51st Annual Convocation Ceremony

Monday, 15 December 2008

Convocation Address

by

Dr. Srikumar Banerjee
Director,
Bhabha Atomic Research Centre
Mumbai 400 085

Sardar Patel University
University Road
Vallabh Vidyanagar 388 120

SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

15th December 2008

51st Convocation Address by

Dr. Srikumar Banerjee
Director, Bhabha Atomic Research Centre
Mumbai 400 085

His Excellency, Shri Naval Kishore Sharmaji, Governor of Gujarat and Chancellor, Sardar Patel University, Vallabh Vidyanagar, Prof. Bharatbhai Patel, Honorable Vice-Chancellor, distinguished members of the Syndicate and Senate, Invitees, Dr. B. Nataraj, Registrar, members of the faculty, non-teaching staff, dear students graduating today, Ladies and Gentlemen.

I feel very privileged and am delighted to be here today for the 51st Convocation of Sardar Patel University, Vallabh Vidyanagar, Gujarat, the birth-state of that great apostle of peace and ahimsa and the father of the nation, Mahatma Gandhi and his worthy disciple, a great patriot, freedom fighter and architect of an integrated India, Sardar Vallabhbhai Patel. It is not just a coincidence or formality that this respectable and well known rural University has been named after Sardar Patel who has inspired the establishment of this institution. In the formation of this University in 1955 and transformation of

this beautiful lush green land (Charutar), other worthy sons of the soil like former ICS Officer, former Home Minister and Finance Minister of India, Dr. H. M. Patel, first Vice-Chancellor and engineer, Shri Bhaikaka and his compatriot Bhikhabhai Patel who were dedicated to rural upliftment, have played a leading role. And I must also place on record my regards and appreciation for the leading and catalytic role of the Charutar Vidya Mandal Trust in carving out this University. The generous donation of the land and funds by the local farmers for the education of rural students in this University will always remain in our memory.

While saluting the farsightedness of these social leaders, I congratulate all the students who on completion of various graduate or postgraduate courses in different disciplines, will be conferred degrees today. I must also acknowledge the tremendous and revolutionary contributions of Padmabhushan Dr. V. Kurien who brought about white revolution with the help of the enterprising farmers of Anand and the neighbouring Kheda district and gave India the brand **"Amul"** that epitomizes India's competitiveness in global economy today.

The convocation day is one of fulfillment, pride, hope and aspirations for a student. One gets a feeling of being somebody important and recognized, having acquired certified

knowledge and skills. One looks forward to a better tomorrow - a career full of opportunities and promise. And, knowingly or unknowingly, one reckons the need to contribute to the welfare of the society at large.

Nations are built on the vision, wisdom, intellectual inputs of some exceptional leaders in the field of science, technology, industry, economics and politics. India has today emerged as a strong nation, a resurgent nation as a consequence of a strong foundation in science and technology, guided by the ideas of visionaries like Dr. Homi Jehangir Bhabha, Shanti Swarup Bhatnagar, Prafulla Chandra Mahalnobis, Dr. M. Swaminathan and the indelible intellectual influence of the geniuses Sir C. V. Raman, Dr. J. C. Bose, Prof. S. N. Bose and Prof. S. Ramanujan. Science and mathematics were an integral part of our culture and history as evident from the works of Aryabhatta, Sushrut and Maharshi Kanad. But to carve a niche in modern science requires dedicated research, innovative ideas, sensitive techniques, conversion of the fruits of research into development of new technologies and finally, deployment of new technologies for societal benefits. Individual brilliance needs to be nurtured by establishing institutionalized facilities to carry out top class research. The ideas of a visionary like Bhabha were backed up by the strong political will displayed through the

commitment of Pandit Jawaharlal Nehru. Newly created institutions such as Tata Institute of Fundamental Research (TIFR) and Atomic Energy Establishment, Trombay (AEET), later renamed as Bhabha Atomic Research Centre (BARC) took up the task of development of sophisticated and difficult technologies, faced numerous challenges and came out successful in making our country a technologically advanced nation. Major educational institutions, which Pandit Nehru once described as modern day temples of knowledge and creativity, continued to provide generations of scientists, engineers and managers of independent India who could bring about the present state of international competitiveness.

