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The SARAS inaugural flight

THE inaugural flight of *Saras* took place at 8.20 a.m. on 22 August 2004. Joining the applause to hail this remarkable step forward in Indian civil aviation were Shri Kapil Sibal, Minister of State for Science & Technology and Ocean Development and CSIR's Vice President; Dr R. A. Mashelkar, Director General, CSIR; Dr V. S. Ramamurthy, Secretary, Department of Science & Technology; Shri N. R. Mohanty, Chairman, Hindustan Aeronautics Limited (HAL); Dr T.S. Prahlad, NAL's former Director and Directors of 35 CSIR establishments.

Shri Sibal described the morning as a, "day of great pride. As the *Saras* soared skywards, our spirits soared too. You've grown wings for the Indian nation today," he said. Shri Sibal drew from the famous quote of Charles A. Lindbergh, the first aviator to fly non-stop across the Atlantic Ocean, to say, "To me *Saras* represents science, freedom, beauty and adventure". "A book on the story of *Saras* would make absorbing reading", he said, even as he exhorted the *Saras* team to think big so that this technological juggernaut moves forward. Indicating that the aviation project during the next decade was as high as Rs 100,000 crores, Shri Sibal said: "We must expand markets, we must look for bigger market shares, we need public-private partnerships, we need international collaborations". He ended his inspiring address by reading out lines from his impromptu poem: *Why do you fly so high, Saras?*

The SARAS inaugural flight ...

Shri Kapil Sibal interacting with Dr R.A. Mashelkar during the *Saras* inaugural flight

"Today is the 22498th day of my life, and I've not known a happier morning," an elated Dr Mashelkar declared as he greeted the *Saras* pilots – Sq. Ldr. K.K. Venugopal and Wg. Cdr. R.S. Makker — after the aircraft landed perfectly following a 20-minute flight.

Six test flights on 29 May, 7 June, 19 July and 18,19 and 20 August 2004 had preceded the first 'official' *Saras* flight. So the *Saras* actually flew four times in five days last week.

This was National Aerospace Laboratories (NAL), Bangalore's most remarkable technological achievement in its 45 years of existence, and the mood at the Technology Day function that followed was decidedly jubilant. Dr B. R. Pai, Director, NAL, welcomed the huge gathering, assembled next to the *Saras* and the R.B. Damania hangars, and briefly traced the history of the *Saras* programme. Expressing his tremendous joy at the morning's happy outcome, Dr Pai cautioned that NAL "still had a long way to go".

Dr T.S. Prahlad, NAL's former Director and, in many ways, the 'Godfather' of the *Saras* project, then offered a very detailed narrative of how the *Saras* development unfolded. Dr Prahlad recounted how NAL went through moments both of extreme exultation and deep disappointment. "Building a *Saras* kind of aircraft with no legacy databases or expertise to fall back on is indeed a profound challenge," he said. Dr Prahlad thanked CSIR and Dr Mashelkar for providing "vital energy" to the *Saras* project.

Dr R.A. Mashelkar was understandably delighted, especially because Directors of all CSIR establishments – NAL hosted the CSIR Directors' Conference during 21-22 August 2004 to coincide with the *Saras* inaugural flight -- were present to view the *Saras* flight. "This is a triumphant moment for CSIR, and it's really wonderful that representatives of the entire CSIR family are present to share our collective joy," he said.

Declaring that "spirits were flying high", Dr Mashelkar hailed NAL's outstanding achievement and marvelled at the courage of the ASTE test pilots. "To get *Saras* airborne, we had to fight battles both on the ground and in our minds. But we've proved once again today that India can make it!" Reacting to criticism about Saras's extra weight, Dr Mashelkar explained why this wasn't a "serious concern" ("most first aircraft prototypes worldwide tend to be heavier; designers have to play safe!") and appealed to everyone to offer *Saras* the "emotional support that it richly deserved". "We've had the inaugural flight of India's first civil aircraft, shouldn't this be an occasion for celebration?"

Dr V.S. Ramamurthy said that he had only two words to say, "congratulations and good wishes". "We're experts in making a list of things we *cannot* do", he remarked, only half in jest, and talked about how he had received a large number

of sealed envelopes from his critics after the Technology Development Board of DST took the decision to support the *Saras* programme. "When the US sanctions adversely affected the *Saras* progress, I opened the first envelope. It said 'I told you so!' When *Saras* faced a second major problem, I opened the second envelope. It said, again, 'I told you so!' I still have many unopened envelopes", Dr Ramamurthy went on, " but I too have left many unopened envelopes with our critics. I hope they've opened one of my envelopes today!"

In his remarks, Shri N.R. Mohanty, Chairman, HAL, said that the *Saras* success made him feel very proud to belong to the Indian aviation family. "All of us at HAL are just as delighted today", he said. Shri Mohanty also explained how a motivated work force could significantly speed up project execution times. "I shall always feel proud of the way the HAL teams designed and developed the HJT-36 intermediate jet trainer in double quick time". Before ending, the HAL Chairman asked Shri Kapil Sibal for a gift. "We would like you to announce a first order for 30 *Saras* aircraft," he said.

In his generous response, Shri Kapil Sibal told the *Saras* team, "You have given a great gift to the nation today. An order for 30 aircraft would be a small way to compensate this effort."

The inaugural function ended with the vote of thanks by Dr K. Yegna Narayan, Head, C-CADD and the *Saras* Programme Director.

For further details on *SARAS*:

(i) *CSIR News*: 54 (2004), p 161;
(ii) *CSIR News*: 53 (2003), p 33.

Interview with Dr K Yegna Narayan, *SARAS* Programme Director, NAL

How does it feel now that SARAS is airborne?
It's wonderfully euphoric. I can't find words to describe our joy when we saw SARAS in the skies.

But this is only the beginning?
Yes, of course. We still have a very long way to go. We've barely flown three hours so far. We need to fly at least 500 hours before the aircraft can be considered for certification.

Is the SARAS performance so far meeting your expectation?
These are early days. But we think we've made a very encouraging beginning. The pilots are happy with the performance.

There are concerns expressed about the SARAS weight?
Yes the aircraft is currently heavier than what it should be. But you must realize that this is only the first prototype. We have to play very safe to start with.

How's the second prototype, VT-XRM, coming up?
It's about 60% ready. VT-XRM will fly in 2005. Once we have two aircraft flying, we can double our flying hours and reach our target of 500 hours sooner.

What does this SARAS experience mean to you?
It means a lot, really a lot! Some of us have spent 15 years working on SARAS, and waiting for the programme to take off, so this success is very special and sweet. SARAS also taught all of us to work together, both within NAL and outside NAL. My colleagues have worked hard, and made big personal and professional sacrifices.

