Plenary Session

with Minister of Science & Technology, HRD and Ocean Development

Address by Dr L M Singhvi

Distinguished Delegates, Distinguished Members of the Panel, and Friends,

No greater pleasure for me than to welcome a man who has provided leadership where leadership accounted for so much in the field of science and technology, in the field of human resource development, and in the field of interpreting India to the world in terms of its quintessential heritage.

Dr Murli Manohar Joshi is here with us, with his entire team of the Department of Science and Technology, his Secretary, and all those who make science and technology happen in this country.

I want to pay a special tribute on this occasion for this session, which is specially designed for Dr Joshi and for what he has to say. We will have another session on science and technology also. But this is a session of the greatest importance and we all join in welcoming him most warmly and in paying a tribute to him for his deep interest in science, his commitment to science, his recent stewardship of the many initiatives in the Science Congress, his announcement of the great award for science; our own premier award for scientific achievement, and for his being a man of science, as well as a man of culture.

To have him with us here this evening is indeed a great privilege and a pleasure. But there is one caveat. He has to leave for a Cabinet meeting and he still has the deepest interest in this occasion when he will be speaking to us and then he would be interacting with us all.

I give you the most distinguished Minister for Science and Technology, for Human Resource Development, for Ocean Development, and what not. He is not only a Minister. He is a man who is trying to make history in the fields of education, culture and science.

Thank you.

Address by Mr S K Tripathi, Education Secretary, Government of India

Hon'ble Minister for Human Resource Development, Chairman of the Organizing Committee, Dr L M Singhvi, Hon'ble Panellists on the Dais, Distinguished Delegates, Ladies and Gentleman,

On the occasion of the launching of the Bharat Shiksha Kosh, we have received a message from our beloved and Hon'ble Prime Minister, which I will now read out to you. The message is as follows:

"I am glad to know that the Ministry of Human Resource Development under the able leadership of Dr Murli Manohar Joshi has constituted the Bharat Shiksha Kosh as a registered society. The objectives of the Bharat Shiksha Kosh are for a noble cause. This is a step in the right direction of participation of society and individuals in the human resource development of the country.

Since Independence, India has made impressive strides in the field of education. The literacy rate, which was just 16.67 per cent in 1951, has risen to 65.38 per cent in 2001. The number of educational institutions, the enrollment of boys and girls and the number of teachers have all registered similar increase over the years.

The government is trying to make available maximum funds for human resource development. The task is gigantic. The Government of India has decided to create this non-governmental forum so that everyone desirous of making contribution to the development of human capital may use this channel for investment in education.

I hope that all those interested in making contribution for the educational upliftment of the country will come forward and make donations generously for this noble cause.

I extend my heartiest congratulations to the Hon'ble Minister for Human Resource Development and all those involved in this venture and wish the Bharat Shiksha Kosh a grand success."

Sd/-
A B Vajpayee.

Thank you.

Address by Dr Murli Manohar Joshi, Minister of Human Resource Development, Science & Technology and Ocean Development of India

Dr Singhvi, Chairman of the Organizing Committee, and the Panellists on the Dais, My Dear Friends of the extended Indian Family.

I do not call you as a Pravasi or Pravasis, but I call you as members of the extended Indian family.

I welcome you all. I have a time constraint because I have to attend a cabinet meeting at about 6 o'clock. So, I would not be able to remain here for quite long. On the education side, you have seen the film, which has given you a glimpse of what India is doing in the field of education starting from elementary, right up to higher education, both technical and general.

I can only say that we will now try to establish a very good rapport with the Department of Space which has promised us to give an education satellite, i.e., a satellite totally dedicated to education and that will increase our outreach several fold and we will be able to cover every nook and corner of this country.

So, our attempts are for making India literate, educated and technically qualified to compete with the rest of the world. I want your participation and suggestions in this endeavour.

The other Ministry of which I hold charge is Science and Technology. As you are all aware, India had a very long history of scientific tradition. Even in the ancient Indian history, you will find a reference to the technological achievements by Indians. Generally, it is believed that India had only philosophy, or the Upanishads, or the literature like the Vedic literature or the Shankararcharya's philosophy, or the other schools of philosophy, but it had very little contribution to technology.

But I would say and I would request you to kindly, completely debrief yourself on this point. India had a very brilliant tradition of Science and Technology. There is not much

time today to dwell on this subject, but I can say that the Indians discovered the references to various scientific principles which are supposed to be quite modern nowadays, even in the pre-Christian era.

