

MEETING

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of

JOINT LEGISLATIVE TASK FORCE ON BIOTECHNOLOGY

"Testimony from industry representatives and
members of the academic community regarding
photonics and electronics technology"

LOCATION: Princeton University
POEM Center
Room J-323
Princeton, New Jersey

DATE: December 9, 1994
1:00 p.m.

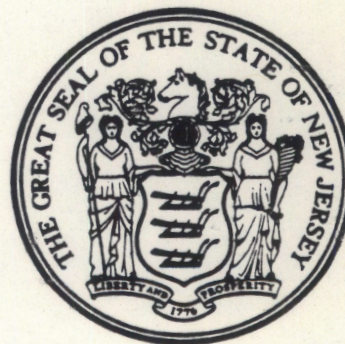
MEMBERS OF TASK FORCE PRESENT:

Senator Robert W. Singer, Chairman
Caryl Russo

ALSO PRESENT:

David Dentz
Jay Brandinger, Ph.D.
William Ayres, Ph.D.
Marshall J. Cohen, Ph.D.

Walter C. Kowalski, III
Aide, Joint Legislative Task Force
on Biotechnology
Office of Legislative Services



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New Jersey State Legislature

JOINT LEGISLATIVE TASK FORCE ON BIOTECHNOLOGY
LEGISLATIVE OFFICE BUILDING, CN-068
TRENTON, NJ 08625-0068
(609) 984-0445

ROBERT W. SINGER
Chairman
NICHOLAS R. FELICE
Vice-Chairman
JOHN H. EWING
JAMES E. MCGREEVEY
JOANNA GREGORY-SCOCCHI
ANTHONY IMPREVEDUTO

T A S K F O R C E N O T I C E

TO: MEMBERS OF THE JOINT LEGISLATIVE TASK FORCE ON
BIOTECHNOLOGY

FROM: SENATOR ROBERT W. SINGER, CHAIRMAN

SUBJECT: **TASK FORCE MEETING - December 9, 1994**

The public may address comments and questions to Walter C. Kowalski, III, Task Force Aide, or make bill status and scheduling inquiries to Ramona A. Morales, secretary, at (609) 984-0445.

The Joint Legislative Task Force on Biotechnology will meet on **Friday, December 9, 1994 at 1:00 PM in Room J-323, the Center for Photonics and Optoelectronic Materials (POEM Center), Princeton University, Princeton, New Jersey. (See attached directions and parking permit.)** The Task Force will entertain testimony from industry representatives and members of the academic community regarding photonics and electronics technology.

Issued 11/28/94

Assistive listening devices available upon 24 hours prior notice
to the committee aide listed above

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SENATOR ROBERT W. SINGER: Ladies and gentlemen, we're going to start the meeting. I do have a few brief remarks to make before we start listening to testimony.

First of all, I want to thank Princeton University for being so gracious to host this forum here today. Let me just briefly tell you what my goals are from this meeting. I am the current Chairman of the Joint Assembly and Senate Task Force on Biotechnology. It is a three-part area: it deals with pharmaceutical biology, bioremediation, and it deals with areas concerning the future of the biotech industry in the State of New Jersey.

Recently, we had, I think, an excellent meeting at the opening of a new biotechnology firm right here in Princeton, where we discussed bioremediation and the problems facing bioremediation in the State. Through that, we have drafted some legislation. The Task Force, which is about two years old now, has a series of five to six bills that are going to be posted for a Senate vote -- we heard today, officially, on the 15th -- which should be moving toward the signing by the Governor. Jay may elaborate a little later on that.

Through the help of the Commission on Science and Technology, we received a \$1.9 million grant which the EDA will be matching or, actually, coming up with a lot more money to open the first incubator the State will be operating. The site is still in negotiations. We hope to announce it officially within the next several weeks. It is a 200,000 square foot site. It will be retrofitted for not just biotechnology, but also the software industry and the electronics industry. There are an additional 40 acres which would be available for the building of companies' facilities there. We're very, very excited about that.

Commissioner Medina, the Commissioner of Commerce for the State of New Jersey, is very pro high technology. It is his

belief that the State's future is in these fields, and we must help develop them as much as we can.

Through the efforts of Jay and numerous other people -- Caryl Russo to my left -- we have also developed a Software Task Force. We are just waiting for the Senate President -- it has been approved -- to name the industry members. The legislative members have been named. That will be meeting to develop concerns of that specific industry; what they need and what they want through the State. We did that through a meeting of NJIT, where we heard from the industry their concerns and why they felt it was important that we were industry specific on a Task Force.

After that meeting, several weeks later, Caryl and Jay called me on it and discussed the fact that the electronics and photonics industry also would like to have a Task Force formed to, again, deal with the concerns of the industry -- bringing the industry together. My response is this meeting here today.

I'm looking forward to hearing from the industry, from those people who deal with it on a day-to-day basis, to tell us why you think a Task Force is necessary and what the Task Force can do for you.

All the other members-- Again, it's Friday, I know you appreciate in December it is tough to get all the members found. There is a transcript being taken. They will have copies of it. Certainly, if you are convincing today, and I'm sure you will be, we can then -- if we feel it is prudent -- request the Senate President and the Assembly Speaker to allow us to appoint a third Task Force.

Now, let me just say one other thing about that. The legislative members stay on it, the difference is the industry is represented on it. So the biotechnology people who are on the Task Force now, in due deference to them, really don't have the interest in the electronics and photonics as the legislators do. So they don't sit on the Software -- will not be appointed

to the Software -- and they would not be appointed to the Electronic or Photonic. They would be members of the industry and recommendations coming from Princeton University, Rutgers University, and the Commission on Science and Technology, as well as recommendations from the Senate President and Assembly Speaker. We usually look to have five to seven members from the industry. We count on them heavily to help guide us and bring in--

As I said, from the original Task Force there are five or six pieces of legislation that we will vote on in the State Senate on the 15th. Two of those pieces have already passed the Assembly, so that means they will go right to the Governor's desk. Because of the interest in it, we have had meetings directly with the Governor. She was hostess of a breakfast with the industry at Drumthwacket, talking about their concerns, sharing their thoughts on it. We hope for the exact same thing with the software, and possibly, we hope to do the same thing here.

Lastly, I'll say one thing; there is money available. There is a concern for the State that we must develop these industries in the right direction and that New Jersey is business-friendly. So I don't want you to think that there is no money available or anything. We will find money in our own ways as we did, hopefully, for the incubator facility.

Also, from the biotechnology concern, the EDA would not loan money to biofirms. The reason being is, as you may or may not know, biotechnology firms are not profitable, certainly, for their first five to ten years out of the box. They may be cash rich with money in the bank, but the EDA was familiar about looking at a statement for the last three years saying, "Let me see your profitability." Of course, these companies did not have that, so the EDA was unable to loan them money based on the direction the State was taking at that time.

Because of the effort of the Task Force, because of the lead of Commissioner Medina, we have instituted the first loan to a biotechnology firm, \$1.2 million, which is very important because they have money in the bank. They make payroll every week. They pay their rent where they are every month, but they want their money for R&D, not to be tied up in building a lab and things of that sort. So it was important that the EDA recognize that, understand the value of this to the State and to the industry, and look at them with a different light.

Those are some of the important things that come out of these hearings. There is action to what is said and done, and I am hoping that today some important information will come out to give us the ammunition to the Senate President and the Speaker and say, "This industry also needs a Task Force to develop and help them grow within the State of New Jersey."

So I have said enough. I would like the panel-- Why don't we all introduce ourselves and say where we are from so everyone knows that.

MR. KOWALSKI: Walter Kowalski, I'm the aide to the Joint Legislative Task Force on Biotechnology.

MR. DENTZ: David Dentz, I'm with the Airtron Division of Litton Industries.

DR. BRANDINGER: Jay Brandinger, I'm with the Commission on Science and Technology.

Senator, if you would allow me to make a few comments?

SENATOR SINGER: Absolutely.

DR. BRANDINGER: I'd like to first come back to the point that the Commission is very interested in supporting and, as you note, has been working very closely with the EDA on the biotechnology facility not just with money, but actually involved with them in reviewing the number of biotechnology facilities outside of our State to understand how to make ours better. So we will, in fact -- I think when we finally put it

into operation -- have something that we can all be very proud of and a center for the United States.

The second point is an important aspect of the process which you stimulated was the subject of venture funds. That process is going forward, and a number of very interesting proposals have been made to the EDA on the subject. I'm fully confident that by the first quarter of this next year we'll know about a venture fund that will deal with early stage funding of companies. I think that is a major step forward. You can be proud that you stimulated that. I think the State really needed it, and it was an important thing that we're stepping forward to.

The other thing I wanted to comment on was this particular meeting. Before 1988, New Jersey's photonic companies were isolated from each other, and there was no single place in the State where they could focus their R&D efforts and stay in touch with the latest in academic research.

With support from the voters through the 1988 Jobs, Education, and Competitive Bond Act, the Commission helped Princeton build this beautiful facility to serve as the focal point. The investments of the State have already paid off in an increased sense of New Jersey's status as a place where photonic technology is moving forward.

POEM serves to connect some of the nation's very largest technology companies who will put photonic switches and computers into the global information superhighway with the many smaller shops which are creating the specialty hardware and software needed to make the system business- and consumer-friendly.

Senator Singer, your bipartisan Joint Legislative Task Force is to be congratulated for broadening its focus from biotechnology to several other high technology sectors that can influence the State's economic future. By working together, as

we have done for more than a year in biotech, we can all help create the jobs of the 21st century.

Thank you.

SENATOR SINGER: Thank you.

Ms. Biotechnology? (laughter)

MS. RUSSO: I'm Caryl Russo. I'm with Enzon. It's a biotechnology company. I'm also the legislative Chair for the Biotechnology Council of New Jersey.

If I could just make a couple of comments-- I had been invited by Steve Forrest and Joe Montemarano to come visit POEM a number of months ago. At the time, I was looking at this more as another industry that was comparable to biotechnology and that, perhaps, what had been done for the biotechnology industry could be duplicated for electronics, photonics, and optics.

One of the most interesting results of that meeting was the knowledge that there is not only some direct application between these industries in terms of business -- and there is the possibility of bringing the photonics and the biotech industries a little closer together -- but also indirect.

I sat at the software round table. I listened to Steve articulate some of the issues confronting the photonics industry. As high-tech emerging industries, there is an awful lot of overlap, which is why it was important that the process that was begun with the biotechnology industry be the vehicle that looks at all these other industries as well, so that we're not having somebody recreate the wheel each time an industry is identified as one targeted.

When I say "targeted" I refer to those industries that locate here because they, in fact, capitalize on New Jersey's existing natural strengths, not the least of which are our academic centers, and Princeton is clearly one of those.

Nonetheless, I'm delighted to be here, and I look forward to taking back this information to the biotechnology

industry. I look forward to working with these other Task Forces in finding ways that, even as industries, we can begin to work in a more cooperative manner.

DR. AYRES: My name is Bill Ayres. I'm President of Electron Transfer Technologies. I'm also a member of the American Electronics Association and a member of the American Electronics Association's Task Force for Technology Manufacturing and Infrastructure.

I'd like to just second some of your remarks about the commonality of high-tech industries, especially their needs in the different growth stages for financing. Your comment about the EDA having different criteria, which was probably from 20 years ago or so, is certainly important to look at now.

MR. COHEN: I'm Marshall Cohen. I'm Vice President of Sensors Unlimited, a photonics company here in Princeton.

SENATOR SINGER: I just have to add one last comment before we have our first speaker. It is funny how things outside the State affect all of us. I received a number of phone calls yesterday concerning what happened in Orange County, California with the investment of moneys there.

One of the bills we have up for vote in the Senate will allow the pension funds of the State of New Jersey, which is \$30 billion-plus -- probably the most successful pension fund in the entire country -- to meet ARISA standards, which are Federal standards. Which means that they can invest in venture capital funds if they wish to -- not mandating it, but making it permissive that they can allow to do that. Of course, the question was: "Does this put at risk what you're trying to do because of what happened in Orange County?"

We are always vulnerable to what happens in other areas of the country. Poor management and mismanagement are never excusable for governmental funds. These are funds that belong to the people and, in this case, the pensioned people of

our State. We have a prudent fund. This is a prudent piece of legislation and certainly would not jeopardize anything.

But I am saying to you that we always have to be aware that things that happen outside of the State also affect us in State. The fact of opening the thinking of the EDA and things like that is very, very important to these industries, because without it, number one, New Jersey does not remain competitive. But number two, if these companies cannot remain in the State, they're going to find other areas where states are more receptive to them.

The example being Caryl's company, Enzon, which the State of Wisconsin owns 10 percent of, the State of New Jersey owns nothing, and they are the largest biotech company in the State. It doesn't mean that they're going to move to Wisconsin, but the idea is that even their own state can't invest in them. New York can, Pennsylvania can, Wisconsin can, but we can't in New Jersey. So those are the kinds of things we have to deal with and be aware of.

Vic, why don't you just introduce yourself? You came a little bit late.

MR. McDONALD: I'm Vic McDonald from the Senate Majority Staff with Senator Singer.

SENATOR SINGER: The first speaker is Allen Sinisgalli, Associate Provost, Princeton University.

Allen, I hope I pronounced your name right.

A L L E N J. S I N I S G A L L I: Yes, you did. Thank you. Sometimes I don't even pronounce it correctly. (laughter)

I'm very happy to welcome the Task Force here today and to be the first speaker on the agenda. I think it is important to talk about what happened 10 years ago. Ten years ago, the New Jersey Legislature created the Commission on Science and Technology with the express purpose of making long-term investments on behalf of the State to strengthen the State's position in certain areas of science and technology that

it deemed important for the long-term economic health of the State.

Even though the State then already had a very strong industrial R&D capability, it was thought that a top priority investment should be made to enhance the academic base in certain areas. Specifically, investments were made in the form of the Advanced Technology Centers at New Jersey's five research universities. The investments in ATCs were made in biotechnology, materials, information systems, and environmental technology.