For the pioneers, of course, this was a dream. Now the dream has been realized. Friends, many of you may not be aware that this year we are celebrating the birth centenary year of Dr. Homi Bhabha. What we see today on the nuclear science and technology front is the realization of Dr. Bhabha's dream. It is a saga of self reliance, self confidence, unflinching commitment to meet nation's needs with indigenous technologies and faith in our home grown high quality human resources. Dr. Bhabha's dream encompassed not only empowerment of the country in terms of energy security but also applications of nuclear energy in industry, agriculture and

healthcare. Ensuring national security through the development of nuclear technology was also part of his dream. Non-power applications of nuclear technology are directed towards realising the hopes of small farmers looking for better varieties of crop plants, millions scouting for clean water and the growing demand for radioisotope based healthcare facilities.

In August 1955, Dr. Homi Bhabha said:

"For the full industrialization of the under-developed countries, for the continuation of our civilization and its further development, atomic energy is not merely an aid, it is an absolute necessity. The acquisition by man of the knowledge of how to release and use atomic energy must be recognized as the third epoch of human history."

Dr. Homi Bhabha spent his whole life in pursuit of this grand vision. He inspired a generation of scientists with his bold dreams and ambitions for the nation and his selfless service. He was a great scientific pioneer and a great builder of modern India.

India is the largest democracy with nearly one-sixth of world population. Today, the per capita income in our country is quite low. In recent years, we are witnessing an impressive growth in GDP. To fuel and sustain this growth, it is essential

to have a matching growth in the availability of energy. Our per capita electricity generation works out to 610 kW hr per year. In the OECD countries, this figure is about 10,000 kW hr. India's population could rise to 1.5 billion by 2050 and we must plan to have total electricity generation of about 7500 billion kW hr per year by the year 2050. This is about twelve times the present generation level. Nuclear power is now widely acknowledged to broaden the natural resource-base usable for energy production and, when safely handled, it has little impact on eco-systems. India plans to substantially increase its installed capacity of nuclear power generation from the present level of 4120 MWe and hopes to reach 25% of national energy production by 2050. This confidence emanates from our mastery over both the front-end which includes exploration, mining, development of nuclear fuel, design and construction of reactors as well as the back-end consisting of fuel reprocessing and waste management of the nuclear fuel cycle. The recently inked Indo-US nuclear deal and its forerunner, the 18 July 2005 agreement on civil-nuclear cooperation are indeed testimonies to our country's technological prowess. With signing of bilateral agreements also with France and Russia, the door of international commerce in civilian nuclear energy has opened up. Our contributions to Pressurized Heavy Water Reactor (PHWR) technology are well recognized all over

the world. We are among a few countries who have the ability to develop fast breeder reactor technology and we are unique in our plans for harnessing our vast resources of thorium for power generation in the third phase of the nuclear programme. This well planned programme is aimed at not only meeting our energy needs for several centuries but is also likely to ensure for our country a pride of place in the comity of nations. Young graduates in science and engineering must recognize that our expanding nuclear programme offers career opportunities in the field of research and development, operation and maintenance of the nuclear reactors as well as in the entire management of the front and back ends of nuclear fuel cycle. I may add further that there is also tremendous scope for the young minds to explore career opportunities in societal applications of nuclear technology in industry, medicine, agriculture and environment protection.

Let me highlight today the aspects of Dr. Bhabha's dream that have been realized in respect of societal applications of nuclear science and technology. These emanate from direct use of nuclear radiation as well as utilization of spin-off technologies. Agriculture is both a way of life and the principal means of livelihood for 65 per cent of India's population. Our farm population is increasing annually by 1.84 per cent. The average farm size is becoming smaller

