

Four Questions That History Might Answer

J. V. NARLIKAR

INTRODUCTION

History is more than a catalogue of events and characters that occupied the stage of the world in the past. It is a chronological sequence of the evolution of human societies and cultures. Although specific human beings and specific events do play critical roles in turning the evolutionary path in a different direction there are also slow but steady changes going on as knowledge accumulates and societies adapt themselves to its growing store. Science and technology, howsoever primitive in the past are part of that knowledge and have played influential roles in shaping civilizations. The discovery of fire and the trick of producing it artificially, the transition from stone to metal in making implements and the discovery of agriculture have been cornerstones in such historical development of mankind.

We often talk of the history of science as if it were an isolated branch of history that deals with how scientific knowledge evolved, who contributed to its major discoveries, how its controversies arose and were laid to rest, how circumstances prevented its progress and how accidents led to new breakthroughs. In my opinion history of science should go further than all this, extending its scope to the interaction of science with society. For, science has been one of the influences in shaping the society and social influences have controlled scientific thinking.

It is in this context that we need to look at our own history and use whatever investigatory tools we have towards answering questions relating to the state and evolution of scientific thought as well as questions relating

to the antiquity of some of our ancient works from scientific allusions in them. This article raises a few questions of this kind.

While raising these questions let me confess to being a total novice in the field of history of science. It is thus quite possible that my questions are not well posed in the jargon of experts; perhaps some of them have already received answers: in any case it is quite likely that they may have been discussed by the cognoscenti. My sole reason for raising them here is a layman's curiosity.

Q.1: What is the scientific content of the Vedas?

We often hear very sweeping statements that all important discoveries of modern science are to be found in the Vedas, if only we learn how to interpret them. Also, much is made of the so-called Vedic mathematics. And, as corollaries of such statements, we are told that because there are descriptions of sophisticated guided missiles in the *Rāmāyaṇa* and the *Mahābhārata* the societies described in those epics were technologically advanced.

For the typical Indian mind anxiously seeking parity with the West it is tempting to look for a glorious past as a compensation for the present 'developing nation' status. Scholars of history have to set aside such prejudices and objectively assess whatever information that can be gleaned from the ancient literature.

Let us look at the Vedic Mathematics in that light. So far as I have seen its expositions they look like a compendium of methods of quick calculations. None of them to my knowledge contain essentials of higher mathematics, like results from number theory, results from higher algebra or theorems of geometry let alone the more advanced levels of topology, analysis or algebraic geometry. I will be only too happy to be proved wrong by scholars of Vedic Mathematics, but this will require demonstration of a sophisticated mathematical result starting from a well defined set of axioms.

Let us next consider the claim for high technology in the ancient times. To base such claims on epics which are literary works rather than technical accounts is like concluding from the reading of Grimms' Fairy Tales that the Europeans of the seventeenth to nineteenth centuries were versatile in sorcery and magic. Let us instead ask the following relevant questions. Is there anywhere a description of what we consider today the basic amenities like water on tap, drainage system, electric lighting etc.? Simpler than the nuclear power or ballistic missile technology is the technology that produces electric power and delivers it to urban populations. Is there any evidence that the forces of electricity and magnetism were known and harnessed for power?

It is claimed that some Vedic psalms contain a description of how the Sun derives its power from nuclear fusion of hydrogen to helium. Frankly, even if the description is taken to be as claimed it does not tell us about the internal constitution of the Sun, what keeps it in equilibrium, how is the energy transported from the central core to the surface, etc., which in modern framework requires the knowledge of the forces of gravity, electricity and magnetism and of hydrostatics and radiative transfer. To say simply that the Dirghatama Rishi knew about nuclear fusion as the source of solar energy without filling in the above aspects of solar interior is giving a less than complete picture.

To put it in a nutshell, what we require is the equivalent of a technical text rather than a superficial poetic description. It is argued that the Vedas do contain that information also, only it needs to be dug out by 'decoding' the language of the psalms. If so we need a unique and unambiguous key to that code. That is, the code should be agreed upon by at least a few scholars in the field *before* the interpretation is undertaken. Only then the attempt will command credibility. It is certainly worth taking up such an exercise provided one is not preconditioned to arrive at an already known answer from Western science. Moreover, the case will be strengthened if such an attempt reveals some scientific truth hitherto unknown to modern science.

