

THIRTY SEVENTH  
CONVOCATION ADDRESS

*The Need For Coherent Synergy*

Address by

**R.Chidambaram**

*Principal Scientific Adviser to the Govt.  
of India and DAE-Homi Bhabha Professor  
Bhabha Atomic Research Centre*



Indian Statistical Institute, Kolkata  
21 March, 2003

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Professor M.G.K. Menon, President of the Institute, Professor K.B. Sinha, Director of the Institute, Members of the Faculty, distinguished invitees and my young friends, who will be graduating today:

It is a great privilege to be here with you today when some of our brightest young men and women are getting their degrees at this famous institute, founded by Prof. P. C. Mahalanobis, who, along with Prof. S. N. Bose and Prof. M.N.Saha, formed a famous trinity of contemporary Bengali physicists and contributed to Indian science in different ways. Prof. Mahalanobis initiated research in the then new discipline of statistics and also later introduced the culture of sample surveys; the effect of the latter is that today the statistical data on Indian economic development are considered reliable while those in China, where they did not have a Mahalanobis, are often looked at with doubt by some economists. The Indian Statistical Institute is not only a frontline teaching and training institution, but has expanded over the years, doing research in applied statistics and related frontier areas spanning a wide range from agriculture and economics to computer science and genetics. This is important because today, there is no modern technology and no important industry that does not need inputs from mathematics and statistics. And unfortunately, unlike as in the already developed countries, not enough mathematicians and statisticians in India are involved in these areas; that is why I am very happy to see the presence of the Indian Statistical Institute in these areas.

A few years back, I tried to analyse the 'Patterns and Priorities in Indian Research & Development' (see *Current Science*, Vol. 77, pp. 859-866, 10 October, 1999). I gave high priority to basic research, which is a cultural necessity because the highest intellects must be allowed to work on problems of their choice; to mission-oriented research in strategically important areas; to industry-oriented applied research; and to country-specific applied research; I gave low priority to what I call 'parasitic research' – i.e. research which appears to be important because it follows global trends, is pursued with excessive foreign contacts and collaboration and consequently tends to depend on foreign patronage (I must say that working on exciting problems of international interest must be welcomed but original ideas must come from India and the research work must be done mostly in India); to compulsory research for short periods by reluctant college teachers to improve their promotion prospects; and to directionless applied research. Much of the



research in applied statistics would fall into the category of 'country-specific applied research' and should be given high priority. Of course, I must also add that the boundary between basic research and applied research is fuzzy and applied research must be backed up by basic research in the relevant areas to fill unexpected gaps that may emerge in the future.

Today, more than at any time in history, Technology in Power, if I paraphrase Alvin Toffler. Technology domination is sought both by companies and by countries, in fields as diverse as human genomics and nuclear weapon systems, through the instruments of Intellectual Property Rights and Technology Control Regimes. So, in areas which are profitable-commercially or strategically-technologies will continue to be denied to India. And India must counter this by becoming self-reliant. In today's world, self-reliance does not mean avoidance of international scientific and technological cooperation. In fact, the latter is a must and today's India must take and must give in equal measure in international cooperation. That is, India must go for international cooperation on an 'equal partner' basis and must also participate in international 'mega science' projects from high energy physics to genomics. Self-reliance today implies immunity against technology denial. This immunity India has developed in the nuclear field and must also develop in other fields.

### Technology Foresight

India has recognized ever since independence that its national development will be driven by science and technology and the large governmental effort in this direction has been wide-ranging. And there are achievements to show – indigenous nuclear power plants, our own satellites, nuclear weapons and missiles, the green revolution of the sixties etc., but much more remains to be done.

What are the reasons for developing technology? I think they are the following: creating national wealth; improving the quality of life of the people, particularly those living in rural areas; and enhancing national security.

Choosing the right technologies requires technology foresight. Technology Foresight involves determination of possible futures, taking into

account existing as well as emerging technologies, and of strategies likely to yield the maximum economic, social, environmental and security benefits. Technology foresight must be distinguished from technology forecasting, which attempts prediction of future technological developments, without worrying about the impact of these developments on the economy, society or the environment.

Technology foresight analysis helps in the selection of critical technologies for development at any point of time and this has to be based on a national perspective. You don't get the same answers from India and, say, the USA when you ask if fast breeder reactors or rural e-connectivity is an important technology. India fortunately also does not have to follow the trodden path of technology development; we can learn from the mistakes of others and leapfrog.

So what are the critical technologies for India today? India is a large country and its technology requirements also correspondingly span a wide range. It has to continue to develop strategic technologies – nuclear, space and defence-related. National Security also requires development of technologies related to information security, counter terrorism, and of "dual-use" (*sic*) technologies denied to India under the Technology Control Regimes. Technologies related to food and nutritional security, energy security, health and water security, environmental security, advanced manufacturing and processing, advanced materials, etc. information technology and biotechnology and rural development-related technologies are all important for us.

### Nuclear Technology Foresight

Technology foresight may be applied also to the sub-sets in a given technology. Take nuclear technology, for instance. The vision of the founder of the atomic energy programme in India Dr. Homi Bhabha is reflected in our nuclear technology choices with the components:

1. The three-stage nuclear power programme – pressurized heavy water reactors, fast breeder reactors and thorium U233 – based reactors.

2. The development of a credible minimum nuclear deterrent.
3. Applications of radiation and radioisotopes in medicine, agriculture and industry.
4. Development of major facilities for research – research reactors, accelerators, etc.

## Information Technology

The exponential growth in processing powers, the availability of advanced graphic subsystems, highly capable software and multimedia capabilities have resulted in a healthy and beneficial proliferation of information systems in all walks of our life. The revolutionary progress in computer communication has opened up many new possibilities for information exchange. The popularity and spread of the Internet have evolved into a strong environment for electronic commerce where buying and selling of information, products and services, electronic money transactions, electronic publishing, virtual prototyping, etc. are taking place.

As benefits of Internet are increasing, so are the threats: threats to security of information and privacy. Identifying specific technologies, systems and structures to be established in areas of protection, surveillance & monitoring and certification in the context of information security has, therefore, become imperative and urgent. The Society for Electronic Transactions and Security (SETS) has been formed to meet just these requirements.

We all know that Cryptography (encryption and decryption) is probably the most effective way of keeping information secure. It is also well known that the goal of cryptography is to make it extremely difficult to take a cipher text and reproduce the original plain text without the corresponding key and to raise the cost of guessing the key beyond what is practical. Thus, higher the key length, harder it is to break the code. And then there is asymmetric cryptography. This field is going to become increasingly important in keeping data confidentiality. Here we need synergy among IT specialists and mathematicians – number theorists and function theory

specialists. I am very happy to note that the Indian Statistical Institute is interested in this field.

### The Need for Coherent Synergy

To make India into a developed country would require a range of efforts, in fact a variety of efforts even in the Science and Technology field – the choice of critical technologies based on technology foresight, the selection of R&D priorities, the human resource development initiatives at various levels, enhancing of academia-industry interaction, pro-active selection of areas for S&T international cooperation, initiatives for getting NRI/ PIO scientists and technologists back - physically or at least intellectually – the policy initiatives of the government to improve the S&T environment, and so on. Each of these efforts individually must have synergy among the concerned parties and collectively there must be coherence among all the efforts. That is why I have coined a new phrase: “Coherent Synergy”. For India to go forward rapidly, there is need for coherent synergy in all our efforts.

I wish all the young people, who are graduating today, the best in the future – whether they take up jobs or continue their academic pursuits.

Thank you.