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SCIENCE AND TECHNOLOGY
A FUTURE PERSPECTIVE

ABID HUSSAIN

RAJIV GANDHI INSTITUTE FOR
CONTEMPORARY STUDIES

Dr. Abid Hussain is the Vice Chairman of the Rajiv Gandhi Institute for Contemporary Studies. Dedicated to the development of India's economic and social growth, he has served in many senior and executive positions both at the State and Central levels in the Government of India.

After having served as Secretary to the Department of Heavy Industries and the Ministry of Commerce, he became a Member of the Planning Commission in January 1985. He was India's Ambassador to the United States of America from May 1990 to July 1992.

At the international level, Dr. Hussain served as the UN Adviser on Community Development to Turkey, then Industrial Adviser to the Fiji Islands, and finally as Chief of Industrial Technology, Human Settlements and Environment in the UN Regional Commission of ESCAP, Bangkok.

Presently, Dr. Abid Hussain serves on numerous committees and planning groups in India, and other developing countries. He is a special Rapporteur of the UN Commission on Human Rights on the Promotion and Protection of the Rights to Freedom of Opinion and Expression. Recently he was appointed as member of the Prasar Bharati Board; and UNESCO's International Panel on Democracy and Development.

The views expressed in this paper are those of the author and are not necessarily those of the Institute.

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Science and Technology
A Future Perspective

Abid Hussain

I consider it a great privilege to deliver this year's Jawaharlal Nehru Birth Centenary Lecture. Speakers before me in this lecture series have been men of great distinction and eminence. I pale in comparison to them and I realise that I owe the honour of being this year's speaker more to the affection and kindness of the organisers, than to any merit.

Nehru's Vision and Science

Pandit Jawaharlal Nehru was a man of many splendoured parts. He distinguished himself and surpassed the best of his contemporaries, who were also men of considerable brilliance and accomplishments.

Today, looking at Jawaharlal Nehru's vision of India and his world view, one marvels not only at the defining quality of his fight against colonialism and his role in winning the war of freedom for India, but also for unleashing the creative forces of science and technology in modernising a traditional society. He had enormous faith in the ability of science in redeeming mankind from its many woes and for providing it with a decent quality of life. He laid the foundation of a scientific temper in India. Pandit Nehru encouraged science and scientists to play an active role in India's developmental programmes, and maintained a close relationship with the leading scientists of his time.

In view of Panditji's overriding concern for the future of mankind and the role he assigned to science and technology in the upliftment of a traditional society, it would be in the fitness of things to reflect today on the subject of "Science and Technology, A Future Perspective".

Today we live in a world where the impact of science and technology is all pervasive. The world is powered by science and technology, and to abdicate its support will be to condemn oneself to an area of darkness, denial and gloom. Science gives our contemporary society its coherence, and modern life, its meaning.

Early Scientific Quest

Nehru once described the scientist as "the sage unattached to life and ever seeking truth whosesoever this quest might lead him". With an insatiable sense of curiosity, man has always been engaged in exploring his surroundings and his own activities. Man has loved to see, hear, question and enquire, and to create a new order of things. He would sometimes "put himself speculatively" on the sun, moon, stars and nature around him and try to understand what makes them what they are; attempt to conquer Nature and explore other planets.

Through sight and senses man found the marvels of nature breathtaking. The magnificent sight of a rising sun and brilliance of a starry night; blooming of flowers

and their wilting, the beauty and majesty of magnificent mountains, sparkling waters of flowing rivers; the ebbs and tides of the deep blue oceans; seasonal changes; the tremendous varieties in the animal and plant worlds; and last but not least, the sounds and fury of nature made him think. In the beginning, these sights led men and women to worship the forces of Nature. Overpowered by them, they visualised a God in the mysteries of life; attributing their origin to divinity—a supreme creator—in terms of religious beliefs. God and religion were thus born. Thereafter haltingly, man tried to unravel the mysteries of nature and defined them in human terms. Thus moving on to a new path of discovery. Through experience, and trial and error, man arrived at rudimentary scientific explanations. The early scientist thus went beyond reverence to nature to discoveries and inventions.