Our astronomy is very ancient. Our metallurgy is very ancient. If you have any time, you can kindly visit the Iron Pillar near Qutab Minar, which is at least 1,500 years old. According to another estimate, it may be 2,100 years old. But be as it may, even if it is 1,500 years old, it is a marvel of technology. It is rustless iron pillar, which has not rusted for the past 1,500 years. It has withstood all degrees of nature, climate, rains, heat, dust and everything, but it remains unrusted.

I don't think that any modern steel or iron factory or foundry can produce such a miracle. I would rather challenge anybody anywhere in the world to produce such a metallurgical miracle.

In the system of medicine, we were very proficient. Our system of medicine is very ancient, very effective and without any side-effects. We had a history of navigation. We used to navigate much earlier, much before the Christian era. We had gone to various countries. We have seen that there is Nalanda and Takshila, and in Takshila one of the important features was that a student had to prove his worth after leaving the institution. So, one of the students was given the task to identify any herb, shrub or plant, which was injurious to humankind. After a few years of his discoveries, inventions, and surveys, he came and said, "Lo and behold, I have surveyed all this area and I declare hereby that not a single plant, herb, or shrub is injurious to humankind, and if it had any toxic effect, I have found out a method to remove that toxicity."

So, that was the type of scientific temper in this country. Many of our authors of scientific text have said that whatever we are describing in these books, we have not described any experiment in a book of chemistry, which has not been personally experimented by a human being.

One of the authors says that the teachers of the chemistry are those who can perform all experiments, which they teach to the class, and the students are those who can repeat those experiments. Otherwise, they are all actors on the stage and audience in the auditorium. So, that was the level of experimental science in our country. That was the approach towards science.

In physics, mathematics, chemistry, metallurgy, medicine, and astronomy, we are the pioneers. And I say if the patent law would have been operated in the holy days, then we would have patented the numerals and all royalty coming from the computers would have come to India because the computers working on binary system are based on 0 and 1, which are the discovery of India.

So, that way, I can say that let us first have this confidence that India had a long history of scientific tradition. Now, after Independence and just before Independence, what we were doing, most of you know that there were persons like Ramanujan, S N Bose, J C Bose, Prof Raman, P C Ray. Those who were the products of pre-independent India. They did wonderful science and they worked on the subject not only in the field of academy but also for the progress of the country. They created a large number of students who were committed to science and technology, and those whose very roots were within India. So, that was the very important feature of free independent Indian science that all those scientists were completely well-versed in the Indian history, in the Indian traditions and a few of them completely well-versed in the knowledge of Sanskrit literature.

So, those scientists created a system. They created a group. They created an atmosphere.

But after Independence, we started not only remaining confined to those few institutions but for expanding. I must say that the first phase was in which we established several institutions and just like the IITs, the Indian Institute of Management, Central University and institutions like the Indian Institute of Science and several other R & D institutions like the network of CSIR, the laboratories under biotechnology, the laboratories with Science and Technology Departments, and also the identification of certain areas which were essential for R & D in this country.

Then, in the second phase after this infrastructure came into existence, we attempted for addressing some of the immediate requirements of the country. As you know, we have now food sufficiency through Green Revolution, followed by White Revolution, milk. India is now sometimes the largest, sometimes the second-largest producer of milk and milk products in the world. Then, there was Yellow Revolution in terms of pulses and the Blue Revolution in terms of fish.

Now, we are net exporter of bulk drugs and licensed production of a large number of products. Indian drugs are not costly. They are quite cheap as regards their price. I can give you an interesting example that when this September 11 incident took place, and there was a danger of Anthrax, the anti-Anthrax tablets were required in bulk, the only one company used to produce them was the Bayer Company in America and its branch in India.

The tablets used to cost something like 5 dollars per tablet and one didn't know how many tablets per day and for how many weeks or for how many months. But, then, when this became a little endemic and people became apprehensive, all patent laws were relaxed, and we were allowed to manufacture it and reproduced it for 25 cents. There comes the international price down to 95 cents.

So, that is the type of thing we can do and which we are in a position to do. We produce and provide the cheapest drugs to large parts of the world also.