Over the last 10 years, these targeted investments in the State's five research universities have helped them become contributing partners with private industry in collaborative research. Throughout strengthened academic structures we have been able to be most successful in contributing to the economic well-being of the State of New Jersey.

The ATCs have been resoundingly successful. Benefits derived are numerous and I would like to just mention a few. We have been able to move technology transfer at a much quicker pace from our laboratories to commercialization in a way that was unseen 10 years ago.

We have been able to train a competent workforce in graduate and undergraduate students, so that New Jersey industry has the people they need to continue their success in a very highly technological area.

We have stimulated scores of scientific discoveries in our own laboratories and in industry. We've helped create new companies in the State of New Jersey that didn't exist before.

We've certainly helped established companies stay competitive and keep their edge. We've developed a leadership position in the State of New Jersey for many industries that serve us well in the economic competitive battles.

Even with all these successes, I believe it would be shortsighted and dangerous to believe that there no longer

exists a need for the State to support the ATCs and maintain a continued investment in them.

The vast majority of the State's manufacturing firms are small businesses. Few have the in-house expertise or engineering experience to maintain their competitive edge in a rapidly changing international market. The ATCs are able to provide this kind of expertise. But the corporations and the universities alone do not have the funds to maintain the core that is needed. Therefore, they need continued support.

Although the investments in the ATCs are very strong from the State of New Jersey, the ATCs go a long way to try to support themselves. Indeed, records show, from Jay's reports, that in Fiscal Year '94 we got three times as much money as the State of New Jersey had provided from outside sources. So we leveraged the State funds very well.

I think even here at POEM I have to say something prideful for ourselves. It is higher than three times, so we think that we're doing a great job.

I believe that the State of New Jersey has to capitalize on the momentum already gained by the existing ATCs. The State should not only continue to support them, but broaden its investment in those places where the ATCs can strengthen their R&D collaborations with key industries that they are not able to do now. I think that has to be looked at very carefully.

In that way, I believe the residents of New Jersey will be served best, and the State can continue its ambitious plans to grow and remain competitive. R&D is a major industry in New Jersey and, as such, resources should be allocated to help it remain strong. A major component in the equation are the five research universities of the State and the ATCs in which they manage.

Thank you very much.

SENATOR SINGER: Just stay for a minute, because I have a few questions. I don't know if any other members of the Task Force here do.

Does anybody have any questions? (no response)

Is there any Statewide organization of the industry itself, an active organization?

MR. SINISGALLI: Of universities or industries?

SENATOR SINGER: No, we're talking electronics or photonics, you do deal with it all.

MR. SINISGALLI: Not that I'm aware of, correct.

DR. AYRES: Well, there is the American Electronics Association.

SENATOR SINGER: Yes, but there is no State--

DR. AYRES: No, but it has a New Jersey Chapter that is very active.

MR. SINISGALLI: I think the answer would be that the ATCs would probably be the best focus for that kind of collaboration and cooperation to exist.

SENATOR SINGER: When companies move out of that and develop into their own area, do they move out of state? Do they tend to move out of state for any reason?

MR. SINISGALLI: In the past, they have tended to move out of state unless the resources are around where they can get continued support. That is why it is important to realize, I think, that if the employees are New Jersey State people they're going to want to stay in the State of New Jersey. This is where they live. This is where their parents are. This is where they went to school. There is a comfort zone.

So we see that across the country. There is a circle of corporations that come around the major universities. It happened in Massachusetts on 128. It happens in Triangle Park. It happens in Silicon Valley. People tend to stay close by to where their ideas and products have been generated and where

there is an active community where they can participate, learn, and grow from.

SENATOR SINGER: Who is our competitor in that aspect? In other words, if they're going to move out of New Jersey do they move south? Do they move out to California? Do they move to Massachusetts?

MR. SINISGALLI: They would move to Massachusetts, to Triangle Park, and the Carolinas, down in that area. Certainly, Pennsylvania is trying to produce the Ben Franklin Partnership to create this kind of environment that we have in New Jersey. New York State around Rensselaer, outside of Albany, is another area where they are trying to compete.

Massachusetts, of course, would be a very strong draw. However, as I said, I believe that what we have done here has not only stemmed the tide, but we have created centers of excellence, so that people look to New Jersey as the place where they really want to be.

I see many people coming to my office and to Jean Mahoney's office, who does technology transfer, because they know that we are certain players. To be in the corridor between Rutgers and Princeton in a biotechnology area is the place where you want to be and to locate your company because they know the support is here.

SENATOR SINGER: Thank you.

Does anybody else have any questions? (no response)

Thank you very much.

MR. SINISGALLI: Thank you.

SENATOR SINGER: The second speaker is Stephen Forrest the Director of the Advanced Technology Center, POEM.

STEPHEN R. FORREST, Ph.D.: Well, first of all, on behalf of the Center for Photonics and Optoelectronic Materials, I'd like to welcome you all from government, industry, and the public.

I would particularly like to thank Senator Singer, as Chairman of the Joint Legislative Task Force on Biotechnology, for convening the round table on photonics and electronics here.

DR. BRANDINGER: Steve, they're recording this, could you take one of the microphones?

DR. FORREST: Sure. No, I can't. (difficulty removing microphone from stand) Okay, that's fine. Thank you.

I think one of the things I'd like to do is to let people know that there isn't a wide gap between photonics and biotechnology. Photonics has made a number of strides in biotechnology that a lot of people are aware of and some they're not: areas such as medical diagnostics, analytical instrumentation, in-situ probing; of course, everybody is aware of laser surgery, angioplasty, and technologies such as that. So there is a great deal of overlap in these types of technologies.

Optical-based technologies have long played a role and are continuing to play a role. I suspect, as the future unfolds, you'll see a considerable increase in the amount of photonics that has entered the biotechnology sphere.

Just for one example, at POEM we have a program in respiratory and blood gas imaging using noninvasive laser spectroscopy in conjunction with Magnetic Resonance Imaging. The technique, which was invented by POEM researchers, affords enormous sensitivity advantages over alternate techniques. Currently, we are working with several partners in efforts to ultimately commercialize the technology. There is considerable interest, obviously, in such a technology as that. But that is pretty much where the similarities begin.

If I were to tell you that I would like to describe an industry which is very economically strategic both to the State and to the country, the industry was born in New Jersey and has been a world leader for several years in that technology, the technology is capital intensive, it requires a highly skilled

workforce, it takes five to ten years or even more to bring products to the marketplace, and, of course, there are tremendous regulatory compliance issues that must be resolved, you would probably think I was talking about biotechnology. But I am talking about photonics. That is really what we're about here. We have many of the same issues and some of them are even more intense. The foreign competition, of course, is growing all the time.

What I would like to do in the next few minutes is just to introduce some of you to POEM. POEM is an Advanced Technology Center, as you have heard. It has been funded since 1989 by the State of New Jersey. They have contributed really very tremendously both moral support but, more importantly, economic support to get our facility here running. I think we're working very closely with a lot of industries, both small and large, in the New Jersey area. It is fun to work in New Jersey in this respect, because New Jersey is where it started and it is still largely maintained here.

There are, to answer your questions, significant efforts in Massachusetts and southern California, the two big alternate players in photonics, but New Jersey is certainly not second to either of those locations. It is the home, of course, to the telecommunications industry, which is now almost completely photonics oriented in terms of the long haul. You will see photonics merging as well into -- coming right up to the doorstep in the not too distant future.

So let me just do a very quick sort of survey of what POEM is about. I think the best place to start -- if somebody would grab the light back there-- It's right after lunch so I don't want people to fall asleep. We don't want to make it too dark. (uses overhead projector)

I think a good place to start is: What are we about? That is, through our statement of purpose, to explore new and potentially useful photonic technologies, to ensure timely

transfer of those technologies to industry and government, and to maintain New Jersey and U.S. competitiveness in photonics. You always have to work with the word "potentially". I know that with the economic times we're in people don't like to take risks, but to maintain the lead we've gotten, which is primarily based on risks that were taken in the past, we must take risks today and in the future, and of course, that takes resources.

I'd just like to give you a list of those companies which are our partners in risk. These are the New Jersey companies we're working with. Some of these interactions are very strong, some of them not so strong.

I think we've added an important one that nobody has heard about, but they are certainly very excited to be working with us, it is American Biomimetics Corporation down in Margate. This is sort of a dynamic list, but it gives you the feeling that there are lots of very strongly photonics oriented industries/companies in New Jersey. They have located themselves here for very good reason, because there is a lot going on. It is a good place to get access.

I'd like to, sort of in a visual tour of the place, just let you know that we have-- Photonics is a very capital intensive operation. To start a company in photonics today you probably would need upwards of several million dollars just for the equipment alone. This is a role that we can play in a university to work collaboratively with industries with our somewhat -- not somewhat but very sophisticated technologies. We have several facilities which we work, again, with our industrial partners and with academic players in the field, etc., but these are basically them. (indicating)

The most expensive operations you do in photonics are the first two, which is grow the material -- it's semiconductor-based, organic material-based -- that's done using large vacuum systems. I can show you a picture of what one of

these little things look like. This is down the hall. It looks like a massive dairy machine.

I should turn it this way (indicating) so that, at least, I'm not-- Nobody else would worry about that, but it was backwards. (laughter) I could tell because his right side looks considerably different than his left.

This is one of these systems. It is ultrahigh vacuum. There is probably about \$2 million tied up in this machine alone. This is the heart of semiconductor growth technology.

Once you grow the materials you have to make something. That is, typically, semiconductor lasers, photo detectors, receivers, something to transform electrons into optical signals, and for that, this is our temporary semiconductor processing laboratory.

As in all semiconductor processing laboratories the color is different because it is, basically, a safe-light room. It is UV filtered because the basic processes are photographic. There are deposition machines and so on. There are actually tremendous amounts of equipment. Again, to install this in your own company would cost upwards of a couple million dollars.

Of course, where would photonics be without lasers? So I have a pretty picture -- not terribly useful, but it gives you an idea. We have very fast spectroscopic technologies here that are useful for measuring chemical processes, the nature of solids, etc. All these things which are useful not only in optical communications, but in biotechnology -- certainly, one of the areas. This just shows a multiwavelength laser system in operation. That is the pretty part of photonics. Aesthetics plays a very large role in this whole business.

I think it is widely recognized in the industry that what keeps photonics out of your house, other than in a compact disc player, is the fact that the components cost too much. The reason the components cost too much is not the semiconductors and all that growth infrastructure, etc., the problem is putting

it into a package and coupling an optical fiber through those devices is still a very expensive operation.

We are starting here, and it has really been our ambition to make POEM a sort of a centralized area where industry can work with us in resolving some of the very complex packaging issues, which, again, are still the main barrier to fuse this technology into the home. These are just a few things that we have going. We're also looking into doing what is called flipchip bonding, etc., which, again, takes substantial resources.

I guess you'll hear about this, too, but we do work closely with industry. This is my favorite view graph. You'll see some of the output of this. This is where working with a local industry, which is Sensors Unlimited-- Michael Lang is an engineer with that company.

Why I like this view graph is, first of all, this camera is sitting back there. (indicating) We helped develop, over the years, the imaging device that is used in that camera. This camera is used then in the clean room on occasion to fabricate more devices, which are even more sophisticated, because of its imaging capabilities. So there is sort of a nice concept of feedback from the whole thing.

Then, finally, for those of you who couldn't walk in the front door-- We're never sure in this building which is the front and which is the side, but-- The reason I show this is not to show bricks and mortar, but to tell you that New Jersey has really made this facility possible. We're hoping that we're repaying New Jersey with interest on their investment.

There is one last thing, just to show you a new technology that we're getting into and what the stakes are. I think many people in the room have probably heard about the importance of displays to the economics of this country. It seems to be the next threshold for computers and other devices to enter, to have a very inexpensive, flat-panel display

technology, which really does not exist. This is just an industry estimate, similar to many. This one is by Hitachi, and it shows the growth in the display industry over the years. This is the type of dollars we're talking about here.

In 1995, which is about here (indicating) we're talking about a \$25 billion a year industry in displays. What is kind of amusing about this is that this was gotten from Hitachi, but there is a bullet here, "market for flat-panel displays is not satisfiable." That is the type of market that I'm interested in, totally open-ended. (laughter) So this is growing exponentially, getting to \$35 billion by the end of the century.

We do have an activity here which is very aggressively looking at displays. There are many faculty-- These are organic flat-panel materials. If I could show you these things when they are transparent, when they're off, they consist of thin films which are only a few molecular layers thick. We can make them in green, blue, and red.

This is the sort of thing that we're doing here. We're keeping our eyes on the big technologies that are out there and photonics plays a significant role. Another is wireless, which is another exploding market -- telecommunications using wireless technology, and that has a big photonics component in it.

Thank you.

SENATOR SINGER: I have a question for you. Where do most of the research moneys come from? Is it venture capital?

DR. FORREST: Most of the research money in photonics, at present, is coming from the Federal government. Many of the companies have been so near-term profit driven in the recent past because of the economic climate that they have retreated. I'm seeing a return to the research side of things by those companies. But primarily ARPA and other agencies of the Federal government are the main players. New Jersey is really quite an

outstanding player in this. I think it's one of the reasons why the industry here certainly has its ups and downs but has never left the State.

SENATOR SINGER: Is there an approximate-- They talk in the biotech industries of the cost from when they have the idea in the lab until it comes to fruition, and that cost can range from \$100 million to \$150 million. Is there any type of similar cost to say, from when the idea starts in the lab until it comes to fruition, how much approximate cost to bring something to that level?

DR. FORREST: That is very difficult to answer because photonics has so many aspects to it. The cost of bringing CD lasers, which was done primarily in Japan, from the laboratory to the marketplace in terms of time was about five to six years and in terms of money for a given company -- and there were many companies working on it -- on the order of \$100 million. So it is quite comparable.

But if you look at light wave technology and the investment, for example, that AT&T has placed in it, it's in the billions. I always have-- My semi tongue-in-cheek answer to a lot of questions is that if light wave technology were invented today -- it was really invented in the mid '60s -- we would never see it really evolved into the business that it has become. It would never really enter communications because the risk factor would be far too great today.

