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**First Foundation Day Address
Indian Institute of Technology Dharwad**

RODDAM NARASIMHA
Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore

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Prof Seshu, Distinguished Guests, Faculty, Students and Friends,

It is a privilege and honour for me to be here with you on your First Foundation Day, exactly a year after the Inauguration. Please accept my warmest greetings on this occasion, and my best wishes for a glorious future.

Karnataka has, for several decades, been attempting to persuade the Union Government to set up an IIT in this State. I am glad that when this desire was finally fulfilled, the location for the new IIT was chosen in the city of Dharwad close to its twin Hubballi: an area that is a great south Indian centre for north Indian music, and the great Kannada poetry of Da Ra Bendre, whose mother tongue was Marathi, and many other literary and scholarly citizens. The IIT system is probably unique in the world. It is one family, distributed all across the country. It is, in a peculiar way, an ingenious method for managing the enormous diversity of our country through a federal institution with a widely distributed regional presence. It is one extraordinary example of how to promote Unity in Diversity - the only one I know in the world with a somewhat similar philosophy is the University of California System, but on a much smaller geographical scale. I applaud the entry of IIT Dharwad into the IIT Republic.

The establishment of IIT Dharwad occurs at a particularly interesting time in the history of independent India, and of the world. It seems to me that we are living in times when India, and the rest of the world, are in for some big changes in the coming decade. The evidence seems to indicate that the changes could be much more rapid – may even occur in only a few years rather than in decades. One reason for this view is the spectacular advances being made by China in economic, political and military power and in science and technology. China has left us far behind. The Chinese economy is now the second largest in the world. The world's fastest computer today is in China. China is making a big entry into civil aeronautics through the C919, a potential rival to Boeing 737 and Airbus A320 (both of which are familiar in Indian skies). And it has the biggest radio telescope in the world (500m in diameter). China is at least 10

years ahead of us – in achievement and in ambition. This is not limited to technology only: apart from astronomy, we can see that in several other fields, including education. For example, UK has recently decided to translate Chinese texts in mathematics into English, following the success of the Singapore-Shanghai model which has the objective of showing that almost anybody can learn mathematics.

India is in many ways unique. As this week's issue of *The Economist* puts it, India is both a "terrible and brilliant" place in which to do business. Unilever gets 70% return on equity, but India is still low in per-capita GDP. However several new initiatives have recently been taken by the Union Government in many fields: Make in India, Development for All, Digital India, Public-Private Partnerships, Jan Dhan, GST, Swacch Bharath and so on and, most particularly, in articulating the vision of *a new India*. It will take time before the effects of these initiatives become more visible and can be critically assessed. And we have some very successful programmes in space, the Light Combat Aircraft Tejas, Fast Breeder Reactors, etc. but then the list begins to taper off. We can say that the Space Programme has shown how modern technology developed here can help tackle or meet many societal needs: communication, tele-medicine, tele-education, meteorology, agriculture, natural resource mapping and so on. Still, on the whole, in spite of some remarkable and brilliant visionaries among both scientists and engineers, we have a long and hard way to tread. In domestic civil air traffic we are now number 3 in the world, and the Indian market is growing at about 20% per year (highest in the world), but we do not make our own regional transport aircraft. And we have the largest market in the world for mobiles but we do not make our own here.

Most importantly, what is the new India we want, and how do we build it? A new academic institution takes time to grow but it could also have a long life, sometimes longer than that of most imperial dynasties in the world (Takshasila lasted more than a millennium, Cambridge is more than 800 years old). Its foundation therefore has to promote a culture that is a happy and creative mixture of past and present: it has to combine continuity and change. S & T keep changing all the time, but the culture of the Institute can and must, at the same time, preserve, create and disseminate knowledge – all three are found in the great universities of the world. Such institutions may be small, big or huge, they may be found in nations that have widely different languages, cultures, and political, economic and social systems - US, UK, France, Germany, Russia, China and so on. But they all have two things in common.

1. UG education and research on the same campus, under the same roofs. Great research, upsetting widely accepted ideas and introducing game-changing new concepts, builds scientific temper among young students on the same campus, because they absorb the

nature of the scientific enterprise not so much by listening to lectures as by seeing it happen in what sometimes is dramatic action.

2. Post-graduate students, post-doctoral fellows and faculty, all working together creating that new knowledge which demonstrates that everything in your text book is not eternal truth. Good under-graduate education demands a culture where new discoveries are being made all the time, old theories and beliefs modified, rejected or replaced by new theories, often based on great experiments, and freshman classes being taught by game-changing scientists.