Will the SARAS be commercially successful?
We've commissioned three market surveys by independent agencies and they all indicate a market for at least 150-200 aircraft. The Indian skies are opening up. There's a lot of excitement with low fare airlines. India is such a large country. It has so many people. Certain parts (especially the North-East) are still so poorly connected. Our economy is burgeoning. SARAS is designed to perform a variety of flying roles. I really see no reason why SARAS can't be commercially successful.

Interviewed by Srinivas Bhogle and R Guruprasad

SCIENTIFIC AND TECHNOLOGICAL CHALLENGE

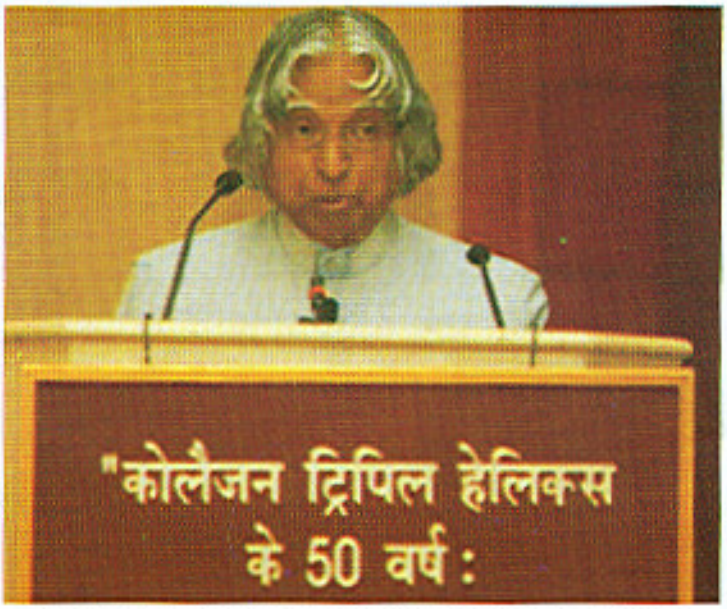
President of India Dr A. P. J. Abdul Kalam's address at the Symposium on 50 Years of Collagen Triple Helix: A Celebration of Science

PRESIDENT of India Dr A. P. J. Abdul Kalam stressed on the need to integrate nano-technology with biotechnology, information and communication technology and space technology for the benefit of mankind, while delivering his lecture on 'Scientific and Technological Challenge' during a special session at the 'Symposium on 50 Years of Collagen Triple Helix: A Celebration of Science. The symposium was organized by the Institute of Genomics and Integrative Biology (IGIB) Delhi; Vigyan Prasar, New Delhi; and the Central Leather Research Institute (CLRI), Chennai, on 7 August 2004 at Vigyan Bhavan, New Delhi, to mark the 50 years of the discovery of the triple helical structure of Collagen by Prof. G. N. Ramachandran. Shri Kapil Sibal, Minister of State for Science & Technology, and Ocean Development, and Vice President CSIR, was also present at the special session.

In this lecture the President also dwelled on technology interfaces with economy and environment and traced the development of technology through the ages. He focussed on India's areas of strength, underlined the emerging challenges and outlined the path ahead for scientists and technologists in their quest for a better tomorrow. He also took part in a lively interactive session with the young researchers.

The address is reproduced below.

I am indeed delighted to participate in the celebration of the discovery of the Triple Helical Structure of Collagen by Prof. G. N. Ramachandran (GNR). My greetings to the organizers, scientists, academicians, students and distinguished guests participating in this function.



President of India Dr A. P. J. Abdul Kalam delivering his address at the Symposium on 50 years of Collagen Triple Helix: A Celebration of Science

GNR's Contribution

GNR's life, which was a fusion of curiosity, creativity and problem solving for successful missions, is indeed an example for emulation by all scientists. GNR was wondering how to go about with x-ray diffraction and x-ray crystallography base with application to bio-molecules as a main theme. In answer to a question by GNR, JD Bernal, the famous crystallographer and chemist who was on a visit to India in 1942, said all the structures proposed so far for collagen were unsatisfactory and GNR could take a look at that. How to get collagen was indeed a big problem for GNR at that time. When he presented his problem to Dr Nayudamma, the then Director of CLRI, procured a tube full of collagen from Australia within a few days. This helped GNR to publish the first innovative paper on the collagen structure, which gave strikingly original triple helix – it appeared in the journal Nature in August 7, 1954. The proposed structure consisted of three separate helical chains, with their axis parallel to the fiber axis, stacked in a hexagonal array. This structure was not only innovative but it also provided better quantitative agreement with the X-ray data. Collagen is today finding large-scale application in the treatment of third degree burn injuries, since it has been found to have extraordi-

nary healing properties. Also collagen has led to a separate branch of biology named structural biology, which is being taught in many universities. I was thinking what thoughts I can share with young researchers and students on the occasion of celebrating 50 years of the Discovery of the Triple Helical Structure of Collagen by Prof. G. N. Ramachandran. I have selected the topic "Scientific and technological challenges".

Technology Interfaces

Technology is the non-linear tool available to humanity, which can affect fundamental changes in the ground rules of economic competitiveness. Science is linked to technology through applications. Technology is linked to economy and environment through manufacture. Economy and environment linked to technology promotes prosperity in the society.

Technology Through Ages

Through out the last 120 centuries, unique cultures have come into existence due to advancement in technology. The first 118 centuries had a dominance of primarily stone, bronze and iron ages. The last two centuries have seen rapid development of the chemical age. The advancements made in material science and technology gave the impetus for both nuclear age and biological age to flourish. Succession of these technology periods has involved progression from simpler materials to more complex forms of science and engineering. We are today at the convergence of Nano, Bio and Information technologies. This age, I feel will create historical revolution and we must be on the driver's seat to contribute towards this societal change.

When I think of Nanoscience and Nanotechnology, I am reminded of three personalities. The first person is Richard Feynman, who described the concept of 'building machines" atom by atom in his talk at Caltech titled "There is plenty of room at the bottom". The second person is Eric Drexler, who wrote the book titled 'Nano Systems, Molecular machinery, manufacturing and computation". The third person is Prof. C. N. R. Rao, who pioneered and fostered nano science research in India. Since independence, the country had all along been taking recourse to technology for societal changes and economic prosperity. A nation that is alert should be sensitive to the changes that take place in the technological fabric of the world and prepare itself for the arrival of newer changes on the horizon. As the country was acquiring the technologies of steel, agriculture, space, missiles and IT, we grew to be anywhere between third to fifth nation in figure of merit. In information technology we have a possibility of becoming the third knowledge power. We believe that nanotechnology would give us an opportunity. If we take appropriate and timely action; we can become one of the important technological nations in the world.