SENATOR SINGER: Are there any questions?

MS. RUSSO: I just wanted to elaborate on something because we've gotten so used to quantifying. X number of companies have been spun out of various technology centers or out of the universities. Of course, Princeton gave us one of our greatest biotech companies, Transel Technologies. But you also function to support, on a regular basis, existing companies.

DR. FORREST: That's correct.

MS. RUSSO: It's not the same sort of system where you are going to develop the technology and spin it out. You're here to help these companies as they're growing up.

DR. FORREST: That's correct. We are not particularly interested in spinning off our own companies. I'm sure if that eventuality comes about that will happen, but our main mission is really to help in the small- and medium-sized businesses and also to work with the large companies in working on this issue. But that is where we have been chartered by the State, I believe.

SENATOR SINGER: Thank you. Thank you very much.

DR. FORREST: One last statement I'd like to make, Senator Singer, in response to an earlier question you had. There is a photonics industry association. It is not New Jersey based; although, there may be New Jersey Chapters. It is called the Optoelectronic Industry Development Association, it's O.I.D.A. It is a very strong spokesman for optoelectronics in this country.

SENATOR SINGER: Thank you.

Our next presenter is Dr. Michael Ettenberg, of the David Sarnoff Research Center.

Doctor, thank you for coming today.

M I C H A E L E T T E N B E R G, Ph.D.: Thank you, Senator.

DR. FORREST: Do you want some view graphs?

DR. ETTENBERG: No, I can do it without view graphs.

(laughter)

Sarnoff is, has been in photonics research forever having invented television -- color television -- and still remains a powerful force in that area. I guess I may, as photonics speaking here, have the longest history with photonics as I look around, I'm afraid. I'm getting old. But what I've seen over that history is New Jersey inventing it -- Bell Labs and Sarnoff -- and it moving either offshore or to other states.

New Jersey has made, as a State, considerable investment into this area and maybe has not seen that return yet.

But there has been a world change in the last few years. It comes in two forms. One is, when we look at a major corporation like IBM breaking down into local autonomy, being able to move more quickly in this moving economy -- a worldwide economy driven by the Japanese, I think. But to move faster into product means more local autonomy, which means to New Jersey that the local New Jersey parts of the companies that are looking to invest in photonics will keep it here, rather than moving it around the country.

Maybe more importantly, when I look at photonics, small companies are making the world change especially in the United States. We are partnered with many small companies, many of them in the audience. They move five times as fast as we can move, and we're only a \$100 million company, but ten to a hundred times as fast as major corporations can move in making the economies go. You see it in terms of new jobs. You see it in terms of new product creation. It is really making the companies -- the larger companies -- move much faster on their feet.

With that in mind, we see that New Jersey -- if the investment is made by the State and maintained here -- could be, and probably is now the world leader in photonics technology going into the future, because we do have the small companies. We do have the university support. We have a long history of very talented people here and the chance of keeping those products here instead of letting them go out into the world and into the nation.

So we urge you to do whatever the State can to support these people. Sarnoff will continue to do so.

Thank you.

DR. BRANDINGER: Mike, what is it that we're missing here in the State of New Jersey that is limiting us in terms of the development of photonic small businesses and applications?

DR. ETTENBERG: New Jersey just doesn't have enough venture funds. When we look for venture money for our spin outs, or the companies in this area look for venture money, they find themselves out in California. They find themselves going to Massachusetts and even Triangle Park, where there is much venture money around and that tends to draw them away. That is, the venture capitalists may want to be closer to the company, and these companies are very mobil, especially when they start out.

I think the technology base is strong, it needs to be maintained. If we lose it we're going to be in trouble, especially at a place like POEM. It's kind of unique throughout the country. But the venture funding is very thin.

SENATOR SINGER: Thank you.

Dr. Gregory Olsen, President of Sensors Unlimited.

G R E G O R Y H. O L S E N, Ph.D.: (off microphone) I wonder if it would work better if you project it against this wall? Let me turn this around and see if it works. (referring to overhead projector) Is that better for you in the back? (affirmative response)

As was mentioned, I'm Greg Olsen from Sensors Unlimited. I'm here with Marshall Cohen, who is Vice President at Sensors and who is also the brains behind the camera that we have back there.

Sensors Unlimited is a start-up in Princeton. There are a lot of them. There is Electron Transfer here with Bill Ayres, (indiscernible) and probably a couple of others in the audience.

You asked about spin-offs in New Jersey. I had a company before this called Epitaxx that spun off with Sarnoff from RCA Laboratories. At RCA and Sarnoff, that Mike just

talked about, is kind of a breeding ground for a lot of companies -- microwave semiconductors, with Ron Rosenzweig, that has gone on to Anadigics, which is really doing well now. So there is quite a history of Sarnoff's in the photonics and the electronics areas in general.

But after Epitaxx, going on to start Sensors Unlimited, a lot of the help we received starting up was from POEM, Steve Forrest, and the New Jersey Commission on Science and Technology. First of all, I want to acknowledge all of those organizations and to give you some examples of how this works in reality.

Now, when Joe Montemarano first called me up and asked me to give a talk at a biotech seminar I said, "Well, what's the connection? I don't see it." But actually, I answered my own question because I thought about it and at one of our technical conferences called CLEO -- Conference on Lasers and Electro-Optics -- we had a plenary lecture on DNA given by Professor Hood, who is well-known in the area.

He gave this talk explaining all about DNA and I only understood part of it, but in the end he gave a plea. He said, "Look, we have this human genome project. We have to identify hundreds of millions of DNA strands, and the only way we're going to do it is by using your laser spectroscopy techniques. So, now that I'm at a conference of laser people, please help us." That was one of the best examples I could think of of the interplay between the two. Those types of laser spectroscopy techniques are going on here at POEM and are being developed, so it is a nice connection.

But what I thought I would talk about in my 10 minutes is who we are, a little bit about how New Jersey has helped us and other small businesses, some of the details of our interactions, and a couple of examples of technology transfers. I mean, this really works. You see this camera in the back, that's a commercial product. We sell some of our devices to a

company that does glucose monitoring, and I'll say a little bit about that at the end.

Okay. Sensors; we're a recent start-up. We like to think that we commercialized the kind of stuff that gets invented and conceived at Princeton University and gets developed further at David Sarnoff, which is another organization we work very closely with here.

We're involved specifically with infrared lasers and cameras and the applications to do gas sensing of things like methane, carbon dioxide, water vapor, pollution monitoring in general, and infrared spectroscopy. Another thing that is worth mentioning here is we use the SBIR system. The Small Business Innovative Research Program to develop technology.

Again, our specific programs are DFD lasers that were developed by the David Sarnoff Research Center -- and we've been able to market them -- the camera we have in the back, and we make detector arrays that are used to measure light for spectroscopy.

Our personal goals as a corporation are first, to achieve profitability, which we've done, and to hit revenues on the order of \$10 million in two years. We haven't done that yet, but we're working on it.

Let me start off saying: How does New Jersey help small business? How did it help Epitaxx? How did it help us and other people? There is a lot of high-tech business already in this State. Right there is a big help. There is a great labor pool, smart people. There is venture capital.

I agree with Mike's comment there isn't much in the State but there is in New York and the surrounding areas. But I agree that is a weakness in the area that could be worked on. There is great infrastructure. I can't think of another area in the United States -- maybe Silicon Valley -- where you can buy just about any part from the special stainless steels to the exotic gases and anything of that sort.

New Jersey supports the SBIR system very heavily. We have a consultant in Washington who gives advice. The Commission on Science and Technology gives help. It gives financial grants in between. When the funding dries up it helps out. It has helped us very much. They helped Epitaxx and a number of people here.

There is a lot of start-up support at the various State agencies where you can have business plans looked at. There is an incubation center coming on that was talked about. There are funding sources. That's the EDA, I hope that wasn't a Freudian slip on my part. (laughter)

We're testing that system now. We're glad to hear that funds are available. We're now about \$2 million in revenues and we're profitable. United Jersey Bank has said to us, "Okay, it's all right with us if it's all right with them." So now, we're in the process of working with the EDA to see if we can get some equipment financing to expand our production facilities.

Finally, and maybe most importantly, we have a lot of large universities and labs: Bell Labs, Sarnoff, Princeton, Rutgers, NJIT. Those are the seeds from which companies like ours grow.

Now to be a little more specific about, how do we interact with POEM and Princeton University? Well, the first thing I want to say about our interaction is, it works. You often see programs on paper, consortia, and things like this, but what really makes it work is this sort of thing. It's a bunch of people who know each other and work together.

You know, here is a list of people at Sensors, here is a list of people at POEM. We know each other. We have breakfast together. We argue together. Some of our employees have threatened to name our new chip the "Newt." Professor Forrest has rejected that. (laughter) But it is that sort of thing that makes an interaction like this work, the ability to

do something like that. He doesn't know it's going down, but--

But those are the things that we do when we interact. It's not just a paper thing where, "Here is a list of things that we do." We actually have things that go on and products that go out the door.

We have about five of these Small Business Innovation Research Programs going on. I won't go into detail about what they are. We have equipment and personnel exchanges. Steve explained how they have a great equipment infrastructure here. We've been fortunate to be able to tap into that. We save millions of dollars in start-up costs, as he explained, by being able to access this facility. We have our own research programs, as well as the joint ones with POEM, and we're able to carry a lot of the research out here.

Now, on our side, we do a lot of the packaging that Steve mentioned. How do you actually make something a part and get it out the door? How does that camera-- How do you put plugs on it and have someone look at an infrared image? Well, that's the sort of thing we're trying to specialize in. We want to be complementary to POEM that way, so they can use our facility as well as we use theirs. We have publications, patents, grants.

It's nice to see Jean Mahoney here. She is working on one of our patent applications for the-- We're making a three-color infrared camera.

Later, we'll have Marshall say a couple of words about our camera, but that bright light along the diagonal back there is a soldering iron. Our camera involves a chip that was first worked on by Steve Forrest and people at POEM, to look at heat waves.

Well, the next generation is being done here at POEM under a SBIR Program in what we call a three-color infrared camera. Now, that actually is a false color image, but typical color TVs have red, green, and blue. Well, infrared has color,

too, and even though your eyes can't see it-- It's just different wavelengths or frequency of the electromagnetic field.

Here is an example of how we have pixels or solar cells, which respond to different wavelengths of light. Now, by using appropriate lasers and other light sources, you could use these three detectors to detect different types of gas like carbon dioxide, methane, water vapor, and so on. You could form an image, a three-color image, where each color corresponds to a gas. You could do emission observation on cars, factories, things of that sort. You could tell what gases are coming out and how much. This is just an example in a research lab. We expect in maybe two years that this thing can actually be sitting on a pedestal for sale.

We have several joint grants from the Commission on Science and Technology to foster some very low temperature research here. Again, the practicality of technology transfer you are seeing back there-- That is an infrared camera. It sells for \$25,000, and it is being eagerly sought by people who do thermal imaging, as well as covert surveillance. Again, I'll ask Marshall to say a few words about it when I'm done.

Another thing we're very active with is infrared arrays. Now, these are just lines of detectors that are used for spectroscopy and other forms of measurement. Here is an example of what one of these arrays looks like. Most of this is the package. Now this little sliver in the middle that you can hardly see is the thing that POEM developed. It's called an indium gallium arsenide detector array. That is able to sense different wavelengths of light.

Now, what Steve meant by packaging is just this: How do you take this all, put it together, plug wires in, and make it useful for someone? That is where we come in. We're bringing that expertise to the party.

Now, I'll give you what I think is a very impressive example of how this has been transferred. Again, it relates directly to the biotech industry.

This is one of the first commercial glucose analyzers that doesn't involve sticking a needle in your finger and drawing blood. This is a machine that utilizes light and a detector of the type you saw before. It is a unit that-- Well, they say here it's coming out in late 1994. We all know that really means early '95, maybe mid-- (laughter) It works and the reason it works is because it has an array of the type that was developed in a laboratory like this.

Just think of how many people who have children who have to measure their glucose level two or three times a day, every day, year-round. An instrument like this, leased over a five-year period, is a very economical thing for a family. Just think of the pain and discomfort that it eases.

But there are just a whole-- Just as we say the 1980s was the decade of fiber optics, the 1990s is going to be the decade of this kind of stuff, where lasers get into medicine and gas analysis. But it is just one of many examples you can point to where this kind of technology being done here is hitting the commercial market.

Now, being as it is the holiday season, we all have our wish list for Santa. We have one for what we would like to see for not only POEM but from the State of New Jersey on what we can do. Our objectives are we really want to stay pushing the forefront of technology, getting the very latest technology out on the commercial market.

So we want to see these things like lasers, detectors, and electronics all put on one chip. We want to see things like quantum wells and exotic materials that key people know about and put them all on a single chip. This is the kind of work that is going on right now, ever since Steve came to POEM, being

pursued on a research level. We'd like to see it in the commercial market three to five years from now.

So that is why our wish list to them is to keep doing all the things they're doing, making layers that are ten atom layers thick, and keep integrating all these electronics and optics, so that we can come up with new devices for the commercial market.

Now, I'll close by giving a last example of how we interact. This is a picture of our infrared camera. As I've said, it is award winning. We've won, to date, three awards from trade journal magazines as "Best Product of the Year." Sometimes awards like this are political and they're to get advertising. But the very fact that we've received three, I think, is a big testimony to the validity and uniqueness of it as a product.

Again, the basic chip in front of this was developed by Steve and with his help from POEM. That has gone from the laboratory to the market, and one of the ways we interact can be seen in how we make the chip.

Well, we have this photodiode array -- that is what was developed at POEM -- here is a silicon multiplexer, which is a readout to get the image out of the chip. It has to be fabricated by a technique called "bumpbonding," where you actually form indium bumps, about 10,000 of these on each side of a chip, and squoosh them together. Well, we're doing the squooshing and that is part of this packaging effort that goes on. But I think it's a great example of how we work together. The device couldn't be made without one of the other parties, so, again, we're thankful for this.