Then, we are now using this capacity for providing cheaper kits in terms of HIV and AIDS detection and identification kits. They were very costly. Our biotechnology department thought that it is something not possible for every HIV or AIDS patient in India, or even in the Third World to procure them. So, those kits, which were normally 400 dollars, have been now reduced in price to almost 400 rupees and some of them are 20 rupees, 50 rupees. We have now very special methods of testing it. And we are exporting it to many countries.

So, the detection of HIV has now become easy, it is cost effective, and poor countries can afford it. We are also using science and technology for reducing the digital divide within our country and also within other nations. We have a large number of illiterate people. So, should they wait for the use of information and communication technology till they become literate in another 10 to 15 years? In the meantime, the world will move so many miles ahead.

So, our scientists decided to produce some system which will be affordable and which will cater to the needs of illiterate people. A simputer has been designed. This is a personal computer, a hand-held computer and it doesn't have any keyboard. It functions on icon system, touch system and information comes through voicemail. It is easily affordable. Cost is less and if it is produced in bulk, I think, it will not cost more than 200 dollars.

We have not patented its technology. But under the special general licence scheme, it is open on the Internet with the only condition that if one is a developing country they will have to pay a lifetime fee of 20,000 dollars to use it, and if it is a rich country, they will have to pay 250,000 dollars.

So, that way we try to help the developing countries also and this instrument can not only give you the information, but it can make one literate also. It works on four languages at the moment - Hindi, Kannada, Tamil, and English. For other languages, software can also be produced. And it can be also produced in other languages of other countries.

Now, these are the efforts that our technology is directed like that. In other words, we are using science and technology for the benefit of the poorest of poor, apart from the high technology which we do perform in space and atomic energy in which we are-I would not say that 100 per cent indigenous, but mostly self-reliant.

It is our own talent. Mostly our materials. Mostly our own designs and now we can compete in terms of space and atomic energy with the rest of the world. We have, in terms of nuclear technology, a fully self-reliant and globally competitive technology, fully indigenous design, fabrications, installation and commissioning of power plants, strategy for thorium utilization, which is unique to India, R&D in the emerging nuclear systems such as accelerator-based power plants, diverse applications in manpower use of nuclear technology, new high-yielding seeds through radiation mutation, radio pharmaceuticals for healthcare and industrial applications of nuclear radiation.

In space, we have indigenous capability for satellite design, launch and ground segment instrumentation, remote sensing technology for development, applications specific satellite such as Metsat for your meteorological observation, Oceansat and Geosat.

In ocean development, we have the first indigenous ocean thermal energy plant nearing completion, special materials from polymetallic nodules from the sea, and an Indian station in Antarctica. We are also now attempting to have another station, programme on exploration and use of gas hydrates.

And another most important achievement of this ocean research was that some of our scientists, while exploring oceans near the Bay of Cambay, Khambhat ki Khadi near Gujarat, near Dwarka, they discovered another site under the sea and whatever materials they could pick up from that site were very interesting. They are all kept now in our laboratory in Chennai.

One of the pieces of wood, which was found from that place, proved to be very important. It had a human intervention and its date of that chronology or the antiquity of that piece of wood is 9,000 years from today, i.e., 7,500 years before Christ. Whatever the earthen material was found, thermo-luminescence studies have been made and these also give you almost the same date. All these have been verified not only by two labs in India but by one of the laboratories in Germany also.

Now, this has opened up a new chapter about Indian culture and about the existence of habitats in India and human intervention on trees or woods or the manufacture of terracotta or some weeds which is now the most ancient recorded or found discovery in the history of this part. And obviously then it becomes the oldest civilization of the area.

So, that has given not only the researches in ocean in terms of ocean resources, but it has thrown some light on the Indian history and on the antiquity of India's history.

Now for the 21st century, what we thought was to produce a new approach to science and technology. We had a science policy, and then we had a technology policy, and that too was about 20 years ago when we had it. So, we decided to give a fresh look to science and technology policies and now we have produced a science and technology policy, i.e., one policy guiding both science and technology.

Science is technology and technology is science. Today, you can't make a very serious distinction between them. The fundamental science of today becomes the technology tomorrow. This technology then further promotes fundamental research and so the circle goes on. So, we produce now a new science and technology policy.

This is now Science Technology Policy 2003, which was released by the Hon'ble Prime minister in the Science Congress. And we have an emphasis in that policy on global competitiveness in terms of quality and price, clean, efficient and environment-friendly technologies, technologies that help to bridge the social divisions of all kinds, recognition and use of traditional knowledge base and science and technology for mitigation of natural disasters.