Q.2: Can astronomical allusions be used to date ancient writings?

Lokmanya Bal Gangadhar Tilak in his monograph *The Orion* had undertaken a unique exercise which is briefly described below.

Although Tilak is well known as a freedom fighter he was also a Sanskrit scholar with interest in mathematics and astronomy. It was while writing his famous commentary on *Gītā* (known as the *Gītārahasya*) that a verse in that volume set him thinking.

In Chapter 10 of the *Gītā*, Lord Krishna identifies himself with excellence in all things in nature, living or non-living. The line which attracted Tilak's attention was

Māsānām mārگاśīrṣoḥam ṛtunām kuṣumākaraḥ,

meaning that amongst the months he is *mārgashīrshā* while in seasons he is 'spring'.

According to the present Hindu calendar, the month of *mārgashīrshā* (identified with the constellation 'mrigashiras' or the Orion) does not come in spring but in autumn. Why this apparent discrepancy? Why does not the 'best' month belong to the 'best' season?

Tilak's argument which is given in detail in his monograph *The Orion* rests on the premise that the above reference was correct at the epoch it was made. Because of the precession of equinoxes the 'first' month of the year (which was identified with the spring equinox) happened to be *mārgashirshā* then; but it is not so now. Going further in his researches Tilak looked for references to seasons and constellations in the Vedas and argued that to reconcile the apparent discrepancies therein one has to assume a substantial precession of the equinoxes. And from these astronomical inputs one can estimate the epoch when the references in the Vedas were written. Tilak's calculations set the antiquity of the Vedas and the initial Aryan period as far back as 6000 BC.

Other scholars dispute this estimate which, they claim, makes the Vedas far more ancient than estimated by other methods based on evolution of literature, history and anthropology. On astronomical grounds, however, Tilak's approach is hard to fault. Its weakness lies in how clear-cut are the astronomical references on which the theory rests. As I mentioned earlier Vedic language is neither easy nor unambiguous. Perhaps a more systematic search along Tilak's lines is needed to improve the estimates given in *The Orion*.

The above exercise illustrates a possible combination of history, literature and astronomy. Other astronomical allusions include eclipses, rising and settings of certain *nakṣatras* in relation to planets, comets and so on. The planetary motion despite some secular and irregular effects does provide a good clock whose accuracy is being continually improved by better and better computer programmes. Some well-known comets like Halley's comet can also be used as period indicators. If literary quotes about astronomical sightings can be authenticated as genuinely belonging to the times of the work concerned (and not added subsequently!) then the astronomical clock can be used effectively as a check on the period concerned.

Q.3: Were any supernovae observed in India during the Siddhāntic period?

I begin with the example of the Crab Nebula which is so well known to astronomers as the sighting of an exploding star by ancient cultures. I mention this example because it belongs to the time when Indian astronomy was flourishing in its Siddhāntic period. (I take the Siddhāntic period as from Āryabhaṭa in the fifth century to Bhāskara II in the twelfth century.)

The astronomers in China and Japan nine centuries ago were accustomed to keeping meticulous records of all heavenly bodies. Their purpose in doing so was largely astrological. For it was widely believed that if the

ruler of the country strayed from the straight and narrow path of virtue and behaved badly, he would be warned of punishment by God; and the warning would appear through unusual happenings in the sky. So it was the duty of the court astronomer to keep a close watch on the heavens and to report anything uncommon.

Against the well-regulated movements of stars and not so well regulated but still predictable movements of planets, the unusual occurrences usually consisted of eclipses of the Sun or the Moon, meteor showers or visits from comets. The astronomers during the Sung Dynasty were certainly not prepared for what they saw on 4 July, AD 1054 (date as per today's calendar!). Their records reads^a:

On a Chi-Chhou day in the fifth year of Chi-Ho reign period a 'guest star' appeared at the south-east of Thien-Kaun measuring several inches. After more than a year it faded away.