I'll close at this point. I may ask Marshall to just say a few words about how the camera operates and maybe some of the image details.

Thanks.

DR. COHEN: Okay, just very briefly, in the camera that is in the back of the room, the core of the camera is a indium gallium arsenide near infrared sensor that, in principle, is very similar in operation to a silicon CCD you would see in a home video camera.

The challenge, of course, was to make it in an infrared material which is sensitive to wavelength beyond what you can see with a silicon camera. In a home video camera -- that you can go buy for a few hundred dollars -- it's because of the nature of silicon CCDs. You literally go right from the sensor to your TV set and that is all you have to do. In these sensors, as Greg showed, you have to make the device with readout electronics. So there is, basically--

In that particular camera, there are about 17,000 little photodiodes mated to 17,000 cells of readout electronics with these indium bumps. Then in that camera, is a full computer that takes what wouldn't be such a great looking image and makes it into a nice looking and useable image. So there are a lot of photonics and electronics, and there is a lot of activity that goes into that, as well as the packaging.

Again, one comment I'd like to make about an interaction with POEM. You often think that, well, we're a start-up company. We're working very hard to get new products out the door, and here is this high-powered university who is there to support us with the long-range research that we couldn't ordinarily do. Well, that is what eventually happens.

I think the interactions are most effective on the mundane. If you start with the day-to-day things, just help with the things that should be easy but never are easy. There is a good support group, and most of the good ideas come while you're waiting that 45 minutes for something to pump down, and you're chatting with the person on the other end.

I think POEM has been especially useful to us on things that you might not necessarily consider earth shaking but

were very helpful to us getting off the ground on the generic things, and that has led to some of the long-range things that Greg was mentioning.

DR. OLSEN: One thing I forgot to mention is, this three-color camera that we're coming up with involves new materials. One of the materials exists nowhere else in the world except right here in Princeton. It was developed by Bill Ayres. It's called an antimony generator. Antimony is an element like silicon aluminum, but it's necessary for the next generation of chips to have this element in, in order to image the longer wavelengths.

Bill's company, Electron Transfer, is doing that, and we're interacting with him over at David Sarnoff making the next generation chip. So there is a lot of interaction amongst the small companies here.

SENATOR SINGER: Are there any questions?

DR. BRANDINGER: I'd like to ask Greg one question.

Greg, you're trying to reach \$10 million by '96, what is it that is stopping you from getting there?

DR. OLSEN: Right now, our plant expansion. We need about a half million dollars more of equipment and people to go with it. We're at a point where we have the business to justify it. That is why this EDA loan is especially critical for us.

SENATOR SINGER: The money just arrived. (laughter)

MS. RUSSO: We saw you sneak in, I leaned over, and said, "EDA arrived." (laughter)

SENATOR SINGER: Is the check in the mail?

UNIDENTIFIED MEMBER OF AUDIENCE: Soon.

MS. RUSSO: You missed the part where he said they are profitable.

UNIDENTIFIED MEMBER OF AUDIENCE: I'm taking notes. (laughter)

SENATOR SINGER: Are there any other questions?

MS. RUSSO: I just had one question. When you were talking about gas sensors, I leaned over, and asked Bob, "I wonder if there is any application?" We're bracing in the State of New Jersey -- as many regions in the country are -- for this emission testing. I have to tell you this is sending-- The Legislature doesn't know how to handle this, because we've got these mandates on the Federal level, and they're going to be imposed right down to the person who has to sit, allegedly, for hours and hours to have all these tests run. Is there an application?

DR. COHEN: Yes, absolutely. I think the way that's done now is people drive around in little vans, take gas samples from the tops of chimneys, and either analyze it in a lab in the van or take it somewhere else to analyze it.

SENATOR SINGER: That's air quality. That would be under Discharge Permits, Air Quality Discharge Permits. We're talking about cars.

DR. COHEN: Even on cars, we've been talking with Daimler-Benz, General Motors, and Ford, is optically-- One of the points of the DFB lasers that we work with Sarnoff plus POEM on is that you can choose the laser to a wavelength associated with specific gas molecules -- methane, carbon monoxide, whatever -- and then with a simple detector you do very simple spectroscopy to detect parts per billion, depending on what you're looking at.

So, right now, I think it's more a matter of cost than anything. But the technology is there that, in principle, could be put on every car. A little bit is the chicken and the egg. You have to get the quantities up to get the cost down. So, from a business point of view, you need the in-between markets to drive the price down. It's hard to jump right into the \$10 million car-per-year market.

But, again, the technology is there, and that is one of the things we're working towards.

SENATOR SINGER: Doctor, thank you. Thank you both very much.

Our next speaker is Salvator Lalama, Manager in Camera and Display Applications, High Resolution Technologies AT&T.

SALVATORE J. LALAMA, Ph.D.: Thank you.

Although I'm on the list with the other speakers representing the photonics industry, I wanted to make some comments related both to photonics as well as electronics, and wanted to comment a little bit on the scope of the industry, the scope of AT&T and our involvement in these industries, and talk a little bit about some of the key technologies that we're involved in that we feel are critical.

I've got, for your indulgence, a short videotape of one of our manufacturing locations which is located here in New Jersey. So, if we have a few minutes to look at that, it's all set up in the back.

The comment, Senator Singer, that you made earlier about, how we need to be aware of things that happen outside of New Jersey because they're important to us, and you mentioned the Orange County activity-- In Tuesday's Wall Street Journal, with regard to biotechnology, we need to look on a global scale when it comes to technology to understand what is going on around the world, because the activities that we undertake are affected by global events.

In particular, in Japan, which has not traditionally been active in the biotech industry, an organization has been set up sponsored by Japan's MITI. It is called Time Machine Bio, which is looking at -- and I'm not in the biotech industry, but it's in the field of combinatorics -- specifically, enzymes and combinatorics, which is regarded as a more complex application than the type of combinatoric research that is done here in the U.S. There is an unofficial estimate that maybe as much as \$250 million is supporting this program.

So I think it is very important to keep monitoring the kinds of things that go on around the world because high technology in general is a global activity, just as AT&T is a global company.

There was a report in 1988 by the National Academy of Engineering that talked about global competitiveness. At the risk of preaching to the choir, there are a number of activities that states can be very effective at in terms of helping to support global competitiveness.

With the Joint Task Force on Biotech, I think, you've hit a number of them such as state governments. Because of the close relationship they have with local businesses, they can be more effective at developing programs that help in the desired way. States can join together to form regional activities.

There was mention made of the Ben Franklin Partnership, and an opportunity might be there to work with the Ben Franklin Partnership in the sense of a regional sponsorship of high technology. The State is already involved, as is obvious here, in various educational programs and other types of institutions, so I think you're right on with that.

The electronics industry is absolutely critical to the U.S. It is critical to AT&T, and I think, it's critical to New Jersey. The size of the industry alone is one of the indicators of the importance of this industry.

There was a report by the National Advisory Committee on Semiconductors that was chaired by the retired President of Bell Laboratories, Ian Ross. In '92, the estimate of the size of the world electronics industry was \$750 billion, of which \$384 billion was the U.S. market. So that puts the U.S. as clearly the dominant market for the electronics industry around the world. Because of that, it's very important that we keep a big chunk of that industry here, locally. Much of the data that was contributed to that report came from the American Electronics Association. We are active in that organization.

Another organization was mentioned before by Steve, the Optoelectronics Industry Development Association, the O.I.D.A., of which we are also a member. They put the total optoelectronics industry for 1993 at \$75 billion.

Then, most recently, AT&T has been involved in helping to create the United States Display Consortium for that other critical industry, which is growing rapidly. The data we have show that industry is currently \$20 billion a year.

By the way, the estimate for the year 2000 for the world electronics industry is \$2 trillion for the size of that market; for optoelectronics \$210 billion; and for displays \$40 billion, so these are big numbers. What the big numbers translate into are the criticality and the importance of these industries to everyone, especially here in the U.S.

Another partnership that we're involved in-- I've mentioned these associations. AT&T is active in all of the ones I've mentioned. The importance of them are that-- To put in a plug for the larger companies, I feel that as a large company AT&T has a role to play in participating in these types of associations and consortia and, especially, partnerships with governments.

I think the role we play is by bringing facilities and resources to the table through the laboratories that we have. I'm going to talk a little bit about that, as David Sarnoff Research Center also contributes to that.

Another important area I think that has led to some of the success we've had with Federal programs is that the type of funding that becomes available for either sponsoring technology or for, perhaps, sponsoring new companies is, when large companies participate in these programs, we bring matching funds to the table, typically in R&D. That presence of matching funds is a powerful addition to any type of program. I believe the partnerships that can develop can be very effective.

One of the most recent partnerships we're involved in is called the National Electronics Manufacturing Initiative, which has government participation by both ARPA, as well as the National Science Foundation, and large and small companies alike.

The focus of that particular initiative, called NEMI, is to try to address the issue of manufacturing for the types of devices and products that will be hanging on the end, if you will, of the national information infrastructure. Those types of products are not available yet.

There are all kinds of thoughts and ideas about them, whether they will be computers, whether they'll be telephones, and most likely, they'll be something in between. The manufacture of those devices is going to be absolutely critical. The NEMI initiative is trying to make sure that happens here in the U.S.

AT&T, as I said, is a large company. From our annual report, our total revenues were \$67 billion. What I want to point out is, of that total, \$18 billion is the manufacture and sales of electronic and photonic products and systems. So AT&T, in addition to being a telecommunications service provider -- which is the largest part of our business -- is very intimately involved with electronic products and optoelectronic products as well.

Of the total 314,000 employees that we have worldwide, 51,600 of them, as of the beginning of this year, are located here in New Jersey. By the way, that is the largest concentration of AT&T employees compared to any other state and any other country. Numbers two, three, and four are Georgia, Illinois, and Florida, for instance. But New Jersey definitely represents the largest concentration of our employees.

The types of product families that we are involved in have a very wide range; from MOS semiconductors to photonic devices; photonic sub assemblies; photonics transmission

systems, as well as other electronic components such as circuit boards and power supplies.

We're a manufacturer of optical fiber, telephones including, corded, cordless, as well as cellular, as well as answering machines, desktop computers, parallel computers; and the very large telecommunications systems that are used by telecommunications service providers, such as local phone companies, long distance companies, as well as cable TV companies. We have expanded our product line to provide equipment for those information contact providers.

Manufacturing is, of course, critical to a business that sells that quantity of electronic products. We have 102 manufacturing locations worldwide, 39 of them in the U.S.

I will show a videotape of one of those manufacturing facilities, which is located in Clark, New Jersey. It is a manufacturer of a very sophisticated piece of equipment which is called an undersea optical repeater. It is the electronic photonic package of equipment that resides on the bottom of the ocean, literally, connected to optical fiber to enable communication around the world.

That is a 100,000 square foot facility, 350 employees with about \$200 million of output per year out of that facility. They are involved in some aggressive and innovative workforce concepts. For instance, they are currently experimenting with self-managed work teams. So the types of issues that are important in terms of worker training and manufacturing management are things that we try right here in New Jersey in our manufacturing locations.

R&D, of course, is the driver of high technology. AT&T spends a little over \$3 billion a year in R&D expense. Much of our R&D is conducted here in New Jersey. Just to rattle off a list of locations in New Jersey, we have Bell Labs' facilities in Murray Hill, Holmdel, Middletown, Whippany, Hopewell Township, Piscataway, and Liberty Corner. I'm sure I

left a few out. Although I don't have numbers, my estimate is that there are probably more than 15,000 people located at those locations I listed.

Some of the critical technology areas that we're involved in include: microprocessors, microchips in general, coding and algorithm as they are applied to DSPs -- some of that work, I think, might be relevant to the Software Task Force that is being formed -- light wave devices, and light wave systems, of course.

Much of the technology that has been discussed in terms of developing optoelectronic devices was work that has come out of Bell Laboratories in several of our locations. We are currently involved in displays, as well as cameras. Radio frequency technology was mentioned earlier as being another important technology area for applications such as wireless and portable communications.

We are also involved in network type technology such as switching networks and protocols. For example, the so-called ATM, or Asynchronous Transfer Mode technology, is an area where we are currently working. We have certain development projects going on there as well, as well as software.

So that is a very brief overview of some of the areas we're involved in. Again, as I said, I touched on consortia activities, which we're heavily involved with, and partnerships with government organizations. I talked about some of our product areas and the technologies that support them.

Now, if we have just a few minutes, we can start the videotape and take a peek at our Clark operation. (shows videotape)

Do you have any questions? (negative response)

SENATOR SINGER: Thank you very much for a very fine presentation.

Dr. Tony Warren, TMF Technology Management and Funding. (no response)

UNIDENTIFIED MEMBER OF AUDIENCE: Excuse me, Senator, one of our members has to catch a 4:00 flight, so we would like to go out of order.

SENATOR SINGER: Okay.

UNIDENTIFIED MEMBER OF AUDIENCE: Stanley Binder from Barringer Technologies.

SENATOR SINGER: Okay.

We're going to change the order a little bit.

Stan Binder, CEO of Barringer Technologies, Incorporated.

S T A N L E Y S. B I N D E R: Good afternoon, Senator Singer, and panel. My name is Stanley Binder. I'm President of Barringer Technologies. We are located in New Providence, New Jersey, right around the corner from Bell Labs.

Our company is a manufacturer of analytical instruments, utilizing ion mobility spectroscopy technology. They're used for the detection of trace chemical substances including illicit narcotics, explosives, environmental pollutants, and contaminants.

Our company is a member of the American Electronics Association. We also provide analytical services to the mining and environmental services industries through a 50 percent owned subsidiary.

We made the decision to locate our headquarters in New Jersey five years ago and have recently established a sales, service, research and development facility here. Although we presently employ only 15 people here, out of a total of 200 worldwide, we're planning on expanding that in the next five years at a substantial multiple.

