Other nations, such as France, have the Arianne space project; the Peoples Republic of China and the Soviet Union have been launching commercial payloads; Japan is scheduled to launch its first vehicle in 1992. There is competition and it's worldwide. We cannot be complacent.

Other states and nations have targeted the commercialization of space because of predictions that it could lead to a $200 billion per year industry by the year 2000 and beyond. The first, and thus far the only financially successful use of space, has been satellite communications. Are there other opportunities that we should take advantage of? The satellite industry has been rapidly evolving; $13 billion of private capital has been invested in developing and launching communication satellites. Many of those systems built in California.

I don't like to lose. I don't even like to be behind. We are in a competitive world and space is a very competitive game. A little bit of complacency can lead to a downfall of this very important industry here in California. California's leadership in space could be lost. We cannot let that happen. This is a now and future industry for this state.

This committee is interested in learning the following:

1. Should California have a space policy to encourage and foster the aerospace industry? If so, what should it be?
2. What is the importance of commercialization of space?
3. What are other states doing to commercialize space activity?
4. What is the federal government doing to facilitate the commercialization of space?
5. What is the private sector doing in this area?
6. And how can space technology be transferred from federal research laboratories, such as this one at JPL, and other development programs to the private sector?

Well, that ought to be enough to chew on for a couple of hours, and we need your help. And therefore, I welcome you to this meeting. I'd like to introduce my two assistants, the Chief Consultant of the Science and Technology Committee, Masako Dolan; and our Consultant, Karen Thiel, who have put this hearing together. And they will assist me. I want to welcome Senator Art Torres' staff, Chris Thompson to the committee. Senator Torres has been long involved in space issues and has carried major legislation in this area, the success of which has, I think, stopped at the Governor's desk if I recall, some of the bills that the Governor unfortunately has vetoed. But, nonetheless, Senator Torres' interest, as the interest of many legislators, is keen and we would hope will assist us in developing a policy and program that makes some sense.

Our first witness today is Dr. William Spuck, Manager of Information Systems and Civil Programs Office, at the Jet Propulsion Laboratory. I shouldn't welcome you to your own home, but welcome to the committee, Doctor.

DR. SPUCK: Thank you. Let me welcome you to JPL. As the only JPL speaker today, I would like to welcome you to the Laboratory, and all of our guests that are here. If I could, I'll just stand here and give you an aerospace type presentation rather than sit up there and talk.

I've prepared this testimony to tell you what JPL is doing in this particular area. And just for orientation, I should probably refer you down to my title once more that you repeated to me. The civil programs part of this indicates that I'm responsible for the work that JPL does for civil agencies and for private industry. It's better to define JPL as to what it's not. It's not work for NASA primarily, and it's not work for the Department of Defense. And so the kinds of things we do I'm responsible for.

The first thing I think we need to do is say a little bit about JPL. JPL is unusual in that it has a dual character. We are a division of Caltech, but we are also a center of NASA. And each of those two parts to our character gives us a little different picture, gives you a different picture of us, so that's a different picture of what we should be doing. Caltech, as you know, is a university, a private university in the State of California. The employees here are Caltech employees, they are not civil service. Work performed at JPL is performed, it says primarily on my slide, but the fact is that it is almost exclusively under a single contract with the National Aeronautics and Space Administration in a task-type contract. If we combine that task-type contract statement with the next slide I have here, that all costs are reimbursed by sponsors, we have no sustaining funds of our own. I think we come to an important point which will bear on your interest at least as to what's going on at JPL.

Everything we do here must have a sponsor and all costs must be reimbursed. So there must be someone who wants us to do the specific thing that we might be doing, even if that's technology transfer.

As a NASA center, we're of course under NASA cognizance and we're sort of officially a federally funded research and development center. Another way to phrase that is that we're a national laboratory. We happen to be the NASA designated center for planetary exploration, but that's not all that we will do, and I'll explain that to you in just a minute.

The facilities that we have are government owned. The chairs you are sitting in are government owned; the pitcher with your water in it is government owned. (laughter) The cups, I believe, come from our concessionaire who supplies coffee and who probably took them for other purposes to give you water. (laughter) But other

than that, everything is federal. And in many ways, if you know the other NASA centers, we operate very much like them. And NASA treats us very much like a part of their family.

I want to quickly go to your interest today, which is the business of the commercialization of space and space technology. At JPL, in order to give you an indication of what we're doing, I need to go to the fifth item of your interest which was how space technology is being transferred from the federal research and development programs to the private sector. Because at this point, that is the focus of our commercial relationships-technology transfer.

We do have a technology commercialization program, and we've stated here its purpose. We want to be responsive to the national incentive and to the congressional mandates for technology transfer. As you know, the space act and all succeeding acts mandate that NASA make this technology available to the private sector. We're doing that, not only because it's mandated, but because we believe it's good for the country and it's in the best interest of the national laboratory to do that. We believe that it will, in fact, help improve the U.S. competitive position; that it will increase our productivity in exports; and that it will assist companies to create and retain jobs in U.S. corporations. Since you're interested in California, I would say we could say also California corporations.

We've structured this program into four parts overall. By the way, I'll just call your attention to the fact that everything that has more than one piece in it is called a program, so you have programs within programs. If that confuses you, it's just because it says there are several activities going on. One is the Technology Utilization program, a direct participation in NASA activity. Another is the Small Business Innovative Research Program. Another is the Technology Affiliates Program, which has as a piece of it, the Product Development Program. And finally, we are developing a Super Conductivity Applications Project, which is a single activity, that's why we don't call it a program. And I'm going to go into each of these a little bit.

First of all, the Technology Utilization Program. This is the element of JPL's technology commercialization activity which participates directly in NASA's technology utilization program. That is a specific part of the NASA overall commercialization activity. And I'm sure that Mr. Herbolsheimer, who will testify later, will say something about that program from NASA's perspective. We participate. The focus of that is to conduct the necessary laboratory work that demonstrates the technical, if you will, the commercial feasibility of technology here at JPL. We work a little bit on it in order to make it more available to industry.

Our activity there is presently focused in three areas because we can't do everything. And one of them is bio-medicine; one is environmental monitoring and control; and the other is energy. At the current time, that amounts to about three and one-half full time people. But this is supplemented a great deal and I don't have the exact statistics because it's hard to draw boundaries, but let's say, many times over with work that is funded either by other federal agencies or by state agencies or by private industry itself. So the amplification factor might be at least a factor of 6-to-1, depending on how you count.

Going on to the Small Business Innovative Research program, and I'm just going to blitz through this one because I'm sure Mr. Herbolsheimer has something to say about this. But the purpose of this is to stimulate innovative research in small businesses. Small businesses are invited to submit proposals annually into one of two phases. The first phase of that, they're allowed to have a $50,000 grant for six months or so of performance. And based on the success of that, they can apply to the second phase of up to $500,000 in two years of funding. They must respond to a list of topics that's generated by NASA. And JPL, in fact, participates heavily in the generation of that list, and so they are responding to things which we then believe will be used in the space program, but they also believe will be used commercially. And NASA funds that, and in fact, NASA in its local office administers that for JPL.

We currently are looking over 35 such efforts, about $2 million perhaps more a year in there; and the direct effort at JPL amounts to about three work years each year.

I'll talk about the technology affiliates program and the product development program together. These are an innovation here at JPL to try to accomplish technology transfer from the JPL technology base into the private sector. The affiliates program addresses large businesses and the product development program addresses small businesses. We need to run those somewhat differently because of the cost of administration. Individual companies can join this program and place a retainer here. Now, I mentioned earlier that all costs must be reimbursed at JPL, and so here is a place in which we must somehow or other have the company bear the cost of what we do for them. From that retainer then, they select specific technology transfer tasks from their own needs and they guide them, and we do them. And the purpose, of course, is to transfer technology from us to them. It's not merely to do work for them. Today, 19 firms are participating in these two programs. And this program, being less than two years old, is growing at about the rate of one major firm a year.

Finally, the Super Conductivity Application Center is the purpose of establishing a collaborative arrangement between U.S. firms that are interested in pursuing the commercial advantages of this new technology-super conductivity. And we're doing it

through a combination of a center here at JPL and a consortium of the companies that are working with us. It has been enabled by a grant from the new competitive technology program in the state which is being cost-shared by NASA approximately one-to-one so far. We are now in a planning stage with funds of approximately a quarter of a million dollars, and we will then be proposing for the state granting programs specific tasks which will build this, we think, to about $2 million a year rather rapidly, and then we'll see after we evaluate it for awhile how well we should proceed or whether we should broaden the subject area somewhat. The research will be conducted, as in the state program, jointly by the participating firms and JPL. And we just point out that this work builds on a large investment both by NASA and by other federal agencies in the super conductivity arena. And our hope is that we can get it more rapidly into commercial practice. First of all, we would think in the aerospace industry, but later even into ordinary commodities.

So, in summary, we think we've developed a successful technology commercialization program. It's reaching out to California companies and to companies elsewhere in the country. We have 37 companies involved in some way or another with this in a formal relationship and participation is growing. And if you include the SBIR program, JPL alone expends about $2 million a year on that. That doesn't include the company participation; it doesn't include the NASA funding to the SBIR awardees, and so forth. So, it's a much larger program, perhaps $20 million, if we would add it all up, and that depends on how you add.

So that's a look at JPL's program.

CHAIRMAN GARAMENDI: Thank you very much. That was a good, quick overview. The earlier information that we sent out was focused more directly on the commercialization of space. In the intervening days, as I've just investigated the matter and as my staff has, we've broadened it a little bit as you may note from my opening introduction to the establishment of a space policy for the state.

And a couple questions on that, if I might. Should we? Does it make sense for California to have more direct involvement and a particular policy? Now, we do, for example, have an agricultural policy. We've got a major state department that's involved in that whole area and we do numerous things. I wouldn't suggest we go that far, at least for the next maybe 50 years. But should we have a state policy? Should the state government be more directly involved? Is there a support role that the state government might play that would assist the space industry as well as the commercialization issues?

DR. SPUCK: I'm not prepared to answer most of that in the sense that ...

CHAIRMAN GARAMENDI: Take what you like.

DR. SPUCK: ... Does it help JPL? And I think the answer would be that you notice the issues we're in: planetary exploration, astro-physical exploration, space, and the business of observing the earth from space, treating earth as a planet, particularly with respect to the global environmental issues are the focuses of this laboratory. It's probably not likely that a space policy would effect that directly. Those are the interests of NASA. So, I think, whether that would help NASA, I think you could direct that question to NASA.

CHAIRMAN GARAMENDI: Take it to them.

DR. SPUCK: On the other hand, I think you have, and you are, and you could expand the business of the state's involvement in helping this transfer technology from the space technology base to the private sector technology base, particularly at JPL because, in fact, that does cost money and someone has to pay for it. And many times the cost of providing the matchmaking is not of interest to the industry until they see there is really something they can make. So the competitive technology program is, in fact, one step in that. And, of course, NASA has an equivalent program funded by Congress in technology utilization. That's where we're active.

CHAIRMAN GARAMENDI: One final question. President Bush, earlier this year, spoke of a new space policy for America, interplanetary space travel, perhaps with other countries. I suspect that will eventually mean a substantial expenditure of federal money. Is that federal money likely to be spent in California? Or do we have competitors for that money? Or is it certain that JPL and our related research facilities here would be the place where that money will be ...?

DR. SPUCK: Well, JPL is certainly interested in that program, and feels that it will very greatly effect the direction in which our programs are going. In that sense, we would expect that money to come -- some of that money to come to California. And of course, filtered through us because we do a small fraction of the work that is funded here. It's put out into the private sector through JPL, and of course through Ames Research Center and other places, and that will effect California industry.

CHAIRMAN GARAMENDI: My sources tell me that there are certain East Coast states that are interested in becoming the major research focus or the major focus for that whole project. And if that's the case, we are once again in competition, it seems. And if we're going to have a space policy, it may very well be that our first issue is very near at hand.

DR. SPUCK: There's no question that the private sector can be competitive in wanting to have that. The academic institutions compete for those resources and those responsibilities. And NASA decides which NASA centers will have which roles in those. As the deep space, unmanned exploration center for NASA, I would expect that we will

have a role of some sort in that activity.

CHAIRMAN GARAMENDI: Is it certain that we will? Or is it that we must compete to obtain that?

DR. SPUCK: JPL? We don't compete, we discuss it with our sponsor. (laughter)

CHAIRMAN GARAMENDI: Very good. Thank you very much. Doctor, we appreciate that. I understand that you're on your way to some other meeting and whenever you must take your leave, please do. Thank you.

Yes, Lawrence Herbolsheimer, Deputy Assistant Administrator for Commercial Programs, NASA Headquarters, Washington.

MR. HERBOLSHEIMER: Thank you. It's a pleasure to be here, especially in the beauty of California and the temperate climate. Right now Washington is being buffeted by torrential rains and tornadoes, and as I understand it, freezing weather which makes it much more enjoyable to be out here.

CHAIRMAN GARAMENDI: We'll accept your endearing gratitude for having called you west. (laughter)

MR. HERBOLSHEIMER: Any time you wish to call me again, I will gladly come again. (laughter)

It's an honor to be here, to testify before you. What I'd like to do is submit my written text for the record. It's on your table. And then just speak from some notes which I put together.

It is an honor to talk about this important topic. It's important not only for the State of California, but our nation as a whole. It's important insomuch as what we are doing here and with commercialization of space will not only improve our lives physically, which I'll go into more detail later, but also strengthen our national economy and enhance our international competitiveness. I think competitiveness will be probably much more of a watchword in the '90's than it even has been in '80's which may be hard to believe, but I think that's the case.

