Tradition of Science in Indian Culture

Dr. Jayant Vishnu Narlikar

The later half the twentieth century is reckoned as Vijnana-Yuga, the era of science. If the man living in the city just reflects on his day to day activities, he will soon realize the authenticity of this observation. Right from waking in the morning till he retires to sleep, he will meet with so many inventions of science. Leaving the city if we move towards the villages we shall see science advancing in the rural areas as well. In a progressing country like India in which agriculture has an important role, the farmers are fast taking advantage of the inventions of science.

When we perceive the important results of science, two important aspects catch our eye. One draws us to look towards the future and the other towards the past. Will science and its technological advances increase day after day? Will the scientific inventions be successful in removing the hardships faced by human society? Or will our society collapse due its inability to assimilate the increasing inventions of science? The experts concentrating on studies about the future (futurists), the sociologists and the scientists are seized with these questions. The questions are discussed quite often. Nothing can be said with certainty what course future society will take under these circumstances; due to lack of unanimity among the experts such a predicament is not surprising.

When we look towards the past we are faced with another sort of uncertainty. The foundation of modern science was laid in Europe nearly two centuries back. When we behold the scientific advancement in Europe, this progress is ultimately transformed into industrial revolution. Science taught man the use of latent energy in coal, which enabled him to run huge machines. Thereafter he obtained energy from other sources as

well. Now a days many other forms of energy, other than coal, are utilized by man in his day to day usage. They are petrol, nuclear energy, water dams, gobar gas, etc. But when we turn towards the past whole picture becomes blurred. Has science always played an important role in social history? Was there a time when more importance was given to science than what it is being given today?

In all the parts of the world Europe is the only place where intensive research was made seeking answers to these questions, two and a half millennia before. On the basis of the books available today we can learn the interrelation of science and society in the greek civilization dating two and a half millennia ago.

Excepting Europe, in the history of other countries of the world, there is absence of books on these subjects. Hence it is not surprising that these questions were not discussed then.

But in a country like India where a high culture has an amazing continuity since thousands of years, where tradition of literature, music, and arts continued unobstructed, where in the philosophers and religious leaders have inspired the society since ages, what had been the tradition of science? I feel that this is a subject which should be discussed by the experts in this field. With this end in view some of the subjects will be discussed in this article. When we look at the ancient epics like Ramayana and Mahabharata we come across many references and incidents, if we consider them as true events then we get a glimpse of high technology prevailing then. The Pushpak viman; the divine insight of Sanjaya by which he gives a running commentary of the war; the use of long range missiles, man's movement under water, or travel by air, life rejuvenating medicines which were amply successful in increasing longevity of life etc. We read many such events and episodes in various puranas.

On the basis of these incidents at times it is surmised that our ancient culture had passed through an era of scientific development. Many of the new inventions, which we see today

were probably known to our ancestors. That very ancient scientific treasure was for some reasons lost, has come to light again today.

The above contentions are quite controversial. Man's imagination is very explosive. While beholding many events in creation he adds some of his imaginative thoughts as well. In stories and ancient lores we witness how extensive man's imaginative faculty can advance, we see their vivid examples in them. Have such poetic imaginations entered into our puranas? It is quite possible especially when our Vedas and Upanishads and hundred other ancient books were not transcribed or written for hundreds of years and passed on from generation to generation by oral tradition. Hence it does not seem improbable that some new additions or interpolations have been pushed into the books though unauthentic.

Still those who hold the above view may say "It is true man's imaginative faculty is vast, yet it is based on some authentic experiences. Therefore these miraculous events described in the puranas though they may be highly imaginative, yet some element of truth is couched in them.

It is my opinion that those who subscribe to the aforesaid view, must publish some research books which bring to the fore, wherein our ancestors have dwelt upon the technical aspects of some of the technological inventions, if this controversy is to be resolved. Such a book should be of the nature of a 'manual by reading which that particular invention could be practically recreated, for example if we can present such a treatise in which we find the description of the invention of the aeroplane on the basis of which we can manufacture an aeroplane. Till this day no such book has come to my knowledge.

I have seen one modern book in which the writer has quoted the Vedic Richas to show that Rishi Dirgha Tamas was acquainted with the internal formation of the sun. Modern astronomy tells us that the concentration of heat in the sun results

in the atomic process by which hydrogen is transformed into helium. Due to this process energy is released. This energy expresses itself as the light of the sun. In this book the writer while expounding the meaning of the Richas has tried to establish that the Vedic Rishis knew about the function of the atoms in relation with the sun. For this the writer has taken recourse to the key by which the number of words in the richas, looking upon the words as symbolic allusions elucidating the clear meaning of the words and their interpretation. Still modern astronomy has described the sun on the foundation of mathematics. This is absent in the above contention. Therefore, I consider the aforesaid exposition as insufficient.