As a result of the availability of advanced telecommunication capabilities, the situs of where masterminds of new product development are situated is no longer tied to the product manufacturing facility or geographic region. During the next 12 months, we will be making decisions as to where to

expand our operations and R&D capability. I would like to do so in this State.

One of the many factors in our decision-making process is the taxation climate within the State. State and local taxes represent approximately 50 percent of a company's yearly tax bill, a percentage that is expected to grow over the next few years. In general, this increase is a function of the expansion of the State tax base coupled with the elimination or limitation of tax deductions and credits. Greater attention is being paid to this increasing State and local tax burden by middle-market businesses such as ours with annual sales ranging from \$10 million to \$150 million.

Innovation and development of new products and technology are a basic necessity for success and growth in the electronics industry. New Jersey businesses are well-aware of and appreciate the State's recent efforts and incentives to foster business development and growth within the State through enactment of various tax credits for business. The overriding difficulty with these new incentives are the limitations placed upon their benefits.

I would like to introduce Joseph Anania who is the tax partner in charge of BDO Seidman's New Jersey office. Before I do so, I would just like to mention another way in which the State could particularly help a company such as ours.

Our company sells our products to, essentially, security and law enforcement agencies both in the United States and around the world. For many years, we have been trying to get the State of New Jersey's agencies, including the State Police, the prisons, and others, to work with us in developing the applications of our technology. We have not been able to do so primarily due to budgetary constraints; although, there are requests for procurement of our technology sitting in Trenton and have been so for two or three years.

We have been successful in selling our products to states such as Florida, Maryland, Delaware, California, Illinois, and Missouri. All of these states have very successfully utilized our technology. Yet our home State has not been able to or not seen fit to help us in this endeavor. I hope that will change in the near future.

I'd like to introduce Mr. Joseph Anania.

J O S E P H J. A N A N I A, J R.: Thank you, Stan.

Our firm established our office in New Jersey in 1991. Since then, we have witnessed many occurrences of businesses moving their manufacturing facilities out of the tristate area and into other states such as North Carolina and Georgia, where the environment for additional tax incentives plays a large role in attracting and maintaining new industry. Preserving and expanding our State's diversified industrial and technological base and attracting the nation's brightest talents should be a focal point of a dynamic and vibrant economic policy.

As previously mentioned by Mr. Binder, the recently enacted package of corporate tax credits, which are generally available for tax years beginning after December 31, 1993, includes the New Jobs Investment Tax Credit, a Manufacturing Equipment and Employment Investment Tax Credit, and of primary interest to the electronics industry, is the Research and Development Tax Credit. These credits are intended to provide incentives for job creation, investment, and research activities.

The new jobs credit benefit is taken in installments over a five-year period, while the manufacturing and investment credit and the research and development credit contain a seven-year carry over provision. The ability to utilize these credits, when viewed together with the five-year carry over provisions relating to corporate net operating loss limitations, severely limits the benefits of these valuable incentives to businesses whose needs are of the greatest. Those are the new

and start-up enterprises and technology development companies which typically generate losses during their development phase.

The Federal carryover provision for utilizing net operating losses allows for a 15-year carry over period, which provides an ample opportunity for a start-up and/or capital intensive business to develop and mature into a well-established and productive enterprise. Accordingly, New Jersey should consider extending the period for utilizing net operating losses from the current 5 years to 15 years.

In turning to a different but related issue, New Jersey continues to build upon its reputation as a world-class exporter of manufactured goods. As U.S. businesses look toward increasing their worldwide exports, Federal tax incentives such as the Foreign Sales Corporation and, in its limited capability, the Domestic International Sales Corporation continue to support domestic incentives for increasing export activities. To date, we are not aware of any state which has considered extending a similar tax benefit to its local businesses.

The introduction of this form of tax incentive to New Jersey businesses would be a first and a sign to corporate America that:

- 1) The State is proactive in providing incentives to the domestic exporter;
- 2) The State is providing resources to stimulate growth.

The benefit derived from a Federal level of this Foreign Sales Corporation, for example, is generally limited to a deferral of only 15 percent of the corporation's tax liability on qualified export sales. Once the funds are repatriated to the United States, the deferral terminates and the tax is levied accordingly.

A similar deferral technique or credit would play a major role in attracting new business to the State and would, ultimately, result in increased revenues for the State Treasury.

Thank you.

SENATOR SINGER: One point I would like to make that I think is very prevalent is the biotech industry has the same problem. They are not profitable right away, so giving tax credits to someone who is not profitable in the beginning does not help them. They've also requested that we extend that period, so that later on, as they become profitable, they can take advantage of that. That is a very valid point.

MR. ANANIA: To provide even a little bit more of an example-- Typically, the capital intensive nature of the industry requires the purchase of large equipment. As we see through Princeton, the ability to leverage off that equipment here is very useful. But a company going out and spending \$2 million or \$3 million is generating large deductions in terms of depreciation, losing that benefit, and in five or six years if that equipment is sold, they will pay a tax on the recapture of those benefits which they never ever received. That is not something available. So it is something that I would think would help and go a long way to help foster and retain those businesses within New Jersey.

SENATOR SINGER: Are there any questions? (no response)

Thank you for waiting, I appreciate it. Thank you both for fine presentations.

MR. BINDER: Thank you very much.

SENATOR SINGER: David Vaughn, Manager, Legal Affairs, OKIDATA.

D A V I D L. V A U G H N: My comments today concern the problems of a more mature business, not necessarily an emerging high technology business as I've seen here today; however, many of our concerns are mutual and, if not now, certainly in time as these industries grow.

As I begin my comments today, I would first take time to recognize the efforts of the American Electronics Association

of which we are a member and, particularly, Bob Cummings, for his assistance in making this forum available to us.

Also, I would like to recognize Princeton University, who has provided this facility and their support for this event. Certainly, recognition must be given to the Senator and the panel members for taking the time out of their busy schedules to be here today and, of course, their continued support of New Jersey's electronic businesses.

Few Americans, and certainly very few New Jerseyans, would take issue with the mandate for cleaner air. We have all experienced air pollution and most of us, on a daily basis, can see, smell, and sometimes taste the outrage. It has affected our health and our quality of life.

OKIDATA, situated in both Burlington and Camden Counties, in Mount Laurel and Cherry Hill, employs close to 600 employees in the State, all who live in close proximity to our facilities. In addition, we also have a significant presence in other states, and we are currently working through similar programs in those jurisdictions.

Essentially, we employ two divergent workforces. One professional or office and the other oriented toward production and manufacturing. The two groups are aligned with the facility. The former is assigned to our corporate center in Mount Laurel. This divergence of worker force needs, along with our location, have made a transition under ETRP most difficult.

Like many New Jersey businesses OKIDATA is concerned about their employees and their communities. After all, we, too, are part of the community. When we first heard of the Clean Air Act Amendments of 1990, we felt it symbolized a move in the right direction.

As it worked its way to the states and, in this case, in New Jersey under the New Jersey Traffic Congestion and Air Pollution Act, we all became familiar with a new initiative called the Employee Trip Reduction Program, or ETRP.

Today, thousands of businesses in our State with employee populations greater than 100 have filed or will file their programs under the guidelines. Today, many of us are reeling at the expense and productive man-hours lost as we exit the planning phase and move toward implementation.

At the close of this calendar year, before the first practiced initiative even begins, OKIDATA will have spent thousands of hours of employee time and thousands in consultant and professional assistance fees. Certainly, we want to and have complied and will continue our best efforts to comply with the law, there is simply no dispute there.

However, this initial exercise gives us pause, because the good news of the initial headlines felt in 1990 has become an implementation nightmare. We are meeting obstacles as our locations and methods of doing business leave only a few options open to us.

For instance, we have agreed to provide ride matching, personalized trip planning, a guaranteed ride home; although, we don't know just how that will work out. We've been through the Yellow Pages and no one wants to guarantee us service. The problem there is that we may need to turn to our management staff, and that means increased risk, vulnerability to liability, and lost productive man-hours.

We will sponsor events, offer incentives, provide introductions, create ride matches, provide for financial incentives for carpoolers; in fact, the majority of our plan is focused here. We'll offer defensive driving courses and provide preferred parking for carpoolers. Finally, we'll explore a compressed workweek and telecommuting.

We will construct pilots on these two latter methodologies, and productivity and expense will be monitored, captured, and analyzed. These options offer real concern, for they will change our very culture which chemistry has helped make us successful as a business.

As each element of OKIDATA's program is viewed, you will note something common to each. That is the expense borne by the employer, expense that has to come from our net profits, and expense that will, in part, impede our ability to compete in the marketplace. Any tax incentives or rebates offered to date will do very little to offset that expense, which grows with each year of our planned implementation.

Options available to other communities throughout this country are simply not accessible to us, and many would use them if they were made ready and convenient. The infrastructure to support these options such as improved highway systems with specific carpooling lanes, something as simple as continuous sidewalks to enable people to walk safely from destination to destination, biking lanes, park and ride locations, and I believe first and foremost in our case, accessible and efficient mass transportation, is simply not there.

OKIDATA then looks to the State, county, and municipal governments to seek out innovative, efficient, cost-effective, and reliable methods of full-service transportation for the South Jersey area. Essentially, we are outside of the urban centers where mass transportation is available.

As one commentator stated during the hearings on the new rules for implementation of the New Jersey State statute, "The responsibility for creating a public transportation system cannot be placed on the employer." Yet another stated, "The development of a reliable mass transit system in suburban areas is critical."

In this same public record the response from New Jersey Transit was that they had initiated a new pilot program specifically targeted toward suburban employers. Further they state, "However, public transportation is only one of many strategies."

The oversight here and a challenge we place before our governing bodies is that although there are alternate

strategies, none will prove better than reliable and safe mass transit in our suburban areas. This can no longer be considered one of many choices. It must be elevated in importance, take on a sense of real urgency, perhaps emergency, because of all the options it's our best hope for reducing air pollution.

It is now clear that there must be a change in mind-set. That is, the expense of creating a system must not be placed solely on business, and mass transit is the key.

In conclusion, we solicit your support and the support of the entire State Senate and Assembly to find ways to eliminate these costly burdens on business and raise the level of urgency regarding mass transit.

Thank you.

SENATOR SINGER: Mr. Vaughn, I appreciate what you're saying. I represent South Jersey in my district. I have 13 towns in Burlington County. There is no mass transit.

MR. VAUGHN: Exactly.

SENATOR SINGER: Many of your employees -- I'm familiar with your company, though it's not in my district, it borders my district -- if they do not have the availability of their own private car, they just can't get to work. That's not going to change.

Unfortunately, car pooling sounds good, but everyone comes from different directions, and there are not major highways to interconnect. There are a lot of back roads and county roads that just really are not conducive for areas for parking or car pooling a van from there.

I believe, at some point, a lot of these things will be taken into account, and there will be some adjustments for firms like yours in rural areas. We tend, in government, and especially in this State many times, to think that everyone lives in a city area where there is train transportation or bus transportation, or something else like that. Therefore, it may be a little inconvenient, but it's not impossible. That just

will never happen in our State based on the rural areas that we represent, and my area is extremely rural. There will be something looked at in that, and we understand that it has been quite burdensome and very costly to business.

MR. VAUGHN: Thank you, Senator.

SENATOR SINGER: Thank you very much.

Tom Werthan, CFO, EMCORE Corporation.

T H O M A S G. W E R T H A N: I think Dave just provided me with a great incentive to keep our employee base below 100.

Thank you for the opportunity to present some testimony here today. As Chairman Singer indicated, I'm Tom Werthan. I'm the Chief Operating Officer of EMCORE Corporation. We're a manufacturer of compound semiconductor equipment. We're located in Somerset, New Jersey. We distribute worldwide, and we just celebrated our tenth anniversary, all of which has been in New Jersey.

SENATOR SINGER: Congratulations.

MR. WERTHAN: Thank you.

I'd just like to briefly touch on three subjects today. They include exports, financing, and finally, just some comments on environmental concerns.

Let me start with exports. Before I even start, let me just say that it is an incredibly emotional area for me, and if I sound angry, I probably am angry. I apologize for that up front.

Historically, EMCORE has generated a significant portion of our sales on sales to Pacific Rim companies. About two years ago or so, we made a strategic decision to try and enter the People's Republic of China because we felt in the new world order China was going to play a major role in the world economic picture.

In fact, I can remember sitting in a small restaurant on the outskirts of Beijing being entertained by our gracious hosts with, literally, chickens running around by our feet,

trying to be a gracious guest, partaking of their delicacies -- including fermented snake blood and fish intestines -- being very nice, and saying to myself, "If we don't get this order, I'm going to be very, very upset." To add to that, when I got home my wife wouldn't kiss me for a week or so. (laughter)

In any case, to make a long story very short, we were successful in finally obtaining an order from the PRC. Unfortunately, then the hard part began. We were denied an export license by our government.

After a huge letter-writing campaign, the involvement of Senators Bradley and Lautenberg, Congressman Franks, Governor Whitman, and the New Jersey State Department of Commerce -- especially Carlos Kearns -- we were able to touch the right buttons in Washington. We had numerous meetings down there. Finally, we were given a verbal assurance that we would receive an export license.

Unfortunately, last week we were denied once again. We really have no where else to go. We had to tell our client that we could no longer supply him an EMCORE system. To me there is just absolutely no legitimate reason for this denial, especially in light of the fact that Secretary of State Christopher, Secretary of Commerce Brown, and Secretary of Defense Parry all visited the PRC in the last year. They all touted Chinese/U.S. relations. They all touted Chinese/U.S. trade. They all touted U.S. investment in China, not to mention the Most Favored Trade Status granted to China.

We have a major competitor in Germany that we have been able to displace, at AT&T in this country, HP in this country, and other corporations around the world. They are shipping into China. In fact, we showed evidence that they violated COCOM, when COCOM was in effect about a year or so ago, by shipping into China.

In addition, there is other technology that is similar to MOCVD that is being allowed to ship from this country into

China. Needless to say, we feel that we are being singled out and we're just not sure of the reason. We haven't been given a satisfactory reason. So the net of that is that we are going to be effectively shut out of what may be EMCORE's largest market.