Scientific Insight

Scientific achievements have been mainly due to the creativity and imagination of gifted individuals. Their ability to understand things and search for meaning beyond what is apparent led to inventions and discoveries. Recognising and understanding the hidden laws of the universe opened new vistas of life for man on earth. Science became a constant endeavour to find order and meaning in our environment and experience. At each step of human development, an individual scientist or a .group of scientists discovered a new order and a new connection between things which were not apparently linked. An original thought is born when the scientist arrives at a successful fusion of different aspects. of nature or experiences, or when he separates different elements which had combined in one form in nature, and endows them separate existence and form.

It is to those with insight that much of nature's hidden mysteries are revealed. By watching the swing of a lamp in the Cathedral of Pisa, Galileo deduced the law of the Pendulum. What struck Isaac Newton was not merely the fact that an apple falling from the tree to the ground was due to the force of gravity, but the connecting thought that "the same force of gravity which reaches to the top of the tree, might go on reaching out beyond the Earth and its air endlessly in space. That the force of gravity might reach the moon and hold the moon in her orbit". An apple and the moon were different things and were differently placed, but -Newton traced in them two expressions of a single concept of gravitation. This was one of the secrets of the physical world that the scientist had discovered and used to enlarge its application on planet Earth.

Many more of such discoveries changed the course of life on Earth. By understanding, intervening and manipulating the different aspects of life and nature, science attempted to master nature and improves life in all its aspects. As discoveries and inventions met the needs of society, science became a predominant vehicle of change and adventure.

Vehicle of Change

The 20th century saw great marvels of science and technology that triumphed over the many natural disadvantages from which men and women had suffered. Material comforts and other conveniences, the fruits of scientific inventions, have now become

available to a large section of people and have brought about a great transformation of life on earth.

Nadine Gordimer made a sober contemplation of an age characterised by revolutionary scientific achievements. She wrote:

"We have made spectacular advances in discoveries that have made life more bearable for some and more pleasurable for others. We have eliminated many epidemics and alleviated much pain with new drugs; we have raised the dead in a real sense, by taking the vital organs from the dead and planting them to function again in the living; a symphony may be heard by means of a small disc thin as a papadum or a crepe suzette; aircraft has revolutionised the possibility of physical presence. The bundle of telecommunications— computers, fax, E-Mail, cellular phone—has speeded up communication by the spoken and written word; we have built towers which penetrate the clouds, we have lifted the burden of manual workers and housewives by machines programmed to do onerous tasks; with other machines we have brought music and moving images into every house. We are the century whose inhabitants passed in one lifetime from riding in a horse-drawn cart or catching a train to as unremarkably boarding a plane; the first to look upon the world from 30,000 feet, from the angels' realm, the sphere of the heavens. Most of us have enjoyed some of these embellishments of life."

Technology has also intervened in the intangible, telescoping of emotions. Our 19th century forefathers and mothers would have to wait weeks or months for any exchange of true minds by post. In our century, the ordeal of dread is banished by instant full communication from anywhere to anywhere. And as for anticipation, that becomes instant gratification. Freud's deferred gratification as a refinement of emotional experience does not compare, for us, with the immediate joy of hearing a lover's voice, or getting a friend's reply to a letter, at once, by E-mail. Ours is the Age of Impatience that does not look forward to something: wants it now. Expects to have it, and gets it, so for as technology can provide it.

Even adventurism has been transformed by technology; walk on the moon and dangle in space instead of 'discovering' jungles and rivers....The new adventurer actually experience, by weightlessness, extinction while still alive, become phantoms whose feet do not touch earth. They are the successors to the angels we, alas, no longer believe in, because we have probed outer space and found no heaven".

The Darker Side

But there is a darker side to science and technology in our times. Our century which reached unprecedented heights of glory in this field has also turned out to be the most murderous century, writes Nadine Gordimer:

"At once there arises from a flash brighter that a thousand suns the mushroom cloud that hangs over our century.

Exploded almost exactly at the half-century, the atomic bombs that destroyed Hiroshima and Nagasaki rise as unsurpassed evil done, even in this century where more human beings have been killed or allowed to die of starvation and disease, by

human division, than ever before in history; where the words of horror Nazi Holocaust, fifty years on, have become a household euphemism as 'ethnic cleansing' in the Balkans and in Africa.