My feelings about this are primarily drawn from some of the experiences which I've had. And if you'll allow me just an anecdote for a second, prior to coming to NASA, I worked in the White House for about 3 years, in '83,'84 and '85. One of the things that struck me during that period was how many industries were coming before the administration in the U.S. Trade Office, seeking various forms of protection from foreign competition. I think as we all reflect back on it, we used to recall the auto industry or steel industry or textiles and so forth all were coming before the administration at this time. I think the conclusion was that we've lost our competitive edge in many of those industries. We can probably attribute some of that to labor rate differentials, productivity differentials, financial advantages that some

countries have over us, just a variety of issues.

But one of the things that seem to keep coming up as we looked at those industries was just how many of them had lost their technological competitiveness. And that reminded me of a speech which I heard back in 1981 in Boston that was given by a man who is in the news today and fairly controversial, Akio Morita, the Chairman of Sony Corporation. He told the story about when he was an engineering student and he took a tour of Detroit. He took a tour of some of the auto factories that were there at the time. Since he was an engineering student he took particular notes of the kinds of technology and machinery and the processes which he saw. He decided to take that tour, roughly that same tour again in 1970. And much to his amazement he saw a lot of the same technologies, a lot of the same processes being used in those factories that he saw 30 years before.

So all that is sort of a prelude to talk about what we were doing here and why it is so important, not only to our space sector, but also to other sectors of our economy. And if you'll allow me, before going on, what I'd like to do is just spend a couple minutes looking at what California is doing in this space arena. I guess I'm struck by the amount of activity that's going on already. Some of our recent studies indicate that as many as 60,000 jobs are taking place in California as a direct result of space and space research. That's 30 percent of the total of space employment in the United States. California is receiving -- at least they received in 1987 $5 billion worth of funding for space and space-related activities. In our program alone, a small program within the NASA organization, the Office of Commercial Programs, we have set up a program called Center for the Commercial Development of Space, and I'll talk more about those later. They're basically, industry, academic, and government partnerships in collaboration to work on various types of space R&D. We have set up 16 of these centers around the country. I was pleased to note that over 30 California companies or universities are involved in the centers, and that's 30 out of 176, which is about 1/6 of all the organizations participating in that one program are California entities.

As Dr. Spuck mentioned a few seconds ago, one of the elements of our office is our technology utilization or technology transfer program. We have underneath that program an organization called the NASA Industrial Application Center Program. That's a center that's responsible for transferring technology to the private sector that was developed within NASA's domain. And we have one of those located at the University of Southern California, which has been successfully transferring technology to California companies as well as companies in 16 other states. This particular industrial application center is right now in discussions with the California Department of Commerce on setting up a Small Business Development Center to help more efficiently transfer technology within

the California area. This center is also involved with the University of California at Los Angeles, University of California at Irvine, and the Department of Commerce on looking at the various areas and possibilities for space-related R&D that would pertain to the commercial sector.

In another area that falls under our auspices in the Office of Commercial Programs, we have what are called Technology Applications Projects. Basically, we work on projects that we see will have ultimately a commercial benefit or a commercial application. Of the thousands of applications projects which we have undertaken over the years, we took a sample of those last week, 520 projects, and we found that -- I was heartened to note that 25 percent of the companies involved with those application projects are California companies. I have a number of examples of some of the technologies which have been transferred to California through our system in my record, and I won't go into those right now.

As Dr. Spuck also mentioned, we have under our auspices a Small Business Innovation Research Program, which is a program that is oriented toward addressing research needs of the NASA centers by putting out requests for small businesses to bid and to do research in those areas. It's a program that runs for roughly two years. If a company is selected to work on a research topic which we have identified, they would be funded to the tune of $50,000 in the first year and $500,000 in the second year. And that project or that program is working very well. I was heartened to note also that since 1983, over 24 percent of all the awards that have come out of this program have gone to California companies. In 1985, 1986, and 1987, almost 30 percent of all the awards came out here to California. No other state even comes close and so I'm pleased that California is doing so well in that program.

One other activity I wanted to spend more time on is the Center for the Commercial Development of Space Program. As I mentioned, we have set up 16 of these centers around the country. I also mentioned their consortia of industry, academic, and government collaborations to work on very focused R&D. NASA funds those centers for a period of 5-to-7 years at roughly $1 million per center per year. I think you could look at that funding as something like venture capital, like seed money that basically gets these organizations started.

But one of the most important things I wanted to talk about in this regard is that these centers are really set up for a limited duration. The government funding is to supplanted by private sector funding, and that is basically how they are oriented. The first five centers which we set up around the country when they were started, the government put in $4.5 million into these collaborative efforts, the corporate sector put in $1 million. Today, however, the government is still putting in about the same

amount of funds that it did before, $4.7 million; and the private sector is putting in $13 million. That's a leveraging of from when they started $1 million to $13 million of private sector funds. The point I'm making in saying this is really these are almost self-sufficient entities at this point. The private sector sees enough merit in them that if they want to -- if they like the research, they're obviously funding it, and you know, if in fact the research that was being done was not of value to the private sector they would fail. And that's probably the way it should be.

Of the 128 companies and 48 universities involved in these centers, 30 are California organizations. Many are covered in my written testimony. They range from companies like Genentech, a biotechnology firm out of San Francisco, which is working with our CCDS at the University of Alabama in Birmingham on pharmaceutical research; as well as our center at Penn State, the center for cell research; Lockheed Bioastronautics out of Sunnyvale is working with our center at the University of Colorado called BioServe, working on life sciences and life support systems for extended duration travel in space; and Maxwell Laboratories out of San Diego has been working our CCDS at Auburn University on space power, and interestingly enough they've already built and are marketing a new product which has come out of the collaborative research, a power controller which can be used in space, but also has a wide variety of terrestrial applications.

One success story which I want to focus on in a little more detail because I think it would be of value to you all is the Center for Macromolecular Crystallography, which I referred to earlier at the University of Alabama at Birmingham. It was founded in 1985 to do protein crystallography work which is basically a method to more efficiently do rational drug design. And they've already spun off one company out of this activity called Biocryst down at Birmingham. That company has flown five experiments on the shuttle already. The results are very exciting. They're working on new drug design. They've already got a few drugs which should make some real breakthroughs when they finish their crystallography work in curing some currently incurable human problems. And what's interesting about this is that all the large pharmaceutical houses are involved, just about all the large domestic pharmaceutical houses are involved with that activity down there. They see it as an exciting new method to do work that they've done in the same way for 50 to 100 years, and this is going to be a new breakthrough which, we think, which will make that whole process much more efficient.

All of this is background really to say that there's every opportunity for California companies to become more involved in these kinds of centers. In a way also there's no reason why the State of California can't do something very similar to this: Establishing centers for research in the space arena or any other area for that matter;

fund them for a limited duration; require corporate co-funding; and then bring together, obviously, some of the top researchers from industry or academia; and basically, let those individuals decide how they're going to do their research and what they're going to focus on. What I think you'll probably see is that the people who will get involved will get out there, they'll hustle for a variety of reasons, mainly because they obviously want to do good things for the state's industry. But I think they all view these as little nuclei for spawning new businesses and new ventures.

So the question arises, how would a state embark upon this sort of activity? We have a Commercial Programs Advisory Committee at the federal level which consists of 18 CEOs and university presidents. They are making recommendations on how we bring about greater commercialization of space at the federal level. There's no reason why a blue ribbon panel of sorts could not be appointed at the state level, whether it's in California or any other state, to look at what the state's strengths are; what the competition is doing in this whole arena; what the resources are available; and basically, how a state would become more active in this arena. I think if you focused on this kind of activity, you would find that there are a lot of strengths which this state could parlay into whole new areas of research and industrial activity. Of course, these things are not quick panacea. It takes a few years for the process to develop and the results to begin to come forward, but I think it would be a good foundation for solid growth in the space arena in the future. So it would be good for the state and good for the nation as a whole.

So that concludes my prepared remarks to you.

CHAIRMAN GARAMENDI: Lawrence, thank you very much. I appreciate your testimony. And all of us in California appreciate the efforts of NASA. We know from our own history how important this is, not only to the nation, but particularly to the state and the economy of the state.

A couple of things in your testimony have caught my interest. If I might just explore them with you.

MR. HERBOLSHEIMER: Sure.

CHAIRMAN GARAMENDI: These Centers for Commercial Development of Space, 16 of them, none of them located in California.

MR. HERBOLSHEIMER: That's correct.

CHAIRMAN GARAMENDI: How did that happen? How does a center get developed? Why are there none in California, from your perspective?

MR. HERBOLSHEIMER: As I reviewed the statistics on that, I think there were about 40 proposals that were made, two of which came from California. They were reviewed by a panel of experts that looked at just a whole variety of criteria for selecting

CCDS's. The ones that were selected were of a slightly different orientation. They perhaps met the criteria which we set forth a little more closely, and the others were selected. It's not to say that we can't have centers in California in the future.

CHAIRMAN GARAMENDI: The reason I'm so interested in this, is that in your testimony you very vividly describe the way in which California companies are involved in these, but their involvement is not in California; their involvement is where the centers are. You gave several examples. Your written testimony gives several. Now, we'd love to help people ...

MR. HERBOLSHEIMER: Sure.

CHAIRMAN GARAMENDI: ... but first we're going to have to be strong in order to be of help to anybody.

MR. HERBOLSHEIMER: That's right.

CHAIRMAN GARAMENDI: There's no guarantee, as I said at the outset, that we'll remain strong unless we're willing to compete. You also said that. These centers appear to be more and more a focal point for NASA to fund research projects through these centers. And you also gave a wonderful example of Alabama where the research center gave a spin-off to a company located in Alabama even though it was a California-based company that started a particular piece of work. That methodology of economic development is, in fact, the way most of California's industry has developed. First research, then industry following it.

What do we need to do to get a CCDS in California, or several of them? Are they available if we would make application? Is it a political process? Is it a merit process? Or a combination of both?

MR. HERBOLSHEIMER: It's really a process based upon merit. At this point, however, we don't really have any funds, any new funds in the budget for more CCDS's. What we're doing at this stage is looking at how the CCDS's are operating, and making a determination as to what we need to do to make some improvements if necessary. Once we go through that process, we'll consider more CCDS's.

One other thing I should mention is one thing we <u>have</u> to do is fly off some of the payloads that are emanating from these CCDS's, some of the experiments that is. And until we get some of that going, it's really hard to think about having more. That's sort of the constriction in the process right now, flying off those payloads.

CHAIRMAN GARAMENDI: So, we shouldn't look to CCDS's as a method expansion at least for the short term ...

MR. HERBOLSHEIMER: In the short term, no, I would say not.

CHAIRMAN GARAMENDI: It is a fascinating example ...

MR. HERBOLSHEIMER: If I may say, Senator, I mean it is certainly reasonable for a

state government to consider setting up something of a similar nature within their own boundaries. I mean, it can be done.

CHAIRMAN GARAMENDI: In fact, I think we may be doing such things.

MR. HERBOLSHEIMER: Good.

CHAIRMAN GARAMENDI: The competitive technology program and the super conductivity program here at JPL are examples of that kind of thing, and indeed we may have to do it ourselves; it's a distinct possibility.

MR. HERBOLSHEIMER: Well, you can probably contract with a lot of people. But we're trying to solve that problem right now. There are a variety of ways which we can fly off some of those experiments. We're looking at those right now, including a mid-deck carrier called Space Hab, and expendable launch vehicles, and sounding rockets, and so forth.

CHAIRMAN GARAMENDI: Does your experience indicate to you that an active state government involvement leads to additional research and commercial activities within a state?

MR. HERBOLSHEIMER: From what I've seen, I think some states are beginning to take on more of this responsibility themselves. I hail from Illinois. I've seen what Illinois has been doing in the last year or so, and they are making some great strides. California is doing exactly the same thing. It's probably farther ahead than Illinois. Yes, I think it really is incumbent upon the state governments to look at what strengths they have, what resources they have, where they can concentrate their efforts. And in addition to that, look at what the competition is doing abroad. We don't want to have launch sites in every state. That's just not very practical, but look at what's happening elsewhere, and decide where should we best concentrate our efforts. And that can't really be done very well at the federal level. I mean, there's certain things which a federal government can do, and there's certain things which really the states have to take on more of a responsibility for.

So I applaud your efforts to take that as a challenge to do more of that here. And I think it would set a very good example for other state governments to follow.

CHAIRMAN GARAMENDI: One brief question about Vandenberg.

MR. HERBOLSHEIMER: Yes.

CHAIRMAN GARAMENDI: What role do you see that playing in the commercial efforts?

MR. HERBOLSHEIMER: I am not an expert in launching, but one of the things that I have -- I've been briefed on is that Vandenberg probably wouldn't be the best kind of facility for commercial satellites. But it would certainly serve the country well, or the state well in terms of launching experimental rockets, sounding rockets, and so forth, for various types of experiments. That could be done, and I think that should

be pursued. It's obviously got to be worked out with the Air Force, but I think you've got enough talent in the private sector here to be able to assess that and to make a good report to you as to the viability of such an idea.

CHAIRMAN GARAMENDI: Testimony indicates that it needs to be investigated. Is NASA investigating that? Or is that an activity for the states to investigate, or this state to investigate?

MR. HERBOLSHEIMER: That would really be an Air Force activity to help coordinate. You know, NASA could work on a study with the state government, sure, there's no question about that.

CHAIRMAN GARAMENDI: Thank you very much. I appreciate your testimony.

MR. HERBOLSHEIMER: Thank you.

CHAIRMAN GARAMENDI: Thank you for coming to California to endure our weather.

MR. HERBOLSHEIMER: Oh, it's lovely. Thank you.

CHAIRMAN GARAMENDI: Thank you.

MR. HERBOLSHEIMER: It's a pleasure to be here.