If we suffer a business downturn, I would hate to have to tell my employees that although our technology is the best in the world and we were the vendor of choice, we can't ship because we're just not allowed to with no good reason.

I think it goes without saying that what the Director of POEM Center, Steve Forrest, said -- he's indicated a lot of high technology in this room here today -- if it could happen to EMCORE, it could happen to anybody. I hope that doesn't happen. I hope we can correct the situation.

The next topic is financing. As a capital equipment company, a lot of our cost of sales is in the components we buy to build our systems. Oftentimes, we get advanced payments from customers which makes it quite easy to fund the inventory. There are times that we don't.

Thank heavens for the New Jersey Economic Development Authority. They have an export line of credit where you can borrow about \$250,000. It's a terrific program. EMCORE has utilized it many, many times.

You, essentially, assign a letter of credit that was given to you by your customer to the NJEDA and they cut you a check for \$250,000. The fact that it is at the low interest, below prime interest rates, doesn't hurt.

If we have any complaints about it, it's as an equipment manufacturer. We sell systems that we sell for upwards of \$1.5 million. Therefore, the cost of those components going into that system far exceed that cap of \$250,000. There are times when we have two or three of these systems in our backlog all supported by letters of credit, but we can't borrow against them because of the cap. Any

legislation that could possibly increase that would be greatly appreciated.

From a selfish point of view, if you look at EMCORE and the New Jersey EDA, I think the risk to the EDA is quite minimal because they have as collateral an irrevocable letter of credit from our customer. EMCORE has shipped in excess of 100 systems since inception. We have never not delivered a system where we have taken an order for, we have never not been paid for an order that we've shipped.

Finally, just some environmental concerns. We do utilize various chemicals and gases in our operation. We employ a sophisticated monitoring device that takes readouts continuously throughout the day. As a small company, we employ a full-time safety coordinator with a Bachelor of Science in safety sciences. Our insurance company has a safety program in which we participate. We have a safety manual that all employees have and are very familiar with. We have periodic drills. We use licensed contractors for any disposal issues. I guess what I'm saying is we're just perfect.

I know that there is going to be a need, probably, for expansion in the future at our facility, based on past history. We're not doing anything yet, but based on past history or past experience, there are going to be problems obtaining the variances of the permits that we're going to require to expand our facility.

In closing, I would just like to say that our lease expires towards the end of 1995. We are negotiating with our landlord. We are listening to Pennsylvania and North Carolina. Give me a reason not to move out of New Jersey, because we really enjoy it here.

Thank you.

SENATOR SINGER: Thank you for your presentation, and I hope you enjoyed your meal in China. (laughter)

There are a few comments here I would like to say. First of all, the new Commissioner of the DEP, Commissioner Shinn, is business oriented and is making major, major strides to cut through the redtape, to cut through the bureaucracy, and really help business, and I think he is.

The Department of Commerce is going to have one-stop shopping in that area very soon. I think you'll find it smooth sailing in that direction.

As to New Jersey, and not touting where you are now, there are areas that a company such as yours can work to. We have six -- the most recent one was in Mercer County -- Free Trade Zones, which enable companies that do import or export things to avoid the custom duties until such time they're disbursed in this country. If you import certain items, you would pay no duty until you ship to this country or shipped them abroad, you pay no duty at all. That is a Federal status, but there are six of them in New Jersey.

There are a number of -- there have been seven more created -- Enterprise Zones, UEZs, which might be very advantageous to a company like yours, because during the first five years in those zones, the sales tax that is collected in the area for qualified companies is reduced from 6 percent to 3 percent.

What does that mean? The 3 percent stays locally to be loaned out to local businesses for economic development, expansion, and anything else like that. You're talking some of these areas would have \$6 million, \$8 million, \$10 million available each year to loan out to local companies.

So there are some things in New Jersey that you can take a look at, and they've expanded it so it's not just the inner city type of situation. Maybe I'm not supposed to say because I'm the Mayor of Lakewood, but we just became the newest UEZ zone. We have the second largest industrial park in the State, so come on down. But I'm only saying to you--

MR. WERTHAN: I would like it. I live in Freehold so it would be terrific.

SENATOR SINGER: But I'm only saying to you there are some things the State has done to work in that direction, and we want to continue doing that.

I really can't help you too much on the status of being able to ship to China, but I appreciate what you're saying. Sometimes there is a double standard in government and no one can really tell you why not. You should have a clear understanding as to why you were denied and why similar technology from this country is being shipped there. But, more important, if your competitor is shipping there now, what are we hiding?

MR. WERTHAN: That is our point exactly.

SENATOR SINGER: That becomes the bureaucracy at its worst, and I, unfortunately, can only tell you that maybe we can cut through that in some understanding. I will mention it to Commissioner Medina. As a matter of fact, we'll generate a letter from this meeting to him asking if he can inquire through the Governor's Office directly to the Federal level -- maybe Senator Dole -- as to how we can at least justify if similar technology is being shipped from competitors, why we're holding back.

MR. WERTHAN: We appreciate that. Thank you.

SENATOR SINGER: Thank you. Wait, there is one question.

DR. COHEN: I just think, even on a simpler level-- The camera we have in the back of the room requires an export license, as well as some of its simpler cousin products, and we've shipped all over the world. We've never been denied a license, but when we want to ship to Holland, or England, or countries you would normally think of as our friends, the paperwork is backbreaking. More than just backbreaking, it's difficult for a new company to learn how to do it. I think one

of the things the State could do is help foster education programs, seminars, just ways to help a new company get involved in an export business, because--

SENATOR SINGER: We have those. We have a whole area on that that is presently here now, that is available in this State. Part of the problem we have in State government is getting out the information to groups that is available. But it is available through the State. We have an entire part of the Department of Commerce that talks about exporting and how you can export. They bring in that thing so we do have that now.

MR. WERTHAN: We have found programs terrific. We have no problem exporting anywhere. In fact, I think there is a program Monday at the Meadowlands you might want to look into.

SENATOR SINGER: By the way, just on a side note that makes it very interesting, we found out the DEP, for example, in bioremediation, does not have the qualified people on staff there to make a determination whether the new technology is viable or not.

We are drafting legislation that should be out sometime soon that will require an advisory panel of scientists to the DEP who will look at emerging technology and approve whether it can be done either on an experimental basis within the State, on property here, or be granted a license to do so.

I'm concerned that with the high technology that you're coming out with is there really that expertise to make that determination on the Federal level, whether it is something that should be shipped or shouldn't be shipped? Really, who is making that decision? It just bothers me that some person in some back office some place, who really doesn't have that expertise is saying, "No, I'm afraid of this." So maybe we have to look at that too. That might be an interesting aspect.

DR. AYRES: I have a comment, too, just to put things in perspective. It has just dawned on me, listening to the presentations, that we have seen everything from the final

product of the camera, to the integrated circuit and photonic device that goes inside the camera, to the equipment that makes that chip. I remember earlier from the photograph that we saw -- the stainless steel vessels and all -- that is that device, and our company makes the gases and the raw materials that feed into that device that makes the chip.

So the electronics and photonics industry spans all the way from chemical manufacturing of the chemical gases that go into a manufacturing process that makes the chip and then goes into a final product. So our concerns are not just narrow, they are with the DEP, they are with financing, and they are with exporting.

The major problem we have with the DEP is it, the last time I looked, still has like 4000 people and a budget of \$200 million a year. There aren't many companies in the State that are that large, so when you're up against that-- My own experience in calling them is that it is very difficult to get answers just because, as I think you're pointing out, there often isn't the expertise. Even to go to outside consultants or panels, that slows it. So there is a need for companies to be able to present their own solutions to the problem and have those solutions looked at, rather than mandated from some central agency.

SENATOR SINGER: I would just say, not that I would ever think that I have to defend the DEP, I don't want to, but as Commissioner Shinn has stated, it has taken years to build up this bureaucracy. It's going to take him some time to bring it back to where it should be.

One of the problems which has always been our gripe from the DEP is its incentive has been fines. Their budget, different from any other budget in the State, is based on the fines they collect. So there is an incentive there to get you.

This is the last year it is going to be funded this way. In '95, the budget will have them being funded-- Their

money is going to come into the general till, and they're going to be funded like everybody else. So, if you want to fine, go fine, but it's not going to help your job or keep your job by doing that.

I think that is going to go a long way with a different attitude. We're here to help people, we're not here to punish people. We're not talking about the bad actor who does it intentionally. We're talking about people who generally have problems working with them. So I think under Commissioner Shinn and the direction of the Governor you're going to see a positive change. But that might be something, again, we have to look at as something if there were to be a Task Force set up to do--

Ms. Russo?

MS RUSSO: I was just going to say, remember, too, there is a new office in the Department of State, the Business Ombudsman. I was just at a Business and Industry function and they are really trying to promote this. It is another place where you can go and they can help you, not just with the DEP but primarily.

On the export licenses, I also wanted to point out that PSE&G works very closely with the State and they've got a lot of programs. I know my company has worked with them. I can send you some information. They're wonderful also, and they do work with the State on helping companies get to that export.

Since the subject of export licenses came up, on behalf of the biotech industry, I just want to put on the record that this is an issue for us, too. What happens here is that if a company is producing, they've got a product, they're in there at the clinic, and they're starting to anticipate their approvals, if that approval is going to occur -- typically it does outside of this country first -- then that company has to consider what they're going to do to manufacture.

All of the paperwork, all of the difficulty involved with getting an export license usually is the thing that directs a company to establish their first manufacturing facility outside of this country. Their approval comes quicker in foreign countries, and the export licenses make it prohibitive for a biotech company, a small company, and, I'm sure, some of the big ones too, to even consider putting in a manufacturing facility. They would rather get that approval in the United States and import that product. That is ludicrous, but that is certainly something--

Perhaps at one of these Task Force hearings we can invite somebody from our Federal government. I know Congressman Zimmer sits on the Science and Tech Committee. Because there are some issues that maybe we can at least highlight.

SENATOR SINGER: Good point.

Vic?

MR. McDONALD (Senate Majority staff): Just one point, as far as your particular situation. What happened earlier last month, as far as the sweep that went through the national Legislature, I think the whole atmosphere there is going to be much more amenable to your situation. I would actually suggest retracing your steps a little to try it again. It's amazing--

MR. WERTHAN: We don't give up easy, so--

MR. McDONALD: Just some of the breaks we've gotten on the State level since the November elections-- There is a new flexibility.

SENATOR SINGER: Is that because of the Republicans?

(laughter) I don't like to-- This is a bipartisan Task Force.

MS. RUSSO: I want to see that chip they're going to name Newt. (laughter)

SENATOR SINGER: Thank you.

MR. WERTHAN: Thank you.

SENATOR SINGER: Thank you very much.

Nick Zwick, COB, Dialogic Corporation.

N I C H O L A S Z W I C K: Good afternoon. I'd like to thank everyone for allowing me this forum today. I'm Nick Zwick, Chairman of Dialogic Corporation. We're located in Parsippany, New Jersey. I'm one of the founders of the company, which was started in 1983. We've grown from nothing over 10 years ago to just over \$120 million in sales this year.

How we do that is we develop the market software and hardware components that are used in automated call processing systems. Examples of that would be when you do telephone banking, that's a call processing system, or voice mail would be another example of how those components are used. So the technology we offer puts us at the heart of a new market that is emerging that's now called Computer Integrated Telephony.

Our activity at Dialogic is a mix of software development, other types of R&D, marketing, along with subcontracted circuit board assembly. I should point out that our primary subcontractors are also in New Jersey.

We sell on a worldwide basis with approximately 30 percent of our sales going outside the U.S. We directly employ about 540 people, three-quarters of those are in Parsippany. Our sales are growing at about a 30 percent rate as is our employment.

I believe we are fairly typical of a high-tech, high growth company that is producing job growth and economic growth for the region and typical of what any region would want to nurture if it found a company like us in the region or would want to attract if we were outside the region.

The growth I just described is really not very easy to sustain. I believe it's even more difficult here in New Jersey than it would be if we were located elsewhere. I'll touch on three areas where we experience this.

The first one is interaction with some of the regulations. The second is the ability to recruit and keep talent. The third one is the difficulties in expanding locally.

We find that many of the regulations that we're required to comply with were produced with a model of a stable factory or an office business in mind, not a high-tech, high growth company as a target for that regulation. Many times, that produces a result that is the opposite of the intent of the regulation when it is applied to a company such as ours.

An example would be -- although this didn't happen -- the Clinton health care plan, where Dialogic already offered a benefit that is above the standard that the Clinton plan had in mind. But, in order to comply with it, we would have had to scale back things in order to not be overcome by the expense of it.

Another example would be the Employee Trip Reduction Program, and I echo Mr. Vaughn's comments earlier. That just doesn't make sense for a company that needs to provide a great deal of flexibility and has a high growth rate.

On the recruiting front, recruiting technical and marketing talent is very key to our success and our growth. While we find good talent locally here, it's not enough. We can't find enough locally to sustain the growth rate that we need to maintain to remain competitive. That is especially in the specialized areas of telecommunications and computer technologies that we emphasize. The center of expertise for those technologies are in Texas, North Carolina, California, Washington State, and other states around the country.

We find it virtually impossible to recruit from those locations into New Jersey for two main reasons. The cost of living as it is embodied in the cost of housing, the tax rates, the insurance costs, etc. The second one is just the perception of the quality of life here. I disagree that the reality is much different, but the perception is that we have a high crime rate and our education system isn't as good as it could be elsewhere.

Regarding local expansion, we recently went through an expansion in Parsippany where we have taken on more than triple the space we had before. We thought that move would have been welcomed by the town and the State and, initially, it appeared to be. But as that process wore on, we experienced much cost, delay, and complexity that we thought would have been unnecessary for such a move. Special testing and inspections were required. We were forced to make changes in our design, even though the existing design was within the code.

On the plus side, we did receive the necessary variances fairly quickly to allow us to plan for an internal manufacturing option if we should decide to do that. But the lack of dual-use space in the area kind of compounded that decision.

