Inauguration of National Conference on "Declining Interest in Science Education and Research Among Students: Reasons and Remedies"

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Inspirers of science

I am delighted to inaugurate the 2 day national conference on **"Declining interest in Science Education and Research among students: Reasons and Remedies.** My greetings to the organisers, participating renowned educationists, speakers, panellists, scholars, students, special invitees and distinguished guests. It is an important mission, how to inculcate interest in science education and research among students. I appreciate the initiative taken by Osmania University College for Women and the Andhra Pradesh Academy of Sciences in association with NGRI, IICT, and CCMB. I would like to share a few thoughts with you on the subject **"Inspirers of science".** I will be discussing on how to create interest in science, propagation of science - certain experiences, necessity of experienced scientist with scientific magnanimity, challenging task in research inspire the young minds and need of science cadre.

How to create interest in science?

Experienced scientists and teachers have to interact with high school students who are in 8th, 9th and 10th class and give a message, how science can make them unique, inspired with life stories with great scientists and challenge the young minds, and what science can give?

1. **Science can make you "unique" - Unique You : Seven unique achievers in inventions and discoveries:**

Dear friends, Look up, what do you see, the light, the electric bulbs. Immediately, our thoughts go to the inventor ***Thomas Alva Edison,*** for his unique contribution towards the invention of electric bulb and his electrical lighting system.

When you hear the sound of aero plane going over your house, whom do you think of? ***Wright Brothers*** proved that man could fly of course at heavy risk and cost.

Whom does the telephone remind you of? Of course ***Alexander Graham Bell.***

When everybody considered a sea travel as an experience or a voyage, a unique person questioned during his sea travel from United Kingdom to India. He was pondering on why the horizon where the sky and sea meet looks blue? His research resulted in the phenomena of scattering of light. Of course, ***Sir CV Raman*** was awarded Nobel Prize.

Do you know an Indian Mathematician who did not have formal higher education but had inexhaustible spirit and love for mathematics which took him to contribute to the treasure houses of mathematical research - some of which are still under serious study and engaging all-available world mathematicians' efforts to establish formal proofs? He was a unique Indian genius who could melt the heart of the most hardened and outstanding Cambridge mathematician Prof G H Hardy. In fact, it is not an exaggeration to say that it was Prof. Hardy who discovered a great mathematician for the world. This mathematician was of-course ***Srinivasa Ramanujan*** for whom every number was a divine manifestation.

Do you know the scientist who is famous for Chandra Limit which describes the maximum mass (~1.44 solar masses) of a white dwarf star, or equivalently, the minimum mass for which a star will ultimately collapse into a neutron star to black hole following a supernova. Two of his students got the Nobel Prize before him. It is of-course the famous Nobel Laureate ***Chandrasekhar Subramanian*** . Friends, there was a great scientific lady who is known for discovering Radium. She won not one, but two Nobel Prizes, one for physics and another for chemistry. Who is she? She is ***Madam Curie.*** Madam Curie discovered radium and she was doing research on the effect of radiation on human system. The same radiation which she discovered, affected her and she sacrificed her life for removing the pain of human life.

When I mentioned the scientific inventions and discoveries, you all jumped and quick with your response of the names of scientists, technologists who created the great event. They are unique personalities. Young friends, can you join such unique performers of scientific history? You can. Definitely, you can. Let us study together, how it can be made possible?

Friends, I have, so far, met 15 million youth in a decade's time. I learnt, ***"every youth wants to be unique, that is, YOU! But the world all around you, is doing its best, day and night, to make you just "everybody else".***

In the home, dear young fellows you are asked by your parents to be like neighbours? children for scoring good marks. When you go to school, your teacher says "why not you become like the first five rankers in the class". Wherever you go, they are saying "you have to be somebody else or everybody else". Now, dear young friends, how

many of you would like to be unique yourself.

The challenge, my young friends, is that you have to fight the hardest battle, which any human being can ever imagine to fight; and never stop fighting until you arrive at your destined place, that is, UNIQUE YOU!

2. Inspired minds and events : Let me highlight, how important it is to cheer the young minds at the right age by providing good books in science, mathematics and good devices. In Albert Einstein life, we find that his interest in science started early, beginning with his encounter with magnetism, which he called "the first miracle". He was given a compass by his father and Einstein was endlessly fascinated by the fact that invisible forces could make object move. This experience made a lasting impression on him. His interest in compasses was reinforced when he found a caring mentor to shape his ideas. At the age of 12, he experienced a second wonder in a little book given by his mentor Max Talmud with Euclidean plain Geometry which he called "Holy Geometry Book". Einstein called this his "second miracle". Here Einstein made contact with the realm of pure thought. Without expensive laboratories or equipment, he could explore universal truth, limited only by the power of human mind. Mathematics became an endless source of pleasure to Einstein especially if intriguing puzzle and mysteries were involved.