CHAIRMAN GARAMENDI: I invite all of the witnesses to not only listen and participate, but to comment in writing upon what you've heard here, and if you have thoughts that are generated by other testimony, please drop us a letter or memo and we'll include that in the hearing record, so we can take it into account.

Laurance Milove, Chief of the External Relations Office at Ames Research Center.

MR. LAURANCE MILOVE: Like Dr. Spuck, I'm going to give a traditional aerospace overview, so Larry from Washington is really going to experience it sitting up at the front table. So, if we can get the lights down.

I've looked forward to this opportunity. I came to Ames Research Center about five years ago to lead the space commercialization effort when the office was first formed. And since that time we've evolved into the title of external relations. What we do there is very much what you heard earlier. We integrate several of the commercialization programs because they build on each other: The technology utilization program which has a 30 year history of accomplishments; the small business innovative research program for the smaller companies; industrial research and development for the larger companies which win very large contracts. We have a novel program called University Consortiums because at Ames, like at the Jet Propulsion Laboratory, we have a very close working relationship with universities. There's a community of interest there, in not only the graduate students, but in the basic research that goes on between those two. And in fact, I think last year Ames spent about $98 million with universities just in California on basic research activities. And then in light of the competitiveness thing and some of the things that Larry

Herbolsheimer has mentioned, we started a program called Joint Enterprise where we try to link those two together with universities on a project-by-project basis similar to the Centers for Commercial Development in Space.

Today, however, I'm going to focus most of my remarks on the commercialization of space program. But I want to give you at least a couple of examples of technology transfer and how those things work into a commercialization of space program.

As an Ames Research Center employee, I have to give the commercial first, so I'll try and make it brief. Ames is located about 30 miles south of San Francisco. And I remember working with you on a commercial opportunity at an Ames seminar several years ago, which is really when I first got started in this area. I'm proud to know that you've been looking and keeping a watchful eye on us over the years that have evolved. I think as you heard in Larry Herbolsheimer's testimony, there is lots of good news for commercial space activities in California. Ames Research Center has about 5,000 people; we have about a half a billion dollar a year budget; we're focused on both aeronautics and space activities, about 50-50, so we have lots of experience in transferring the technology to aeronautics industry. And now the challenge is to take it into the space environment, we can also create a similar commercial activity. I think there are lots of good lessons in looking at how the NACA works. So I think there's lots of historical examples of how we want this relationship to proceed into the future.

At Ames Research Center I think there are three basic areas where we can contribute in the commercialization of space arena: one of them is an autonomous systems; one of them remote sensing; and the other is life science. I'm going to give an example in each of those areas.

In addition to the Ames Research Center, we operate the Dryden Flight Research Facility located on Edwards Air Force Base, where we perform much of our high speed flight research. Obviously, Sunnyvale is not the proper location for high speed flight research any longer. We're also working very closely with orbital sights on this new vehicle which you may have heard about, which is a new commercial expendable launch vehicle. So we are providing some assistance in that regard.

But one of the key things that we do there, that happens there, is the shuttle returns there. When I put together this presentation, I was in Texas with Larry Herbolsheimer. Just as a kind of a funny note for anybody here who looks carefully at this chart, while I say that the shuttle returns at Dryden, this is a shot of shuttle return at Kennedy. So we got the wrong chart. But now it does return to Dryden. This is the Kennedy runway. I think it returned twice there. That's just for those with a keen eye.

In thinking about what California should do in terms of the commercial use of space, and in starting the commercial use of space program at Ames and the technology transfer program, it's integrating those two things together. I summarized how I think these relationships work, and that is you need to look for opportunities where NASA has a unique capability. And those result in facilities, specific facilities that can be offered for expertise in terms of personnel. And then the second interest -- and this was partially referenced in the first comments -- a community of interest; that is, at a federal research laboratory, there's a lot of things a federal research laboratory can do. We have machine shops, we have an enormous capability if challenged, if requested, if funded, we could probably produce cars, but probably wouldn't do that efficiently.

So you really have to look for areas where there are similar research objectives, and then from the state perspective look for areas where there is funding availability. And that's really what I have tried to do in operating the commercial use of space program at Ames. Let me give you an example of that. Ames Research Center operates high altitude aircraft. This is a shot of an ER-2 aircraft and a U-2 aircraft over the San Francisco area. You can see the bridge there in good shape. We operate these aircraft, and do monitoring of the environment. We actually use these as test beds for centers which will go into space. We do this in cooperation with Jet Propulsion Laboratory, where other NASA centers create a sensor, and its space on a flight on a high-altitude aircraft to test them to make sure it's working in ways you think it's going to work.

We've had a lot of close working relationships with the State of California in that regard that you may be aware of. This is a shot of the Yellowstone fires, and as you know, those created a significant impact in California. This is a danger to the firefighters and it's very difficult to fight a fire like this. If you can take NASA technology such as an infrared sensor and be able to fly over areas like this to determine where the hot spots are, this enables you to move the firemen in a much more efficient and effective manner, but safer manner. I think companies in the very near future may, in fact, develop a small satellite capability to operate this sort of thing. And I think California is uniquely prepared because of the entrepreneurial spirit which is reflected in the SBIR program to take advantage of these opportunities. So I think a lot of the small businesses you may see move into these areas which are not big facility oriented, but little opportunity oriented.

Another project that I must congratulate you on is the competitive technology initiative. I'll take a little credit for that as well. We spoke about that early on. We were there with you early on, and had one of these first projects funded. And I

have with me today that I'll place on your desk and everybody can see here the latest version of the PC computing. And there's a very nice article in here on the inside, on artificial reality. This is done at Ames Research Center.

CHAIRMAN GARAMENDI: Strange they'd be writing about the Legislature.

MR. MILOVE: That's right. (laughter) And this is actually a project that was initially started when you first got the competitive technology initiative going with the Department of Commerce that has been very supportive of this kind of activity. And then once the new technology or Competitive Technology Office was established we've been working with Tom Walters, and this is one of the projects that was initially selected. The things that you are doing are working, they're having an impact, and this is just an example of that. I'm sure you'll hear more from Tom on that.

I'm going to slide over now into a project that I'm very proud of, the Genentech collaboration as an example of why California companies have wanted to become involved. And this is a quote by Kirk Raab, the President of Genentech. He recently -- and I have a press release in my prepared remarks that I'll submit to you as well -- worked with Genentech on a long-term collaboration. Their interest really grows out of an interest in the cell and tissue changes measured after space flight. And really the high regard they have for the capabilities and technologies of those NASA scientists and scientists at the center for some research in Pennsylvania which is one of those Centers for Commercial Development in Space. And what they're doing, the scope of the project is they're looking at a series of ground base and space base experiments; and in particular they want to expand on some of the previous basic research activities which have gone under NASA funded programs in the past; and they're looking at reductions in bone calcium and immune cell function. And it doesn't take a rocket scientist to figure out the commercial implications of those, but I'll throw them up here on the chart for you just briefly. Genentech, while the premier biotechnology company, or one of the premier biotechnology companies, also views themselves as a small, rather small pharmaceutical company. So they're looking at the space environment to give them a competitive advantage. It's an excellent collaboration because Genentech has a very strong scientific talent base. So it works in both ways. That is, they've heard about what we're doing; we heard about a lot of their techniques. They have a lot of attributes that we don't have. They have a lot less bureaucracy in their system. So oftentimes when they catch an idea; they can run it through a whole series of tests and a whole process where we're still writing up the "our town" proposal to get it to headquarters to get it funding for it to do all those other things. So it's a very mutually beneficial relationship. And that's what I mean by community of interest, community research objectives.

Here the NASA scientists are looking at exactly the same thing that the Genentech scientists are looking at. So the government is getting a double bang for its funds. We're helping NASA accomplish its mission because deep space, long-term space flight requires the same sort of analysis and post-menopausal osteoporosis and immune cell functions here on earth are part of the same analysis. So you can force-feed commercial space in a lot of ways, and some of that is good as well. But there are also, if you sift through it all, there are these opportunities. And I think that's what the Centers for Commercial Development of Space are doing so well. They are consciously going through the inventory of technologies and capabilities and finding those gems and pulling them out. Larry and I just came from a meeting in Texas, and I can tell you in a two-day period we heard some incredible stories about those commercial opportunities.

One of the things that we're doing -- and this is a kind of an example of our capabilities, we're contributing to the pie in terms of Genentech. We're building the animal enclosure modules, that's what Genentech is interested in doing. They're interested in flying some animals with the proprietary compound; exposing them to the microgravity requirement and watching the accelerated biological process occur there; bringing them back down for some tests; and seeing if they can use that to determine some of the earth base activities. NASA has created equipment like this, so Genentech doesn't have to do that again. So we can go ahead with those commercial programs. They provide the funding to do that. So when you talk about leverage funding opportunities, Genentech is spending a couple hundred thousand dollars on this program, but we receive several hundred thousand dollars from the Office of Commercial Programs last year to build this equipment for Genentech, really. I mean, Genentech is the true beneficiary of this activity to integrate their payload into the shuttle system which is a very complex system. A lot of paperwork and something that Genentech probably doesn't want to get involved in. So, that's one of the primary roles that a research laboratory, like the Ames Research Center or the Jet Propulsion Laboratory can play.

Summarizing why people want to get involved with NASA and commercial space activity, I use Genentech as an example here, being a local guy, not a Washington person. I'm going to stick to the one project at a time. Access to the universities, scientists, engineers, and an organized data base, those are the things that we contribute to the pie. Access to ground base and space flight hardware and facilities by NASA here at JPL, and we have an opportunity to take a tour of some world class facilities, we similarly have some world class facilities and the opportunities for people's mutual benefits are significant. And streamline access and flight opportunities and that's really what the Centers and Office of Commercial Programs are

doing. They are really accelerating the pace at which commercial organizations can get into the space flight environment. And so while there are no Centers for Commercial Development of Space in California, there are university bases for those, I would like to suggest that it's a very good thing that many California companies are involved in CCDS's, because the objectives of CCDS's are to spin out afterwards. You go in there, you can get access to the scientists, the engineers, the equipment; then you spin back out. And I think what we'll find in the long run is because of the very much entrepreneurial spirit that many of those companies will spin back out and then they'll end up here in California.

I'm going to close with the Ames logo in trying to respond to the specific questions you posed, and that was what California could do? You already pointed out the fact that several other states are active. I've spoken in Colorado and Texas and Florida on this same subject. I think one of the things that you can do that you've already done an excellent job of is to encourage California-based companies and universities to work closely with the Office of Commercial Programs and the competitive technology went a long way to do that. You went out with a RFP, everybody knows about it, overwhelming response, people become active and motivated and they start knocking on my door at the research center and say how do I get involved, and what's happening here? So, not only do you get it in the specific proposals that you fund, but there's also a secondary benefit which occurs as well.

One thing I'd like to suggest is you may want to undertake a study to inventory those space-related activities which are focused in commercial space areas, such as the Genentech or some of the SBIR activities. And based on this study you may want to establish some sort of aerospace commercial space advisory committee. And many of the people that are here today that I've seen at other forums, you have really an expert inventory of personnel here that you can draw on for this advice and counsel. You may want to in the competitive technology area set aside some specific resources in this particular area; say okay, I want commercial space projects to be funded at, you know, 10 percent of the budget or 15 percent of the budget; or two projects; or some sort of thing like that.

Another area where I've been working very closely with the Office of Commercial Programs is that perhaps California should get more involved in the Phase III SBIR program. The Phase III is the commercialization. I believe there are significant opportunities, Senator, for a state to maybe approach NASA with some organized relationships to say, "Okay, we'll help take care of this Phase III funding or help stimulate Phase III funding," because with NASA funds -- a large number of those proposals for $500,000 -- are lots of opportunities for matching that and actually

getting the products into the system. And a lot of the low-cost space-flight hardware, which would develop an expertise which I think would contribute to the commercial space environment. And then another obvious one -- and these are all just suggestions -- within the State Department of Commerce you may want to identify maybe within the Competitive Technology Office, maybe in some other location. And I'm sure you and Ken Gibson and other people are in much better positions to make that decision than I am.

And that concludes my testimony. I do have a written text that I'll submit. I'll be happy to try and answer any questions.

CHAIRMAN GARAMENDI: Thank you. I appreciate your testimony, and reviewing, really, the progress that was made in the last few years on many of these items. The SBIR program has been mentioned several times, and it's amazing how prevalent that program is in this industry and in several others, the Department of Defense obviously, but mostly the federal government. We have tried now for two years to provide some bridge financing between Phase I and Phase II where many of these companies just drop out of sight. They successfully compete Phase I, and then never get to Phase II, let alone Phase III. Our efforts have not been successful in persuading the administration that these SBIR grant companies need some bridge financing.

We'll look at Phase III soon, but we're talking a lot more money by the time we get to Phase III, and the present attitude has not been particularly good in the Department of Finance. But hopefully, the kind of testimony we've received here today will help us a little bit in encouraging the administration to look at these things a little more favorably because so many California companies are involved.

MS. MASAKO DOLAN: Phase III, that's supposed to be commercialization, venture capital.

CHAIRMAN GARAMENDI: Let's take a look at the Phase III issue, in a little more detail. Masako correctly points out to me that we need to do this. It relates to some other work that we're doing in venture capital. Phase III is commercialization pure and simple. No longer do we have a research project, you've got a product. You're suggesting the state get involved in Phase III. Tell us why, what problems you can see, and what shortcomings there may be from your perspective and experiences?