To summarize, the result of all of these things is that our future growth and expansion plans will likely focus on the possibility of expansion outside of New Jersey. The difficulties that we encountered here, relative to some of our competitors who are located in what I would call more efficient areas, coupled with some of the incentives that are provided by other areas, would compel us to seriously consider that approach. I wouldn't say that we would move the existing facility, but when we do expand we would have to look hard at doing it outside of here, rather than continuing to grow in New Jersey. I hope that doesn't become a reality, but it is a concern that we have today.

Thank you.

SENATOR SINGER: I have heard your comments loud and clear. I must tell you that Central/South Jersey is more user-friendly in many cases because we are so in need of bringing high-tech companies and high paying jobs to our area. We do tend to streamline things.

MR. ZWICK: More so than northern New Jersey?

SENATOR SINGER: Yes. Not that I want to put north against south, but very, very honestly, with the need for ratables with the appreciation of it, there are tax abatement programs, there are other incentives available -- that one-stop-shopping, hand carried through the boards. The idea is that we thank you for being there. It has happened.

Hopefully, that will change in the area you're in, too, a little bit. But there are areas of the State that welcome your type of manufacturing, your type of business, and that would do handstands to attract you there. So I would hope that if there is that feeling, before you would look out of State, you might look in-State and see where there is--

As a mayor of a town, I appreciate what you're saying. If the local government does not have a positive attitude, it doubles the problems you have. They can delay you months, just in going in front of boards, inspectors asking ridiculous things that, certainly, can be taken care of, forcing you to go back in front of boards, permitting delays, other delays, and anything else like that, in making certain accommodations.

That is the purpose of our Task Force. Everything is not just a broad-brush approach to business in this State. There is a specific need to do things like that, and we're going to follow up on this, because I'm quite concerned when a company of your size says, "We like New Jersey. We want to stay in New Jersey, but you're making it impossible for us to do so."

Thank you.

MR. ZWICK: Thank you.

SENATOR SINGER: Robert Lagno, President, Airtron Division, Litton Industries.

ROBERT A. LAGNO: If you don't mind, we'll also use the overhead? (witness uses overhead projector)

SENATOR SINGER: Absolutely.

MR. LAGNO: First, let me thank you for the opportunity to appear here this afternoon.

Airtron is a division of Litton Industries, which is a \$3.5 billion corporation. Airtron has been in New Jersey since 1949. The division is a \$50 million division that employs about 330 employees, with about 210 residing in New Jersey. We are a member of the AEA, so we have been invited here today based on their arrangements.

Although Airtron is considered large business because of our Litton relationship and our sales volume -- we are not privy to the SBIRs and other small business assistance -- we have, over the years, developed several photonics related businesses, two fairly large ones, in fact.

One is a laser electro-optics business, where we are the world's largest manufacturer and supplier of solid-state, single crystal materials for the 1 micron laser and the general visual to infrared/near infrared range.

We also, in New Jersey, have the world's number two supplier of a semiconductor material, gallium arsenide, you've heard a lot about that today. We grow single crystals and fabricate substrates for the device manufacturers, and some of the things that are in Greg's videcon are our substrates. We're number two in the world, number one in the United States.

So, as you can see, the development of photonics in the State of New Jersey, as supported by POEM and the various assistances, and our work, which is internally funded and also from some Federal government programs, has developed a fairly good business at Airtron. The next important thing is to keep it here.

I was very happy to hear some of your comments relative to the State DEP, but if I might, at the risk of being redundant, share with you just a few of my frustrations?

SENATOR SINGER: Please.

MR. LAGNO: Maybe you can raise that a little, Paul?
(referring to overhead projector)

Just a few comments relative to the impact that the regulations have on our operations. First of all, we're certainly overregulated. I don't need to expand on that. The enforcement is punitive rather than cooperative. I'll go into that with a few examples. This one I was very happy to hear your comments about, because I don't feel it should be totally funded by fees and fines. I think there is legislative action required to limit the continuing negative impact of our regulatory infrastructure. That is not only State but it goes for Federal, as well, in my mind. The bottom line is that in my experience, over the last 10 years, I haven't seen the environment benefit from our regulatory process and the effective cleanup of all of the problems.

We have a groundwater problem at Airtron that stems back to the '50s. We haven't even started to do the first step of cleanup; although, we've spent over \$2 million in investigations, legal issues, ACO development, and all that good stuff.

Next line, Paul.

Some typical examples-- This is not a State issue, but-- We have a PCB transformer that has not leaked a drop of oil, but about 1987 there were some additional regulations which required some inspections to be made and documented and notification of the local fire chief.

We had, when a Federal inspector came in about two years ago, all but one set of documented inspections and that was for the first year. We didn't have the documentation that the fire chief had been notified; although, the existing chief was well-aware of it.

We were initially fined \$60,000 for that infraction; although, we had every record since then, for the many years that the transformer was properly inspected and is in A-1 shape. We subsequently negotiated that to \$16,000, but in my mind that is severe.

We have a problem with our groundwater, and control of the prune was found to be, based on some of our remedial investigations, kept under control by the pumping of a neighboring company's well. It forms a cone of depression and pulls any of the contamination to that effluent. Our groundwater is not impacting any potable water sources. We've already determined that.

But because of some recently enacted legislation and increased tightening of the specifications, our neighbor was very concerned that he could now -- because the effluent he was pumping and discharging to a local river was dangerously close to the limits -- be faced with onerous fines, so he stopped pumping. We could not convince him nor the EPA to allow us to take control of his pump and continue to pump or even put filters on it that would have kept it within spec while we went and put another source of remediation in.

We still, to this day, haven't begun to pump. It was over two years ago when this happened; although, we are now finally installing a pump and treat system.

The point here is that I think some sensible regulatory flexibility should exist, so that when you have some sort of a problem like this, people don't just say, "Well, those are the regs, and if you exceed those, you're going to be fined and that's the end of it." So people were doing negative things relative to the environment because of the regulations, that is the point here.

Administrative Consent Orders is another issue we have been dealing with. It has taken us several years to negotiate with the State of New Jersey and ACO to do this remediation and cleanup. In my mind they're burdensome with State oversight. In other words, business would not operate this way. If you have a problem you take an engineering approach, set some specifications, then go ahead and build a system to deal with it, and check to see if the system works.

But with the State regulatory system it's, "You do this and then you send it to us. You've got so many days. Then we'll have three-times that much time to look at it. Then we'll get back to you, and we'll tell you what we want you to do next and so forth."

So you spend months and years just protecting yourself legally in that respect -- in developing these ACOs -- and then the bottom line is if there is a dispute there is no resolution, because you cannot have a dispute resolution clause in an ACO. So companies are very wary of these things. It's a very difficult situation.

So those are some of my personal experiences, and I would like to share with you just a couple of suggestions. First of all, the punitive regulatory system should be replaced with performance based regulations.

In other words, develop the specifications that need to be met as far as the groundwater, the air, whatever, and then allow industry with the help of consultants to develop the systems to do the job and not have so much oversight. It takes a lot of people. That is a good way you can cut that budget. Just get rid of all those guys down there getting in the way.

SENATOR SINGER: People, we say. Not guys, people.

MR. LAGNO: People, okay, all right.

The State regulations should not be more restrictive than the Federal, and we have many cases -- I won't bore you with them now -- where the State regulations are more restrictive. I think we should eliminate the environmental bureaucracy and replace it with a more business-like organization, incentivized to cooperate with industry in cleaning up the environment. The oversight should be restricted to determining if remediation is in conformance with the requirements. It should not be dictatorial. Basically, that's it. I know you've heard these things a million times before, but I would just like to reinforce it till we see some action.

Thank you.

SENATOR SINGER: Thank you. Let me say to you that there is a piece of legislation that is working its way through the Legislature. It is coming back for concurrence from the Governor's Office, again, on standards going to Federal standards and not having State supersedment. So that is being worked on now and, hopefully, will be signed into law within the near future.

I sit on the Environment Committee for the State Senate. We are looking at adjustments in the Clean Water and Clean Air Enforcement Acts to be more realistic about it. We have a concern that-- We talk about industry and cleanups -- we want to get them cleaned up, and the more roadblocks that we put in the way, the less cleanups are happening. Second of all, it becomes so costly at some times that they're just backing away.

The irony of the whole thing is that government is not exempt in that. We are going through, in every town in this State, removal and cleanup of oil storage tanks. In some cases, to the tune of hundreds of thousands of dollars. There has to be a less expensive way to do it. We're going broke doing it. School boards, every school has them, townships have them, so there are-- I think these cries are starting to be heard. So the fact is, that though some of the restrictions that industry has been feeling for years are now working their way down to government itself, people are now taking a second look at it.

MR. LAGNO: I'm happy to hear that because, you know, I breath the air and drink the water like everyone else does. As a responsible businessman, I don't want to pollute anything. I want to be squeaky clean. But it just seems to me that the way the Federal and State bureaucracies are going about it, they're taking a fairly simple problem and making it very difficult and protracted.

Thank you.

SENATOR SINGER: Thank you for your testimony. We appreciate it.

Ron Rosenzweig, CEO. Is Ron here? (affirmative response)

Sorry to keep you waiting, Ron.

R O N A L D R O S E N Z W E I G: It must be 3 o'clock. (laughter)

SENATOR SINGER: No.

MR. ROSENZWEIG: Hi. My name is Ron Ronsenzweig. I am the President, CEO, and one of the founders of Anadigics, which is a company that makes integrated circuits in Warren, New Jersey, Somerset County.

I've been involved in starting up high technology companies in the State of New Jersey since about 1970. This is the second company I've started, and this is the first time I've had an opportunity to speak to a group like this from the State of New Jersey.

I want to thank Chairman Singer and his group for spending the time to hear what we have to say. So, for me, it's really kind of a first time to have a chance to see how the State can help us run our business better and be more effective competitors. I appreciate the opportunity.

Number two, I'm here really, in a sense, representing the American Electronics Association -- I have been on the board and the executive committee in the past -- which is, I think, the largest industry association for the electronics industry, representing about 3000 companies U.S. wide. It has been a major voice for the electronics industry in the United States. There is a local chapter or council here, of which many people here--

I think it's very important for the State to understand that there is an electronics industry in this State that is very, very important to the jobs and economic growth of this State, and that there be a dialogue that is set up

continually not only through companies like Anadigics and the State but also through the AEA as a spokesperson who can coalesce an awful lot of these voices.

I think what you are hearing today from a number of companies -- I was checking them off -- is that it is probably not known to a lot of people, but there is an underlying technology that has developed in the State of New Jersey through places really like Sarnoff, or what was RCA, Sarnoff Labs, and Bell Laboratories which really fuels almost everything you heard about today, and that technology is gallium arsenide. You've heard about it a number of times.

Not to give a science lesson, but to put it in perspective, gallium arsenide material has two unique properties. One is it emits light and detects light, and so the whole photonics and optoelectronics kinds of things you've been hearing about today are predicated on that material.

The other thing that material does is it makes electrons move very fast in it, so it makes very high frequency devices. Those devices are used in radio frequency applications, high-speed switching, and that sort of thing. That is the reason both AT&T and Sarnoff really invested in that technology. Our company also builds products with gallium arsenide. We make integrated circuits with that technology.

As I've traveled around the country and been involved with the AEA in other places, I've always tried to portray, because I think it's important-- I think the previous speaker talked about the difficulty in bringing people into New Jersey. One of the reasons is it's not really known as a high technology State, despite the fact that the transistor was invented here in Edison and all these wonderful things.

But the phrase I use for New Jersey is, I call it Gallium Gardens, for gallium arsenide, because fundamentally it is a unique capability that exists in this State. To offset the kind of Silicon Valley kind of a thing, we have a very important

technology base here in this State that goes through companies like EMCORE, that makes equipment that grows gallium arsenide; to POEM, that makes lasers with gallium arsenide; to Airtron, which grows wafers with gallium arsenide; to Anadigics, that makes integrated circuits on gallium arsenide; to Epitaxx, who makes detector diodes on gallium arsenide.

So it is very important and I think it's something that as you go around, as you think about things, and you think about the State, it's important to think about it as really a center for a unique type of technology that is based on this type of material. So I, for one, promote Gallium Gardens as a theme for us to try to attract people from around the world to come here because they know this is where the best and the brightest are in that business. That is a plug, a plug for the State.

SENATOR SINGER: We take plugs all the time.

(laughter)

MR. ROSENZWEIG: Anadigics is a company that started in 1985. We've now grown from three people -- the three founders of the company of which I'm one -- to about 250 people. We added about 50 people in the last year. The company is growing at about 30 percent to 40 percent a year. The last two years we've made the INC. 500 list among the fastest growing companies in the United States.

What we do is we make integrated circuits for the information superhighway. So we are making chips that go into cable-set top boxes, into satellite dishes, into cellular telephones. We have taken this gallium arsenide material -- this technology -- which in most people's minds is associated with very expensive defense kinds of things that cost \$100 a piece, and turned it into a consumer electronics kind of product.

We take these products and sell them, actually, worldwide. About 80 percent of our sales are export. We sell

aggressively into Europe and also into Asian Pacific. Now, it also means that we compete with companies in Europe. We compete with companies in the Asian Pacific area, Japan, Korea, etc. We also compete with some of the big aerospace companies in the United States, many of them are in California.

So to do what we're doing, which is taking this technology, making high-volume consumer types of parts, to really go with what the Japanese think is their major strength, is a tough business. It is not a business that is easy. We've been able to excel in this. Finally, after a number of years, we have been profitable for the last couple of years and we're growing quite rapidly.

It would be nice to have as a partner, as we grow, the State of New Jersey backing us. Because what we think we're doing is providing the right kind of image, the right kind of jobs, the right kind of business for the State. By and large, the State has been okay.

We're in, as I said, this kind of gallium arsenide material, which is involved with the DEP, OSHA, and all these types of regulations, so we've been hit with them as much as anybody. We've had lawyers come in. I've had my Miranda rights written to me that I have to know where everything is taken. Because if our effluent is taken to the wrong place, I can get thrown in jail. We've had to deal with those types of issues. It is something that is part and parcel to the business. I don't know what it's like in other states. We do it here.