Unsurpassed evil because not only does an atom bomb kill and maim, it curses the children of survivors, the unborn, with monstrous physical and mental defects. Science for the first time invented a power of destruction which surpasses any natural catastrophe—the power of earthquake, volcano eruption, flood. Thus the final conquest of nature—an aim pursued with the object of human benefit since the invention of agriculture in the Stone Age—has been achieved in our discovery of how to wipe ourselves out more quickly and efficiently than any force of nature. The demonic vow of our century seems to come from Virgil 'If I cannot move heaven, I will stir up Hell'."

We are all beholden to the power of science for the good it has created. But it has also troubled mankind deeply for the evil it has caused. Men have often become victims of their own creations. Throughout history men were killed by the very instruments they made to protect their lives. What was meant for killing termites or blasting away kidney stones is used to destroy humans. Splitting of atoms was to produce energy and not to annihilate life in Nagasaki and Hiroshima. Recent developments in bio-technology, genetic engineering and other biological science could by design or accident spell serious adverse consequences for mankind.

Science is neutral. Misuse of science has been partly due to ignorance and indifference and partly due to malicious intent of men in power and in command of technology, who lacked a sense of social responsibility. Power without responsibility has always been the bane of human civilisation. And Rudyard Kipling defined it with telling effect, "Power without responsibility, the prerogative of the harlot through the ages".

The nefarious designs of power-hungry men increase the social responsibility of scientists and call for greater vigilance from society itself. Whether we use science towards making a good society or destroy it, depends on how well we employ it.

Benefits for People

It is imperative that as science and technology become more powerful and more productive, their benefits should be made to reach a large section of people and not be confined to a selected class.

Great faith is placed on science and technology as the cure for many of the world's problems. The record of science in this regard is undisputed, but in a world built on structures of exploitation and injustice and inequality, millions would never have access to its benefits to uplift their lives. Powerful and persistent tendencies of the better-off classes have to be handled so that new and powerful technologies are not used to impede or defeat their power to remove the enormity of misery in which two-fifth of the world is mired. Paul Kenedy in his book *Preparing for the 21st Century* observed that "the First World's new technologies are far from rescuing the booming population of the developing world and may harm poor countries by making redundant certain eco-activities, just as the Spinning Jenny put Indian handloom

weavers out of work on the other side of the globe. Advanced technologies threaten to undermine the economies of developing countries". He further stated that "over the long term the biotech revolution potentially implies a significant relocation of agriculture production out of the developing world. Worsening its trade position, increasing its indebtedness and general dependence upon richer countries".

This would indeed be so as long as the driving force of science and technology remains in total control of Multi National Corporations (MNCs), who are driven by no other motives but private gains. But a stage is reached when these miseries, as they befall the poorer nations, would make impoverished and angry young men (whose number is increasing compared to birth rates in under developed countries) succumb to violent creeds, cults and religious fundamentalism and in a borderless world, hammer and strike blows at the gates of the affluent. Any further igniting embers of social unrest would damage the developed countries, as sporadic violence can lead to major upheavals. Under the circumstances, it would be wise to make MNCs and their countries of origin realise their social responsibility towards other countries. This will be in their own self-interest. Though the Kyoto Conference has shown this to be a difficult task. Our century casts a great responsibility on the saner elements in all parts of the world to acknowledge this new reality and respond positively to the beckoning of history.