MR. MILOVE: Well, I'm approaching it from the user of the final piece of equipment, that is the SBIR program -- it's my understanding anyway, and Larry may want to comment on this -- is designed, was initially designed by Congress to devote a certain portion of NASA resources to the small businesses environment, although it's also designed to continue to accomplish the NASA agenda. And so as a NASA program manager that makes selections on an SBIR project for a piece of innovative space flight hardware like an animal enclosure module, like the type that I showed you, but for a

longer duration time. Right now, the shuttle stays up for four or five days. We made an animal enclosure module that stays up for two weeks. And so that means certain things have to be changed. So the thought there is that we'd like see an innovative proposal come in in that regard. $500,000 may not be enough money to accomplish that objective, to get that piece of hardware all the way through the system.

So an opportunity that I talked about with the Office of Commercial Programs is to say, what if there were a separate funding source that could deal with those situations where the venture capital source is somewhat hesitant, that is, it looks like there may be a market for 10 of these animal enclosure modules and maybe there's a market for 100, but you can't get over that wedge, you can't get the venture capital to commit because you don't have the first 100K in order to get the production line going or the first 100K to go out and do the first oriented marketing. So it may be possible to create some sort of set aside funding to do that. And we've talked with the Office of Commercial Programs about doing that through these Centers for the Commercial Development of Space, and it's putting an extra funding source in there and then letting them work with a small company on the market. Because that's oftentimes what happens is the guy has a great product, he's a great risk taker or entrepreneur, but he doesn't have the marketing aspects to find out who can use it. And that may be going to all the NASA centers, visiting the DOG, going to Europe and trying to sell it in the European marketplaces. And it may be that 50 or 100K wedge that he needs in order to move that product into actual use. That not only helps the particular entrepreneur, but it helps NASA because we get a better piece of space flight hardware.

CHAIRMAN GARAMENDI: Interesting. We have numerous state programs that target small businesses and provide assistance. We obviously have a lot of venture capital operations in California. We're going to spend some time looking at those in more detail. We do have committees in the State Legislature that deal with that. Perhaps with their help and assistance, we can provide better targeting here. And the Department of Commerce is becoming more active each and every year in this whole area, and the result of that may be that we can find a program that fits in that area.

Good, thank you very much.

MR. MILOVE: Thank you.

CHAIRMAN GARAMENDI: Moving along. Bernard Cohlan, Consultant in Engineering and Physics. Bernard.

DR. BERNARD COHLAN: Since I come out of the missile and space business, I'm quite used to standing over here next to a view graph machine, although I am not prepared today. (laughter) In fact, I came late to the introduction to your hearing. I found out about it just last Friday, and since then I've been in Houston, along with some

other members of the community. So I walked in the room not quite sure why I was here. But I think I can serve you best by responding in effect to what I have heard so far this morning. And I think I can serve you best by telling you a little bit of the history that we've been involved in the last couple of years because I think it directly relates to what you're trying to achieve.

My background is a couple of degrees in engineering and a doctoral degree in space physics. I come from a space engineer's background and a space physicist background. But in recent years I've spent a lot of time with the financial community and the business community. And not too long ago, two years or so, I was asked by some members of the international and the national investment community to find their path into the "space business". So, we have spent now two almost full time years in that search involved with now a widening circle of the financial community and the aerospace and the small business community. And what we found -- or what I found -- or we found collectively was that there's a big gap between available technology which is adequate, plentiful, and terribly attractive on one hand, but the perception of the space business, of space and space commercialization on the part of the financial community. And as we all know in this room, we go nowhere without money, whether it comes from government or it comes from business or it comes from the financial community.

So we've spent the last year intensively trying to understand how to bridge that gap between available technology that is being offered by the government, federal government, and the private sector that can apply that technology into the private sector, and back into the public sector for that matter. Early on in the game there was a recognition that the investment community was not about to jump, to take a leap of faith forward into the space business as such, and wasn't in fact ready to take a leap forward into the commercialization of space. That still had a fear associated with it.

So here I come now to tell you what, in fact, we are doing now, and I think it is pertinent to this meeting. We have elected for ourselves -- and who are we? We are a consortium composed of industry, large and small industry; the investment community, large and small; and the academic community, largely the University of California at Los Angeles. That's my background. I sit on a couple of advisory panels there. We are of course attempting to -- and I think we will be successful -- develop collaborative relationships with CCDS's, with other NASA funded centers, with NSF centers, and the Department of Defense has parallel programs for technology transfer, extensive ones. I have tested that thoroughly and find that these are agencies that are serious, they're motivated, and they are not just playing a political game for political reasons. This is a genuine effort on the part of the agencies that we're

interested in.

Because we are focused on California, we have named ourself Space Cal Consortium, and so our role to put it simply, is to transfer technology into California from the technology community within California.

But we are not going to address the question directly of space commercialization. That is a leap of faith that our investment partners are not quite ready to take. And so we are taking an interim step which may, in fact, be one and the same thing. We may just call it something different. We may achieve the same goal, space commercialization. Our role is to -- well, I'll tell you what it says on the front of our formation book. Our formation book says that this is a public/private sector collaboration for "the productizing of space derived technology." It doesn't say we're going to commercialize space, but what it does say is that we're going to use that mountain of technology that has been accumulating over years and years, and continues to accumulate, and turn it into a product. Whether that product goes back into the government in space or whether it comes out into private industry or nonspace-related is not of first importance to us. Our intent is not to be in the research business per se, but to use all of this good research and development that is either completed or in the process of being completed in federally funded laboratories, in space programs, and the SBIR, and what have you.

That concept has proven to be very attractive to our financing partners. They see that as a reduced risk path. They don't see it as a public crusade to commercialize space. It satisfies their need for profit motivation. And so we are just about at the point where we are now funding, we have funded our definition phase. We are forming.

You will ask me what should the state be doing? And I will respond by giving you a sense of what would help us over this gap between our industrial partners and our financing partners. We still have a gap that we are narrowing out. Some of the obvious ideas. First of all, there is not a great concern, but a low level concern that we are inventing something, a consortium, that will have some sort of antitrust conflict. And so I am repeatedly asked, is this a violation of the antitrust law? We have counsel in Washington, well qualified in this field, and we've been assured that either there are laws in place or there are laws in process in the Congress that will relieve that concern. But I think it needs more public visibility, that consortia are not antitrust -- are not subject to antitrust action. There have been a few articles in the press that have been somewhat reassuring, but part of them have been discouraging. This is something the government can do for the private sector. Another thing ...

CHAIRMAN GARAMENDI: A state sponsored consortia...

DR. COHLAN: Well, I think you have to address the broad question of consortia, sure. From my viewpoint, if you address the question, it's space technology transfer. Let me narrow it to that. If you could address the question of technology transfer consortia, fine and dandy. But that's a political question.

And let me make a point that I did not make, and that is that this field of technology transfer or productization, as we call it, is we do not think -- we, again, our partners at the university, our partners in the financial community, and in industry large and small -- we've convinced ourselves that you're really not going to do it in monolith companies, establish monolith companies. It's too expensive to do and probably you don't have the right talents in the first place. So we have turned to the consortium model. And in that consortium we have just about already established the full spectrum of talent from academic research to market placement within our consortium. We think that's crucial to a success. We believe strongly that when you take on the task of productizing a rather complicated technology, you better have at that first decision table all of the partners to the act from any additional research to the marketing. Marketing is particularly crucial, although I'm obviously not a marketer.

Another thing that comes to mind -- I'm just -- as I was sitting here -- is that if the governments, state and federal, could -- well, let me back up just a little. We are a private sector, for profit, organization that does not intend to directly solicit funds from government agencies. Okay? What we are going to do is use the programs in place now, and they are adequate and plentiful, as I say, and underutilized. We think severely underutilized. So we are going to use, in effect, government resources that way. But one thing that does come to mind that would be particularly attractive, I think, to our financial partners, which I think is key is, as I said before, is some tax benefits. I have not kept up with the current law, but I think we lost sometime back our R&D tax credit. Can somebody help me on that?

CHAIRMAN GARAMENDI: You didn't. The federal government is in the process of extending it. State government has an R&D tax credit in effect now, and it is a two-tiered one with a higher credit being available for university-based research sponsored by individuals or corporations. A somewhat lower credit, slightly lower credit for industrial-based rather than university-based. It's a substantial credit when taken with the federal credit, which has been extended. Federal credit has been extended.

DR. COHLAN: It has been extended. I had heard ...

CHAIRMAN GARAMENDI: It was in process for the last 6-7 months.

DR. COHLAN: I had heard -- my latest -- and I'm behind on this, but the latest was

that it was probably not going to be extended.

CHAIRMAN GARAMENDI: My other role is Chairman of the Revenue and Taxation Committee -- and those consultants are not with me today, but I'm ...

DR. COHLAN: Well, I think I've asked the right person, then.

CHAIRMAN GARAMENDI: There is probably a good way of finding out ...

DR. COHLAN: That will help us. That will help. That will make our financial partners feel a lot more comfortable. If you wanted to go so far as to try to specifically encourage consortia, then ...

CHAIRMAN GARAMENDI: To take advantage of the California credit, the research has to be done in California. Please keep that in mind.

DR. COHLAN: That's our intent. (laughter) That's our intent. The fact of the matter is, this is an interesting side point, that we now have two other countries at governmental level that have asked, in effect, to either directly join our consortium as governmental agencies or to encourage their industry to join our consortium with the idea that they would transfer their technology into our consortium or "productizing." And then with the understanding that in some collaborative or joint way, the final product would go back to the homeland or some joint market, and pick possibly some joint production. But our intent for good operational reasons is to do our productizing here in California.

I think I've said the best I can say for the day in a spontaneous way.

CHAIRMAN GARAMENDI: I appreciate that perspective. I know that many of the witnesses here returned from, I believe, a meeting of some sort in Texas and you may have covered many of these issues there, but I'm pleased that you also returned, Dr. Cohlan, and as well as the others. Thank you very much. It was a very interesting insight into that new consortium idea.

Jim Bennett, the acting President of the American Rocket Company. Jim.

MR. JIM BENNETT: Thank you. I'll forego the use of view graph today. I'd like to start by thanking you for the opportunity to come here and present our views. And to point out that we have already seen a number of other states in the Union and also local governments overseas take on substantial initiatives in space commercialization and promoting space commercialization in their states. As Californians who started in one company here in the state, entirely in the state, we've been sort of hoping and waiting to see California take some initiatives of its own. I am very happy to see these hearings because this may be a start in that direction.

We would view ourselves as a good example of commercial space entrepreneurship, commercial space innovation in California. Starting four and a half years ago, American Rocket Company has taken and brought to bear an entirely new space

transportation technology, the highbred rocket engine compulsion technology, which had been started but never fully developed, never brought to utility by government efforts in the '60's. For the time of our existence, we have conducted over 150 firings of more than 30 engine designs and types at Edwards Air Force Base. We've done this entirely with private money, with no government aid or contracts or funding of any sort between now and the time we started. We have done this by making extensive use of federal facilities in California, Edwards and Vandenberg Air Force Bases; and also with sort of the informal aid of many of the elements of California's base infrastructure, particularly the university base resources, university personnel, and very particularly the business and the technical infrastructure available in the state. This has all been either informal or in straightforward commercial fashion. The fact that this is here, the fact that there's already a large critical mass of space resources in California makes it a good place to start a commercial space company.

However, it was also noticed that there are drawbacks to being a California company in space commercialization. The cost of living and cost of doing business in California has been something we've had to take note of. As a person who has sat down with a number of interviews with a number of highly talented people we wanted to get on the team, we have noticed that sometimes we are unable to recruit them to move to California. We weren't able to offer them enough money to break into the housing market here, these things. So we have a lot of advantages being a California company; we have disadvantages that we have to strive to overcome. I think that California, again, because of its critical mass, because of the existing resources we have here, and also because of the very entrepreneurial climate you have in California, the fact that we were able to go to attorneys who understood entrepreneurial fund raising immediately, we were able to take an entirely new technology, look at the problems of starting entrepreneurial company with it, be able to adapt to this whole different set of business resources, financial and venture capital networks, although we didn't rely on institutional venture capital, we used an informal network of individual investors and got started in the Bay area and the Los Angeles area and the capital. You have all these resources. But I think now you have to take some steps to organize some of these resources. You have to look at what the other states are doing and say, are there bases where we can take initiatives to stay parallel with them so we don't lose what is a natural resource. I think if you do this we have an excellent chance of capitalizing on resources that we have already, spinning into the lead in space commercialization.

So what can we do? I've come up with three sort of groups of areas of things you can do. The first would be in the category of normal business assistance or normal encouragement of business, especially encouragement of entrepreneurial business. We

should look at regulatory streamlining where appropriate. We should look at things like development bond assistance for infrastructure capital development. I might point out that Florida has already been very active in that area as Hawaii has been discussing taking corrective measures in that area. And these are very attractive to us. Tax relief, use of enterprise zones where appropriate is a possibility. You can go to a launch site type project and Hawaii is looked at, combining the launch site industry park developments with an enterprise zone and that becomes an attractive package. Again, saying we have the high cost of living and doing business in California, tax relief in some areas, stronger investment credit. You might look at some of the things that were done to encourage alternative energy back in the '70's in terms of tax policy. I know West Germany made a lot of progress in space commercialization by use of, again, a very aggressive investment tax credit program which got their first private launch company started even back in the late '70's when it was an extremely pioneering type venture. Again, look at what other companies -- what other states are doing both in space commercialization and other types of high tech entrepreneurship. I think we'll see some useful examples.

Some specifics: Florida aided the Astrotech Space Operations of commercial space payload processing facility by making local development bonds available, low interest, long term development bonds. I know that was a big factor in their being able to get that going and creating a new and profitable venture there.