each year and the cost-risk-return structure of farming is becoming adverse. Sustainability is at stake. Though India has overcome the famines and shortages of mid-twentieth century by introduction of new varieties of wheat, rice, pulses and oilseeds through mutation breeding, there is a constant need to have more improved varieties of crop plants for different agro climatic conditions and to deal with biotic and abiotic stresses. The green revolution pioneered by Dr. M.S. Swaminathan in this country has found its echo in the crop improvement programme of various agriculture universities and of institutions like BARC. Radiation-induced mutation and subsequent conventional breeding have till date resulted in the release of 37 improved varieties of crop plants, mainly oilseeds and pulses, developed at BARC, Trombay. These include 14 of Groundnut, 3 of Mustard, 2 of Soyabean, 1 of Sunflower, 7 of Mungbean-green gram, 4 of Urid- black gram, 3 of Tur-pigeonpea, 1 each of Chavali-cowpea, Rice and Jute. It is to be noted that while India has achieved self sufficiency in the production of wheat and rice, there is a considerable shortfall in production of oilseeds and pulses. Against the annual requirement of 115 lakh tons of oil, only 78 lakh tons are available. The high yielding and early maturing groundnut varieties developed at Trombay have, therefore, made a very significant national impact. They contribute to nearly 30% of the national breeder seed indent of the Department of

Agriculture and Cooperation (DAC) which get multiplied several fold in the seed chain through various agencies. Last year about 600 quintals of breeder seed was supplied by BARC. One of these varieties, TAG-24, has now become a national check variety. Some of the major agricultural universities have taken it upon themselves to generate large quantities of seeds of the Trombay groundnut varieties. Some progressive farmers have also benefited tremendously from cultivation of these varieties and have obtained record yields.

It may interest this audience that our Centre has made significant contribution to agriculture sector in Gujarat State, particularly through the development of 4 groundnut varieties (Somnath, TG-26, TPG-41, TG-37A) which were released by the National Research Centre for Groundnut, Junagadh and Agriculture University, Junagadh. Three other Trombay Groundnut varieties (TAG-24, TG-26 and TLG-45) have also been popular in Gujarat. Especially the new large seeded and confectionary varieties TPG-41 and TLG-45 with a maturity of 110-120 days and can indeed be exploited by growing in larger areas. TG-26 and TG-37A are adaptable to salinity and drought prone areas. We have made consistent efforts over the years to supply quality (breeder seeds) of these varieties to Gujarat farmers, Agricultural Universities, KVKs, GSSC and seed companies.

In pulses, which is a major source of protein, India today is producing approx. 15 million tons while importing between 1 to 5 million tons. The projections for 2020 are 26.3 and 2.7 million tons respectively. Thus the per capita availability of pulses is 36 g/day as against the requirement of 50 g/day. TAU-1, a black gram variety, developed at Trombay in collaboration with Panjabrao Krishi Vidyapeeth, Akola is sown over 95% of the cultivated area for Urid in the State of Maharashtra. Nearly 30 per cent of the breeder seed indent of DAC is of this variety. Further, for another pulse crop, the mungbean or green gram, out of the more than 43 varieties released by Ministry of Agriculture since 1985, 15 are produced by induced mutation and of these, 7 are developed by BARC. They are all better yielding and some of them are disease resistant. It goes without saying that these crop varieties offer new vistas in agri-business.

I believe there will be a substantial number of graduates, post graduates and Ph.D aspirants in Biosciences here today. Bio-medical science has been heralded as one with tremendous impact on human and animal welfare in the 21st century. Biotechnology is a highly promising field for both students and industry. We have heard of transgenic plants, edible vaccines, DNA vaccines and stem cells and their revolutionary potentials. Plant Tissue Culture is an area that

offers business opportunities for commercial exploitation of biotechnology in agriculture. Protocols have been developed at BARC for micropropagation of elite varieties of banana and also for pineapple and sugarcane. Tissue culture developed banana plants have been transferred to farmers through various Krishi Vigyan Kendras.

Much of the modern biotechnology deals with manipulation, alteration and transfer of genes from one organism to another for beneficial purposes. These include genes for useful proteins like insulin or growth hormones, cytokines, proteins conferring resistance to insect pests in crop plants (e.g. BT cotton) or those responsible for enrichment in certain types of fatty acids and depletion of anti-nutritional factors. We can selectively manipulate the genomes of plants, microbes and animals and even ourselves. The advances in molecular biology now allow us to manipulate genomes directly at the level of single genes and their constituents with speed and precision far exceeding the natural evolution. These capabilities will revolutionize agriculture and healthcare and we shall need competent hands in every aspect of application of this technology from laboratory to commercial and regulatory level. Another such revolution in restorative healthcare on the anvil is application of stem cells.