Technology in India

India after independence was determined to move ahead with planned policies based on socialist pattern through five-year plans. On account of the green revolution, India is now self sufficient in food. Operation Flood has made India, the largest producer of milk in the world. Health services have also been improved since independence with increase in life expectancy from 33 to 64 years, fall in infant mortality from 148 to 71 per thousand, and eradication of diseases like small pox and cholera through vaccination etc. Small-scale industries provide a significant percentage to the national GDP. India is in a position to design, develop and launch world-class communication and remote sensing satellites. India is having capability of building large Thermal and Nuclear power stations. Defence research has led to many significant developments in weapon systems like strategic and cruise missiles, sonars, underwater weapons, light combat aircraft, tanks, electronic warfare systems and various armours. India has a strong base in the development of information technology and the country is progressing in hardware and software business of more than $66 billion. Yet, India is a developing country.

Emerging India

As you are aware the first independent movement started in India in 1857. This was the first vision for the nation. Our forefathers and freedom fighters struggled for 90 years continuously and achieved independence in the year 1947. After 1947, our science and technology has brought about self-sufficiency in food, milk and improved the standard of living to a certain extent. In spite of continuous work during the last fifty-seven years 26% of our one billion population is still below poverty line. They require habitat, they require healthcare, they require potable water, they require education, they require power and above all they require employment opportunities to improve their living standards. This I am told by the economic pundits that this can be achieved if our economy can grow over 10% GDP annually. Scientists and technologists have to

work persistently to achieve this target for making India a prosperous and happy nation by 2020.

Integrated action

To meet the need of one billion people, we have the mission of transforming India into a developed nation. We have identified five areas where India has a core competence for integrated action: (1) Agriculture and food processing (2) Reliable and Quality Electric power, Surface transport and Infrastructure for all parts of the country. (3) Education and Healthcare (4) Information and Communication Technology (5) Strategic sectors. These five areas are closely inter-related and if well done would lead to national, food, economic and security.

Green Revolution-II

India has to now embark upon the Second Green Revolution, which will enable it to further increase its productivity and diversity in the agricultural sector. The second Green Revolution will have the farmers in focus, farming technology as the friend, food processing and marketing as partners and the consumers as the angels to be satisfied. From now on to 2020, India would have to gradually increase the production to around 400 million tonnes of grains. The increase in the production will have to be done under the reduced availability of land from 170 million hectares to 100 million hectares with reduced water availability. We should also learn to diversify to meet specific consumer preferences, export markets and also in the interest of ecological balance. This is to be achieved through information access to all stakeholders and not with central controls or restriction of movements of agro products. The challenges for the scientists and technologists would be in the areas of development of seeds that would ensure good yield even under constraints of water and land with ecologically balanced farming. The challenges for the scientist is indeed a knowledge graduation from characterization of soil to the matching of the seed with the composition of the fertilizer, water management and evolving new pre-harvesting techniques for such conditions. The domain of farming would enlarge from grain production to food processing and marketing. Newer forms of cooperative entities are required to be established for ensuring maximum benefit to the farmers. E-marketing concepts may also be put into practice to provide farmers choices in selling. Some of the areas, which need focus, are: soil upgradation, dry land agriculture, temperature and salinity resistant seeds and minimum water cultivation. There have been successful experiments carried out by TIFAC team in Bihar, where per hectare output of wheat has been tripled by farmers in collaboration with agricultural scientists through scientific methods. Such experiments can be replicated in many parts of our country, carefully tailored to local conditions. The earnings of the participating farmers have remarkably improved. This is a crucial socio-economic need. Access to food will need enhancement of purchasing power of the rural and urban population. This can only come out of employment generation through entrepreneurship and through increase in the incomes of existing farmers by techniques adopted by the TIFAC team briefly mentioned above.

Areas of research in Biotechnology

The key areas of research in biotechnology are Gene therapy, Gene modifiers, drugs designed for individuals, nano-medicines, developing a living cell, DNA repair, stem cells, drug delivery nano-robots and tissue culture.

Stem Cell Research

The recent identification and characterization of progenitors with stem cell properties has opened up new avenues that may be useful for treating functional impairments caused by the death of specific cell population. The stem cell may help restore functioning of certain defective organs, by repopulating or rescuing the damaged cells from further degeneration. There will be a revolution in the medical treatment for heart care, cancer, the visually impaired and mentally challenged. It is essential to launch an integrated national stem cell research program. During my visit to various laboratories, I happened to see the beginning of stem cell research for different purposes including brain research. I would like to share with you two very important stem cell research applications in the field of cardiology and visual impairment. When I met Dr P. Venugopal, a famous cardiac surgeon, he told me about his experiences. He said in one of the cardiac diseases, where conventional, medical and surgical treatment were ineffective because of the affliction of the heart muscle, use of autologous bone marrow stem cells implantation into the diseased heart muscles had been applied in order to improve the function of heart muscle. This kind of application of this procedure is the latest and very few cases have been done in the world, and for the first

time in India. This is expected to open new frontiers in the treatment of patients for regeneration of heart muscles, thereby giving new hope for the patients suffering from end-stage heart disease. The stem cells are being tried in other diseases like diabetes in order to offer cure for the patients suffering from long term and intractable diabetes. This is being applied by injecting the stem cells into the patient's artery supplying the pancreas. Similarly, my friend Dr Taraprasad Das has administered the stem cells in the affected retina portion of the eye region with success.

Space

Today, competence has been established for advanced remote sensing and communication satellites and their applications. Our launch services and satellites are cost effective and we should enter into the global market aggressively. The exploration of the moon through '*Chandrayaan*' will electrify the entire country, particularly the young scientists and children. I am sure the moon mission is just a start towards further planetary explorations and manned missions, which will lead to Mars exploration vital for our economic needs.

Development of reusable launch system

Currently, global space industry has a capacity to launch over 200 tonnes of satellites every year. However, the forecast is that projected demand will consume less than half of this established capacity. Thus a bitter price war is on to capture this limited market. The cost of access to space forbids further expansion of space activities. The Indian concept of hyper-plane, a fully reusable system is an innovation in rocketry providing a payload fraction of 15%, drastically reducing the launch cost. Therefore, it is an opportune moment for India to work with international agencies and launch a major universal mission to provide the benefit of space technology to the whole mankind.