Secondly, I would say that we should look at the specific assets of California, the intellectual and institutional resources. I think that the initiative that Dr. Cohlan's outlining is a perfect example of that sort of thing we want to see and encourage. We've been sort of at a distance watching the formation of that. We are in some indirect contact and some direct contact with some of the individual partners in that consortium. We're excited by that sort of thing going. We're particularly interested in seeing some of the resources of the universities made available more directly to entrepreneurial companies. This might even grow to the point of taking on some other role in the National Advisory Committee for Aeronautics on the federal level in supporting the fledging aeronautical industry. And I'm pretty familiar with that because our chairman, Mr. Stuart Krieger, was an old pioneer with Northrup and ran a number of aeronautical pioneering ventures in the '30's and '40's. And he has been very explicit about how helpful it was just to send a couple of your engineers up to the NECA centers, such as Ames, and just be able to walk in the door, sit down, discuss very recent development problems you had with the very knowledgeable researchers they have there, outline very quickly a series of experiments you can make a little bit of research or being directed toward something that's already in their library or data

base, pull the results back very quickly, get back to your laboratory and apply them. This was something that was extremely important in helping California aeronautical companies get going.

NASA has gotten away from that model quite a bit. We don't have that kind of immediate direct cooperative access to the researchers there. We have advocated and they have begun initiatives to try to get back to the NECA model helping us. However, given the strength and resources you have in California, I think maybe a pilot program or initiative started at the state level might be a pathfinder that the federal model could come and look at and be able to implement it. And this is a sort of smaller scale, but very useful type activity which is certainly within the resources of the state. As a matter of fact, you already have the resources. It's more a case of devoting a little bit of resources to a coordination of them. Perhaps you have to look at some of the university rules in the state university system on cooperation with private companies. Maybe you want to see whether you need to change those.

CHAIRMAN GARAMENDI: Just a brief comment. There's a program here at Caltech that is along the lines of that model. For those of you who are interested, it's RIMTECH, and it's specifically designed to, I think, meet the general criteria that you've talked about, accessing the research going on in this facility, Caltech, not so much JPL, but Caltech.

CHAIRMAN GARAMENDI: We'll give you some names, you might look at that; and for the rest of you, we'll include some information on RIMTECH and that model in the information from this hearing.

MR. BENNETT: The California Space Institute down in La Jolla, we think, was an excellent initiative and one where you might consider expanding it and giving them more links with the rest of the private and public universities in California. I would say that it may even be useful to take this California network with both state and private university participation and look at negotiating separate communication or status with NASA rather than just going into the CCDS program as a California-based CCDS. You might put the state network together and then negotiate a particular thing. Because we have a lot more critical mass. We're in a different position than most other states, and I think that we should be able to use these intelligently to our advantage.

Finally, I'd like to get to a couple of specific initiatives. Florida and Hawaii and several other states have been looking very strongly at spaceport projects. We of course are using Vandenberg Air Force Base as a launch site right now under a federal agreement. In using that, we've seen a number of ways where a state-supported or state-sponsored spaceport authority or spaceport development body might make commercial access easier. I think that at this point it's a little premature to make a commitment

to a California spaceport, but I think that the state should actively examine and research the possibility of a California spaceport project, either using facilities already at Vandenberg, using facilities adjacent to Vandenberg, a new construction in the region, possibly using some of the offshore oil platforms, the disused ones, which is done say at the a site in Africa. Possibly doing a small polar launch site at San Nicolas Island on the navy facility there. These are all options which I think deserve study. We ourselves think that there are a lot of potential flights to polar orbit, which means not being able to use Canaveral, preferably using a California launch site. In surveying the commercial launches that we expect to be able to serve, we may see as many as a third of those being polar launches. Earth resources satellite and small electronic mail data collection and relay satellites are all things which prefer polar orbits. And we would like to see a small launch facility available for those. For the larger vehicles, such as the ones at General Dynamics and McDonnell Douglas, there aren't that many launches. But for our category of launchers, the smaller launchers, there's quite a bit of demand for polar orbit service.

And that gets me to another initiative which California might consider. There has been a lot of motion now on very small, very low-cost satellites launched by smaller lower cost launches, so-called light sats or cheap sats. There are a number of uses of these satellites, particularly in emergency communications, and with the video versions for data collections, for earth resources inventory, which would meet the needs of the state government. The state should consider an experimental program of buying several small satellites and launchers from California companies, running a pilot program say in emergency communications, remote and environmental data collection, or a three sources inventory using these kinds of satellites. I would point out that if you can buy the satellite, the electronics to run the satellite, the earth stations, the launch vehicles and launch service, and launch it from California all within statewide resources, so it would be an intelligent display of California resources do to such a thing.

Also, I would point out that Virginia has procured the launch, a very small 35 pound satellite from a Virginia-based launch company, which will be using Edwards Air Force Base. So they can't do it all in Virginia, but they're already taking a little lead there.

This would not be a huge budget item. I remember back when Governor Brown first talked about using a satellite, you had to talk about a large relay satellite geosynchronous and you were talking many tens of millions of dollars. This could be -- the whole program could be accomplished for under $10 million, I believe. So, it would be something that would not be an extraordinary outlay on the part of the state. It

could fit in to the ordinary cost of doing business with the state. And it would be an intelligent initiative.

These are a few initiatives which, surveying the field, I would recommend. I think they are well within the capability of California. I think they would be initiatives which would enhance greatly the possibility for commercial development in California and help us keep it as competitive. Thank you.

CHAIRMAN GARAMENDI: Thank you very much. Before you leave, you're one of the first people that we've been in touch with that is interested in Vandenberg, and have pointed out a particular direction. Most people we talk to see Vandenberg as being not of particular use. And your ideas in that will give us some opportunities to explore, as you say, smaller payloads.

MR. BENNETT: I think that's where the use of Vandenberg would be, in the smaller orbital payload and sub-orbital category or for that matter any California spaceport because that's where the polar orbit demand is lying.

I would also recommend that the state, if it begins to actively study use of Vandenberg, contact the U.S. Department of Transportation, their Office of Commercial Space Transportation because they've given substantial assistant to Florida and Hawaii in their state spaceport projects. I think that cooperation would be fruitful for you.

CHAIRMAN GARAMENDI: Which probably brings us to the point that we really have no agency in California to conduct any of these studies, which is one of the reasons we're doing this hearing to see if such an agency might be of use to us.

Thank you very much.

MR. BENNETT: You're welcome.

CHAIRMAN GARAMENDI: I understand that, at least a couple of our witnesses have other commitments and they need to -- and I may need to modify my agenda here. Is Louis Friedman with us? I believe you have another commitment, so if you could join us now.

MR. LOUIS FRIEDMAN: Well, it's a pleasure to be here and talk about California's role in commercialization of space. Actually, I'm not going to talk about that very much, either California or commercialization. But I think it will be relevant to that subject. I apologize also for my voice, which I'm losing, a little more each day it seems.

I represent The Planetary Society, which is a nonprofit public membership organization, and is a public interest group. One of the aspects of space is that it is relevant to all aspects of society. And for that reason alone, I think your hearing is very welcome.

I'm trying to represent, I think, three parts of the aspects of society which I

think are of interest to you. One is the public interest aspect; second is education; and the third is the future of industry, California industry which is so important in the space program.

The Planetary Society is the largest space interest group in the world. It has 125,000 members in over 100 countries; 14,000 members in California alone. So, we have proof that the subject of space is very interesting, it's very popular, it's of enormous motivation and interest to the public.

Our outlook is really about exploration, exploration of the planets, search for extraterrestrial life. It's science-oriented as opposed to commercial-oriented.

However, one of the aspects of space that we see, not just in industrialized nations, but all over the world, is that it is a great motivator and therefore provides a major role in education. I don't have to tell you this, you remember Sputnik. The American reaction to Sputnik was that we are behind in education. Today there's a lot of concentration in President Bush's initiative about it being a motivator for education. The charts that were shown the day he presented that initiative to back it up, related the number of Ph.D.s this country produces in science and technology to the funding in the Apollo program. Whether or not -- although the shapes of the curves were directly coincident and the phase lag was appropriate, one could still argue the cause and effect I assume. But I think there has been a well documented relationship between science and technical education and maybe even education in general and the space program. This is not surprising. Space, as I said, is very highly motivational. It demands excellence. It inspires creativity, and has a broad breadth and depth.

A number of projects that we're involved in, I think, testify to that. For example, we right now operate the only search for extraterrestrial intelligence going on regularly anywhere in the world. There's a radio astronomy, radio telescope at Harvard University. It runs continuously, it's fully funded by The Planetary Society through the donations of its members. We have students at Harvard who work on it. We had students at Harvard help built the receiver that went to it. It's served as the basis for a couple of theses. We expect that a couple of theses more will come out of it. It has inspired volunteers from around the state to come and work at their own expense to stay in the vicinity of the telescope and work at it a few nights. And it has been the motivation of an education.

Similarly, another interesting project of ours is something called the Mars Balloon, which will fly as part of a Soviet mission, as part of a French/Soviet experiment on that mission. A balloon will fly over the surface of Mars. We have involved in that program students from about five universities, including an outstanding group, in this case from Utah State. But we could use Cal State Northridge

and Caltech students as well. And it also is the basis of several graduate student theses, and a number of research programs, and some course material has developed.

I think the types of things that the space program spawns, I heard earlier mention of Cal Space, has been a great stimulator to university courses, and of course even at the high school and lower levels. In the last several years we've been involved in education programs with various states. We had a Voyager Watch this year, which was connected with the Voyager space craft encounter with Neptune. The Voyager Watch Program, which was nothing more than sending out information to teachers around the country, was adopted by the Indiana State Board of Education as a curriculum program in their plan for the year. Again, because of that excellence of creativity it inspires, as well as the knowledge that is learned from the program itself.

Turning now to the third subject, which is the future of industry in the state, I think there's a lot of attention that is being given to the President's initiative, sometimes called the Moon/Mars initiative, which he announced on July 20th, the anniversary of the Apollo landing. The goal, human exploration of Mars, has inspired many people. It inspires a lot more. We have been circulating a Mars declaration. I'll leave it with you. It testifies to the types of signatures we have; it testifies to the broad support of ecumenical support that is given to it. President Gorbachev has proposed it last year as a summit topic for him and President Reagan to talk about. We weren't ready then to do that, but with President Bush's initiative this year, I think progress is moving in that direction. A goal of human exploration of Mars will, of course, be of enormous significance in many of the ways that I mentioned about Sputnik and Apollo, not just in space, but in education, technology, and science, indeed in the social aspects. It will be multi-national. It's almost certain if you read any public opinion poll there is very little sentiment for doing this type of a goal unilaterally or nationalistically. So, it will probably be multi-national involving many countries.

How will such a -- but it's very expensive and how might it be funded? Why would President Gorbachev with all of his problems be interested in it? And how would the United States with its deficit ever consider it as a possible program that it might get funding? There really is only one option, but it is a serious option which is getting a lot of attention on the part of those who are proposing it, including in the White House now, and that is that it will have to come from what is obviously happening and that is military cuts. Cuts in the military spending, cuts in the strategic weapons spending particularly. The cost of a man-Mars mission is in the order of $100 billion. That's similar to the cost of the strategic weapon system, a large one to be sure. The cost of a NASA budget that might support a human exploration of the moon and Mars is in

the $20-to-$30 billion range certainly. But that is certainly something that the country can afford and we have afforded it for many, many years in many other programs. The question is, is where the priorities are happening.

Well, there is a large shift away from the strategic weapons, and there is a lot of consideration of military cuts, and I alluded already that that would be the only reason that President Gorbachev would be interested in it. It's really the only reason that we could get into it ourselves. That, I don't have to tell you, has an enormous impact on the California economy. I think industry is aware of this. I think the interest they're showing in the initiative says they're aware of it. Naturally, they're a little behind, but they are beginning to catch up in recognizing that there is a conversion going on. I think that this will loom very important to California, as it will to many other states. But with our reliance on aerospace economy, it will be particularly of importance here.

I think that really concludes the three areas I have to cover. If you ask me what the state should do about them all, I'm not pretending to be expert in that, but would be glad to try and ...

CHAIRMAN GARAMENDI: I appreciate your testimony. I'm not going to try your voice with a whole lot of questions. You've covered three areas, and I think the other testimony will give us an opportunity to develop some programs. Thank you very much for your testimony.

MR. FRIEDMAN: Okay.

CHAIRMAN GARAMENDI: I believe that Sam Mihara from the McDonnell Douglas Company is going to provide us with written testimony and is not here at this time. So, we'll have that included as written testimony.

Dennis Dunbar of General Dynamics. Dennis is here, I met him earlier.

MR. DENNIS DUNBAR: Good morning, again. And thank you for the opportunity to speak before this group. You heard from one of the of great entrepreneurs in the commercial launch business, Mr. Bennett and his Amroc Company, and perhaps I represent one of the more staid players in the business, General Dynamics. We're very impressed that your committee is tackling this issue now; your timing is excellent.

At General Dynamics we employ 4,700 people in San Diego at our Space Systems Division, men and women who are engaged in the design, development, and manufacturing of launch vehicles and upper stages for America's space transportation infrastructure. We have 180 people up at Vandenberg operating two launch pads, and we have 400 people down in Florida at Cape Canaveral operating two launch pads there as well. In addition, our Commercial Launch Services subsidiary company in San Diego is marketing and providing commercial launch services, using the General Dynamics Atlas family of

vehicles, to both domestic and international customers, as well as to the government for its commercial needs.

And I might add we'd be pleased to fly off any payloads that need a ride. I heard of some earlier.

The commercial space industry has performed most strongly in the last decade in the area of communication satellites. The commercial launch industry in America, established only a few years ago in the aftermath of the Challenger accident, shows considerable promise now of being the next success story in commercial space. And yet, ahead of us lies promising new applications for satellites for earth observation like meteorology, resource development, navigation, geopositioning, asset tracking. In addition, with the advent of the Space Station, the promise of new commercial opportunities abound in the life sciences, microgravity research, and material processing, things we've heard about earlier. The question before this committee is, how can California foster these new industries for the benefit of all of California and, indeed, for America and the world?