The appearance of a new star would certainly cause comment, especially when it was bright enough to be visible by day being about five times as bright as Venus in the morning or evening! The star, however, did not stay bright for long and began to fade. In two years, it was not visible to the naked eye. Its location in the sky relative to the background of other stars was fixed, however. The Chinese and Japanese records of the position 'several inches south-west of Thien Kaun' imply Zeta Tauri in the constellation of the Bull. Because the star made only a transient appearance in the heavens, it was called a 'guest star'.

Where else in the world did people see this remarkable event? It should have been seen in India, Europe and Middle East and also in the American continents. Unfortunately, we do not have meticulous records available.

As I mentioned, the date of the Crab supernova falls within the golden age of Indian astronomy and so it is pertinent to ask if the Indian astronomers had recorded this unique event. Even though 4 July falls within the south-west monsoon period when the skies are overcast, it is hard to imagine that the entire subcontinent was under a cloud cover. Moreover, even after the actual explosion the object was visible as an exceptionally bright star for several days. It would have been hard to miss.

It is argued that Indians never recorded anything and ours was an oral tradition. This may be so: but still I feel that during the Siddhāntic period when astronomers did write books, there must have been records. It is also likely, as in the Chinese case the records may have astrological significance and may have been discussed in that context. Also, aside from the Crab

^a *History of the Sung Dynasty*, by Ho Peng Yoke (1962).

Nebula, one may ask if there were any references to even earlier supernovae, since one would expect to see some such spectacular event once in two to three centuries.

Q.4: Why did scientific activity decline after the Siddhāntic Period?

With a few exceptions, after the twelfth century, the leadership that India enjoyed in astronomy and mathematics petered out. Indeed, by the time a few centuries later, as Europe woke up to the new age of science and technology there was hardly any activity in these fields in our country. *Why did this happen?*

This question has been pondered over by many on various occasions. The reasons given also are diverse. I summarize them below:

1. In Europe the climate was unfriendly and survival under wintry conditions was always a challenge. Challenge brings forth the best in a population. Thus many left to look for more lucrative colonies and their adventures on the high seas required them to devise science based navigational aids as well as technology of shipbuilding. Those who remained also discovered that science and technology provide means of improving living conditions and so actively sought discoveries and inventions.

The climate in India by contrast is benign and does not pose challenges for existence of the same order as in Europe. Further there were religious taboos on leaving our shores which actively discouraged colonial adventures.

2. Our religious and social values have always stressed simple living and denial of worldly goods. This attitude, while admirable in many ways, discourages attempts to seek comfort and luxury. Thus the lure of applied science and technology was never so strong in the Indian ethos.
3. Science advances through a spirit of enquiry and not through rote learning. The Indian system of education was largely through oral recitation of the *śāstras* in which thoughts and precepts orally passed on through centuries only were propagated to the detriment of anything new. It required strong original thinkers like Āryabhata and Bhāskara to add new ideas to such a system. Unfortunately such strong personalities were not forthcoming.
4. In Europe, science and technology received patronage from the rich aristocracy as well as from the royalty. The Royal Society and the French Academy are examples of royal patronage. But the main point is that even rich private individuals felt it worthwhile to support scientific pursuits just as they supported music and the fine arts. In India support for

the latter existed but not for the former. A Mughal emperor would patronize a Tansen or build a Taj Mahal but he did not think it necessary to support science.

For this neglect we had to pay a heavy price. For the British could control India not simply because of their policy of 'divide and rule' but also because of the tremendous edge they enjoyed over the natives in access to science and technology.

These are possible answers; but do they tell the whole story? I pose this question to the experts. The answer may hold guidance for the present also. For today science and technology have taken control of our lives and history may help guide us in our appreciation of these subjects.

CONCLUDING REMARKS

I think I have aired my ignorance sufficiently to convey a few areas in which research in the history of science may offer useful information. The word 'ignorance' stresses the possibility that I may not be aware that the information I have sought here already exists. In any case the project of putting together the whole story of evolution of scientific thought in the sub-continent over several millennia promises to be very rewarding and the questions I have posed are but the tip of the iceberg that research in this field will bring out.