Then, we have also emphasis on human resource development, on quality improvement, on research-based education, schemes for identification and nurture of talented students and scholars. We have now Kishore Vigyanik Prothsahan Yojana. We have facilitation through scholarships and fellowships. We have scholarships for women scientists, fast-track scheme for young scientists, research grants for projects, Swarn Jayanthi fellowships for young scientists of proven track record, and Shyama Prasad Mukherji scholarships.

And then, there are several awards like Shanti Swaroop Bhatnagar prize for scientists below 45 years, National Bioscientist award for scientists below 45 years awards for women biotechnologists, indigenous technology development award, biotechnology process and product development award, distinguished biotechnologist award for retired scientists.

And now recently, we have announced an India Science Award of Rs.25 lakh, about which the modalities and its parameters will be decided shortly. This was just announced on the 3rd of January by the Hon'ble Prime Minister.

I have already pointed out about diagnostic kits. There are vaccines about which I must say, I must refer to Hepatitis B and Leprosy. And this leprosy vaccine is about only Rs.20 for three doses and brings down the total cost of treatment and also by reducing the time of the treatment.

Hepatitis B is just Rs.75 per child and Rs.120 per adult. This substantially brought down costs of imported vaccines. This has been certified by WHO and it has been exported to several countries.

The Prime Minister had added one more important slogan to this country's original slogan of Jai Jawan and Jai Kisan. He has also added to it Jai Vigyan. So, we are now concentrating on Jai Jawan, that is the national security; Jai Kisan, that is the economic security including the food security; and Jai Vigyan, that is the knowledge security, the power of knowledge. We are determined to use science and technology for the solution of Indian problems and the problems of other countries also wherever we are required to do it.

What we say is now that the Indian experience can be shared by several of those countries where the Indian diaspora is in large numbers participating in R&D and their experiences can be shared by us. I would like this participation to grow because many of you have learned high-class science and technology through your efforts and through your hard work in different countries. Now we, and what we are doing that can be shared by others can share that experience. So, India can become a platform where we can receive from one end and can transfer it to the other end.

We have, therefore, now instituted several mechanisms through which this exchange

and transfer of technology can take place. You must be happy to know that we have now tried to discover the indigenous talent in those who are although not educated but have a technological mind, a technological bent of mind.

We have now an India Innovation Fund, i.e., that those who innovate. They may be educated or they may not be educated. They may be having any degree or not having any degree, but if they have something to offer, something unique, something which can be commercialized, something that can be widely used, we will help them.

And we have very good experience. In the very first year, we received about a 1,000 applications, but in the next year we received about 13,000 or 14,000 applications. We have transferred some of these grassroot technologies to South Africa where our illiterate dropouts were carried to South Africa. And there they stayed in the villages and improved their life, improved their technologies. That is a very wonderful experience, which we had with this programme where our ordinary common folk people tried to solve their problem through their own indigenous talents and ultimately their solutions turned out to be highly beneficial.

I can give you two examples. One was in Gujarat. We have a crop of cotton. One variety of cotton is such which had some difficulty in separating the thread from the seeds and is used to be plucked by hand manually and whole of the village was engaged in that for one full month. One of those thought that this was a complete drudgery. If some mechanical device can replace it, it would be useful. He came and produced the design of the machine. He came to us. We saw it. It worked. It was workable. We just helped him with about Rs.5 lakh. The machine came in the market and in one year we could earn a profit of Rs.55 lakh and now this machine is quite popular. This gentleman is not even 4th class passed. After 4th class, he did not go to any school. But this is the technical skill, which he possessed, and we used it.

There is another case. It was a very interesting case where this grassroot technology became ultimately high technology. One of the persons who was used to spray his field with pesticides felt that he has to go once in this direction and then come back. Because while spraying you have to keep one hand on the pump and other hand on the nozzle and you carry your bag on your back. Then, you go on pumping it and spraying it. So, you go on once on this side and then you return back.

So, he said if I can proceed in one direction and use both of my hands, then time will be saved and it will be more efficient. After some thinking, he made some springs in his shoes and connected it with the pump and now by just walking he could spray with both hands. Now it is as simple as that. Now, a foreign entrepreneur who was touring that area saw it and asked him will he sell his technology to him? Now, this fellow never knew that technology can be sold. He thought it was personal invention and it can be used by anybody. He came to us. He said, "Yes, do sell it."

