Convocation Address by

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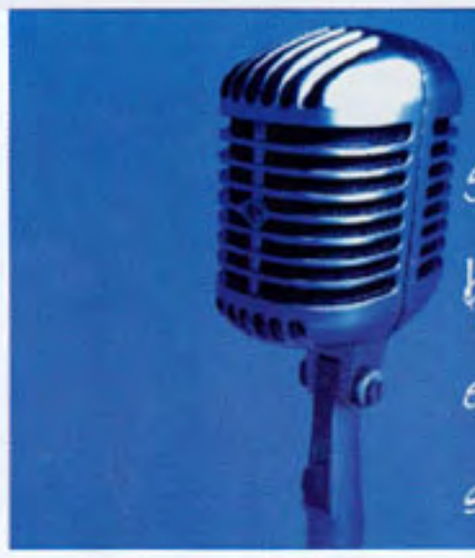
Does Science and Technology Education Matter to the Public ?



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What is science, what is technology and what is education? Science is the accumulation of solid knowledge, on which to base decisions in daily life, industry and politics. Science is often characterised by research to indicate that it is essentially the long-term search for truths. Technology is the translation of knowledge into a useful application. It includes short term research enabling such translations. Education is the schooling of children or young men and women, the transfer of established knowledge, so that the next generation can base future activities on what is known, on what has to be questioned and what or why we do not know things for certain. Education in science and technology, including biotechnology is probably the most important base for any community, any country and any industry. For Orissa this is of particular importance because education is very efficient in creating great value within a few years. Switzerland was a very poor agricultural society 200 years ago and education made the difference in the past 150 years. Immigrants played an important role as did Swiss emigrants learning abroad before returning home. New Technical Universities were also an essential factor in this development.

Education in the broad sense includes handing down not only of knowledge but also human behaviour, family values, society, health issues including eating habits, hygiene and social welfare. This of course is the task of our parents early in life, helped by the families, and subsequently by kindergarten and primary schools. And therefore it is extremely important to have "good" parents and excellent primary schools. To have good primary schools we need the best people to become teachers, as we need the best people to become politicians to make the right decisions. . But we all realize that neither in developed nor in less developed countries is this basic principle guaranteed because the payments of both primary school teachers and politicians is not the most rewarding, as it should be.

Who needs education? Of course everybody. But what is particularly important is to educate girls and young women because they are the most crucial carriers of what I have just enumerated. They work hardest within the families, they hand down all the practical knowledge that is important in future life at an early stage during our education. This includes looking after your garden, not to waste water and energy, not to throw away plastic bags, to cherish the environment. If girls and young women are educated the rest will follow.

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While we are all clear about the beginning of education it may be less clear when should education end? Of course education never stops, be it in science, in technology or in general aspects of life. Nowadays electronic networks throughout the world make this permanent education and widening of our horizons extremely easy (if such connections i.e. hard and software, are provided). The crucial role of science and technology in our daily life is tangible everywhere and always. Much of the progress and improvement in agriculture, medicine, information technology, banking and all other practical aspects of our lives depend on science and the transfer of science into products such as antibiotics, antivirals, chips, computers, satellites etc.