Let me address spaceports. There's been much discussion within the industry and within several states on the potential need for new commercial spaceports to provide additional launching facilities to meet the launch demands of the future. Currently, commercial launches in the U.S. are conducted from the U.S. national ranges at Cape Canaveral and at Vandenberg for America's largest boosters: the Atlas, Delta, and Titan. These facilities are already established and, I might add, paid for, and appear capable (with some improvements) of handling the projected load for launches to the turn of the century. That forecast presumes that the U.S. industry can capture about half of the world market for commercial launches, which we estimate to be on the order of 10 to 15 a year, that is for the "big three" companies. Consequently, efforts to establish new, clean sheet spaceports in states such as Hawaii, Florida, and Virginia do not hold much promise in our view. New commercial spaceports capable of launching the Atlas or the Delta or the Titan cost between $500 million and $2 billion. Recovering such a massive investment, at the kind of launch rates we anticipate for commercial missions, would be very difficult indeed to do and be economically viable. That conclusion was reached after a fairly comprehensive study of developing a spaceport in Australia at Cape York, where the only feasible way to make that economically viable was through the import of artificially low-cost launch vehicles, such as the Soviet Union's Zenit, which they appear to be willing to sell at about half the market price.

Instead of new spaceports in the U.S., efforts are required to improve the efficiency of our existing spaceports and to improve the ability of commercial and

military missions to co-exist on the same campus.

Although this conclusion may be true for the "big three" booster companies, it may not be true for the entrepreneurial companies like Amroc, represented by Mr. Bennett. These companies are designing products that do not require the massive infrastructure of the national ranges and may benefit from a smaller scale commercial spaceports, as he described earlier.

General Dynamics has invested over $300 million in the State of California of our own money in developing our commercial launch program. Our investment covers development of new commercial derivatives of our venerable Atlas vehicle and major facility upgrades in San Diego, at Vandenberg, and also at Cape Canaveral in Florida. We plan over 60 launches through 1998, commercial missions and airforce missions, most of which will be conducted on our Florida pads, with a sales value expected to be over $3 billion, most of which will go to California.

Why couldn't these missions be flown from California, you might ask? The answer is geography. Most commercial spacecraft today are launched into an orbit called "geosynchronous" orbit. To reach this orbit, vehicles fly in a southeast trajectory. And to fly such a trajectory from California would cause us to fly over populated land, and that would be judged unsafe to our population.

Why fly southeast? Well, geosynchronous orbit is that very unique orbit where communication satellites rotate at the same velocity as the earth, and consequently, appear motionless over the earth. From that vantage point, they can relay messages to the ground, back and forth to the ground from any vantage point. Since the earth rotates west to east, rockets must fly east. This orbit is above the equator in order for the satellites to remain geostationary. That means the rockets must fly southerly to get to the equator and then bear left when they get to the equator. The closer the launch site is to the equator to begin with, by the way, the more efficient launch vehicles can be. Consequently, the French fly their arianne rocket from Kourou in French Guyana, in South America, which is nearly right on the equator.

A limited number, as was pointed out earlier, of spacecraft fly to a different orbit called a "polar" orbit. This orbit requires rockets to fly north or south, and Vandenberg is very well suited for that orbit. On the other hand, Florida is not well suited for that orbit. Satellites in these orbits are primarily for earth observation as opposed to communications. This segment of the market, frankly, has not grown as rapidly as communications, but it does show promise for the future. And California should prepare now for that future.

This brings me to the question: Does California need a commercial space policy? I believe the answer is yes. The following points may warrant your consideration:

First of all, Free Trade Zones. California should establish a free trade zone, perhaps at Vandenberg, to allow the import of foreign manufactured satellites for our foreign customers without being subjected to taxes. Since these satellites were really being exported to space, their temporary stay in California is only a transit point on the way to space. And this argument is used in Florida.

Second, tax considerations. Consider sales, use, and property taxes on launch services. A commercial space launch activity consists of the sale of a launch service as opposed to a launch vehicle. The current California law has discouraged this activity because it imposes sales tax, use tax, and property tax on the items of property that are consumed in this business operation. This can be remedied by exempting the space activities from these taxes. Finally, state tax credit for space-related manufacturing as an added incentive to attract space-related industries to California, a tax credit might be considered. This would extend the credit on R&D, talked about earlier.

Third, let me discuss financing support. Consider loan guarantees. California may wish to consider providing loan guarantees for new ventures which benefit the state. Entrepreneurs in the space business face higher than normal risks, require larger than normal expenditures, and yet have higher potential returns. Loan guarantees could be enormously helpful in improving the investment climate for commercial space projects in California. Also, consider bonds. Low-cost financing through the issuance of "space bonds" may be worthy of consideration for especially attractive projects.

Fourth, we talked about the center for commercial development in space--NASA's project. We heard earlier that none of the 16 centers are in the state, yet 30 businesses in California enjoyed some participation in that program. The University of California should become even more active in supporting that program. These centers can demonstrate how academia can bring together business, government, and academic exports to interact in promising research areas that have potential commercial applications.

Five, you might consider other industry/university cooperative projects. I'm encouraged by the efforts that JPL reported earlier. But much can be gained through strengthening the relationship between our fine universities and our industries working together on cooperative projects. State grants with corporate matching funds may be a mechanism to foster that cooperation.

And finally, let me echo the remarks of Mr. Friedman on education. With the supply of scientists and engineers quickly dwindling in California and throughout the nation, a major effort to reignite the fire in our young people in the sciences, and mathematics, and in the promise of space exploration is clearly necessary. Earlier

this week, state college officials urged Congress to double the science education budget with half the new money to be used to upgrade undergraduate science education. The state will benefit with similar efforts aimed at grade school and high school students. After all, it is they who will be the ones we will have to rely on to lead us into the next century in space commercialization.

Mr. Chairman, we applaud the efforts of your committee on exploring the potential benefits of commercial space for California, and we encourage you to give serious consideration to developing a California Commercial Space Policy. With those remarks, I'm hopeful California will continue to lead the way in space.

CHAIRMAN GARAMENDI: Dennis, thank you very much. I appreciate your testimony, and particularly the five or six notions/ideas that you put forward for us to explore. As this hearing goes on, it seems to me I should have brought one additional consultant with me, my tax policy consultants. (laughter) We will certainly be taking on these issues when we return.

On looking at our agenda, we have two more people that are supposed to be testifying. We're probably going to take another 15-20 minutes for that testimony. And that will give us about another half hour to 40 minutes of time before we're scheduled to depart. We'll probably take about a five minute break, but I'd like to take the last half hour of this hearing and have a discussion, and have some interaction among all the people here. So, make your little notes and be prepared for a discussion in about another 20 minutes or so, and we'll give-and-take, and see where it takes us. Maybe we'll get some more ideas that way.

Dennis, thank you very much.

While Randy Reidel of the National Space Society is on his way up to testify ... Is Randy here? Oh, we're going to go much sooner I suspect into this give-and-take discussion.

MS. DOLAN: You may want to ask if there's anyone else from Los Angeles Chapter.

CHAIRMAN GARAMENDI: Is anybody else from the Los Angeles Chapter of the National Space Society here? Did you want to testify, or make some comments? Randy was scheduled to, but perhaps Randy is not -- I suspect what I would like you to do is just introduce -- tell us what your chapter is all about, and what your society is all about, and the role that you play in, I suppose, the advocacy of space. Would either of you like to do that? No takers at this point. Okay, be shy. We'll get you later.

Tom Walters, from the Office of Competitive ...

MS. DOLAN: Senator, he's coming.

CHAIRMAN GARAMENDI: Oh, come on up.

MR. GEORGE GRIFFITH: Do it right now?

CHAIRMAN GARAMENDI: Yes. Your turn. Just introduce yourself and tell us what your society is and what you guys are up to.

MR. GRIFFITH: First of all, this caught us completely off guard and wasn't expected. We have nothing ...

CHAIRMAN GARAMENDI: You can handle it.

MR. GRIFFITH: ... prepared at all, but I'll do my best, thank you. Okay, I'm from OASIS, that's the Organization for the Advancement of Space Industrialization and Settlement. What we are, we are the Los Angeles Chapter of the National Space Society. What we are primarily organized to do is to be a grassroots, just at the people level, to get people educated and informed about space issues. To promote space development on a political level, we have political involvement groups that try to lobby congressmen, and such, for pro-space votes in Congress, that's in Washington, of course. And we have educational groups get together, give people talks about pro-space issues, technology education, primarily.

CHAIRMAN GARAMENDI: We have three different groups that are these lobbying and public interest or public awareness groups, the National Space Society being one, and your local chapter another. There's the California Space Institute, I don't know if they have anybody here. We've been in contact with all of these groups, and we appreciate ...

You didn't introduce yourself.

MR. GRIFFITH: Oh, my name is George Griffith.

CHAIRMAN GARAMENDI: George, thank you very much. You are now an official witness. Thanks for joining us, George. Appreciate that.

CHAIRMAN GARAMENDI: Before we move on to our last witness, which is Tom Walters, Chris just gave me a note and we'll make this part of our discussion towards the end. SB 69 by Senator Torres, I thought it had gone to the Governor's desk. Apparently, it's still in the Ways and Means Committee in the Assembly. It establishes the California Aerospace Commission, an idea that several of you have alluded to in your discussions. One of the initial projects of that commission would be to create an Air and Space Center, and a California Air and Space Foundation. When we have our discussion in a few moments, you might contemplate that program; and Chris, we'll ask you to explain it in a little more detail, and see how it relates to this whole issue of commercialization as well as the space policy.

So as I've said earlier at the outset, Senator Torres has been into this for some while, and I think he did have a bill that did get to the Governor's desk.

Mr. Chris Thompson: That was vetoed, second effort.

CHAIRMAN GARAMENDI: Okay. My memory hasn't completely faded.

Tom, where are you? Please join us, Tom. Your program, Tom, has been discussed many times in complimentary terms. I think that's for two reasons, one is the very fine job that you have done as the first director of the Office of Competitive Technology; the second is, it's a fair idea to begin with; and thirdly, is that you've had vast experience with the Jet Propulsion Laboratory, which I think was your former base of employment before joining the wonderful State of California. Welcome.

MR. TOM WALTERS: Thank you, Senator. I'm Thomas Walters, Director of the Office of Competitive Technology of the State of California, and on leave from the Jet Propulsion Laboratory to do that. I'm here to represent Kenneth Gibson today, Chairman of the Department of Commerce for the state, who sends his regrets that he could not be here because of a previous engagement. And we want to just address very briefly your question to us on, what is California's role in the commercialization of space, and then especially establishing an office to focus upon that?

As you know, the California Department of Commerce has grown a great deal in the last 8 years. You, in a spirit of bipartisanship, I think, have been a very major player in that, not only in the establishment of my office, but in other activities which basically, probably for the first time in the state's history, made California begin to be a proactive player in terms of attracting industry and business into the State of California. At this time, there has been no major effort to establish a special office to address just space or aerospace technology, and there is no plan at this time to do that. However, that doesn't mean that we haven't addressed many of the interests of the aerospace industry. I think, as you know, Mr. Gibson and myself have met with aerospace industry leaders and have talked about some of the problems facing the industry in California, including some of the environmental problems. Also the potential for establishing cooperative R&D consortia to assist them in being competitive in world markets in aerospace products. But there is no movement at the time within the Department to push any kind of establishment of a special department that would focus upon aerospace issues.

That's really the extent of my ...

CHAIRMAN GARAMENDI: Well, I have a few questions. Tom, should we allocate a percentage of the competitive technology money for space, or for any particular activity? What's your experience, and what do you think?

MR. WALTERS: At this point, we've discussed this extensively with our advisory committee and you -- I know there are several representatives from the Senate on that committee. And they are of the opinion right now that given the level of funding of the office that we should pretty much let market forces push that issue. Now, within the legislation, your legislation -- I realize I'm not telling you anything -- there is

provision for the advisory committee to advise the Department of Commerce that there are particular commercial areas within the state that deserve a special push because they're vital to the long range interest of business activity in California. And the committee concluded at its last session that market forces are doing that pretty well now. And that especially in something like the space industry, the level of our funding wouldn't be enough to make a major push in space that would merit special activity in that area. I think you know now our funding is at $7 million a year, and there probably isn't any effort that we could mount that would have a major impact on the space industry given those kinds of markets.

CHAIRMAN GARAMENDI: Now, we do have two priorities, I believe, that have been established, either legislatively or at least by policy. One is the super conductivity which is a JPL activity, which was discussed earlier. The other is the Institute of Manufacturing and Automation Research, the project for advanced manufacturing technologies ...

MR. WALTERS: Yes.

CHAIRMAN GARAMENDI: Those are the only two areas that are sort of singled out.

MR. WALTERS: They were singled out in the legislation, but they were not given priorities as far as the evaluation of proposals was concerned. So, all of the items that we funded that went through the proposal process basically had no boost because of their particular technology or industry. And that, at the latest meeting was still the consensus of the advisory committee that we should <u>not</u> at this time boost any particular industry.

CHAIRMAN GARAMENDI: Tom, why don't you sit right where you are. All of those witnesses who want to get involved in a roundtable here, pull up a chair. The reason I want you up close is that microphone's at that table. So, come on up, bring your chair with you, and join us. Don't be shy. If you're really loud, you can sit in the back of the room; raise your hand if you want to make a comment. We'll just kind of go at this in a roundabout way. I'm going to ask you before you speak to state your name, for the reason that there is no eyesight in that magnetic tape, and I won't have the foggiest notion who you are.

My experience over 15 years of this, this is where it really gets to be fun, if we can just feel free and don't be shy.