Now, that technology was sold. That company is now producing wonderful toys by using this technology. They have small toys. Something is fitted in the shoes of the toy, and when the toy moves on you just wind it up and allow it to move. It sprays, it gives out beautiful colours, and there are bubbles and so on and so forth. That entrepreneur has now manufactured very nice and attractive toys, and the fellow is now getting enough money.

So, what I mean to say is that India has a vast fund and a large number of talented people. I can cite examples after examples, which I found. We have to train them and we have to uplift them and give them a little more help. So, now we have also tried to introduce a scheme which will be on line sometime in June where we will certify these people so that when they go abroad or go anywhere, their skills are recognized. We will

ask them to appear before an examining body, and if they certify that it is good for a certificate, you will be a certified mechanic in this field.

If it's good for diploma, we will say he is a certified diploma-holder for this field and even if the person is competent to be qualified as an engineer, you can say yes, he is an engineer.

So, this will be a great empowerment to our technologically skilled people, but who have, fortunately or unfortunately, missed the English education. So, we are trying to create an all-round revolution in the field of science and technology and will use it for the development of our country. And I have discussed with my scientist friends and we now feel that we must have a motto that India innovates, India leads, and India does not follow.

Thank you very much.

Address by Prof E C Sudarshan

I am so pleased to be here and I would like to thank a number of people who insisted that I should be here and I am glad that I came according to their wish. This is very much better than I had ever expected.

In the last Indian Science Congress at Pune, Prof Mashelkar said, "He had a dream." And the dream was that he opened the morning newspaper and found the headline as usual "the Indians have swept the Nobel prizes. There were three Nobel prizes at that time, one for Physics, one for Chemistry, and one for Medicine."

Well, I hope this will come to pass because this happens to agree with my own wishes. I would like to say that sometimes I think I was born too late. Because, if I was born a few centuries ago, then India would have been the land of excellence with regard to science. Since we do have Dr Chidambaram who would certainly hold up his end of the technology, let me say something from the other end.

When one talks about science and technology, it is always technology, which happens to have science attached to it. I am reminded of little squirrels that we have in Kerala, which have very large tails and very small bodies. So, when they keep running, you only see the tail, which is wagging in the wind, but there is always a squirrel attached to it. Without the squirrel, there would not have been a tail.

At the present time, the distinction between science and technology is itself a technical subject. Because one has to decide what is to be done, but I would like to give a practical method of distinguishing between them. Science is searching for things, which we do not know, and by people who do not know where they are going, but when they find it, everybody understands that something has been discovered.

In technology, on the other hand, repetition is the important thing. It must be reproducible. It doesn't matter whether you discovered how to do it as long as you are able to do it very well. We know that our science-based technologies in India have demonstrated how much this is true.

Very often, scientific discoveries come out of things, which were not expected. But one of the things that has come to pass is that in recent times, the last few decades, the lead time between science and technology has reduced. But also the lead time between technology and science also has reduced because the highest class experiments that

you do cannot be done without somebody with a considerable amount of technological experience.

A few days ago, Charles Towns Nobel Prize winner for the invention of the laser was here and he was telling us how important it was that he had some technological experience when he was working for the US war effort and therefore, he knew many people who knew a lot more than he did. So, when he started experimenting with the possibility of a laser, many people told him it is impossible, but other people told him that if you want to get an oscillator working in a certain fashion, we can do it for you. So, he said it is the combination of a number of people who knew more than he did and who were willing to give him the technology because he had worked closely with them. The invention of the laser was an accident, a very lucky, very calculated, and deserving accident. So was the invention of the tomograph and both these things have now played such an important role in everyday life that, in fact, we cannot imagine how people could have lived before us.

What is, therefore, needed is a constructive interaction between science and technology. The best of scientists help technology and best of technologies come to the aid of science. Science is not necessarily the lead horse and the technology is the cart that follows. In fact, it is simply something which is a leapfrogging arrangement.

To mention the examples of what I have found in the United States is that two or three things happen. One of them is that scientists work very hard. I was in a research institution here and we always used to say, we are doing intellectual work and we cannot work all the time like other people.

But when I went to the United States, I found that my professor, my colleagues, all the people work very, very hard. I have found that this is not special for that particular period of time that many Indian research scientists who are doing indifferent work here, when they happen to go abroad even for one year, it turns out that their output becomes tremendous.

