Science, anti-science and the scientific outlook

To survive in a rapidly changing world dominated by science and technology we have to move with the times as well as be selective according to our needs. Only a scientific outlook can help in order that we are neither blinded by traditions, nor dazzled by science.

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I will discuss here the interaction between science and society, refer to the growing impact of science and technology on our lives, the reactions to this effect, and why it is necessary to adopt a scientific attitude not only individually but on the part of the society as a whole if we are to survive and prosper.

Time was when science was a subject to be studied in the laboratory. The trend changed when James Watt discovered the power of steam, how it pushed aside the lid of the pot containing boiling water. Today, it may seem to be a slow progress from this discovery to the invention of a steam locomotive, but those were early days. It was the slow but sure advent of technology following on the footsteps of science.



The march of science and technology

Let me begin with one of the major programmes in basic physics, viz. the search for finer details of the ultimate structure of matter. In the previous century scientists had arrived at the atomic structure of matter and gradually the picture emerged at the beginning of this century of an atom built like a solar system. The picture describes a central positively charged nucleus surrounded by orbiting electrons. It was believed that the nucleus cannot be cracked open. When Ernest Rutherford achieved the impossible by breaking up the nucleus, it was to mark the beginning of the nuclear age. His apparatus for doing this experiment was built in the workshop of the Cavendish Laboratory and could be held in the hand. It cost about one hundred pounds.

That was in 1919. In 1930 Walton and Cockcoft built an accelerator which occupied a room. The nuclear particles could be energized to high speeds and their collisions studied. Its cost was about 15 times the Rutherford instruments. This triggered the human efforts to build bigger and more powerful accelerators at higher costs, in order to probe deeper into the matter.

Today, the enormous accelerators at CERN in Europe and the Fermilab in the USA occupy distances measured in kilometres, have hundreds of people working as scientists, technicians and infrastructural staff, and cost billions of dollars. Of course, at this stage the efforts become multinational with participation of scientists from several countries.

The story of computers is equally astounding, although here with increasing sophistication in technology, the size has shrunk. When I went to Cambridge, England in 1957 for higher studies, I was using the EDSAC which was an enormous system filling a large hall with big cupboards of tubes, tapes, etc. One fed a paper tape into the computer with instructions in codified machine language punched in through holes. Today's laptop computer is more efficient than its primitive ancestor. The design of computers has been going through one revolution after another and its usage has become really simplified. Instead of the complex machine language of the fifties, the software of today is very user-friendly.

Similarly, advances in technology have benefited diverse fields such as medicine and surgery. Today, while we enjoy the benefits of telephone, fax, e-mail and webs of databases, it is hard to recall that information and plans of the 1857 uprising were being passed by night-runners carrying *chapatties*. Today's surgeons perform their operations with so many diverse tools; so too, the case with diagnostic devices.

Not all advances have been benign, of course. When

Rutherford opened up the nucleus, he also created the path to the nuclear bomb. The devastation and human suffering produced by the two nuclear bombs in Hiroshima and Nagasaki were unimaginable. Though that was a little over five decades ago, the destructive capability of the present nuclear weaponry will still be unimaginable. Carl Sagan once put it in the following words:

"A nuclear war of modern times is equivalent to the destruction produced during one lazy afternoon at the rate of one World War II per second."