However, and this is not so easy to state, but is also not so easy to accept, we all have to recognize that "there is no such thing as a free lunch". The problems in our world are all linked to too many people profiting from the interesting and wonderful life on our planet. From this point of view education is of paramount importance. Educated women have fewer children (look only at Italy, where 50 years ago the birth rate was greater than 2 and now is the lowest in all of Europe). This correlates directly with the excellent schooling of women, their own aspirations to go after an interesting job and translates directly into fewer children (but even this process is not without costs). There are additional serious problems today besides too many humans. The biggest change during the past 100 years has been that we are not exposed to as many infections as we used to be. Of course this applies particularly to the so called developed world and still applies less to the developing economies. The next problem is that in many societies we have too much to eat, this also has never occurred before! Obesity is however often not only a problem of eating too much and the wrong food, but also that our worm burden has been largely reduced or even eliminated. Of course one could argue that perhaps we should go back to more "natural" conditions (where infections reduce our life expectancy to around 20-30 years as was the case 100 years ago), to starve regularly as we did earlier, but of course this is not a real alternative. Nevertheless we must keep in mind that survival of the species is dictated by reproduction. We humans need to survive for 20-25 years to bring up the next generation, but then we are not really needed biologically any longer. Infections that kill children before sexual maturation, the so called classical childhood diseases including polio, small pox, measles, cholera etc. are selected against for host resistance. Vaccines against these diseases have therefore been so successful. Later in life after 30 years of age tumors, autoimmune, degenerative diseases including arthritis and arteriosclerosis limit our quality of life and life expectancy, but these diseases cannot be efficiently selected against by evolution and selection.

Let me summarize what I have said so far in a different way: Science and technology education is about teaching and learning that $2 + 2 = 4$, it is neither 3,95 nor 4,05. Once this general rule has been established, is accepted and has been found to be true, the next generation will simply learn that $2 + 2 = 4$. Knowledge about science and technology is teachable because results must be repeatable. Therefore the next generation can add to this established basis in a directional way of progress. Also prevention of disease is based on science, as are vaccines, chips, computers, international communication. In contrast to this vectorial type of science increase our knowledge about society, love, happiness, believes, politics, history, is not strictly known, defined or proven and therefore not repeatable. Every generation and every individual have to make their new experiences, new insights and survive new conflicts. Some people want to negate science and use uncertainty arguments and believes against science to question the efficacy of vaccines or the evolutionary history of our world. Remember $2 + 2 = 4$, vaccines protect and the world simply has not been created in 6000 years, it has taken billions of years.

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As stated earlier science and technology are based on long term research and shorter term translation of such knowledge into practical technology. There is no sharp limit between basic research and science on one hand and applied science and science technology on the other hand. So as stated by the US Academy of Science applied science and technology do not really differ from basic research and science "basic science is simply not yet applied science".

Research and science but also applied science and technology are essentially human. This is what makes us different from animals. Basic research , applied science and technology belong to arts, sports, poetry and philosophy. They are fundamental characteristic of what we are and therefore the general public and our communities should be funding these activities. Without arts, sports and science we are not humans.

Let me finish with two general thoughts. First, I want to submit to you a rather critical and perhaps difficult statement about how things will progress, how you as students and accomplished scholars of science and technology will have to confront the future as we all have to. Our environment and our handling of progress in both research and technology have limits. If our consumptions of the environment and of both knowledge and application changes more and more rapidly, so that the half life of knowledge and of technologies becomes shorter and shorter, we may have to deal with a serious societal problem: As I mentioned before each generation of humans needs about at15-20 years from birth to becoming a responsible member of our society to fully function within the restrains of our families, communities, universities, states and our world. During this time period of about 20 years we learn not only as family members but also about established and new science, research and technologies. The open question is what if the half life of what we know, learn and use gets shorter and shorter, while our physiological generation time stays 15-20 years. How long can we handle this acceleration? Is there somewhere a limit to us as society changing quicker and quicker and what will be the consequences? Will our families, societies and political systems simply change or will they decay? This to me seems a key question that we all have to come to grips with independently of our age. The second is a more optimistic statement: Science, research, technology or biotechnology are all wonderful activities in universities, colleges, schools, industries and daily life. We all have the great privilege to study, to search, to research, to develop, to translate ideas and knowledge into something useful. This privilege is largely made possible by the general public and by all tax payers. All schooling, education and development work is based on our society, starting from family to local province or state to federal governments and even world organizations such as the World Health Organization or the World Trade Organization. To develop and end up with an efficacious therapy, useful technical products or cheap and rapid computers is probably the best experiment anybody ever can do. Ideas are cheap although necessary, but to prove or disprove an idea and to translate that idea into an experimental result or a product is what really counts.