Of late the success of agriculture is threatened by undesirable calamities such as development of salinity in soils, drought and diseases and pests. There is a need to develop crop plants which can withstand these biotic and abiotic stresses. The undesirable side effects of pesticides are also being recognized and there is need to develop technologies to assess the quantity of pesticide residues in the soil and to facilitate their biodegradation.Radioisotopic and biotechnological approaches hold a key to these problems.

Mere enhancing food production is not enough. We must ensure its safety, reduce post harvest losses and facilitate fair distribution. Today we have a situation where the buffer stocks are overflowing, a large quantity of agriculture and horticulture produce is available and yet there is an unfortunate segment of our population, the poor, who cannot buy enough food to meet their calorie requirements. The post-harvest losses due to microbial spoilage, insect infestation etc add up to 30 to 50% depending on the commodity. Even if the farm produce is of good quality, it would need to be amenable to processing and value addition, withstand rigors of handling, storage, transport and distribution. Furthermore, in the global context - it should meet the requirements of international quality and quarantine. Therefore, there is a need to focus on post-harvest management of our agriculture produce. In twenty

years, an additional 60 to 70 million tons of food-grain will be required annually. A significant portion of this requirement can be met by cutting down the post-harvest losses.

For over thirty years scientists of BARC have carried out studies on radiation processing of various foods and food-products. It involves controlled application of the energy of radiation such as gamma rays, X-rays and accelerated electrons. This ensures killing of pathogens and insect larvae or delaying the biochemical processes that lead to sprouting or ripening. We already have two technology demonstration units, one of which is also being commercially used for irradiation of spices and several other food-products requiring medium to high radiation doses. A demonstration plant for using radiation to prevent sprouting in onions and potatoes was commissioned in Lasalgaon in 2002. A new chapter in the history of India's agriculture export was written when, on 26th April 2007, the first consignment of irradiated Alphonso mangoes left for US. This year more than 270 tons of irradiated mangoes have been exported. There is need to extend this processing to other fruit, if India has to realize its potential as the second largest producer of fruits and vegetables. Some private entrepreneurs are also coming forward to set up food irradiation facilities. Radiation processing provides an eco-friendly alternative to fumigants which are being banned and

phased out due to their deleterious effects on human health and environment. Setting up of such facilities and in future the electron been accelerators will create career opportunities for quality control, plant operations and regulatory personnel. It will also impact on food trade and boost exports provided approvals are granted on generic basis as recommended by the Codex Alimentarius Commission.

Another major beneficiary of the development of nuclear technology in our country has been the healthcare sector. We are producing a large number of radioisotopes for use in diagnosis, therapy as well as basic research in health sciences. Radiotherapy of cancer and diagnosis and therapy of several other diseases have been facilitated by the use of radioisotopes. For example, Cobalt-60 teletherapy units and linear accelerators are routinely used for treatment of cancer. BHABHATRON, a teletherapy unit indigenously designed and fabricated at BARC was commissioned last year in the Advanced Centre for Training, Research and Education in Cancer (ACTREC) of the Tata Memorial Centre at Kharghar, Navi Mumbai. Nine such units have been installed at various places in the country. It costs about 60% of imported unit and its deployment on a large scale will be a major thrust of our national cancer control program. There's a need for at least one radiotherapy facility per district in the country and we have more than 600 districts.

BARC was at the forefront of the development of nuclear medicine in the country. Radioisotopes like I-131 can be used for diagnosis of thyroid disorders and treatment of thyroid cancers. The first medical cyclotron and positron emission tomography camera in the country were installed in Radiation Medicine Centre at Parel, Mumbai in 2002. Thousands of patients are being treated and diagnosed using this state of the art facility. Developments of radioimmunoassay kits by the Board of Research in Isotope Technology have facilitated estimation of several clinically important molecules such as thyroid hormones, insulin etc. Attempts are now on to develop brachytherapy sources (needles containing Cobalt-60 or Cs-137) for treatment of cancers by implantation at site of cancer. Initial trials for treatment of ocular cancers have been conducted at Sankara Nethralaya, Chennai. New radioisotope treatments for inflammatory diseases like arthritis (radiation synovectony) may become possible in near future.