God's Creation of Nano-materials

Whenever I go for a morning walk in the Mughal Garden, I see the peacock dancing with its colourful feathers, during this season. When I look at the deep and beautiful colours on the feathers of the peacock in the *Rashtrapati Bhavan*, I have often wondered how even after many years, the colour of the peacock feather does not fade away. I recall as a young kid, I used to keep peacock feathers in my books. This phenomenon of long lasting original colour to the peacock has come from God's own creation of nano materials, coated in a peacock's feather and these diffract light, which gives us the rich colours. Every thing in this universe – from giant stars to our bodies work on a molecular scale. Our hearts and lungs are big objects but all the processes take place at the molecular level. Therefore, everything in our body and in the physical universe is already based on nanotechnology. Observation of the nature and the role of science in understanding it from our research in Nano sciences can be converted into a technological product by using the same or similar Nano materials which gave the natural colour for the peacock feather, as part of our shirts, saris, fabric and apparels. It is a welcome destination for science to mature into technology and become a product of utility for the society.

Nano-bio-info technology

The world market in 2004 for nano materials, nano tools, nano devices and nano biotechnology put together is expected to be over hundred billion dollars. It has been noticed that the fastest growing area among these is nanobiotechnology. Carbon nano tubes and its composites will give rise to super strong, smart and intelligent structures in the field of material science. Nano bio medical sensors will play a major role in glucose detection and endoscopic implants. Drug delivery system will revolutionize the health-care to a large extent. Molecular switches and circuits along with nano cell will pave the way for the next generation computers. Ultra dense computer memory coupled with excellent electrical performance will give society low power, low cost, nano size and yet faster assemblies. The last four decades have also affected the packaging concept. Electronics packaging of the past has given way to the present Microsystems packaging and the shift in the trend is now towards the futuristic nano packaging.

Integrated approach for nano-structures to manufacturing

For us to succeed in manufacturing of nano products and their deployment we need to tackle the issues of science and technology, product development and societal aspects in an integrated way. Judging by the past experience of the country in driving technology missions like in Aerospace, Agriculture, Atomic energy and IT, I am confident that, if we take it in a mission mode with a clear-cut vision, the country will reap the benefits of nanoscience and technology.

Research Areas

CNT based Photo-voltaic Cell: Presently silicon based photo-voltaic cells have an efficiency of only 13 - 15%. This has become a big challenge for converting solar energy into power. Research has shown promise of increasing the efficiency of the photovoltaic cell to 40 to 50% using CNT. This will have significant effect in the capital investment of solar energy plants.

Treatment for Parkinson's Disease and Epilepsy: The primary symptoms in Parkinson's disease, as you are all aware, are tremors or trembling in hands, arms, legs, jaw, and face, rigidity or stiffness of the limbs, slowness of movement and impaired balance. Prof. Varadan has devised a wireless system for monitoring and control of Parkinson's disease. The system consists of an implantable DNA insert in the head region for generating a pulse to the nerve system; controlled either by a modified pacemaker or smart hat and passive polymer based gyro sensors, which are implanted in the tremor location. The sensor gets the power from the Pacemaker and the Pacemaker then reads the tremor motion. The Pacemaker then generates the pulse in the implanted device in the head to control the tremor. This appears to be a promising line of treatment for such diseases. It has been reported that 13 patients affected by Parkinson diseases had full recovery.

Energy

Our generating capacity has to triple by 2020 from the existing hundred thousand Megawatts of power. This has got to be achieved through three different sources namely hydel capacity, nuclear power and non-conventional energy sources primarily through solar energy. This capacity build up will need large scale power generation through solar energy and other renewable energy sources to an extent of 1,00,000 mega watts. Nuclear, hydel and thermal stations will cater to the balance 2,00,000 mega watts.

Water

Globally, there are a few solutions to solve water shortage. The solutions are redistribution of water, water re-cycling and prevention of wastage, rainwater harvesting and inter-linking of rivers. What is the solution that scientists and technologists can provide for these missions? We must find scientific solutions to these missions so the missions are executed in a cost effective manner maintaining the ecological balance and bio-diversity. One important solution is to create new perennial sources of fresh water by seawater desalination. India attaches importance to research and technological solution for various desalination processes. But we are only in the pilot plant stage. We need to work for large volume desalination plants, both Multi Stage Flash and Reverse Osmosis, which can cater to the needs of big cities. Our scientists should also carry out research in the area of drinking water generation. Another area of research involves culturing of water through seawater bacteria, releasing hydrogen ions, which can be converted into drinking water. This is probably a long-term solution to water problem. Regional cloud seeding with the cooperation of participating states with the effective seeding techniques needs to be explored in our country.

Earthquake prediction

In many places in our planet, we experience severe earthquakes resulting in loss of life, loss of wealth and in some cases it destroys the decades of progress made by the country and its valuable civilizational heritage. India has earthquake problems periodically in certain regions. Earthquake is a sub-terrain phenomenon and predicting this from space observations would be a great challenge to space scientists. I am sure that if you all work with the determination that you have always exhibited, we will reach the light on the other side of the tunnel. Earthquakes occur when the crust reaches a critical state, emission of electromagnetic signals before final rupture is theoretically plausible, notably in the ultra low frequency (ULF) range and very low frequency (VLF) range. It is hoped that well organized electromagnetic monitoring may provide unique observational information on the pre-slips.

Conclusion

For fast national development, I am convinced that 'Nano' is the greatest building block for healthcare, structural materials in electronics, automation etc., and will become the platform for new cutting edge technologies to grow for better living of the mankind. We need to integrate nano-technology with biotechnology, information and communication technology and space technology for the benefit of mankind in education, healthcare, communication water, power, materials, manufacturing and disaster management.

As you all know, there is a big debate going on, whether human cloning should be encouraged or not. This is one of the pet subjects of bio-scientists and technologists. I would like to share with you my own personal view. God has created human being after millions of years of genetic creation and engineering.

Every one of us carries genes with memory and the experience of our forefathers who lived millions of years ago. I don't think man can compete with God in engineering these cumulative characteristics. Hence, cloning of human beings should not be permitted. However, it is essential to clone various organs of the human body system like eye, liver, heart, pancreas, kidney etc., which can help in repair and rejuvenation of the human system.

My best wishes to all the members of the scientific community for success in your scientific and technological missions.

May God bless you.

Symposium on 50 years of Collagen Triple Helix: A Celebration of Science

The symposium marked the monumental discovery of triple helical structure of collagen by Prof. G. N. Ramachandran and was entitled '50 years of Collagen Triple Helix: A Celebration of Science.' A galaxy of eminent scientists attended the celebration; and many of those privileged to have worked directly under or with Prof. G. N. Ramachandran shared their thoughts.

In his Welcome Address, Prof. Samir Brahmachari, Director, IGIB, said that the symposium was essentially to document the discovery made by Prof. G. N. Ramachandran (called GNR by his peers and friends) —a towering scientific personality, who stood "shoulder to shoulder with Nobel laureates such as Francis Crick and Linus Pauling." He reminded the audience about the global celebrations last year that had marked the 50 years of the discovery of the DNA double helix and expressed regret that an Indian discovery of similar consequence lay neglected. Further, he mentioned that, the next generation has, "forgotten the success of our unsung heroes." He hoped that the students and research scholars, who comprised a large part of the audience, would go back infused with pride at the end of the day.