I have a friend who always used to say that he could not come before 10.30 in the morning to the laboratory because he had to do lots of poojas. He got up at 5 o'clock and then went on doing poojas. I got him an appointment in my university for a short time and he had a class at 8.00 o'clock. So, he got up at 6, not at 5, had his bath, had his quick breakfast and he was in his office by 7.30. So, I asked him, "How come that you can do this here, but not in Chennai?" He said, "Well, I have now decided that the poojas can be done when I have time, but these things really deserve to be done."

We have a problem with regard to formulating a science policy. Not the policy that the Government is mentioning, but rather with regard to everyday thing. I have been a guide for a number of students. I have had excellent teachers who were teaching me. But it was always clear that, in fact, you go in a particular direction with a certain direction, but discoveries cannot be dictated.

When Braton, Shockley and Bardine invented transistor, Braton was simply working, playing with what would happen if electrodes are put on crystal. He did not know why it was. Bell Laboratories said that all right we can afford a couple of people who were doing nothing. And he was one of those people who did nothing. But he found some anomalous results and then he asked Shockley, "What is this one?" Shockley knew something about the theory of condensed matter. He said, "Ah! This is very interesting and let us try to find what it is." Then, they did experiments together and Bardine, who is a theorist, joined them and the transistor was born. Now, we cannot imagine either technology or science or even everyday life without the transistor.

So, in general, as was said before, scientific discoveries are made not by planning to discover some particular thing, but by actually working very hard on something or the other. Once you do the thing, there are always lucky breaks that come.

I hope my friend would forgive me if I said that there is far too much of science and technology put together. Let us have a little bit of science. Let us not invade that science and restrict all of them into concentration camps called the central institutions. But let us make sure that the real learning happens to come about in universities. Universities are places where people come and go. You have temporary research workers, temporary staff members, and somebody like a good graduate student can teach a professor a great deal more than the professor can learn from another professor. This possibility is because of the fact that the people are there only for a short time. So, like flowing water, when you have a continuous flow of people through the thing we have the possibility that, in fact, great things could happen.

Just as a continuous pumping of excited atoms, which then emit, what we have to have, makes the laser is a flow and the flow happens in the universities. Unfortunately, despite the University Grants Commission and the Government's good intentions, and many people's very hard work, and a lot of bureaucrats in the UGC, we find that the universities are essentially starved of research material. They are starved not only of money, but also of self-worth, because they are told that if you are really good you would be at this or that central institution. We really have to look at the universities, upgrade the status of the universities not only by giving them aids but by giving them the right people. Because universities are universities.

In the US, in addition to many government agencies which are contributing to research work and subsidies, there are also many industries which do the thing. They don't do it out of altruistic motives. They do it out of a very clever investment philosophy saying that a little bit of money that is given for these people would be worth millions later on because this is the mechanism by means of which you make very good people.

I understand that Dr M K Chandrashekaran has endowed Anna University MIT laboratory with a considerable amount of money, with the understanding that you do good work. I don't care what you do. You do good work. So, there is a team of people there. A range from linguistics to pure mathematics, to electronics to biochemistry, and they are all working very hard from morning till evening. I understand that Dr Narayana Murthy is seriously considering doing something, but currently he also thinks about education.

The Tatas have always contributed to higher education and research, but they have generally tended to give it to special institutions with their names on it. It would be very nice if we can find people who would endow universities. We need 100 Chandrashekars an who would endow the appropriate universities. But in addition to this one, we should get other industries to do something of this kind. I am hoping that the Reliance Industries, which is doing so well in so many other things, will also seriously consider contributing to this one.

There is one movie that I saw some time ago in which by accident, a gardener, not even a gardener but a gardener's assistant, is considered somehow to be wise because he doesn't say anything ordinary. He says only extraordinary things. So, when he was asked what his name was, he said, "My name is, I happened to be, I am a gardener." So, they said, "Oh! you are Chancy gardener." And he became such a hit that the President of the United States asked him for economic advice. We are having an economic slump. I mean not this president, because he would not do such things. But another president and he asked this man Chancy, "What do you think, what should we do." He said, "I don't know anything about finance and economics, but I do know one thing. If you plant the bulbs and look after the roots the shoots will take care of themselves. So,

the president was very puzzled because he did not do any gardening. But after thinking about it, he said, "Oh! I understand what you mean. You say that you must attend to the fundamentals and once the fundamentals are attended to, everything else will take place."