Yet when we set aside the descriptions of the technical side of inventions and turn towards the principles discussed in the Vedas and Upanishads we find many examples which reveal to us the glimpses of the scientific temper of the thinkers of those days. Rather than looking upon the phenomenon of creation as just divine miracle those thinkers like the modern scientists have expressed their curiosity. They asked relevant questions and tried to find their answers. This habit of questioning later on seems to have faded out. Taking the authority of the guru's words as final गुरोर्वाक्यं प्रमाणम् "the spirit of enquiry among the students seems to have ended." Thus rather than seeking knowledge by research and experiments they just took recourse to learning by heart or cramming. Why did this happen and when this happened is a matter of research.

Leaving this subject at present when we turn towards the ancient books, the events enumerated by them can be useful. Let us take one such example from Mahabharata. On the occasion of the slaying of Jayadratha it is said that just before sunset Lord Krishna concealed the sun for some time, due to this it became dark for some time and it gave semblance of night. If we take this event as true what can be the reason for this from the point of view of modern astronomy? On the 16th February

1980 we had witnessed a total eclipse of the sun. It will not be difficult to believe that at the time of the death of Jayadratha such a complete eclipse of the sun must have taken place. The total eclipse of the sun is not seen every where on earth. By use of modern calculating apparatus the astronomer can tell exactly when such a complete eclipses of the sun had taken place on earth and in which places they were seen. Hence if we inquire as to when such a complete eclipse of the sun was seen in *kurukhetra,* just before sun set, the answer to this querry may help us to determine the period of the Mahabharata war.

Apart from the eclipse, there is another method by which we can successfully ascertain the period of different events in the puranas, on the basis of modern astronomy. The earth rotates on its north-south axis. The direction of the axis also is not steady, when calculated on the basis of the stars, but it goes on changing very slowly: to cite an example the polestar 'Dhruva Tāra' appears to be stationary but on the basis of the axis of the earth it circambulates a little which takes around 25000 years. The other stars also share the same condition. For those who view them on earth, the direction of the stars also changes slowly and this change is maximum in 12500 years. Therefore, if we find the description of the direction of the stars in the sky, given in ancient books then by calculating, about the direction, by modern astronomy we can determine the period when these treatises were written. Late Lokamanya Tilak in his research book named "Orion" has cited many such examples on the basis of which he has tried to establish and determine the period of the Vedas.

Mathematics and Astronomy

It is often said that Indians contributed the concept of "zero" to mathematics. In fact the imagination of zero is more difficult when compared with the other digits because we can see the other digits in concrete forms; say, four mangoes, five trees etc. Zero is abstract, though it occupies a very important place in

mathematics. The addition and subtraction of digits is always incomplete without the zero. (In modern algebra the definition of the process of the addition of the positive and negative numbers creates a group the unit of which is zero).

Moreover of 'zero' is also considered as infinite in the puranas: पूर्णस्य पूर्णमादाय पूर्णमेवावशिष्यते "By deducting infinite from the infinite what remains is infinite". Infinity, like zero is an abstract imagination. It is quite possible that both these imaginations emphasise the importance of the abstract concept of the thoughts of Indian tradition.

Apart from the concept of zero and the infinite and their abstract imagination, it is understood that the decimal system originated in India. This method was propagated in Europe by the Arabs. In comparison with this the Roman system of writing numerical seems unnatural. It is therefore, not surprising that the mathematicians and the important thinkers accepted and developed this Indian system in mathematics. The use of this system is considered as an important revolution in mathematics.

Though mathematics is considered an abstract subject yet its utility in the common day to day life is evident. The science dealing with the subject of creation stands on the very foundation of mathematics. Nearly two thousand years ago astronomy was the most important aspect of the study. On the basis of the available treatise Greeks, Arabs and Indians had made a profound and interesting study of the stars in the sky along with the sun and the moon. For this they took recourse to mathematics. Greek philosopher Aristotle, who was also the guru of Sikandar (Alexender) for some time had a great impact on the scientific and philosophical thoughts of his period. According to the principles laid down by Aristotle, the earth was steady, and the sky adorned by stars and planets revolved around it. Most of the stars seem to encircle or move on a circular path around the earth. But the path of the planets seems to be irregular. The greek mathematicians like Hipparchos and Ptolemy tried to rec-

oncile his opinion by the use of abstruse difficult methods of geometry.