Delivering the keynote address at the inaugural session, Dr R. A. Mashelkar, Director General, CSIR, paid tribute to the genius that was GNR. He said that it is ordinary mindset to look through windows and doors opened by others and to borrow their own worldview from them. However, GNR was one, who was always at the forefront and one who opened new doors and windows, and so his legacy continues. Dr Mashelkar provided glimpses into situations that arise while one is actively pursuing one's own dreams. He urged Indian researchers to look for "points outside the lines" or for "zones of discomfort". He agreed that everyone, be it the research scholar, the Ph.D. mentor, Editor of the research journal or the reviewer of the paper, is happy when the findings match the hypothesis or expected results. "But," he said, "great ideas go beyond" (the expected). He encouraged the researchers to break away from conventional wisdom, to find the courage to question and to look for triggers in unusual situations or under conditions of anomalies, which, he said, are "simply new opportunities in science waiting to be investigated." He

Dr Huanming Yang, Director of Beijing Genomics Institute, China, being felicitated by President of India Dr A. P. J. Abdul Kalam, during Symposium on 50 years of Collagen Triple Helix: A Celebration of Science. Seen on his left is Shri Kapil Sibal, Minister of State for Science & Technology and Ocean Development ; and on his right, Dr R. A. Mashelkar, Director General, CSIR. On extreme right is Dr V. S. Ramamurthy, Secretary, DST

shared with the audience many reminiscences of his own research days to embellish the point he wanted to make that "points that lie beyond" are challenges to break away from the old ideas. He detailed among others, the discoveries of the Mashelkar-Marrucci Elastic Boundary layer Model that broke away from Prandtl's 1937 boundary layer theory, the Devotta – Mashelkar Model that dealt with reptation-disengagement-diffusion dynamics for the first time and the ECTN model by Lele-Mashelkar, again a breakaway from the conventional wisdom of phenomenological constitutive equation. He said that he had found breakthrough even in a "failed SEM" and although this was a lucky accident, "serendipity smiles only at the alert because the eyes do not see what the mind does not know." He underlined the fact that, "discovery path is highly non-linear and unpredictable" but reiterated that chasing anomalies and discontinuities is a rewarding experience. He ended by asking the future GNRs seated in the audience, to dare to learn, and to learn to dare, because risks bring rewards.

Dr V. S. Ramamurthy, Secretary, Department of Science & Technology, in his Presidential Address said that the history of science is full of pathbreaking discoveries made by the discoverers. The touchstone to determine whether a discovery qualifies to be called 'pathbreaking' is the question, "Would it have made a difference to the history of science if the discovery had not been made?" The answer "Yes" to this question would qualify the discovery to be listed as a pathbreaking one. He pointed out that the history of science is a list of pathbreaking discoveries. He said all great discoverers have questioning minds that do not accept what others say just because a teacher/senior /boss says so, and that they have questing minds that do not take anything for granted. He exhorted the present day researchers to convince themselves first, to identify and look for anomalies, to have the patience to go beyond, and to have dogged perseverance. He urged them to transcend artificial boundaries. His message was, "Don't close yourself to what is happening on the other side of the wall because you have set up the wall. Rather, destroy such walls." He asked the students to "chase big dreams—to hunt lions, not rabbits!" He asked the students to develop holistic vision and to look at the problems and solutions in totality. He agreed that resource crunch existed but pointed out that young human resource is making India globally competitive. He said that GNR could be projected as an icon to young students of today.

Prof. Samir Brahmachari chaired the session entitled 'Collagen Revisited'. Dr Manju Bansal of Indian Institute of Science, Bangalore, a direct student of Prof. G. N. Ramachandran, put into current perspective and brought one up-to date on the collagen story. The title of her talk was "Triple Helix: Story Retold". She said that even though collagen is a plentifully available protein, with one-fourth of the body's protein being collagen, only sketchy details about its structure were known when Prof. G. N. Ramachandran began his study. She spoke about "his great leap of imagination, rather his educated guess" when he made the assumptions about glycine being "sequentially and regularly distributed" in the collagen molecule. She said that Prof. G. N. Ramachandran's genius lay in collating floating information into his own research findings. Unfortunately, however, the research paper of such seminal importance languished for eight months before being published in the journal *Nature (1954, 174:1771-1775)*. The following year Francis Crick and A. Rich suggested minor modifications. Undeterred by the criticism, Prof. G. N. Ramachandran went on to use the anomalies to great advantage and designed what is today known as the 'Ramachandran map.' Dr C. Ramakrishnan's talk was entitled, "From Collagen Structure to Ramachandran Map". He said that the map evolved from Prof. G. N. Ramachandran's, "great objectivity that led him to scrutinize and reassess in the face of criticism." He said that, "the map is not the monopoly of proteins but its principle can be used for any molecule, but this use has to be made judiciously. It is not a predictive algorithm, rather it is a confirmation or diagnostic kit to cull out data and interpret it without bias."

Dr N. K. Ganguly, Director General, Indian Council of Medical Research (ICMR), New Delhi, chaired the second session. He said that there are many types of collagens. The triple helical structure of collagen is a pre-requisite for its proper functioning. He pointed out, that collagens change under disease conditions such as atherosclerosis. "The collagens change, their interactions (with other proteins) change, and tremendous amounts of biological molecules are released, and the collagen disease process (in fact, any disease process) begins," he said.

Dr T. Ramasami, Director, CLRI, Chennai, spoke on "Collagen: The Smart Material". He walked the lanes of history by reminding the audience that CLRI had sourced and purified the original collagen sample from Australia for Prof. G. N. Ramachandran. This exotic sample, which helped Prof. G. N. Ramachandran discover the collagen structure, had

Sponsored/Consultancy Projects taken up and Technical Services rendered by CECRI

THE sponsored/consultancy projects taken up and technical services rendered by the Central Electrochemical Research Institute (CECRI), Karaikudi, in the recent past include:

Sponsored Projects

- Feasibility study for up-gradation of waste water for recycling— M/s NSP Electronics Ltd, Bangalore (Rs 51,000)
- Feasibility study on 'Nickel— diamond composite coating on stainless dental burrs' —M/s Pivot Fabrique HP., Mohali (Rs 18,000)
- Feasibility study on 'Electropolishing of 304 grade stainless steel valves' — M/s Gany & Co, Maraimalai Nagar (Rs 25,000)
- Feasibility study on 'Electropolishing of 420 grade stainless steel needles' — Easystich Needles Pvt Ltd, Bangalore (Rs 50,000)
- Creation of energy storage devices using nano structure unit materials — Japan Science and Technology, Japan (Rs 2.30 million)
- Feasibility study on 'Electro refining of lead from scrap lead acid batteries' —M/s Lead Age Alloys India Ltd, Bangalore (Rs 100,000)
- 'Electrolytic production of high purity calcium metal' — Department of Atomic Energy, Mumbai (Rs 1.10 million)
- Cytochrome P 450 isoforms in aquatic invertebrates in relation to xenobiotics metabolism — DST, New Delhi (Rs 1 million)