Srinivasa Ramanujan was one of the greatest geniuses known and acknowledged of his time. He lived only for 33 years and did not have formal higher education or means of living. Yet, his inexhaustible spirit and love for his subject made him contribute to the

treasure houses of mathematical research - some of which are still under serious study and engaging all-available world mathematicians' efforts to establish formal proofs. Ramanujan was a unique Indian genius who could melt the heart of the most hardened and outstanding Cambridge mathematician Prof G H Hardy. In fact, it is not an exaggeration to say that it was Prof. Hardy who discovered Ramanujan for the world. Professor Hardy rated various geniuses on a scale of 100. Prof. Hardy rated himself as 25, rated most of the mathematicians around 30 but rated Ramanujan as 100. There cannot be any better tribute to either Ramanujan or to Indian heritage. His works cover vast areas including Prime Numbers, Hyper geometric Series, Modular Functions, Elliptic Functions, Mock Theta Functions, even magic squares, apart from serious side works on geometry of ellipses, squaring the circle etc. One of the tributes to Ramanujan says that, ?every Integer is a personal friend of Ramanujan'.

Promoting science - What science can give you? : Dear friends, I would like to share with you one question, what is the uniqueness of being a scientist? Friends, science gives you better eyes because science can remove the mental blindfolds and it gives your brain a challenge to solve many scientific problems that are yet to be solved. When people in general talk in dimensions, just less than one millimeter or few hundred thousand kilometers requirement in flight, the scientists will easily move from the behaviour of proton (10-15M) to the size of visible universe approximately 1028M 43 orders of magnitude. Most of our friends, who are not in the field of science, will slice the time perhaps maximum up to one hundredth of a second. You scientists will slice the time into femto seconds (10-15 Sec) which may decide a fast photo chemical reaction. When you think way back in time, it will be big bang, some 15,000 million

years ago and the beginning of the life on earth about 3800 million years ago. Again you will be ahead of 17 to 18 orders of magnitude. Science indeed will connect you into the brains of many smart people who were there before you. Hence, science makes you feel good to stand on the shoulders of the giants like Issac Newton, the discoverer of the Laws of Gravitational force, Albert Einstein the discoverer of general relativity theory, Stephen Hawking explained the string theory with an attempt to integrate multiple loss of nature, Sir CV Raman the discoverer of Raman effect, Chandrasekhar Subramanyam, discoverer of Chandra limit and blackhole, and Srinivasa Ramanujam the number theory originator.

II Propagation of science: certain experiences

(a) **Science education reaching 3 million rural students**

On 18 Oct 2012, I visited Agastya International Foundation founded by Ramji Raghavan, a pioneer in Science Lab. In Gudivanka Village (near Kuppam), in the state of Andhra Pradesh, where I inaugurated Guru Graha Astronomy Centre at the Agastya Campus at Kuppam. There, I witnessed the 4 centres of scientific excellence - Vision Works where a number of mechanical systems, scientific instruments and Scientific experiments tools are designed. Next, I visited the Guru Graha Astronomy Center, where I saw the beautiful solar system simulator, where all the planets are orbiting around the sun on mono rail platform - a beautiful way of explaining the functioning of the Solar system; the Orbital Plane was beautifully explained how the Sun, Earth and moon combination systems are working beautifully and scientifically.

Agastya Foundation has reached over 3 million children in more than 10 states in India.

Based on their experience in Bihar, the MSL instructors have commented that the rural children of Bihar, with whom they have interacted continuously for over 2 years, have some unique qualities. What makes the children of Bihar unique?

1) Their tremendous enthusiasm and hunger to learn science measured by their willingness to brave hardships and long distances to visit the MSL.

2) Scientific spirit and innovative ideas are bubbling in Bihar children.

3) Their innate curiosity and questioning spirit. Rural children have demonstrated that they are at par with students from the best schools.

4) They have the potential to become Young Instructor Leaders - children who can teach and lead other children.

5) They can become role models not only for children in Bihar but for the rest of India.

