Sky-gazing for survival

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AS AN astronomer, I am often asked why anyone should study astronomy and bother about the nature of distant stars, planets and the remote galaxies in the sky above. The questioner implies that such an activity is of little practical value and that we astronomers are really parasites on the society by siphoning precious funds for its pursuit.

This question, of course, can be answered at different levels. At the deepest level, the motivation to study astronomy is the same as the motivation for any intellectual activity. Over the years human civilisations have supported creative activities in the arts, literature and the more abstract variety of science. So, at this level, we can argue that astronomy should be practised in order to satisfy our innate curiosity about the cosmos and to understand our place in this universe. And, as the following example illustrates, an intellectual activity can lead to useful results.

The 16th century astronomer, Tycho Brahe, had made meticulous observations of the sky and in particular the motion of planets. He felt that Copernicus was wrong and hoped that his data would prove his conjecture. To extract the facts from his data, Tycho needed an assistant proficient in mathematics and he got Johannes Kepler for the job. Kepler spent several years to codify the essence into three specific laws for planetary motion. These laws describe how the planets move round the Sun in elliptical orbits.

Kepler's laws raised the question as to why the planets move in this fashion and the answer came from Isaac Newton who had the genius to postulate the existence of a universal gravitational force between any two objects. From then on, study of gravity has played a crucial role in understanding the structure of our universe.

At the next level, one can list several technological offshoots which have come about from the application of the law of gravitation and these have benefited mankind. Indeed, most of the benefits of space technology, which we enjoy today, can be directly traced to the better understanding of how gravity works which, in turn, was prompted by purely astronomical considerations. That we can launch satellites around the Earth or can send spacecrafts to the Moon, all in highly precise trajectories is because of our understanding of Newton's law of gravitation. The benefits we enjoy today from space technology, be it remote sensing of Earth resources, or sending a fax or an email message or watching the World Cup live on television, all owe their existence to the law of gravitation; and the law of gravitation itself owes its genesis to the data from astronomy that was painstakingly collected by Tycho.

We can actually go one level further and argue that astronomy is essential for our continued survival on this planet. We are aware of the history of the Jurassic age when huge beasts like dinosaurs used to dominate this planet. What catastrophe took place that wiped them entirely from the face of the Earth?

There is much speculation. But one serious possibility is that the Earth may have been hit by an extraterrestrial body of appreciable mass and the impact caused a huge turmoil wiping out all, or at least most, life forms from the Earth. What could the impacting body be? Can we trace the impacters through the craters they leave?

The surface of the Moon is pock-marked with craters, showing evidence that outside bodies have hit it on several occasions. The Earth has also such craters; only many of them are filled with water and appear as lakes. Two examples of craters believed to have arisen from impacts are the Meteor Crater in Arizona, the US, and the Lonar Crater Lake in Buldhana district of Maharashtra in India. A meteor is a piece of stone passing through the atmosphere which heats up by friction and shines.

Such material comes in all sizes, ranging from less than a millimetre to several metres and the larger ones can be devastating in their impact. For example, the meteorite whose impact caused the "hole" at Lonar was about 60 metres in diameter, weighing about 20 million tonnes. The hole so caused has a diameter of around 1,830 metres and a depth of 150 metres. Tom Gehrels from the University of Arizona has used a graphic way to describe the energy released in such celestial impacts: through a comparison with the energy released in a nuclear bomb. The energy released in the Lonar catastrophe was equivalent to that coming from a six megaton H-bomb, about 500 times the atom bomb dropped on Hiroshima. Of course, no nuclear energy is released in a meteoric impact, but the heat released is sufficient to initiate combustion that could significantly deplete the oxygen in the atmosphere.

There are even bigger entities than such rocks going around in the Solar System. In July 1994, Comet Shoemaker Levy had impacted on Jupiter. The event was witnessed by telescopes on the Earth. On the huge planet the impact of a comet had, of course, a transient and relatively mild effect. But what if a comet strikes the Earth? Indeed, such a possibility was raised in 1992 in connection with Comet Swift Tuttle. This comet passed by in 1992. At the time it was predicted that in its next visit on August 14, 2126, it will come very close to the Earth. Although it cannot be definitely calculated, the probability of its actually hitting the Earth is not negligible. A better estimate can only be made when the comet is sighted again in the 22nd century.

In the 1970s I had written a science fiction story in which a comet like this was headed for a collision with the Earth. How did the scientists avert the catastrophe? The solution used in the story involved sending an unmanned spacecraft to rendezvous with the comet; with the provision that close to the comet it would carry out a nuclear explosion generating shock waves that would divert the comet from its original path. The same solution is now being proposed for saving the Earth from any impending impact by a comet or a meteorite, or, an asteroid. Keeping such possibilities in view, astronomers in the US have initiated a Spacewatch programme, in which a dedicated 1.8 metre telescope is looking for all solar system bodies of such appreciable sizes in our neighbourhood. With their trajectories charted out we can predict if any of them will come dangerously close to the Earth in the future, and take preventive action as needed.

This example again reminds us that sky-gazing is not a mere idle activity: it can help human survival.

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