Scientific Temper

In order to be able to make rational choices, it is extremely necessary for us to inculcate a scientific temper in people. Nehru constantly underlined its importance and bemoaned its absence in India through the ages. For in it he saw the possibility of bringing new ideas and rational ways of doing things. The Renaissance and the evolution of the scientific revolution in Europe had their starting point in the questioning spirit of science, of not accepting things at their face value but testing their truth. Looking for truth through concepts held by faith or by authority or by conviction that they are self evident and need not be questioned, leads to superstitions and suppression of truth itself. Scientific temper asserts that "By doubting we are led to enquire and by enquiring we perceive truth'. This is the key to the scientific revolution. Unfortunately, in India we are still victims of many beliefs which are so well-entrenched that they inhibit change. Therefore, our goal should be to help people to get rid of them. Nehru carried it as a mission but, sadly, both at the popular and the elite levels, the concept of scientific rationalism remained stunted. So-called god-men and astrologers with apostolic pretensions remained influential and gained legitimacy with the establishment. Much of the blame rests with those who are educated but have, out of sheer gullibility, let their thinking be obfuscated, and thus have abdicated their social duty and intellectual integrity. This explains much of inertia and lack of drive in our people, who suffer from ignorance without bliss and bewilderment without philosophy. Bringing a rational attitude in people is crucial to India's progress.

Akbar's Apathy

While discussing the achievements of Emperor Akbar in *The Discovery of India*, Jawaharlal Nehru wrote, "Akbar was full of curiosity, ever seeking to find out about things, both spiritual and temporal.... And yet it is very odd how his curiosity stopped

at a point and did not lead him to explore certain obvious avenues which lay open before him". One such instance cited by Nehru is when the Portuguese Jesuits presented Akbar with some printed books including the Bible and some mechanical clocks; but he showed no curiosity about printing or mechanical contraptions like clocks. The implication of this event that took place nearly four hundred years ago is, firstly, India missed a golden opportunity of availing itself of .an extraordinarily simple and cheap but most powerful instrument of information technology, viz., printing, and secondly, failed to discern the concept of automation present in an embryonic form in the mechanical clocks. Subsequently, it was the mastering of this very principle of automation that paved the way for the industrial revolution. Curiosity might have killed the cat, but in the case of man, a lack of curiosity has more often than not proved to be near fatal.

However much we may boast of a formidable army of Indian scientists serving in the country or abroad, it is ironic that the average Indian lacks scientific curiosity and the imperative need to know and understand the 'whys and the wherefores' of the natural phenomena around him.

Updating Technology

The primitive man gained ascendancy as he could fashion and handle tools that gave him a definite edge over other living creatures. These tools, though crude compared to later refinements, did constitute the then state-of-the-art technology available to the homosapiens at that time. When it comes to supremacy amongst human groups, irrespective of their distinguishing labels or identities, the one employing the state-of-the-art technology has usually been the winner. It is besides the point whether this technology has been employed to plough fields or to run factories, to fathom oceans or to probe skies, to kill and destroy human life in war or heal and enrich it in peace. The ancient Indians undoubtedly did riot neglect contemporary science and technology, as is evident from the advances made in various disciplines like mathematics, astronomy, linguistics, medicine and metallurgy. At some stage, however, our forebears came to the erroneous conclusion that they knew all that was worth knowing and that there were no other frontiers to be conquered in the realm of knowledge. And thus descended the Dark Ages on the Indian sub-continent, bringing in their wake the demons of superstition and ignorance, effete ideas, and tyrannical customs. Now, after an interval of two millennia (to mention this period in terms of centuries will be an understatement), India has suddenly woken to the need for developing science and technology at a brisker pace. India's efforts in this direction are commendable, but, to borrow from Robert Browning, it is a case of 'the little done and the vast undone'.

Perhaps very few thinkers and leaders were more conscious of this Indian failing than Jawaharlal Nehru. When Nehru was contemplating of going in for research in nuclear sciences in a big way, there was no dearth of doubting Thomases, who looked askance at India opting for nuclear technology when the rural landscape was still replete with wobbly, screeching and excruciatingly slow bullock carts rattling along dust roads criss-crossing the countryside. The visionary but pragmatic Nehru, who looked back in history not to bask in its past glory but to learn from the previous acts of omission and commission, silenced the skeptics with the argument that India had already missed the industrial revolution and as a consequence, paid a

heavy price; if India missed the latest revolution heralded by nuclear science and technology, it would be condemning itself to the backyard of human civilisation for centuries to come. Luckily, there was an eager and highly motivated band of scientists under the great Homi Bhabha, and they lost no time in translating this credo of a visionary into a vibrating reality. And, as we all know, the rest is history.