Consultancy Projects

- Setting up of a demonstration unit for electrolytic regeneration of spent ammonical cupric chloride etchant with simultaneous recovery of copper— M/s NSP Electronics Pvt. Ltd, Bangalore (Rs 300,000)
- Advise on Electropolishing of 202/304 stainless steel racks — M/s Tufflan India Interiors, Bangalore (Rs 80,000)
- Instrumentation for structural and corrosion monitoring of Ganga bridge at Allahabad — presentation & specification preparation — M/s Devcon Chemicals Pvt Ltd, Mumbai (Rs 88,000)
- Improving the quality of halophospate day light phosphor — M/s Surya Roshnio Ltd, New Delhi (Rs 200,000)
- Recommendation of suitable anticorrosive paint schemes for M.S. Structures of the boilers of NLC — NLC Ltd, Neyveli (Rs 71,000)

Technical Services

- Testing of 2V/500Ah VRLA batteries — M/s HBL Nife Power Systems Ltd, Hyderabad (Rs 75,000)
- Testing of Ni - MH cells — BPL Ltd, Bangalore (Rs 10,000)
- Testing of anticorrosive treated rods as per ASTM standards for Kottakuppam town panchayat water supply improvement scheme —TWAD, Cuddalore (Rs 10,000)
- Sampling of analysis of water drops generated along with auto exhaust emission with inactive cooling systems - Sri, M.R. Thiyagarajan, Pondicherry (Rs 16,000)
- Testing of the Paints — BSNL, Madurai (Rs 15,000)
- Testing of non-organo phosphonate samples for $CaCo_3$ scale formation control — Neyveli Lignite Corp. Ltd, Neyveli (Rs 37,000)
- Evaluation of CPCC system on carrying out relevant tests as per CECRI Code of Practice — Br.No. 809 in SRR-TA section — Mr M. Subba Reddy, Pattambi, Kerala (Rs 26,000) ❑

been derived from the tail of a kangaroo. Then he elaborated on the present-day success stories of collagen research at CLRI, and highlighted the qualities of collagen that qualified it as "smart material". He said the use of collagen in medical applications was facilitated by its low immunogenicity. So, collagen could be used in ophthalmology (synthetic corneas), wound dressing, burn dressing, as skin surrogates, as scaffolds for infected wounds and in bi-layer systems for drug-release. He mentioned many collagen-based products of CLRI (some of these being second generation), such as Kollagen, NewSkin, Biofill, Colspon, DonerDres etc. Further, he mentioned that the auditorium at CLRI has been named Triple Helix in honour of Prof. G. N. Ramachandran's seminal discovery.

Dr D. Balasubramanian, Director of Research, L.V. Prasad Eye Institute, Hyderabad, detailed the different kinds of collagens found in the

body and spoke about the diseases caused by collagen defects manifest, either because of malfunction or due to mutations. He said that gene therapy, although in its infancy at the moment, could offer some advantage and spell hope for those suffering from collagen disorders.

Dr S. Sriramachari, Honorary Advisor, ICMR paid rich tribute to Prof. G. N. Ramachandran and also detailed an account of Indian Childhood Cirrhosis—A Vanishing Disease. He discussed the herbal therapeutic approaches being investigated.

Dr N. Yatindra of Madras University chaired the session entitled 'GNR's Legacy'. He said that in the 1950's physicists inspired advances in biology. At that time there were only three laboratories or groups working on crystallography—one was at the California Institute of Technology, USA (Max Delbruck, Linus Pauling and others), the second was the Cavendish laboratory at Cambridge, UK (William Bragg, J. D. Bernal, W. T. Astbury, John Kendrew and others) and then there was Prof. G. N. Ramachandran's group at the Dept. of Physics, University of Madras. This speaks volumes for the genius of Prof. G. N. Ramachandran—a man ahead of his times. Dr Yatindra also spoke about the Ramachandran map—the map that maps the mysteries of protein structures.

Dr M. Vijayan of the Indian Institute of Science, Bangalore spoke on "The GNR Legacy in Crystallography". He pointed out that Sodium chloride is a simple molecule whose structure was elucidated by crystallography—a feat that got the Nobel Prize. Prof. G. N. Ramachandran, he said, was from the first to the last a crystallographer whose largely theoretical work illuminated the field. Even if Prof. G. N. Ramachandran had not done anything else, he would still be remembered for his work on crystallography, he added. The Atlas showing the advances made by crystallography and by crystallographers in the 20th century shows Prof. G. N. Ramachandran in "splendid isolation" in this region of the world. Dr Vijayan said that GNR's dream was to establish the field of Macromolecular Crystallography in India—a dream that remained largely unfulfilled in his lifetime. However, post 1983 the situation in India changed dramatically, and today, many groups are working on molecular crystallography, particularly on the structural genomics of microbial species such as *Plasmodium falciparum, Leishmania donovani, Mycobacterium tuberculosis,* rotavirus etc., and the mutant HIV protease enzyme. He concluded that, though GNR's unfulfilled dream is being crystallized in India now, "it is a sobering thought that we are yet to come near the peak that GNR had conquered a generation ago."

Dr A. S. Kolaskar, Vice Chancellor, Pune University, Pune spoke on "GNR and the dawn of Bioinformatics". He pointed out that extraction of data from biological matter began from GNR's times and that it was not enough to do good science but that it was also necessary to present it well as was done in the case of the Ramachandran map, a fact that probably contributed much to its popularity.

Dr Partha P. Majumdar, Professor, Indian Statistical Institute, Kolkata, chaired the session entitled 'Looking Ahead'. Dr Huanming Yang, Director of Beijing Genomics Institute, China provided an insight into the tremendous advances made by China in the field of genomics despite a late start. His talk was entitled "1% Human Genome to 100% Rice Genome". He said that an interesting question thrown up by the sequencing study was how so few genes (about 30,000) could make a complex human being whereas rice needed about 50-55,000 genes. He said that the answer probably lay in the fact that there is massive ongoing tandem duplication of individual genes and "background" duplication of other elements in the rice genome. The whole genome duplication dates back some 56 million years ago but the tandem duplications are still going on. China has also finished sequencing the Silkworm genome in a record two and a half months, he informed. It has 18, 510 genes—a little more than the fruitfly *Drosophila*. Dr Yang emphatically said that studying the genome opens up entirely new vistas for those who ask questions that were not asked before. The situation today is one of "No sequence, no knowledge", he said.