In India, most of our under-graduate education is in universities, with little research. The prescribed text is assumed to contain all required knowledge in its field – so the book gets mugged up, while our mind becomes a collection of quotes rather than ordered, inter-connected knowledge that understands the possibility that some of the accepted ideas may be over-thrown at some time in the future. And the system is very rigid: too highly oriented towards text-books and marks. It is particularly bad for students who are still seeking to discover themselves – for each examination shuts more doors for the student than it opens. Our universities are too strongly oriented towards marks scored, number of papers written etc., rather than on creative thinking. We still fail the Ramanujan test: If he were to apply for admission to an under-graduate course today he would not be admitted at any Indian university – because he failed in his pre-university exam. And all our Institutes of science, technology, medicine, management etc., have to think more seriously about what they can give back to the nation which has spent public money to give them a good education. This does not and should not mean that basic research will necessarily suffer. It is possible to combine basic research with designing novel and appropriate solutions with an eye on the country's needs. There are several subjects which are not yet completely understood as science but are crucial for greater effectiveness in applications. The monsoons are an excellent example. The role played by scientists like Mahalanobis, Satish Dhawan and others in using new S & T for societal needs is a great example. If I may strike a personal note, I have enjoyed doing both basic research and also working on practical problems. There is pleasure in finding that basic research gives one new tools for handling real problems by unusual methods. I discovered this in the late 1960s. For example (if I may recount my own experience, with your indulgence), what I had learnt about rarefied gas dynamics (doing my PhD thesis at Caltech) turned out to be useful in the 1960s for devising a method for calculating the wave drag of the HF 24 aircraft when it was modified to house a bigger engine and crashed. Similarly Monte Carlo procedures devised for solving the Boltzmann Equation came very handy in determining the air-worthiness of the HS 748 aircraft operating for Indian Airlines in the early 1970s. And so on.

To conclude, what is the role of the higher national academic system (IITs, IIMs, IISc, IISERs, ISI etc.) in building a new India? To answer this question we should have a reasonably clear idea of our vision of the new India. This has not been officially formulated, but I had the opportunity once to attempt this for a government report a dozen years ago. There were differences of opinion on a variety of topics in a Committee that had a diverse composition, and counted diplomats, generals, academics, economists and scientists among its membership. It was remarkable that there was unanimity among this diverse membership that the national vision was an India that should aim for being:

- A democratic, multi- cultural nation, creative and tolerant
- Self-confident
- Strong economically, culturally and militarily, and a leader in global S & T
- Non-dominationist but hard-headed, in relations with other countries
- And a force for peace in a multipolar world.

If we agree on something like this, what is it that academia can do?

- First of all, we must realize that lack of talent is not the major problem in India. The space programme has been built mostly by the products of our engineering colleges, not by IIT/IISc graduates (there have been many from IISc in higher positions in the early stages of the programme).
- The problem is talent management. As an example, let me quote from a recent report in the Economic Times. Cargil recruited 1800 bright young people (mainly IIT graduates, I believe) from India: nearly half of the total of 4000 working world wide for the company. “No other country in the world can build such a talent pool in a matter of 2 years”, says Cargil. “Reasons for the success of the Indian graduates are not only specialized S&T talent, but also their cultural flexibility, knowledge of English, innovative thinking, excellent management....” India accounts for 50% of Global Innovation Centres globally, and were 65% of the global captive head count, according to a report in a recent issue of the Economic Times (27 September 2017).

The problems with Indian universities (I do not include the higher national institutions here) is that they are too rigid: one cannot easily change one’s course or discipline after entry – so the student’s progress shuts more doors than it opens. No academic institution in India can make the same offer as Cambridge University does to the new student: You can enter Cambridge wanting to do metallurgy or physics, and emerge with a degree in psychology or history.

To conclude, a new institution like IIT Dharwad has an extraordinary opportunity, because it starts with a clean slate. It can set up new departments, and introduce new disciplines in areas that are rapidly developing. It can give more options in humanities and social sciences, whose relevance to technology is often underestimated (a poll among US executives about the course which made the greatest impact on their future growth was one on the history of technology – it taught them how technology grows). In general, there should be greater flexibility in the courses the student can take. An unbiased course on the history of Indic science and technology can be of great interest and value to young minds. Some emphasis must be laid on particularly Indian problems, where one's contributions can have a profound effect on the nation, and possibly also on many other parts of the world.

Prof Seshu, faculty and students, I wish IIT Dharwad a glorious Indo-global future, and wish you all the best of luck in coming decades!

Thank you for inviting me on this historic occasion of the Foundation Day of your Institute.