India does claim, and justifiably so, to be a member of some elite exclusive clubs by dint of the advances made by her scientists in nuclear and space research, and other frontier areas. Yet, India lags behind the scientifically advanced countries in numerous vital fields. This scientific backwardness bodes ill for the future of the country. India's scientific community, if provided with increased levels of investments and the necessary infrastructure for research, will not only narrow the gap between our technology and that of the developed countries but even achieve breakthroughs in many areas.

Risk of Fundamentalism

There can be no two opinions about liberating people from the dark and dingy world of irrational beliefs. But inculcating a scientific temper does not mean assuming an attitude of arrogance and casting science and technology in the mould of a cult, thus becoming indifferent to the many forces of creation of which we have as yet no clue.

As Einstein put it so appropriately when he said, "Every one who is seriously involved in the pursuit of science becomes convinced that a SPIRIT is manifest in the laws of the universe—a spirit vastly superior to that of man—in the face of which we must feel humble".

Newton was also conscious of this smallness of man and likened himself to a child picking pebbles on seashore.

The need for a sense of humility in a scientist, underscored by the two great men is not mere rhetoric. Science gives power; so it cannot be ruled out that a successful scientist, in a moment of aberration, will not arrogate to himself the role of a cult figure. And here lies the risk of fundamentalism creeping insidiously in scientific investigations, with its attendant distortions and perverse effects.

One important characteristic of science can be illustrated in a jocular vein. Most of us know how, in a quarrel between husband and wife, one word leads to another. So is the case when a scientist is grappling with a riddle; no sooner has he found an answer to one riddle than myriads of other riddles crop up. And thus the exciting chase goes on and on. Fortuitously conveying this very idea, Tennyson wrote, "Yet all experience is arch wherethrô/Gleams that untravelled world whose margin fades/Forerover and forever when I move." "Where tireless striving stretches its arms towards perfection," so sang Rabindranath Tagore.

Unwittingly, maybe, these poetic utterances enshrine the philosophy, which forms the very warp and woof of science that the spirit of science is the irresistible need to explore and not to believe in dogma. But there is no guarantee that a person professing to be a scientist will not be above a doctrinaire attitude. Such a person can think that his finding or pronouncement on a given scientific subject is final and is the

gospel truth. Bertrand Russell, while exhorting people to inculcate a scientific attitude, also warned that a practitioner of science may not *ipso facto* possess a scientific temperament himself. In other words, a scientist can also suffer from a fundamentalist mindset, succumb to superstitious thinking and megalomania, and brand fresh ideas emanating from new sources and enquiries as heresy, little realising that the heresies of today can become the validities of tomorrow and the orthodoxies of the day after. Whatever the field of human enquiry or activity, a fundamentalist has seldom any patience with non-conformists. The infamous research and findings of Lysenko in the field of genetics is a classic case of scientific bigotry and, by implication, of intellectual dishonesty. Possibly, his theory on genetics was custom-made to suit his master Statlin's political designs; or else he pursued his flawed experiments with a closed mind and with blinkers pejoratively speaking, put on by fanatic missionaries. In either case, he unabashedly displayed a fundamentalist approach, which is the very negation of all that science stands for, and in the process smeared the fair name of Russian science, known for its academic excellence and integrity, and scientific transparency and reliability.

Scientists' Accountability

Eric Hobsown, an eminent historian, said "our existential conclusion as creatures of our time is that humankind has not known how to control the marvel of its achievement." History is a ceaseless adventure of man to exercise such a control. The 21st century would be a great disaster if we don't achieve this. We have no alternative. We have to do it.

Scientists have a major role to play in the application of their discoveries and inventions. The concern for humanity must always be the main criterion of all technological endeavours and scientific inventions.

Einstein confessed—"I made one great mistake in my life when I signed the letter to President Roosevelt recommending that atom bombs be made—but there was one justification, that the Germans would make them."