Prof. Samir Brahmachari's talk entitled Triple Helix to Genomics concluded the session. He said that sequence determines structure and structure determines function. Today, Conformation spells Information (like that in CAT Scan). He spoke briefly about the role of conserved peptides and the identification of Invariant Signature Peptides using PLHost and the strategies of finding the "Achilles Heel" of protein structure.

Mementoes were presented to all speakers and the organizers of the event.

Distinguished Fellows of the G. N. Ramachandran Knowledge Centre at IGIB were felicitated. A Documentary film, "The Immortal Coils" especially commissioned for the anniversary of the discovery of the structure of collagen was also screened. ❑

Heterochromatic Silencing and HP1 Localization in *Drosophila* Are Dependent on the RNAi Machinery

DR Utpal Bhadra, Scientist, Centre for Cellular and Molecular Biology (CCMB), Dr Manika Pal-Bhadra (Visiting Scientist, CCMB, Present Senior Scientist Indian Institute of Chemical Technology), Hyderabad and scientists at the University of Missouri, USA and Washington University, USA have demonstrated that Heterochromatic silencing and HP1 localization in the fruit fly *Drosophila* are dependent on the RNAi machinery

Small RNA molecules have been found to play multiple roles in regulating gene expression. These include targeted degradation of mRNAs by small interfering RNAs (siRNAs) (posttranscriptional gene silencing, PTGS), developmentally regulated sequence-specific translational repression of mRNA by microRNAs (miRNAs) and targeted transcriptional gene silencing (TGS). RNAi activity limits transposon mobilization and provides an antiviral defense. RNA interference (RNAi) is required to establish silencing at heterochromatic domains in fission yeast.

Many components of the RNAi machinery have been identified in *Drosophila melanogaster* and findings suggest that the RNAi system could also play a role in targeting heterochromatin formation in *Drosophila*. Components of the heterochromatin-silencing complex have been identified by screens for dominant suppressors of position effect variegation (PEV), the silencing that occurs when a normally euchromatic gene is juxtaposed with a heterochromatic domain.

Tandem repeats of a *Drosophila* white transgene P[lacW] result in a variegating phenotype. Mini-white lines 6-2 (mini.w, one copy) BX2 (seven tandem copies), and DX1 (seven copies, one inverted were examined. Mutations in *piwi* and *homeless* relieve silencing at the tandom repeats, while single copy is normally expressed different homozygous and heteroallelic combination of *piwi*, *aubergene* and *homeless* alleles cause considerable suppression of variegation at DX1. Similar results were obtained for BX2. In some instances, these mutations fail to show a dominant phenotype, but loss of silencing is consistently observed when the mutation is homozygous or present in a heteroallelic combination.

Insertion of the P element, *P [hsp26-pt, hsp70-w]* in a euchromatic domain results in a uniform red eye. Insertion in the pericentric heterochromatin or much of the small fourth chromosome results in a variegating phenotype. These variegating lines show loss of silencing on introduction of dominant suppressors of PEV and respond to changes in copy number of the sex chromosomes. The impact of mutant alleles of *piwi, aubergine* and *homeless* on two such lines were examined. It was observed that the functions of all three loci are required for heterochromatic silencing. Homozygous or heteroallelic mutations in *piwi* result in a twofold increase in *white* expression in line 118E-10. The heteroallelic mutant combination of aubergine produces more than a fivefold increase in pigment. Five alleles of *homeless* were tested, and all cause a loss of silencing.

The RNAi machinery may function through an RNA molecule that directs sequence specific targeting of heterochromatin formation. The effects of homozygous mutations in *piwi, aubergine*, and *homeless* on HP1 and H3-mK9 by immunofluorescent staining of the polytene chromosomes were examined. The RNAi mutations have a considerable influence on chromosomal localization of HP1 proteins dramtically in *homeless* mutation. In *hls/hls*, HP1 is delocalized and uniformly distributed throughout the chromosomal arms of the chromosomes. At the same time, there is a significant reduction of histone H3-mK9. However, the total amount of extractable HP1 in various hls genotypes appears similar, which suggests that expression of HP1 is not affected in *hls* mutant lines, but rather the distribution within the nucleus. Thus, the RNAi system must be intact to achieve targeted methylation of histone H3 at Lys9, and proper localization of HP1. The changes observed readily account for the loss of PEV.

A single copy of the P*[lacW]* transgene at 50C [line 6-2], as well as the *BX2* and *DX1* seven-copy arrays, were examined for the presence of H3-mK9. The location of this heterochromatic array away from the chromocenter allows as a determinant of whether there is an accumulation of modified H3 correlated with heterochromatin like structure formation. The results indicate that the *hls* gene product is required for the proper targeting of H3 modification by methylation of Lys^9 at the mini-white array.

Mutations in *piwi* and *aubergine* result in partial loss of H3-mK9, most

evident at minor sites within the euchromatic arms. Mutation of *homeless* has a more pronounced effect. It results in dramatic loss of H3-mK9 and redistribution of HP1 and HP2 away from the chromocenter, along the euchromatic arms. Antibodies specific for H3-mK9 and for H3-mK27 were used to confirm that the effect is specific to H3mK9. HP1 interacts with SU(VAR)3-9, a major histone H3 methyltransferase, and the normal localization of these proteins to pericentric hetero-chromatin has been shown to be mutually dependent. The general distribution of HP1 along the chromosome arms in the absence of targeted H3-mK9 is not surprising, as HP1 has been shown to bind nonspecifically to nucleosome core particles and naked DNA. HP2 interacts with HP1 through the HP1 chromo-shadow domain and undergoes shift in distribution in the chromosome upon redistribution of HP1.

Although the decrease in silencing of the P[*lacW*] array and of the *white* transgenes in pericentric and fourth chromosome hetero-chromatin is readily detected, it is a partial effect; one does not observe restoration of a uniform red eye phenotype. Since HP1 and HP2 retain nearly normal distribution in the presence of *piwi* or *aubergine* mutations, but not following loss of *homeless* gene product, it is suggested that *homeless* encodes a more central function than *piwi* and *aubergine* for heterochromatin formation. All three loci appear to be involved in targeting histone H3 methyltransferase activity and localization of HP1 and HP2, demonstrating an important role for the RNAi machinery in establishing histone modification, chromatin organization and con-comitant gene silencing.