When we had to build our factory, of course, all the various State regulatory groups had to come through and take a look at it. Somebody made the comment about the lack of technical expertise that is under DEP and some of these places. They drove us crazy for three months on something that was ridiculous, and they missed something that actually could have been serious. I wouldn't have minded if they focused on what

was serious because we had handled it, but they didn't even notice it, in fact.

So you have this kind of bureaucracy that exists and, after a while, it becomes, you could say, laughable. But it is something you just deal with as a pain of doing business. Because it's not intelligent in the way it deals with you.

But my pet peeve today is one that you have heard twice. I'll lend my testimony on that basis. While we're trying to run this business we have global competition. We have NAFTA now, which is going to make things even tougher probably; although we supported that. We have GATT approved, which is going to make things more effective in export, but is also going to bring in more imports. So we're dealing with this whole thing. We're growing jobs. We're adding people.

All of a sudden, we have the New Jersey Traffic Congestion and Air Pollution Control Act to deal with. It is really-- I mean, I have dealt with the DEP, I've dealt with OSHA, I've dealt with all of this stuff. This is the stupidest thing I have ever seen in my life. We have some kind of a-- We came up with-- I mean I have a guy working full-time on this.

Every dollar I've spent-- If you're familiar with the stock market, we would like to take our company public. You can value the company at 20 times the earnings. So, if I spend \$100,000 on this, it reduces the value of my company by \$2 million. I have somebody working on this thing. I have him writing reports. I just did a-- We have a company newspaper that went around. I spent one full page on this newspaper on the Employee Trip Reduction Program. I have meetings, I have three certified people working on this thing. I have no idea where it's going.

Based on where we live and what we're doing, we have a ratio-- I think we have to achieve 1.38 drivers per car. We're now at 1.07 in two years. (laughter) I'm trying to hire people. I'm trying to build a team. I'm trying to get people

to work in an effective, efficient-- I'd like to come down here. If I'm part of this program, I can't get here. How do you get from Warren to Princeton? Does anybody know if you don't get in the car? Do I have to have two people in the car in order to--

SENATOR SINGER: You come down with the Speaker, Chuck Haytaian. (laughter)

MR. ROSENZWEIG: Exactly, exactly.

I don't know what you can do. I recognize that it is a Federal mandate of some kind, and the State is working on that thing. But I have been in more meetings on this project and wasted, in my estimation, more management time, more engineering time. I don't even know where it's going. We have to make a good faith effort, so we're making a good faith effort.

You know, 1.38, I have to start researching telecommuting. I have to start researching all different kinds of ways to get people, when all I want to do is try to become a more efficient company, so I can grow and add more jobs. So you run into the situation where the good news is you hired more people, the bad news is you've got too many people driving to your place. It's a real problem.

SENATOR SINGER: At some point the State is going to address the problem. We have no alternative. Part of the problem really is, and I'll be very honest with you, we probably receive more pollution from out of New Jersey than in New Jersey based on our surrounding states. That has been our big outcry. We're being tagged with that problem.

The flipside of the coin is that we all think California is the worst state, but we have a pollution problem every day in this State. So there is a real problem. The question is: What is going to realistically cure it? This sounds very good, and when you look at the scheme it's wonderful, but where you are--

You know, Warren County to Burlington County are very similar. These are rural counties. There is not mass transit, nor could there ever be affordable mass transit or regional mass transit. It might work for a hospital. I can tell you that with 2500 employees everyone has different shifts, everyone comes from different areas. What are you going to do? Well, they're going to exempt hospitals. They're going to exempt police, and you're saying, "That's wonderful," but what about the private sector?

MR. ROSENZWEIG: That's right. That is why we're 1.38, because the rest of them are one to one, so it falls on the private company. That has to make up for the-- You have a State that -- really, one of its advantages is its highway system. That is one of the advantages of this State.

You know, it's funny, I call on customers in Japan and every plant I visit in Japan is by a train station. So, in fact, if you go to Japan you can, in fact, go to work by getting on a train. When you get off the train you walk two blocks to work. That is reasonable.

SENATOR SINGER: Well, you must also realize that people who live and work in cities are used to walking. In rural America, everyone has to park by the door. You can drive into a mall and there is this parking lot with parking spaces all over the place, but you have to be right to the door. God forbid you should walk that extra 100 feet. So there are some problems that are unique to suburbia, and where companies are located is the problem.

Do you have any questions?

MS. RUSSO: I just have to say that I have done ETRP for my company. It involved a government agency. They saw government relations and they figured this was perfect. We're at 1.05, okay, and we also-- You're ahead of us.

MR. ROSENZWEIG: Yes, we're at 1.07.

MS. RUSSO: We're in Piscataway. There is one way in. Well, maybe two ways in, two ways out, but no mass transit. It is unbelievable. But we thought, "Well, we don't have much money. We're a growing, emerging company so we're going to look at-- So we decided we will do this shifting out of peak, which the employees are loving. We estimate that it's going to cost us over \$10,000 a year to keep our buildings open. That is extravagant.

MR. ROSENZWEIG: Well, we're three shifts, so you can't do it. You have to have people-- It is a very collaborative kind of a process. You can't just have people-- We're thinking about telecommuting centers and whatever. We did a distribution of where all the people are, and they're splattered all over the map from Pennsylvania to New York.

MS. RUSSO: There might be a good business in those telecommuting centers.

SENATOR SINGER: I'll just lastly tell you, that if you ever want to think that we're exempt from the bureaucracy also, I had the pleasure of building my own house recently. If that doesn't teach you what bureaucracy is all about, believe me, it does.

MR. ROSENZWEIG: Right, right. Well, thank you very much.

SENATOR SINGER: Thank you.

DR. BRANDINGER: Ron, I'd like to ask you a question. Who is your main competitor in gallium arsenide?

MR. ROSENZWEIG: Our main competition, actually, comes from what we call alternative technologies. That is, we're replacing existing technologies, and our main competition comes from the old technologies. We've been able to carve out a niche where we have a sole source position pretty much on everything that we get designed into if we can design out the old technologies.

Potentially, we would have competition from Fujitsu in Japan, from NEC in Japan, from OKI, Mitsubishi, some of the big U.S. aerospace companies like Rockwell, it could be Thompson and Phillips in Europe, those are the types of companies.

DR. BRANDINGER: With the implementation of GATT and the opening of the borders from import/export on that basis, what is it that you foresee that you're going to have to do to, in fact, keep your competitive advantage relative to these other organizations?

MR. ROSENZWEIG: Well, one is we see it as an opportunity. We believe, per the conversation before about going into China, our kinds of products used to be highly restricted. Actually, the restrictions have eased up significantly in the last two or three years, so that we can start selling stuff into what was behind the Iron Curtain and that sort of thing. We still have export documents to fill out, but it's not anywhere near as bad as it was, because our technology was "associated with defense," so it's a lot easier.

So we look at GATT-- Right now, for instance, if we sell into Europe it is a 14 percent tariff on our products. If there was a 5 percent tariff on our products that would certainly help us competitively. The U.S. has, by and large, the most open market, so the tariffs have been less on imported products. So, although we think it is going to invite more people wanting to sell into the United States, we view the markets as global, so we think it's more of a positive thing than a negative thing.

SENATOR SINGER: Thank you.

Our last speaker is Lou Coryell, the Director of Fiber Optics Branch at Fort Monmouth, which is another part of my district. I represent Fort Townsend, Monmouth County. I'm also the Chairman of Military Affairs for this State so I deal with--

LOUIS A. CORYELL: Thank you very much for the opportunity to speak before the Task Force this afternoon, Mr. Chairman, members.

As you said, my name is Louis Coryell. I'm the Chief of the Fiber Optics Branch of the U.S. Army Communications and Electronics Command at Fort Monmouth.

We've been involved in photonic research at Fort Monmouth since before I joined in the mid to late 1960s. We've seen the industry grow in New Jersey, starting, as has been indicated previously, at such places as the RCA Labs, Sarnoff Research Center, AT&T Bell Laboratories. There have been many, many spinoffs from these large companies. They have generated a tremendous entrepreneurial spirit among many of the employees. That has helped immensely in trying to build up the photonics infrastructure that has come about in the State of New Jersey.

In Fort Monmouth, at the present time, we are firmly entrenched in photonics. As I said, we have been for well over 25 years. One of the things that has put us in the forefront in photonics is communications on the move.

We had a problem in the last Middle East conflict where we couldn't communicate on the move. We were trying to lay down cable based upon what we called a European scenario. Unfortunately, it just didn't work in a very high-mobility situation. So we started working with other people such as POEM and other organizations, in ways to utilize wireless technologies. One of those on which we're working with POEM is what we refer to as optically controlled phased array antennas.

SENATOR SINGER: Can you say that fast? (laughter)

MR. CORYELL: These are antennas that are electronically steerable. The way we steer them is actually using optically integrated circuit technology. It is a technology that is just emerging at this point in time, just at the right time, technology speaking.

It is something that is required for our mobility in the future, and it is something that is going to be dual use. People are going to need highly mobile systems. Systems that rely on not omnidirectional antennas but directional antennas in order to work some types of systems in the future, like high performance cellular types of systems. We're working quite vigorously to try to work with the industry in New Jersey in order to develop these technologies.

We have contracts with POEM. We have contracts with other small and large businesses in the New Jersey area, where we are trying to foster the photonics infrastructure. We're very much aware of the dual use technologies today.

One of the things that the Federal government has done in the last year or so is to reduce the emphasis on our old military specifications and standards. We're going to a total system of industry specifications and standards for our systems. We're also looking to use commercial technology where it's available.

It is industries such as those here in New Jersey that have much of the commercial tech base in photonics that we can make use of in our future systems without having to guild the lily as we had in the past, perhaps, in overspecifying some of the systems that we were putting out in military systems.

We're also quite interested in technology transfer. We're working with POEM. Our coresearchers at the Army Research Laboratories work here at POEM each week in developing some of the componentry. We're also interested in transferring that technology to other companies in the State of New Jersey, so that we can get these devices produced in quantity, so that we can put them into our production systems not only for the Army but for all the armed services.

One of the other ways we work is through Cooperative Research and Development Agreements. These are agreements where funds don't pass between the organizations, but we cooperate

where we open our facilities to the other partners and cooperate in the development of different technology areas. We have one such CRDA with the POEM Center here at Princeton. We have others with Belcor and other companies in the State of New Jersey.

One thing that Steve talked about earlier today that we feel is exceptionally important is the photonic device packaging. It is something that is not glamorous. Everyone wants to work at developing the best and newest chip that breaks all the records. But the problem is that until you can take these chips and put them in packaging that is inexpensive and still high performance, we're not going to be able to get the photonics industry where it needs to be.

This is one of the things where we're trying to support POEM. We're looking to the State to continue to support POEM in its efforts to firmly establish the packaging center here, because it is going to be a cornerstone necessary for the future of photonics here in the State of New Jersey.

Along with the photonics phased array programs, we're also looking at other Federal programs through the Advanced Research Project Agency's, Technology Reinvestment Program trying to form alliances with companies in the State of New Jersey, in order to commercialize some of the new technologies that are coming about. Things such as wireless communications products, which can also use photonics in order to transmit voice data and imagery over new ATM systems, is something we're vitally interested in, and we're pursuing at the present time with people such as Sarnoff, Princeton, AT&T, and others.

But the problem that we have in the Federal government is we're coming under an area of diminished resources. Things are downsizing considerably. We're not going to be able to continue the level of support of the industry that we have in the past.

We would like to look to the State to help try to fill some of the void that is going to be caused by the reduction in defense spending and help support the different centers such as POEM and the photonics industry here in the State, so it can flourish, and so that we can, in fact, be proud of the industry and have it flourish the way we feel it can and should.

Thank you very much.

SENATOR SINGER: Thank you.

Are there any questions?

MS. RUSSO: I just have one because you tossed about the packaging lab, and it's reminiscent of the biotech industry's problem with filling, maybe it's better directed to Steve. You have that lab now, within your--

DR. FORREST: (from audience) We've got components of it. There are still some major components that we don't have. I would like to say that companies like Sensors Unlimited and the facilities at Fort Monmouth are sort of playing complementary roles.

One is for very, I think, near term to very important packaging areas, to seek out more into very high frequency. What we would like to do is form a triangle where we look at the more advanced devices and the kind of nitty gritty of making extremely low-cost packages and packaging schemes. It is really a very difficult problem.

It seems like it's not glamorous, but the problem, though, is with electronic integrated circuits. All you have to do is put a wire on the chip to make it go -- or maybe 10,000 wires -- but that is still well-known technology. When you involve objects, you need those same wires, but you also have to bring the light down. The alignment of the incoming beam to the device has to be on the order of 10^{-6} or 10^{-7} centimeters. It is an extremely challenging problem which has never been, at least in this country, adequately addressed, and for that reason we don't have the enormous distribution of photonics that we could

have. It's almost a limitless market. This is probably the biggest type of threshold or barrier.

MS. RUSSO: So it would be money well-spent?

DR. FORREST: Yes.

MR. CORYELL: It certainly would be.

SENATOR SINGER: Doctor, thank you very much.

DR. FORREST: Thank you.

SENATOR SINGER: I want to take this opportunity to thank Bob Cummings for allowing us to be here.

Joe Montemarano, who is always there for us, I appreciate it very, very much.

Steve Forrest, we appreciate it very much, also.

Jay, as usual, thank you.

Caryl, I appreciate you representing the Biotech Council and, certainly, your company here today and everyone else who participated in coming.

Again, this has been recorded, so there will be a transcript given to each of the members who were unable to attend today. We will take a look at it. We will digest it. We certainly will be working with Jay and Science and Tech to see what we can do about possibly forming a task force and getting back to you with that answer in a fairly short period of time.

Thank you. It's a long drive. Have a good weekend.

(MEETING CONCLUDED)

APPENDIX

New Jersey State Library

APPENDIX

University of Toronto Library