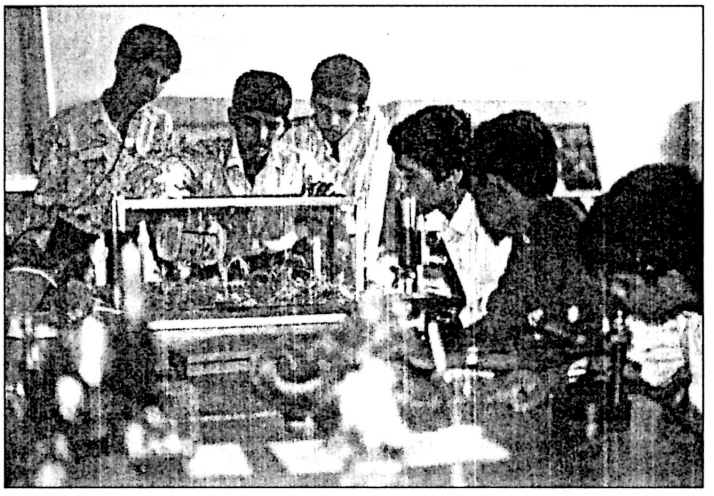
Strategy towards science and technology

Thus from the tremendous growth in even the basic sciences, or the more pervasive growth in applied science and technology (S&T), it is evident that human societies that cannot adapt themselves to the rapidly changing scenario are bound to suffer. What should our strategies be?

To say that we wish to isolate ourselves from this rapid rat race, turn our clock back to the simple way of life of the last century, is an anti-science approach, is not only unrealistic but also impractical. Was life in the previous century as quiet and relaxed as it appears now? It too had its problems, of illiteracy, diseases, famines, short lifespans, to say nothing of minor strifes and major wars.

Society-science interaction

It is very necessary that society looks upon science and technology as tools for its betterment. One approach is that taken towards a well-laden banquet where one eats so indiscriminately that indigestion is the result.



The response of human societies to S&T is somewhat similar. As new inventions continue to pour in there is a rush to grab them. Whether highly industrialized, or developing, societies seem to run after new gifts of S&T indiscriminately, and end up having to suffer the consequences.

For example, having seen the benefits of industrialization, we have gone for it without thinking of it in holistic terms. While going in for automation we have forgotten the humans rendered redundant, which gives rise to social problems of unemployment, drugs addiction or crime. As communications shorten our horizons, we still seem to assert the most parochial attitudes by stockpiling weapons. Although it is claimed that by having nuclear stockpiles wars will be put off, the peace maintained on this basis continues to remain unstable.

The scientific outlook

Surely, if man calls himself a rational animal, human societies are expected to behave rationally and take well considered decisions.

Ultimately responsibility for this rests squarely on society, on how to harness S&T. It is not that everybody needs to be a scientist but everybody should be educated to a level where these issues are appreciated. This is why higher education is important.

In a democratic set up, most funding for S&T comes from popularly elected governments. The directions in which S&T grow have to be decided by the government as a mandate of the people. Yet, these issues are never highlighted in any election. Only a handful of our politicians were or seem aware of these issues at all. Jawaharlal Nehru was one of them.

In his book *'The Discovery of India'*, Nehru had said: "The impact of science and the modern world have brought a greater appreciation of facts, a more critical faculty, a weighing of evidence, a refusal to accept tradition merely because it is tradition."

Today, we live in a free India which is felling its way towards economic prosperity. In 1997, we completed the 50th year of our Independence. We are still a long way from achieving that scientific outlook which is so essential for our future well being.

The scientific outlook arises from the way science develops in its own self-correcting way. Scientific theories do not proceed on arbitrary fiats, they have to conform to a discipline where they are tested against facts. If they pass, they continue, if they fail, they have to go. No person, howsoever great and respected can endorse a theory and expect it to be believed. It is this objectivity that is the hallmark of science that sets it apart from pseudo-science and superstitions.

The scientific outlook need not be the prerogative of the scientist alone. It does owe its origin to human curiosity about nature and as such all of us, whether a scientist or not, are entitled to it. Indeed, just as in the case of science, progress could be achieved only when the scientific outlook prevailed over innate conservatism, so in the case of a society of human beings this outlook acts as an antidote to the evils of prejudice and superstitions.

Superstitions are born out of ignorance of how nature functions. Science is dedicated to the unravelling of the mysteries of nature. When one particular mystery is solved, we should expect the superstitions based on it to disappear. Yet, this does not always happen in practice. This is because of the lack of a scientific outlook.