These significant research findings were published in the prestigious journal *Science*, January 30 issue 2004. ❑

Interaction Meet-cum-Workshop on Solid Waste Management

THE Regional Research Laboratory (RRL), Bhopal; M. P. Pollution Control Board; the Institution of Engineers (India); and Environment Management & Human Welfare Council recently organized an Interaction Meet-cum-Workshop on 'Solid Waste Management' to discuss novel technologies for safe disposal of municipal waste, fly ash and industrial wastes. Professionals, researchers and various user-agencies were invited to participate in the deliberations and discuss the various issues related to technologies for safe disposal of bio-solids, fly ash and other industrial wastes and protect environment and groundwater.

The meet had three sessions viz. 'Bio-solids Disposal Management', 'Fly-ash Disposal Management' and 'Hazardous Waste Disposal Management.' On the second day business meetings with user-agencies and field visit to Thermal Power Station, Sarni took place.

Dr Ramprasad, VC, Barkatullah University, Bhopal, was the Chief Guest at the Inaugural function. Addressing the gathering, he said that, the increasing volume of municipal wastes is an alarming problem. He said that, it is very important to spread awareness among the masses for safe disposal of these wastes and for creative solution to this problem and that finding a proper solution to this problem is a social cause.

Prof. Maurice Be Dusseault, Director, Porous Media Research Institute and Professor, Department of Earth Sciences, University of Waterloo, Canada who was the Guest of Honour on the occasion, said that he could support the cause with all his expertise in the field.

Dr N. Ramakrishnan, Director, RRL-Bhopal underlined the gravity of the problem and pointed out that along with prosperity wastes are increasing and that this grave problem has to be handled.

Dr R. N. Yadava, Head, Water Resources Management Group, RRL- Bhopal, highlighted the importance of the interaction meet. Shri T. V. Subbarao, Chairman, Institution of Engineers (India), MP State Chapter, Bhopal, mentioned about the problems created by various solid wastes.

The deliberations at the sessions will certainly help in solving the serious problems relating to disposal of various types of wastes generated owing to increasing urbanization. ❑

IICT celebrates Diamond Jubilee

THE Indian Institute of Chemical Technology (IICT), Hyderabad, organized its Diamond Jubilee Valedictory Function on 4 August 2004. Shri Kapil Sibal, Minister of State for Science & Technology and Ocean Development, and Vice-President, CSIR was the Chief Guest.

Shri Kapil Sibal, Minister of State for Science & Technology and Ocean Development *(centre)* in discussion with Dr J.S. Yadav, Director, IICT, *(on his right)*, and Dr R.A. Mashelkar, Director General, CSIR, *(on his left)*, during the Diamond Jubilee Celebrations' Valedictory Function

Shri Sibal, in his Diamond Jubilee address said that CSIR should forge the technological revolution in the 21st century. Inter-disciplinary co-operation and partnerships in the scientific community were most important to realize the potential of technological innovations and to facilitate their transfer from the laboratories to the market in the coming days. He pointed out that while land productivity was decreasing, population was on the rise and he called upon the scientific community to solve some of the complex problems of the people. Shri Sibal asked the scientists to focus on technology that would ensure food, shelter, healthcare and education to the 700 million people of the country whose monthly earnings are less than $2 a day (Rs 3000/- per month). He explained that technology would be of no use if one did not touch the lives of these people. The Minister assured the scientists that autonomy of scientific institutions like IICT would be protected. On this occasion, Shri Kapil

Left: Shri Kapil Sibal, Minister of State for Science & Technology and Ocean Development inaugurating the IICT Diamond Jubilee monument, as Dr R.A. Mashelkar, Director General, CSIR, *(on his left)* looks on. Others seen are: Dr J.S. Yadav, Director, IICT, *(extreme right)* and Shri Rakesh K. Sharma, COA, IICT *(extreme left)*
Right: Shri Kapil Sibal planting a sapling on the occasion of IICT Diamond Jubilee Celebrations

Sibal released the Diamond Jubilee Souvenir and presented 'Roll of Honour' to retired and present scientists of IICT. Shri Kapil Sibal inaugurated the IICT Diamond Jubilee monument and planted a sapling on this occasion. He also inaugurated the Biotechnology and Bioprocessing Centre and OPCW test lab in the Mass Spectrometry Centre. He visited the newly developed Nano-materials science laboratory, animal quarantine facilities and Natural Products Chemistry Laboratory.

Dr R.A. Mashelkar, Director General, CSIR, said that country had done well in science and technology and that IICT which had created a niche for itself in the field of chemistry and chemical technology, was a diamond in the CSIR chain. He stressed the need for coming out with newer products in the wake of the patent regime to be introduced from 2005. He said laboratories should adapt to the emerging ambience and new reforms should take the country along the path of progress.

Earlier, Dr J.S. Yadav, Director, IICT, welcomed the gathering comprising of scientists, technologists, members from academia and industry and IICT staff members and explained in detail the growth of the laboratory in the past sixty years, right from its inception on 5 August 1944 through the *firman* of the *Nizam* of Hyderabad to its renaming as Indian Institute of Chemical Technology in 1989 and its Golden Jubilee in 1994. A number of former Directors and IICT clients recalled their association and the work done at the laboratory. Dr A.C. Kunwar, Director-Grade Scientist proposed a vote of thanks. ❑

CGCRI's Naroda Centre wins FGI Award for Excellence (2003)

THE Central Glass & Ceramic Research Institute (CGCRI)'s, Naroda Centre, has been awarded the prestigious Federation of Gujarat Industries (FGI) Award for excellence in the field of Research in Science & Technology for the year 2003. The award was conferred in recognition of its innovative contribution in the development of 'lead free frit' for application in the blue pottery of Jaipur. The award, which carries a citation and a trophy, was presented by Shri Sunil Kant Munjal, Managing Director, Hero Cycles Ltd. and President-elect of Confederation of Indian Industries (CII) at a function held at Vadodara recently.

Dr K.N. Maiti, Scientist-in-Charge, CGCRI, Naroda Centre & Principal Investigator of the project receiving the FGI-Trophy from Shri Sunil Kant Munjal, Managing Director, Hero Cycles Ltd, and President-elect of Confederation of Indian Industries

CGCRI, Naroda Centre, since its inception in 1977 has been catering to the needs of the ceramic industry through the development of several technologies for production of fine stoneware, sanitary-ware, ceramic tiles, bone china, steatite and alumina grinding media and high strength black terracotta etc. It has been accredited with ISO 9001:2000 since September 2002 for all its activities. CGCRI has been involved in the development of Ceramic Cluster in the State of Gujarat since 2001 as the nodal Agency and lauded for its efforts in the technological upgradation and development of clusters.

Lead-less, high strength, eco-friendly blue pottery glaze was developed by CGCRI for the first time in the art of making blue pottery. The technology was transferred to the artisans in several clusters around Jaipur through a series of T&D programmes as well as implementation at units level by CGCRI. ❑

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