I'm going to start off where we left off here a moment ago, Tom. Many of the witnesses have suggested that the competitive technology program be expanded; is a major attribute and asset for the state. Let's talk about expansion. Let's talk about budget expansion. I know the Governor wanted an additional $6 or $7 million in this current year. Where do you see this thing going? And what kind of activities really

need to be funded? What's your experience?

MR. WALTERS: Well, the activities that we're looking at for the future are, of course, a continuation of the one-on-one projects which make up the bulk of our projects right now, but also extended activity in helping to develop consortia for the state. The funding that had been earmarked to give a special push toward consortium, as you know, fell out in the legislative process, an additional $3 million. At the same time, I can tell you that the advisory committee, at it's most recent meeting -- and I'm sure you've heard that from the representative people who are on it -- have said that in order for the state to proceed rapidly in this whole effort of commercialized technology that technology that's developed in the public and nonprofit sector, it should give additional dollars to the program. They suggested that the program for the next fiscal year should be at least approximately $20 million to continue some of the projects that were started and to have a major thrust into consortial areas. So that's the recommendation from the advisory committee on that issue.

CHAIRMAN GARAMENDI: We're looking at $20 million. It's really important that those people that are in this room that -- well, all of you are interested in politics -- got a political deal here. You've talked, Dr. Cohlan, about consortia. The state, and the Governor's office, and my office specifically want to fund consortia. We think it's a public/private and a good way of leveraging the state money in this case. We did not have the kind of support we needed in the Legislature, and there are a lot of political problems that occurred during the year that knocked the money out of the budget. So, we're going to need next year to get at it.

Dr. Cohlan, tell me, is your consortium -- could it be a potential place for state money? Do you need it to get going? Or do you just need to -- what do you need?

DR. COHLAN: As I said before, the largest problem that we have had is spanning this gap between the availability, the technology, which I have said is available and the brave funding to fund that. That's why I said, you know, we're taking this middle road, and we're building our credibility by having a broad spectrum consortium, the university, industry, and so on. And we've got some brave investment bankers. They're stepping up to the line, all right? But I think that we could go faster, and I think those consortia that follow us -- and we would like to be a model, frankly, we'd love to volunteer to be a model for this kind of activity. We've already volunteered to be this model in cooperation with the business school at the University of California at Los Angeles, Anderson Graduate School of Management, I get corrected on that frequently. So they are collaborating with us in using us as a model for others to follow. That's the role for the University. And we're citizens and we're graduates of

that campus, so we're quite willing to do so.

Sure, if the state -- now to answer your question. Sure, if the state would step up and do some fund matching with us, would do -- as I said before -- the investment community responds strongly to tax credits called investment credits, R&D credits, what have you. That appeals to them. And so if you can come through with a combination, some sort of a reinforcing combination, then we'd be happy to work with you to develop some models in this area. And I'm sure we can involve the business school to help in this modeling.

But some reinforcement combination out of a tax push, tax credit, -- I use credit because I think that's a good device. It motivates industry to put their money up. It motivates the investment bankers to put their money up. So I think if there's a combination of some matching funds from the state government, combined in some symbiotic way, synergistic way with tax credits, I think that would make my investment partners a lot more responsive.

And let me add one more thing to that. We have consciously, explicitly tried to combine and have combined successfully in the consortium, large and small, in all of our columns of collaboration if you wanted to, and I think that's crucial to the success of these consortia. We, for one, are very interested in the SBIR program. We think that's a great program, underutilized. And we for that reason, if no other reason, we want to have small high tech companies, some in California, California involved. If you even wanted to, in this package of encouragement, to encourage that large and small combination, it's a powerful combination. Both our large partners and -- no, no, I won't make a comment. But both our large partners are interested in being in a consortium with smaller companies. They see it as an opportunity, not only for helping with the basic theme which is technology transfer, but they also see it as a way of doing joint ventures with them, and making merging and acquisitions, and what have you, investments. So, they're enthused about being in a consortium that has small partners, and obviously the small partners are interested in being in a consortium that gives them access to the strengths of large corporations.

So, you know, that's ...

CHAIRMAN GARAMENDI: You might help us, at some point, get some idea of the people that are involved in your consortium, so we can get ...

DR. COHLAN: Yes, I specifically avoided that for obvious reasons. But I'd be happy to do that whenever you say.

CHAIRMAN GARAMENDI: Larry, NASA, and it's pretty clear that there's not going to be a commercial development of space center in California, at least in the near term, the next 2-3-4 years perhaps. And that it's clear to me that for reasons including the

need to have a political distribution of the NASA budget, other states were chosen. And I suspect among the criteria, looking at the locations, that happened. And therefore, and it seems to me, in your testimony, you have said that there are things that California can do to take advantage of our natural advantage, aside from the CCDS. Is the Office of Competitive Technology, the kind of grants that are involved from that office, consortium-type funding that may be available in the future? Do you see that working in to the kind of projects that NASA might be interested in being involved in?

MR. HERBOLSHEIMER: Yes, I do. The real attraction some of these consortia concepts, or even the concept that Dr. Cohlan is talking about, they really build from the bottom up. And when you talk about starting businesses, they really, most of the time, start as small entities. When you fund them, the more private capital that's involved the better, basically because private capital is usually managed much more carefully than public capital. So that's what you really want to encourage, and that is to bring about the concept or the embryo with a little funding from a government entity initially. But almost insist that this be followed up or surpassed by private capital. And if something won't stand on its own merits, a venture, you know, then it probably doesn't exist -- it probably doesn't deserve to ...

CHAIRMAN GARAMENDI: Would there be any interaction or problems that NASA would have if we financed a consortium, if we had the competitive technology program involved in the way in which it's set up, individual companies? Does it fit well? And I guess, Tom, you've got some experience with JPL; and Larry, your experience with NASA.

MR. HERBOLSHEIMER: I think it would fit very well. I mean, you know, I think, you know, to the extent we can in the federal system supported, we would do so, with a systems guidance, whatever is available to it. But I don't see any conflicts at this stage.

DR. COHLAN: Senator.

CHAIRMAN GARAMENDI: Yes.

DR. COHLAN: I would like to respond to that, if I may. We have -- as Larry knows, we've talked in Houston, and we've talked before, and I've talked with other agencies of government inside and outside of NASA. We have recognized these centers, like the CCDS's, like OESP centers, NASA centers -- I mean NSF centers, National Science Foundation, and the other transfer kind of programs. We see these as a valuable asset that's being underutilized. And when I say underutilized, I don't mean that in a critical sense. I'm just saying they are now getting to the point where they can be utilized by the private sector. Just getting to the point, and the private sector is just getting to the point where maybe they have enough courage to attack this.

And I will say something controversial for the sake of being here, as I think you

wish, and I enjoyed, and that is, I don't think we need another CCDS in the world. Larry's organization has 16 good ones, and they're now getting to the point where they're mature enough to be productive. What we need is what Larry called Phase III, follow up, productizing -- pick the name -- commercialization. Pick the name you like. They all have a little different nuance. We have specifically structured ourselves with -- and we have complete broad agreement and motivation in this regard -- we have specifically structured ourselves and intend to continue to do so, to look to those kinds of organizations -- CCDS's are a very good example -- as our source, our source material. And so we have nominated ourself as the follow up activity. And frankly -- and this is a self-serving statement, of course -- I think our -- and I'll broaden it to the extent, saying our kind of consortium in California that would direct itself to utilizing these existing resources would probably, I think, be more beneficial in California than a CCDS as such because it gets us closer to application, gets closer to the economic impact on the state.

CHAIRMAN GARAMENDI: Okay. Let's talk about launch vehicles for a moment, big and small. We've talked a little bit about Vandenberg. Both of you have said that there's opportunities at Vandenberg for commercial launches. The notion of small launches, as I said earlier, was small vehicles. Payloads was one that I've not considered in the research that we've done on this.

What do we need to enhance this? First of all, I note that the real payoff in terms of jobs is not blasting the thing off, it's in building the thing. You have 4,700 people building it at 150 sites here, and another 180 in -- or something like that -- in Florida. So, it's the building of them that would seem to be the key for the commerce of the state economy.

DR. COHLAN: They were building the payloads that go on top of it.

CHAIRMAN GARAMENDI: Exactly.

MR. BENNETT: First of all, I think that ...

CHAIRMAN GARAMENDI: You are?

MR. BENNETT: Jim Bennett, American Rocket Company. When you're looking at the relative numbers that you're building versus launching, when you get into the smaller vehicles the numbers aren't so disproportionate because, in our case our first vehicle we produced with about -- a staff of 80, including administration and designing people; and launch with a staff about 20. And the smaller the vehicle, actually, the less very large numbers of people that you need in the manufacturing area.

Secondly, one of the things that we're striving for, and this is reflected also in the studies on lowering space transportation costs -- such as the advanced launch system studies going on with the federal government -- is that you want to begin moving

the manufacturer adjacent to the launch site if possible because you cut out a whole step of inspection-reinspection when you get to the launch site. Unless that's probably not a feasible idea. They already have the infrastructure in place and paid for, it probably wouldn't make any sense to make a great deal of changes in that. For us, it may make a great deal of sense, also because the infrastructure we need is just not as massive, not as much of a capital investment. So what I'm saying is the manufacturer is going to follow the launch site.

Finally, I think the payloaders are going to follow the launch site as well. That with a lot of the smaller experimenters, with a lot of smaller payload users, they may want to end up operating your launch site because first of all, it's a concentration of skills and talents and facilities; and you need to have your people up at the launch site when you do a launch anyway. When you get to the kind of macrogravity, research activities, some of the other activities where there's a lot of interaction back and forth between the payload and the launching, and as we get to a situation down on the road when the launches are more frequent, closer in between than they are in today's world, and I think that will only be 5, certainly 10 years away, but maybe even 5 years away, there's going to be in the small launch area much more frequent launch opportunities than you have now. I think you'll have the tendency for some of the smaller payloaders to want to locate relatively close to a launch site. So, keeping the launching activity local is something that has benefits in a lot of other areas, not just the people you actual employ at the launch site. That's always going to be a small number of people, and actually everyone's working right now to make it a smaller number of people. All the tendency is to try to get your launch crews down in number. You have to look at the adjacent activities, the spin-off for the benefits of the launch sites.

CHAIRMAN GARAMENDI: When you say adjacent -- let's say Vandenberg has a launch site adjacent from your perspective. Is that California adjacent? Or is that Santa Barbara?

MR. BENNETT: Let's say Lompoc or Santa Maria. You may want to have an industrial park developed near Lompoc or Santa Maria which would, you know, draw on some of the technical talent, maybe, from Santa Barbara, but really you want to be as local as possible. You want to get down to the point where you hop in your car, and you drive a half hour to the launch site. Right now, we're two hours away from the launch site, and that's why we moved to Ventura County from the Bay Area where we started the company. We got the situation to bring it back down to the actual reality of the thing. Every time we went down to Vandenberg to have a meeting, we had to go up to SFO, get the commuter plane to Santa Maria, and by the time we got there it was federal

lunch hour and so we couldn't get any business done until 1:00. (laughter) And now, we're located in Camarillo, it's a two-hour drive. We can get in the car at 7:00 and be there at 9:00 and have a morning's worth of meetings. And when you're talking about day-to-day business, those kinds of things are important.

MR. DUNBAR: Let me add to a couple of comments, if I might. We are in a highly competitive business. This commercial launch business is extremely competitive, particularly as you pointed out earlier, with foreign competition that's nipping at our heels, or actually we're beginning to nip at their heels because they started a little ahead of us in the commercial side of the business. So we tend to be highly motivated to reduce cost. We've been building Atlases and Centaurs in San Diego for many years. But San Diego, as you know, is not an inexpensive place to employ people. And as a consequence, and because we want to keep work near the launch site, we've actually moved the Atlas assembly work up to Vandenberg. Why? It's lower cost at Vandenberg than it is in San Diego, and the people are adjacent to the launch site. And there's a second benefit that is worthy of note, and that is launching tends to be a sporadic business, keeping a team on the payroll continuously for sporadic business is not efficient. So, we found it to be efficient to put the team on assembling rockets and then shift their efforts to launching rockets and shift them back to assembling rockets as a way to reduce costs and become more competitive. We've also taken some of the work that we formerly did in San Diego and moved it to Harlingen, Texas because of very low labor rates there and because of support that the government of Texas provided in terms of training personnel for us. That's another thing that might be considered in California.

CHAIRMAN GARAMENDI: California has a very extensive job training program with many facets to it, and many different programs. I've noticed over and over again that it is not integrated into the new technology industries, just to give you one further example. It's something that we really must do. All the potential is there. I don't know how many different -- there must be a half dozen different job training programs, some of them extremely powerful in terms of financial incentives, like cover all the cost and a whole lot more. So don't go running off to Texas, because there ought to be something along those lines. (laughter) Come see us first because it's there.

The commercial launch industry seems, in the larger rocket, to be dependent upon a certain level of production being consumed by the federal government. And then the commercial part of it being an add-on. Is that the case?

MR. DUNBAR: It is and it isn't. In General Dynamics' case, it is not. We started our commercial program before we were successful in selling it to the Air Force. We had basically gone out of business of building Atlas's and Centaur's. We had a bid

opportunity to address an Air Force requirement. The Air Force, in their wisdom, encouraged us to look at both the commercial market and the military market, and we put in our bid because they wanted the economic benefits of volume. But we lost the military business, but we were intrigued by the commercial, so we went ahead with it anyway. And we committed to build 18 vehicles with no sales. And it was a year later that the Air Force came back and said, gee, we want a slightly bigger vehicle for our next military requirement and we competed again. Again, they encouraged the industry to look at the commercial market and the military market as one to get the economics of volume. In that case we were successful. So our initial commitment of 18 vehicles rose to 60 vehicles, of which only 20 are being sold to the military. The rest, the other 40, are for commercial customers. So in our case, the military is an add-on to the commercial base. Now, that's not true of McDonnell Douglas and Martin Marietta where they have a larger base of military, and the commercial is an adjunct.