Scientists should refrain from serving the militant designs of unscrupulous, autocratic tyrants. I know the risks involved in it. But looking at the incalculable harm this may cause to mankind, science must not feed the blood-spilling scientific devices nor sell or place scientific discoveries and inventions to be exploited by narrow commercial interests. The subject of science is to establish truth and create a better life for as large a section of people as possible. Upon the truth of this morality rests the edifice of science. Bereft of this truth, the whole edifice collapses. Science should never ignore the value of happiness and love of mankind for that is its biggest asset, strength and the-very raison d'etre. Making science an agent of death or means of exploitation of disadvantaged people has to stop. Science sans morality or science inhibited by morality. There is the rub. Science is neutral, but a scientist cannot function in a moral vacuum.

When we look at the world today, we find that disparities between the rich and the poor within a country and between the developed and the developing countries are enormous and growing. Instead of narrowing this gulf, as mentioned earlier, technological breakthrough is ever widening it.

The process of technology is such that its fast growth is leaving many behind, leading to a precarious disequilibrium fraught with grave social consequences. The poor and those who don't have the new skills are "becoming outsiders in their own homes".

In the new set of circumstances created by the fast-paced scientific progress, social differences between the 'haves' and the 'have nots' are more pronounced and create instant feeling of revolt among the deprived and less privileged. People at the bottom levels of society are not going to be passive spectators and be reconciled to their fate as before. The new technologies of information and communication make them impatient to have equal access to a better life. And if left with unfulfilled expectations, they would not hesitate to commandeer new weapons of deadly-violence. While the rich might be going to cocktails, the deprived would be throwing Molotov cocktails! A world built on such a structure of inequality is bound to explode.

Role of MNCs

This situation can be alleviated only by embracing technological advances for a wider spectrum of society. "Technological apartheid" must end. Serious efforts should be made to transfer technology and lift the levels of those who have hitherto lagged behind.

Moreover, with emerging globalism and growing interdependence, developed countries would soon find that consequences of poverty, disease and bruised and battered environment anywhere in the world would pollute and do incalculable injury to their lives, too. Distances in terms of time and space no longer keep them in safe havens. Developed countries would soon find, for instance, that death rates from environmental pollution would overtake all the improvement in public health they made in the last several centuries.

Not only the scientists, but the thinking classes the world over have a responsibility to find a way out of this malaise. They must join together and exert their enormous influence, using the process of globalisation to make MNCs and their governments to be more socially accountable. The success of such alliances and international campaign should never be under-estimated or ignored. Humanity is not powerless in the face of anti-social destructive tendencies. There is growing evidence of success in this regard. It is encouraging to se that certain grassroots organisations—sprouting in different parts of the world—are exerting pressures to ensure that states and MNCs find solutions to guarantee that the fruits of human inventions are used to improve the lot of common men and women.

Scientists have an equally big role to play. First, they must accept that it is the consequence of their inventions and discoveries and innovations which make or mar the life of a society and hence it is their moral responsibility to prevent others from making inhuman uses of their products and processes. Second, scientists should not think of themselves as powerless tools in the hands of MNCs with a quest for rank increase of profit regardless of social consequences. The scientist should be able to influence MNCs on the use to which their scientific products could be put to. Jointly with other enlightened sections of society, they should raise public conscience to stop

the misuse. They should not silence their scruples and must always be conscious of their social responsibility: The scientific endeavour should contribute to the welfare of human society and not infect it with deprivation, pain and sorrow. Causing pain is the very antithesis of what science is all about.

While discussing science, we talk of conquest of nature as if nature and human beings were antagonistic to each other. We must realise that mankind is part of nature. Degradation of nature degrades mankind. We have to learn to live on the interest on nature's capital and not waste the capital itself, if humanity is to survive on a sustainable basis.

Increasingly, new developments in science and technology are making their impact on society through MNCs. Globalisation has further enhanced their power. MNCs operate on the principle of private profit and are guided by the principle of commerce and not by the spirit of maximisation of social benefits. As a result, the benefits of applied science remain restricted to a few interest groups. The clash between commercial interest and social gain flows from it. Very often, MNCs disregard people's interests. Driven by market forces they become indifferent to the real concerns of human beings. Thus we have tragedies like the one in Bhopal.