The ability of radiation energy to kill microorganisms and thus disinfect syringes, bandages, sutures, injection vials, gloves etc has proven to be a boon in healthcare. Several plants have been set up in private sector including one at Vododara for radiation sterilization of medical products (It may also be useful for food irradiation). In the next Plan period, it

is expected that, the radiation related healthcare programmes will experience large scale investments and consequently generate employment opportunities for healthcare professionals including doctors, medical physicists, radiation technologists, radiographers, laboratory medical technologists etc.

Isotope-based techniques are also useful in water resources management. These employ naturally occurring stable isotopes like deuterium, oxygen-18, cosmic ray produced tritium and carbon-14 radioisotopes and reactor produced Bromine-82 and Gold-198. These techniques developed in BARC have helped in identifying sources of ground water salinisation, ground water recharge, interconnection between water bodies, seepage in dams and reservoirs and in the study of dispersion of effluent in marine environment. A couple of years ago this approach helped in the recharging of water bodies in Uttarakhand through joint efforts of BARC and RuTAG (Rural Technology Action Group). Technologies have been developed for desalination by evaporation using waste heat of nuclear reactors. A 30,000 litres per day low temperature evaporation plant was set up in BARC several years ago. A hybrid 1800 m3 per day reverse osmosis desalination plant is operational at Kalpakkam and another 4500 m3 per day multistage flash evaporation plant

was recently commissioned there. The online domestic water purifier technology using spiral membrane elements has already been commercially exploited as also the reverse osmosis (RO) based technology. Plants based on RO technology have been set up in some villages in Andhra Pradesh and Rajasthan. A barge mounted RO plant has also been commissioned. This plant can move along the coast to supply desalinated water in water deficient areas. Recently, DAE-CSIR programme on safe drinking water was launched. The objective is to reach 50 million people through deployment of indigenous technology to maximum possible extent. It will involve domestic, community level as well as larger plants for reliable, sustainable and affordable supply of water.

People come to live in cities to participate in the good life, said the ancient Greek philosopher Aristotle, and little has changed to revise the basic truth of this statement. The problem is that our nation's cities have been so neglected that they represent very little that is good and threaten, rather than foster, the very existence of their inhabitants. Growing urbanization, indiscriminate and unplanned industrialization and extensive use of fertilizers and other chemicals have created a serious problem of environmental pollution and degradation. Conservation of our environment should be our highest priority. Technologies are, therefore, required for

detection of various pollutants such as heavy metals, dyes, microbes, gases etc as well as for their remediation.

The increasing awareness of the environmental issues is forcing the environmental protection agencies to take preventive action, precautionary measures and enforce strict regulatory compliance. Some achievements of the Department of Atomic Energy in this area are worth mentioning. Not only do we offer services for estimation of various pollutants using sensitive techniques but also technologies for sludge hygienisation using irradiation and solid waste management through the 'Nisargruna' concept of the Biogas Plant. These have proven to be success stories in environment management.

The total sewage generation in urban centres in India is around 30 billion litres a day. While only a tenth of it is estimated to be treated. The odorous waste water sludge contains high level of pathogens which limits its reuse in spite of the fact that it is otherwise a rich source of nutrients. High energy gamma radiation from Co-60 has the ability to inactivate these pathogens in a reliable, clean and efficient manner. Furthermore, the resulting product can be value added using useful nitrogen fixing microbes. One such plant is already in operation in Vadodara and the local Krishi Vigyan

Kendras are using the hygienised and high grade manure thus generated.

The 'Nisargruna' concept is based on the philosophy of repaying to the nature of what has been derived from it. It is a case of generating wealth from waste. The biodegradable cellulosic waste collected from households, hospitals or vegetable markets is degraded by microbes to yield methane which can be used as gas in cafeteria or community kitchen and a rich organic manure can also be produced by a major modification of the well-known gobar gas technology. Forty such plants are operational in different places in India and forty more are under construction. In a few of them conversion of biogas to electricity has been possible. This concept has caught the imagination of the Ministry of Non-conventional Energy Sources, local self-government bodies and state level environment planners.