But in the 5th century A.D., the Indian astronomer Arya Bhatta had surmised that as the earth rotated around its axis, the stars which are stationary in the sky, appear to move from east to west. In support of this view he cited an example that to a person traveling in a boat, the trees on the banks of the river seems to move in the opposite direction.

Though this example aptly describes the principle of Arya Bhatta it was not acceptable to his contemporary colleagues and his students. They either tried to misinterpret the shloka (verse) written by Aryabhatta, or tried to prove that the shloka itself was not written by him. Progress of science has been due to the augmentation of the new thoughts, but these are at times not acceptable, not only to the common people of the society, but they appeared as incorrect, or unpalatable even to the experienced scientists. This is an example in this contexts. Due to the social and religious tolerance of the Indians, probably Aryabhatta did not suffer any punishment for his revolutionary priciples. But many centuries later, in medieval Europe, Giordano Bruno, Copernicus and Galileo had to suffer for their views.

Aryabhatt, Varahamihir, Bhaskaracharya, and others remind us of the tradition of mathematics and astronomy prevalent in India before 10th to 15th century A.D. Arithmetic, algebra geometry, trignometry and so many principles used in astronomy are seen in the books written by these scientists. On perusal of these books it is also found that Sanskrit language was competent enough to give expression to theories of those scientists.

Break of Tradition

It is unfortunate to find that history books reveal to us that the tradition of pure science after the aforesaid period virtually ceased to continue. What could be the reasons for this?

Can we surmise that owing to the rampant aggression on the

north-west frontiers the peaceful conditions prevailing in the country began to totter and due to lack of congenial atmosphere the scientific tradition did not progress? I do not hold this reason to be very valid. If we look at the history of Europe from 1500 AD to 1900 AD when science developed and advanced a lot, there was no peaceful environment at all. Wars continued among different countries of Europe for big or small reasons.

There could be one reason that the religions of India – Hinduism, Buddhism, Jainism, including Islam also, the society instead of concentrating on material progresss and well being, began to look for inspiration in the other world. It is quite possible because of this the scientific progress in the direction of inventions useful for life, did not encourage scientific activity among the thinkers of the period. Against this there was a scientific revolution in Europe. The scientific experiments and inventions, were in a large major conducive for industrialization. Science of navigation, armaments, architecture, medicine etc. and also for other reasons as well, science advanced in strides in Europe during the said period.

There was one more reason for development of of science in Europe. The scientists were supported and they received patronage both from the rich and the kings. This system commenced in Italy and spread in other countries as well. The kings of France gave substantial help to National Academy of Science. In England Royal Society was established. In India, however, we see a complete absence of this system. The kings gave enough encouragement and patronage to architecture, painting, music and supported the poets, but they could not create an atmosphere in which science could progress. In Jaipur and Delhi, however, the *vedhashalas* or astronomical observatories remind us that the kings like Jaisingh were exceptions. Such exceptions could be counted on finger-tips.

Could this be the reason that in India we had musician like Tansen and different schools of music hierarchy ? The Tajmahal

was built but there were no scientists like Newton, Halley, Laplace ? This is a subject for self-retrospection. Even in our science of medicine Ayurveda, the similar situation was prevailent. On the one hand during the puranic period there were treatises of Ayurveda, like the ***Sushrut Samhita*** **and** ***Charka Samhita*** which show the high scientific achievement in medical science, in those days. Quite in contrast between 1500 to 1900 AD there is no book to reach their strature.

Modern Scenario :

In India the Renaissance of Science commences us in the twentieth century. Being under the patronage of British Empire it is quite natural that it received the stamp and impact of European scientific tradition. Independent India also adopted this tradition. To day wherever scientific research is being conducted it is by and large under sponsorship of Government. The ever increasing day to day expenses pose new problems before the society.

Government sponsorship is given from the national exchequer. It is, therefore, quite legitimate that government expects the scientific research should promote national interest and thereby make the nation more and more prosperous and be helpful in removing the hardships of the people. Keeping this in view it is necessary to decide in which field the research is most needed. Even the effluent countries, who have enough funds for scientific research have to discuss these problems in details.

There is no doubt that for progress in the scientific Age, the help of science is imperative. The medicine which the patient uses for treatment of his disease is administrated after ample thought and judgement. The medicine given without proper thought and care could prove to be harmful for the patient. In the same manner the scientific research must be conducted, with proper thought and utmost care keeping in view the paramount

interest of the nation. The scientific tradition which prevailed in India got extended in the medieval period and is rejuvenated in our present era should be further promoted by the scientists of our country. They should participate in the discussions with the scientists of our country and other thinkers in the field to maintain the ongoing flow of science tradition.

(*Translation by* **Jaikishandas Sadani**)