Here we are not looking for a battle between MNCs and the developing world. Rather, we have to work out a system backed by multilateral organisations and governments, which would inculcate or force a sense of social responsibility in MNCs to accept dynamic accommodation in the task of improving the lives of peoples in the societies they operate. The nexus between society and MNCs should improve so that market forces are guided to exert required community pressures. Such an approach in the long run would guarantee sustainable development and would not be averse to commercial interests either. We have entered an age when private profit and public gains have to be reconciled. Failure to do so would cause incalculable damage to all mankind irrespective of where they are located.

Revamping and Prioritising

Developing Countries have to bring about a scientific revolution in their countries. They cannot expect a reformed set of MNCs to lift them out of their present miserable state. They have to (as a growing number of Developing Countries are doing) work to lift themselves up to higher levels of scientific competence. Strong indigenous scientific effort would promote economic growth and attract better technologies from outside. But on shoestring maintenance budgets, scientists would not be able to deliver much even if priority objectives for research and development (R&D) are reasonably well spelt out. The critical control of bureaucracy and hierarchy within laboratories ought to be removed and most importantly, scientists should be given the freedom to function effectively in laboratories. Some of the undistinguished laboratories and research projects ought to be closed down. A periodical weeding is good for the turf. Effective collaboration on present projects with foreign specialised organisations must be encouraged. The insistence to do it overselves is not always the best principle. Getting new ideas from laboratories and converting them into products should be encouraged. Science is international in its nature and should not be bound in territorial chains. It is born free and should remain so; and not be used as a currency of power to exploit developing societies.

It is heartening to note that many Non-Governmental Organisations (NGOs) are now slowly coming closer on the issue of controlling MNCs. The autocratic control of MNCs over new technologies and their indifference to discharge of consequent wastes, if unresolved, would spell disaster. Slowly these institutions are "beginning to see the connective-issue- matrix of shared attitudes". A start is being made to codify behaviour for global societies. India can make a signal contribution in this regard. Our strategy should be to gain further advantage from the scientific revolution and prevent an uncontrolled reign of science and technology from undermining our interests. We must ensure that technology is not shrouded in secrecy from us or used in manners detrimental to our interests.

Education as Prime Mover

Now I would like to talk about how developing countries could take advantage of the extraordinary achievements of science and, technology. Developing countries would have to be persuaded to reallocate larger resources for education in their budgets and provide massive funding for education, especially in science and technology. Similarly, R&D efforts need to be well funded. If the necessary facilities are provided to scientists, they can produce good results. Gone are the days when a Raman or an Einstein could just work with a pencil and a pad. Our scientists should be provided the necessary infrastructure for performing their tasks. Peanuts can only get monkeys. Our ill-equipped labs are no answer to the challenges we face today. Our boys in the labs have drive, ideas, and a will. They should not be allowed to become blossoms in the dust. Our scientists are global men, by neglecting them we have already lost a great deal. Developed countries have engaged them to their own advantage. Now we need to create the right climate for the scientists to work in India. We need to correct the current warped fiscal and other priorities.

Education facilitates adoption of new methods, techniques and processes. Countries which have an educated population benefited most from flows of technology. Skilled workers are constantly moving ahead, while unskilled are not. In our country we have to make sure that people are trained and taught new technological skills. And also that these men and women strive to raise their productivity efforts by adoption of newer technology in their firms and factories. Without an educated working class at the shop floor, the shop dwindles and science at higher level remains ineffective. Through mass literacy drives and specially designed training programmes, India could create a sizeable number of highly skilled trained manpower for sophisticated high-tech operations. Through education we would be heralding an industrial revolution.

Upgradation of college and university education should be a priority task on the state and corporate sector agenda. The quality of higher education and the content of science education have to be improved rapidly. The number of good colleges has to be increased. Unfortunately, science education has not received the attention it deserves. India might lose out the initial advantage and the asset it had built, comprising a large number of science graduates and post-graduates. Current statistics on college admissions reveal a decline in the rate of admission to courses in science. The education system should correct this. The number of scientists per million in India has come down, while it is on the increase in other countries. Present failures in

this regard, if unchecked, would make our college education obsolete. It would l5lunt the possibilities of technological achievements. Colleges, in fact, are the ideal breeding ground for developing scientific personnel of world class. This source for building scientific capability should not be allowed to dry up. Higher education should also go beyond the physical campus of universities through video courses and tutorials delivered over the internet.