CHAIRMAN GARAMENDI: Okay. It seems that in both cases, the military aspects of the single use rockets are the key to that particular large vehicle launch.

MR. DUNBAR: Not only the military, but the stability provided as well by NASA for civil government payloads, planetary missions, or weather satellites, or other scientific missions provides some stability to the industry that it does rely on.

CHAIRMAN GARAMENDI: I think we just need to make brief note here of the reusable launch vehicles, and that the federal policy changes back and forth on their role in this whole game. This is something that we need to be aware of if we're going to have a coordinated space policy here in California.

DR. COHLAN: Senator, Bernard Cohlan, I'm sorry, I forgot to mention that before. I'd like to reinforce ...

CHAIRMAN GARAMENDI: I didn't want to leave his comments, and I wanted to come back to them, so please go ahead.

DR. COHLAN: Should I wait, or should I go on?

CHAIRMAN GARAMENDI: No, go ahead.

CHAIRMAN GARAMENDI: It may be the same thing.

DR. COHLAN: I'd like to reinforce these two gentlemen here. I have some historic background at Vandenberg launching missiles, along with a good, good friend of mine back there in the corner, Bill Patterson, formerly of General Dynamics. But I really want to, because there's no one here to represent the university community at this point, -- and as I said I sit on a couple of advisory panels to space physics and the physics at that department of UCLA, and I'm a graduate at one of those departments -- I think it's very important for California, for this whole developmental community, to have the ability to launch small inexpensive payloads close to home, so that the

university community can participate economically and quickly on a short time scale because their life is, you know, semester to semester, or quarter to quarter, and graduate student to graduate student; and the same holds true for the small business community. This is where a lot of innovation comes from and a lot of risk taking goes on, and a lot of forward moving steps are taken.

One of the problems that -- I am all for supporting Vandenberg. As has already been said, there is a lot of money spent up there, and there's been a lot of years of evolution put into that facility. I've been a part of that in past years. I think California is foolish if it does not take advantage of that existing facility.

CHAIRMAN GARAMENDI: So if we're to develop a space policy for California, it seems as though one aspect of that policy is to specifically recognize Vandenberg as an asset that we should foster the utilization in the private sector, and encourage our congressional delegation to assist us in federal government policy.

DR. COHLAN: I go back to Canaveral, all right. But what is important to be able to use that facility is to make it easy to get in and out of it, minimize the bureaucracy, and this means really a very broad approach. It has to do with range, safety and security and a whole lot of things that this gentleman can tell you about.

CHAIRMAN GARAMENDI: Those are federal level issues.

DR. COHLAN: USAF, air force, okay? And they will hang on to this. They'll hang onto their prerogatives and their control up there. And so it's not an easy political fight that you would take on.

CHAIRMAN GARAMENDI: It's a political fight that a state senator isn't going to engage in, it's a state political fight our Congressional delegation must engage in.

DR. COHLAN: But, you know, you are where the motivation starts.

CHAIRMAN GARAMENDI: I understand that.

DR. COHLAN: The buck starts with you, as opposed to ends with you, all right?

CHAIRMAN GARAMENDI: Now ... Jim?

MR. BENNETT: Yes, sir. I would point out there is a way the state could directly get involved in helping us. And again, I would look to what Florida is already doing. They're looking at the model of a state-sponsored space development organization or authority. It wouldn't necessarily have to be a branch of the state government, but something that they set up, which would be an actual tenant and operator of a set of space launch facilities colocated on the federal reservation or possibly immediately adjacent to sharing the tracking and command destruct facilities which are already at Vandenberg and which would -- and may not pay to duplicate. But in other ways being a separate organization. You already have this model in Florida because Kennedy Space Center, a NASA facility, is on Mare Island on Cape Canaveral itself on the little bit

of mainland there, there's Cape Canaveral Air Force Station. These are two entirely separate institutions which share the same range, safety, tracking, and telemetry that's all performed by the Air Force. What they're looking at now is creating a third entity which would be a commercial facility, maybe state-sponsored, but a separate organization co-located and sharing again those same facilities the same way NASA shares them with the Air Force. And that's a model which might be applicable to Vandenberg because then we wouldn't be on the federal reservation. We wouldn't be on the federal territory and a number of the rules and regulations and pricing policies that we have to deal with could be changed. That's a model that I'm not going to advocate right now as the way to go, but we should take a look at it.

CHAIRMAN GARAMENDI: That entity would be responsible for the launches? Or for contracting time and availability?

MR. BENNETT: It would be the landlord. The launch companies themselves would have their own -- basically the way we do now, we have our own launch site, we have a fence around it, we take the liability, we get the insurance to insure against hazards to the public safety, we comply with the safety and ground mineral, etc. regulations. But there's an entity which would be the landlord, which would be owning the land and overseeing those surfaces. Right now our landlord is the United States Air Force. It may be useful to have a civil entity which would be your landlord there. It would get us out from certain federal government-wide regulations which the Air Force has no choice but to apply to us.

CHAIRMAN GARAMENDI: Very interesting concept that -- we'll explore that.

MR. BENNETT: Happy to be in further communication with you on that.

CHAIRMAN GARAMENDI: Yes, I would appreciate a memo in how that might take place. We have a Florida model available to us, and if you could send that on. The perspective of a large, well established launch company on that same type of issue would be really appreciated. Perhaps the two of you might collaborate in a memo to the committee on how such a system might work.

I want to make sure that we cover the things that you're interested in. Some ideas pop into my mind. And the rest of the audience here, if you have things that you think we ought to be discussing, just toss them in. I'm going to just make that time available. We may have covered -- Jim, another idea?

MR. BENNETT: I'd like to expand on something that Dr. Cohlan was talking about. And this goes into the necessity of frequent research opportunities for universities, especially student researchers working on space-related projects. There's a very basic fact that you have to keep in mind. When a graduate student chooses his project, it has to be concludable in a reasonable time so he can get his degree, get out of there

and get a job so he doesn't have to live in a student apartment anymore. (laughter) This is a very powerful motivation. I had a lot of friends up in Stanford, for instance, who had chosen microgravity research projects in the early '80's expecting to get shuttle experiment space by the early mid-'80's. Because of the Challenger tragedy and because of the general inability of the shuttle to meet its original schedule and cost estimates, a lot of these people were left stranded. They had the choice of either junking their whole line of research and starting all over again with a different project, or waiting until their projects flew. This is a terrible situation to put them in. Now, one interesting thing that came out of the national '88 space policy was that the Office of Commercial Programs at NASA, with the cooperation of the Department of Transportation, funded a very good study on what was called the Space Voucher Research Approach, which would take federal funds -- and this is an opportunity for a possible state participation as well -- and would give researchers, especially at the student level, university level researchers a voucher for launch services. They could take it to Dennis or us and we would fly their experiment, have a big return capsule and you put perhaps a 1,000 different samples in the capsule and you return it. This is already being done on Chinese rockets. The Europeans are paying the Chinese good hard currency to fly these experiments. It could be done, and that way the voucher supported stuff could mix with commercial and industrial supported experiments and possibly even government laboratory supported experiments, altogether help create a strong market and give the whole research community the kind of low-cost frequent access to space resources which, I think, is the real foundation of a research program. And I have to stress that the Japanese have strong research programs going on, industry supported and government supported. Europeans have an extensive government supported microgravity research. We've seen more and more of the international papers are being presented by Japanese and European students and researchers; and the American ones, frankly, are falling behind in research opportunities.

CHAIRMAN GARAMENDI: This brings us around to the point of education, research, technological excellence, and the like. It comes all the way around. Is NASA in the business of supporting such voucher-type projects?

MR. HERBOLSHEIMER: We're still looking at that. But one of the things I wanted to pick up on and it might be of value to you all in terms of your approach to this at the state level. And that is when you do your analysis of where you really want to concentrate your time and your resources you need to do a good and thorough strategic analysis because when you look at some of the things that are being done right now, when you take a look at our Centers for the Commercial Development of Space, you have to sort of look -- well, just take one for example, the one that's doing protein

crystallography. You have to ask yourself, where's the real money going to be made in these ventures? It's not going to necessarily be made at the launch level even though that's very important, or the building of the hardware, or telemetry, or whatever it happens to be. It's going to be at the consumer level. In that sense, the new drugs and pharmaceuticals we get out of those kinds of research, I think, is really going to be the big payoff for the states and for the federal government.

When the state goes about doing an analysis of what its resources are, what its strengths are, you know, to look at how it concentrates its efforts, really the emphasis should be placed on where the big buck is going to be made. You take a look at telecommunications for example, you look at the amount of money that's spent on launching, comstats, or on high definition television that's being done right now, or on DVS type systems, for example. The real money is not going to be made there. It's going to be made in the very small terminals, the aperture terminals that are being developed at this point. And so, in that -- right now, the Japanese are dominating that field. That's the kind of analysis you really want to do. And that's really, in a way, best done by the individuals who are closest to the activity. Our Centers for the Commercial Development of Space, those concepts alone, those people are really closest to where the money can be made. That's why they're going to be, I think, successful down the road.

CHAIRMAN GARAMENDI: I want to just give a slightly different perspective on your comments, not to disagree, but perhaps a different facet. If we were to develop an industry and look at where the big bucks were, we may adopt your analysis. However, we have a huge industry, that's the space industry, in a broad definition. It's launch vehicles, it's the satellites, it's the infrastructure between, it's the research facility such as JPL, Ames and the like. That industry is here and it's in place. It's product is the launch vehicles, the satellites, and so forth.

MR. HERBOLSHEIMER: Sure.

CHAIRMAN GARAMENDI: If we abandon that notion of fostering and supporting that industry and go to the end product which may be the drug that comes from the research done by that industry, we stand to substantially lose in California a tremendous part of our economy. The purpose of this hearing is to draw our attention not to the end product, the drug, or the communications machine on my desk, but rather to the industry that gives us the opportunity to have that, the aerospace industry in particular. So I don't want to lose track of the -- it might be a necessity for our state government to foster this industry which is indigenous and very much a part of California. Now recognizing that these other things are there, too. And if we can do both, then watch out Pennsylvania, we're coming at you.

MR. HERBOLSHEIMER: Yes, exactly. Senator, Larry Herbolsheimer, again. I didn't mean to suggest that these were not important or valuable sectors of the space economy. They are extremely important and we should build upon them. But just in terms of what I referred to earlier, just look at what other areas you might concentrate your efforts. I think that would be very useful. The way in which we went about this is we really took ideas from private individuals out there in the establishment of the CCDS's. These were people who knew a little bit about space, as many people here know a great deal about space, but they knew a lot about the consumer applications of what they might do in space. That's really how some of the CCDS's got started.

CHAIRMAN GARAMENDI: One thing that occurs to me, and this is a new tack here, and spend maybe five minutes on this -- and then maybe end this thing -- is this business of venture capital, of capital period, to create these businesses. It seems to me, Tom, that one of the roles that the Department of Commerce can play or perhaps Senator Torres' Air and Space Center or any of these variations, is to bring together in a setting that I don't think exists today venture capital companies, of which we have many in California, and the aerospace industry large and small, to spend some time just getting to know each other. My experience in the last several years in doing some of this type of work is that you really don't need to do much more than to create an opportunity for these guys to get to know each other and to talk. Perhaps something as simple as having a conference where the aerospace industry, people like Jim, the big companies, small companies all around can get together with venture capital folks. One of the things that I've found very interesting two years ago when we did some work in venture capital was the ignorance of the venture capital people as to what existed at our national laboratories. The Bay area venture capital market is totally into electronics, and they had absolutely no idea what Lawrence Livermore Lab was or where the back gate was as an entry point to Lawrence Livermore. And yet there are numerous ideas that perhaps we ought to consider, Tom. It seems to me a conference in an appropriate location to bring all these people together and let them get to know each other so that they can go about their business in making little employment opportunities around the state.

MR. HERBOLSHEIMER: Good idea. We'll do that.

DR. COHLAN: Senator, I'd like to address this. Bernard Cohlan speaking. I think that with a fair degree of confidence, I could volunteer the Anderson Graduate School of Management at UCLA to host that. I'm close to that department and I think Victor Gish over there would be happy to do that.

CHAIRMAN GARAMENDI: We'll see that Tom has an adequate budget for the mailing of the invitations. (laughter)

DR. COHLAN: And if you have another minute, there's another point I'd like to make on the university. I find myself representing the university today more than otherwise.

In our consortiums developing relationships with the university, they have been very generous with their time on behalf of the incipient consortium over at UCLA principally, and down at Cal Space in San Diego, the Cal Space Institute. But they are using their assets, their time, travel, to help us get us collectively formed. If conceivably through an existing program preferably -- I like to use what exists -- through Tom's program, maybe in a matching way, money could be funneled into the university to support the formative phases of consortia, I think it would accelerate the process because they are all on tight budgets. They all have other things to do in the university. And if there was a way of supplementing their budgets so that I, when I take their time, was not distracting, detracting from their budget, I think they'd be very pleased. I don't think it would take much in the way of money. And I think it would be a powerful device.

CHAIRMAN GARAMENDI: Food for thought. We've had a lot of it today. I want to thank all of the people who have participated. Those of you who have joined us out of curiosity or interest or just nothing else to do today. (laughter) This committee will continue to explore this together with my colleagues in the Legislature, I would expect. And I know that Tom and the Department of Commerce, we'll be able to work with you, the universities, and private sector.

Thank you all very much. It's been very useful and most appreciated.