The nuclear energy potential is about 10 times that of fossil fuels. The increased use of nuclear energy can make significant contribution to the reduction of atmospheric pollution. The approach followed in the nuclear energy sector with regard to safety, radiation protection, resource utilization etc is quite consistent with the goals of sustainable development. When Dr. Bhabha envisioned India's nuclear programme he was fully cognizant of possible deleterious

effects radiation exposure beyond a certain magnitude. In the occupational domain, the radiation exposures to workers should be controlled so as to meet the rigorous standards stipulated by regulatory agencies. This is achieved both at the level of design and at the level of operations. In the same manner, discharges from nuclear facilities to the public domain need to be controlled to within specified international standards. It is mandatory to ensure compliance to these standards by conducting regular environmental surveys, which in their totality, include studies on natural background radiation. Elaborate studies are being conducted on radiation protection procedures as well as development of chemical entities for radiation protection and countermeasures. All these require specially trained personnel. There is an overlap in the requirement of such a training for chemical and nuclear industry. It should include, in addition, training in biostatistics, epidemiology, mathematical modelling and basic civil engineering. Young postgraduates need to take note of these emerging areas for career development.

While the dreams of pioneers like Dr. Bhabha have been considerably realized, the future is full of challenges. The challenges are further made difficult by the sheer size of our population and the existing socio-economic disparities. The ultimate goal is to become self reliant in food production,

energy production as well as industrial production. The new society is going to be fully knowledge based. Knowledge has to be accumulated, transmitted and utilized to lift the standards of every aspect of our social existence. Everyone, whether he or she is a student of sciences or humanities or management or public administration or linguistics, has a role to play in our struggle to stay afloat, nay to lead in the competitive global economy. Challenges throw up opportunities and leadership. I am sure some of these graduates assembled here today will wear the mantle of leadership of tomorrow.

One constant refrain of educationists, and the industry in general, is that our education system produces mindless robots, graduates with dazzling academic records, but lacking specialized vocational skills which they can make use of in the real world. A career oriented education would ensure for them not only a better quality of life in the midst of burgeoning industrial, economic and technological progress, but also instill pride and self-confidence in being a part of our great national resurgence. I am glad to know that this University through its 11 faculty disciplines, 25 departments, 1 constituent college, and 70 affiliated colleges is imparting high quality education in tune with the national needs. There may be a need to introduce new courses such as industrial radiography, medical physics, etc. On the basic sciences front, new materials,

nanotechnology, molecular medicine are the new disciplines that can be introduced. Futuristically speaking, globalization and the growth in biotechnology, agribusiness and environment planning sectors may tomorrow necessitate expansion of the BPO concept beyond the IT domain and we may need biotech-BPO, agri-BPO envo-BPO etc on techno-commercial scale. At the same time, let me emphasize the need for imparting high quality education in basic sciences and humanities to sustain a demanding R&D sector. Research is also a well paying, challenging and at the same time, intellectually stimulating career. I am confident this institution will not be found lagging behind in ushering in such revolutionary changes in education.

Incidentally, the association of the state of Gujarat with atomic energy in independent India has been strong. We have the Kakrapar Atomic Power Station and Heavy Water Plant at Vadodara. Further, the Institute of Plasma Research in Gandhinagar is a premier institution which is the nodal organization for India's contributions for the development of International thermonuclear experimental reactor (ITER). Department of Atomic Energy has embarked upon a hands-holding program with academic institutions on a limited scale to rope in the best available talent in the country and prevent their migration to greener pastures. I understand that

Sardar Patel University faculty in life sciences, physical and materials sciences have had fruitful interactions with BARC scientists in last several years. Some of our scientists have occasionally contributed to teaching here at postgraduate level. I do wish that, these interactions are perceptibly strengthened.

All young men, and women who are on the verge of entering a new phase of life, should have their dreams and ideas - not only for personal betterment, but also for empowerment and upliftment of our masses. Inspired by their illustrious pioneers and mentors, they should make every possible intellectual and physical effort to realize their dreams. I offer my best wishes for those dreams to come true.

Thank you.

* * * * *