Linkage with Businesses

Laboratories and universities also need to develop a link with businesses and industries within and outside. Networking would strengthen the success of science and technology. Furthermore, scientists and universities are no longer disdainful of working with commercial establishments. Today, universities and laboratories are comfortable with the commercial utilisation of their inventions and discoveries. Industrial floor shops are no longer tabooed by the scientist. Nor are industries averse to working with scientists and technocrats. Financial needs of universities and labs dictate that commercial firms will have to be carefully drawn into this process. That is the trend in the US and in Europe and is in the long-term interest of our universities. The country which encourages good universities to conduct advanced courses in science will progress at a faster rate. If science education is neglected, technological divide between countries would become much sharper. A deeper chasm would spell disaster to countries already left behind. Apart froth state efforts in this direction, it calls for a stronger nexus between science and the world of business. Much of our efforts are centralised in India's nationalised labs. A substantial percentage of our research and development is for public good but much more is for private use and the open market. Business and industry should be pressed to support science education in universities, make educational arrangements within their premises and funds for research 'and development in labs within industries and in national laboratories.

These measures could pay high dividends in India since it is already well endowed with a sizeable personnel in the field of science and technology, together with a large number of skilled workers. Given increased funding and a creative competitive industrial environment, their creative output could multiply and bridge the gap between India and the other nations ahead of it.

Science and technology had led many countries to unstoppable upward spiral of economic growth. With less land and little addition to population, agricultural production has gone up manifold in many countries. Modern machines and processes of production have produced much more than ever anticipated. New services are coming up to offer more creative opportunities of employment. Work is becoming less of a torture or drudgery. Innumerable advantages would continue to flow with the widening of the base of' science and technology in society. Fruits of development would reach a larger number of people and raise their living standards. Adoption of technological devices is the key to development. Missing it out would marginalise the people. The tragedy of developing countries is not only that millions of its people are unemployed but the greater tragedy is that millions who are employed either do not work or work with antiquated tools of the past.

Exhortation

What bothers us all is that our scientists are no doubt moving ahead but there is a hint of shakiness and hesitation in their steps. That explains why scientific breakthroughs in our country are few and far between. By and large, Indians are content to make do with second-hand technologies instead of directly tapping the source, i.e., science. Consequently, the yawning technological gap between India and the developed countries is increasing. After all science is a great romance of the human mind and spirit. I would, therefore, conclude with an exhortation to the scientists in general and the budding Indians scientists in particular, by invoking romantic imagery. Science is like a coy but demanding mistress, capable of yielding a thousand delights. She wants to be wooed passionately, yet yields her delights to her infatuated lover very grudgingly and sparingly. My advice to the scientists is: Go and serenade sciences with all the fizz and fervour of a passionate lover. Sooner than later, you will find science has given up many of its secrets.

Conclusion

In the words of James Grant, “We seek a world that places the individual human being at the centre of society and at the centre of the responsibilities of State. We seek a world in which each human being is assured of his or her essential needs for nutrition, health and shelter: A world in which education and community services enable each person to find a productive place in society....”

I’m convinced that by evolving a morally moored and innovatively compassionate world of science and technology, we can make this happen. We can carve out a new realm in which pursuit of knowledge; human happiness and love become the prime purpose of a civilised life. We must strike a balance between science and morality for it. India can assume an important role in this regard. We have scientists of high calibre in our society whose work is admired and whose voice is heard with respect. We are also blessed with an “ancient legacy of unique religious and spiritual imagination”. We can work at both levels to strengthen our scientific genius and rebuild our moral imperatives. Thereby, assist the world in establishing a balance between the power of science and technology and human values. Scientists and thinkers must assume this role and not leave it to politicians. They must assume the leadership to overcome despair, “by dreaming great dreams” of a strong modern India, built on the solid foundation of science and technology. We can thus help in establishing a peacfu1 and just world order. In the words of Bernard Lown, “this would help us in shaping a humane world order for the 21st century and beyond”.