The Mobile Science Laboratories visited rural schools during summer with high temperature in the day time. Notwithstanding the holidays, once students in villages were informed about the visit of the MSL, their response was very spontaneous and they came to schools in large numbers to witness scientific experiments. Some of these students came to participate in these programs crossing rivers by boat, between two embankments of the Kosi in the district of Saharsa or by walking for about 8-10 km! The Head masters, members of Teaching Staff and guardians were very enthusiastic and interested in this novel way of demonstrating scientific experiments to children and encouraging their inquisitiveness by close dialogue and interaction with Science Instructors. It was quite evident that given proper ambience for academic work and opportunity for learning, the students in schools were keen to learn.

(b) **Serve silently to promote scientific temper in villages**

I have known Shri MB Verma for the last two decades. Mr MB Verma comes from a small village Boar of district Darbhanga. Did his schooling in Darbhanga and Patna and reached the senior most scientist position of Project Director, Light Combat Aircraft - a state-of-the-art supersonic fighter aircraft. This is the boy who came from a very small village of Bihar and made a successful project. Finally, when the time came for retirement, Vermaji decided to settle down in his home district Darbhanga. Normally, people who work in big cities will choose to settle down in the big cities only. Although Vermaji worked for many decades in Bangalore, after retirement, he decided to work for the people of Bihar. How many of you friends, would like to settle down in your home village, after retirement, like what Vermaji has done. Today, Shri MB Verma is responsible for rural science education through three mobile science laboratories. The three mobile laboratories have spontaneously attracted students, even teachers, to perform scientific experiments.

III For promotion of science, we need scientific leadership with magnanimity

Scientific magnanimity: I would like to narrate an incident which took place during a function conferring Nobel Laureate Prof. Norman E Borlaug, a well known agricultural scientist and a partner in India's first Green revolution, with Dr. M S Swaminathan Award, at Vigyan Bhavan, New Delhi on the 15th of March 2005. Prof. Borlaug, at the age of 91, was in the midst of all the praise showered on him from everybody gathered there. When his turn came, he got up and highlighted India's advancement in the agricultural science and production and said that the political visionary Shri C. Subramaniam and Dr. M S Swaminathan, pioneer in agricultural science were the prime

architects of First Green Revolution in India. Even though Prof Norman Borlaug was himself a partner in the first green revolution, he did not make a point on this. He recalled with pride, Dr. Verghese Kurien who ushered White Revolution in India. Then the surprise came. He turned to scientists sitting in the third row, fifth row and eighth row of the audience. He identified Dr. Raja Ram, a wheat specialist, Dr SK Vasal, a maize specialist, Dr. B. R. Barwale, a seed specialist. He said, all these scientists had contributed for India's and Asia's agricultural science. Dr. Borlaug introduced them to the audience by asking them to stand and ensured that the audience cheered and greeted the scientists with great enthusiasm. This scene I have not witnessed in our country before. This action of Dr. Norman Borlaug, I call it as "Scientific Magnanimity". Friends, if we aspire to achieve great things in life, we need scientific magnanimity to focus the young achievers. It is my experience that great mind and great heart go together. This scientific magnanimity will motivate the scientific community and nurture team spirit.

IV Challenging task in research inspire the young minds

Research challenges have to be attractively presented to the young: Let me share with you certain scientific challenges that need integrated solution to enrich the life of the people of our planet particularly our nation.

1. In the energy sector, increasing the solar photovoltaic cell efficiency from the existing 15% to 45% using silicon as a base with Carbon Nano Tube is an important research challenge. Scientists in reputed laboratories in the world have established the fact that the alignment of the CNT with the polymer composites substrate is the key issue and this aligned CNT based PV cells would give very high efficiency in photovoltaic conversion. The polymer composites increase contact area for better

charge transfer and energy conversion. In this process, the researchers could achieve the efficiency of about 50% at the laboratory scale. The intensity of research in Indian research institutions have to be enhanced to realize commercial production of CNT based Photovoltaic cells.

2. India has to go for nuclear power generation in big way using thorium based reactor. Thorium, a non fissile material, is available in abundance in our country. Intensive research is essential for converting thorium for maximizing its utilization and generating electric power through thorium based reactors.

3. Proteomics is the study of all the proteins expressed by the genome of a cell. It is the logical extension of genomics. Proteomics helps to understand the basic biological processes critical to normal cellular functions as well as the development of diseases. It identifies the essential components of these processes and exploits these components as targets in the development of new methods to prevent or treat diseases. The proteomics programme is done nationally. The type of work involved is huge and challenging, and much bigger than the Human genome programme. There is national programme in proteomics. This has to be given thrust with cooperation of International Scientific community.