I am pleading with you to say that you too should take care of the bulbs and the roots and then of course the shoots will come. We do have excellent trees which are flowering all over the place, but we need to have some universities, which are the little things that we put in. So, we want gardeners who would care for the things. And a self-respecting university teacher is perhaps the best gardener because he does have things and most of us expect that our students will outshine us. None of my students has yet got the Nobel Prize, but, on the other hand, many of them are much better than I am and I think they have a long life ahead of them.

When they prosper, I feel personally that it is very much like my having gotten something. This feeling is a part of being a teacher and we had a reference in the film about the old gurukul system. Well, universities are ideal places for gurukul systems, particularly for graduate studies. Anybody who has been a graduate student or a graduate adviser knows that. In fact, the bonding between them is very much like in the ancient times that a student is indebted to you. He must come with darbha and other guru dakshina and then ask you for the things and you must then be supporting him in every way that he has, including his personal problems but mostly making him feel that he is something wonderful.

Thank you.

Address by Dr R Chidambaram, Principal Scientific Adviser to Government of India

Prof Sudarshan, Prof Ram Murthy, Other Distinguished People on the Dais and in the Audience,

We are running very late. I am going to make a very brief comment. But most of it we are going to discuss in the panel on science and technology tomorrow.

Throughout the years, India has created a very strong scientific and technological platform and it is interested in strengthening and enlarging the scope of its scientific and technological capabilities. The Indian diaspora particularly that segment of it which is there in the developed countries has helped to strengthen the capabilities of their countries of residence in many frontier areas of science and in several cutting-edge technologies. The time, we feel, is therefore, opportune to establish synergy.

I am going to talk very briefly on what I call coherent synergy between the scientists and technologists of Indian origin and the Indian system. India is too big a country to absent itself from any field of science and technology. But how much it invests in any field at any point of time is a matter of wisdom. We want international cooperation particularly in the hot emerging research areas. We want to participate in the international mega science projects, but on an equal partner basis. We want access to research facilities on a reciprocal basis.

Scientists and technologists of Indian origin can play an important and participative and synergistic role in all these and in topical meetings held in India and in the developing Indian centres of excellence in the frontier areas of science. I come with a background of both basic research and in nuclear technology. India has always supported basic research.

Basic research is a cultural necessity. The highest intellects in any civilized country must be allowed to work on fundamental problems of their choice. We should not forget also that the scientists, who are responsible for laying the foundation of the two most advanced technologies in India - Atomic Energy and Space - about which Professor Joshi made a reference, both of them Homi Bhaba and Vikram Sarabhai were basic research physicists.

Science must also lead to the development of technology. If I paraphrase Alwin Toffler, technology today is power and all countries and companies in fields as diverse as weapon systems and human genomic seek technology domination through two instruments - intellectual property rights and technology-controlled regimes.

So, India has to develop technology. Technology must be developed for creating national wealth, for improving the quality of our people, particularly those living in the rural areas, and for enhancing national security. Here, we have to make wise choices and this requires technology foresight.

To make India into a developed country would require efforts in many aspects of science and technology. Each of these efforts must have synergy among the concerned parties. Interaction between academy and industry should increase. The national labs system and the university system should work together. The academia should synergize with the government to suggest policies, which can improve the environment in the country and so on. Collectively in all these efforts, there must be coherence.

The human resource development initiatives must match the choice of critical technologies. We must be more proactive in selecting areas of international cooperation. In the interactions of scientists and technologists of Indian origin, which is what we are discussing here today, the Indian academia must be coherent with our R&D priority areas and with our human resource development needs. Those with our technologies must match with our technology imperatives, which of course should consider both national development needs and exports. That's why I call the need for coherent synergy, synergy in each effort and collective coherence.

Well, we are going to discuss all this tomorrow - more mechanisms and actual areas of work. In fact, we were thinking of having sub-panel meetings of scientists and technologists immediately after this session, but it is already so late. So, the suggestion is that - and also the audience is attenuating rather rapidly. It is not surprising considering the cultural event, which is not far off. So, the proposal is that we almost close here now and the sub-panel meeting which has been organized by Prof Ram Murthy and his colleagues can also take place in the main panel meeting tomorrow. So, somewhat regretfully, I conclude my speech and also terminate the discussion, which would have followed.

Thank you very much.