4. There are many research and development initiatives and testing of vaccine progressing in the country for prevention of HIV/AIDS disease. It is indeed a big challenge for life science scientists to have an integrated vaccine development leading to production in three years time.

5. Stem cell research through three areas such as adult stem cells, umbilical cord stem cells, and embryonic stem cells has to be pursued on a mission mode for finding cure for many diseases.

6. 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. During my recent visit abroad, I found serious research in Iceland, Ukraine and Russia by young scientists. It is essential India has to work on mission mode research for forecasting the earthquakes using multiple parameters using precursors such as pre-shock conditions, electromagnetic phenomena prior to final rupture and atmospheric and ionospheric anomalies.

7. The quantum of rainfall in a particular area for a particular cloud condition within a specified duration is not being determined by the present monsoon prediction system. Heavy rains and hurricane creates enormous loss of life and property. This brings out the necessity for global monsoon research for determining intensity and quantum of rain in a particular cloud condition through a validated prediction system with detailed research. With this system scientists should be able to provide the information for the particular cloud condition, how much will it rain and duration, through the use of Polorimetric radar.

Solutions to these seven problems, first two relating to energy area, third relating to healthcare, fourth relating to HIV/AIDS, fifth relating to stem cell research, sixth relating to forecasting of earthquake and seventh relating to precision forecasting of rain content for particular cloud condition are challenging areas for the young researchers. In this connection, I would like to mention that the Kothari Commission Report had emphasized the need for basic research being conducted in universities and the science

education at all levels should be strongly reinforced through study of application of local environment and industry. This recommendation is valid even in today's context.

So far, I discussed four types of actions needed to attract the young to take up science as a career. There is another important aspect, which we have to consider. After 10+2 study, students normally decide with parental pressure to choose from technology driven or science driven areas for their further studies. Here I would suggest the necessity of a national science cadre to attract the best minds for taking up science as their life time mission.

V Necessity of Science cadre

During one of my interactions with students, Ms. Arunava Roy, of 1st Year – Biotechnology from the University of Calcutta asked me the following question:

"A majority of the bright students at the high school level aspire to become a doctor or an engineer. How can these rich minds be motivated towards taking up research as a first grade career option?"

This question is indeed is the reflection of the feelings of most of the students who are in the 10+2 stage. We have to find the right answer. I have had many discussions with parents also. The parents spend almost all their earnings in order to educate their children, since they see the education as the best way of promising an assured career. They even go to the extent of sacrificing their personal luxuries and get loans to educate the children. The only vision they have in their mind is to see well settled sons and daughters with guaranteed profession. They see this happen if their children pursue a

degree in Engineering, Management, Medicine etc. They do not see the pursuit of pure sciences and research guaranteeing this.

This, I consider as an important area of concern of the nation and it needs the attention of the scientific community as a whole. In my view, it is essential for the nation to assure a career for those who wish to pursue science as a mission. This will attract many students with the full support of the parents. We should work for the creation of a science cadre with clear mission goals, well defined growth path and attractive salaries. There should be a minimum annual intake of about 400 M.Sc and 200 PhDs with assured career growth in the organisations such as CSIR, DST, Department of Earth Sciences, Department of Bio Technology, Department of Agriculture, ISRO, DRDO, Atomic Energy, and the Universities. This could be discussed and recommended to the government by the academies of sciences and scientific advisory committees. Starting a number of Indian Institutes of Science Education and Research is definitely a good effort towards attracting youth towards science as a career.

Conclusion

Dear young friends, the future challenges of science have several dimensions. The value of science has to be propagated to people at large and they should be made to realize the role played by science in their day to day life. Youngsters should be motivated to enquire into science. The innate fear that "science is a difficult subject" should be removed from the minds of the children through easy to understand, interesting, creative presentations by the science communicators. For this to happen we need to establish science museums and laboratories across the country, so that it

reaches to the students at the primary and secondary level education, so that the spirit of learning science and applying science with creative minds are possible, which will lead to building a borderless world with the spirit of scientific excellence.

My best wishes to all the participants of 2 day National Conference on ***"Declining interest in Science Education and Research among students: Reasons and Remedies"*** organised by Osmania University College for Women and the Andhra Pradesh Akademi of Sciences success in their mission of promoting scientific temper among the youth of the nation.

May God bless you.

By, Dr. APJ Abdulkalam