The great escape to space

If heat, light and noise pollution continue to grow, a time will come when astronomers would be forced to observe the universe from space, writes Jayant Narlikar

ON A VISIT to Chile, I had the opportunity of visiting Paranal, a location in the Atacama desert to the north. Paranal is the site of the world's largest optical telescope system operated by the European Southern Observatory. It has four telescopes, each with a mirror of an eight-metre diameter. So when they work together, they have a light collecting area of around 200 square metre, the size of a large urban flat. Indeed, astronomers have come a long way since four centuries ago Galileo first trained his pioneering telescope of some four-centimetre diameter on the sky.

After a two-hour drive from Antofagasta, through the rocks and sands of the desert, we could see the white domes of the telescopes on a high plateau. However, when the ESO transport set us down in front of the residency or the guest house for the observing astronomers and technicians I could not see any building in front. There was an upside-down dish-like structure covering the ground some 50 metre away and a paved path led to it. There, one encountered a gateway, crossing which, one was transported into something veritably out of science fiction.

For, you were greeted by a garden of lush green plants, a swimming pool, a large restaurant and recreation rooms. The residency is run like a comfortable hotel amid a man-made oasis in the large unfriendly desert outside. It has well-equipped guest rooms distributed over three floors. We had arrived in the middle of the day. Even so, most guest rooms carried the 'Do not disturb' sign on the doors. For, the users had been occupied with their observing all night and were making up for lost sleep now. At sunset they would be up and back at work at their telescopes and computers.

The place reminds you of pictures of proposed space colonies but there is one difference. Every attempt is made at nighttime to prevent any leaking of light from the roof or the walls of this underground building to the outside world. As if to underscore this fact, a huge umbrella opens out under the circular roof after sunset.

At nightfall this light curfew extends rigidly to the outside world also. No buildings in the campus have lights outside. Even driving between the residency and the telescopes has to be done in cars with no headlights on. It can be a scary experience for the novice, for the roads are hilly, winding and without streetlights.

Why such stringent precautions for preserving darkness? Because for using the telescopes in the most effective way, the observer likes to have the sky as dark as possible. Even the presence of the moon can be distracting as it reflects and scatters light from the sun and brightens the sky. The poet may admire the moonlit sky but the astronomer would consider the moon an agent for pollution. Indeed, when allotting observing nights to different astronomical proposals, the telescope committees give nights with less moonlight to observations looking for very faint objects.

Astronomers have increasingly faced the problem of light pollution over the last five decades. As urban populations grow and expand geographically, the night sky gets brighter and brighter with light from streets, buildings, hoardings and transport. This makes it more and more difficult for the astronomers to carry out their observations. Amateur astronomy groups from cities have to plan excursions well outside their cities to find dark enough areas for their night sky watches. This problem is faced by professionals too. Thus, telescopes at the once famous observatories like Mount Wilson or Kitt Peak have been rendered less and less effective and useless. Deserts and high mountain peaks like in Chile and Hawaii, are the havens where astronomers are forced to site their best telescopes.

Light is not the only source of pollution to guard against. A lot of the elaborate arrangements at Paranal made sure that very little heat escaped from the human habitation at the residency. Humans and their infrastructure generate heat, which normally escapes into the atmosphere setting up air currents. Any such disturbances in the vicinity of the telescope make the images of the heavenly bodies flicker. To avoid this phenomenon and to get as steady and clear images as possible, every attempt is made to reduce air currents.

While these problems bring headaches to the optical astronomers who use visible light for their observations, their radio counterparts are no more fortunate. In radio astronomy, the radio waves bring information about cosmic sources far and near. These radio signals are basically very faint and demand sophisticated devices in the radio telescopes to catch and store them. However, these efforts are negated if the background in which the radio telescope operates is noisy, having a profusion of man-made radio waves.

Imagine a school classroom with many students. One naughty boy lets out a shrill whistle. If the overall class is quiet, the teacher can easily identify the culprit. In a noisy classroom, however, this may not be so easy. In the same way, a radio astronomer will not function efficiently in detecting and observing faint sources in a noisy environment. For this reason, radio astronomers the world over have to engage in vigorous lobbying and elaborate international protocols to ensure that the radio wavelengths they use are safe from incursions by the advancing technology. The spread of cell phones is thus a potential threat to radio astronomy.

Such interference with cosmic signals is similar to that arising in the communication between the aircraft pilot and the control tower. To avoid it, there is the usual announcement before take off or landing, asking passengers to switch off all electronic devices, lap tops, and cell phones.

It is ironical that technological advances help the astronomer devise more and more efficient telescopes, and yet the same advances also bring in their wake threats like light and heat pollution and growing radio noise. As these threats grow, a time will come when astronomers would be forced to switch all their serious efforts at observing the universe to space. As the salutary experience of the Hubble Space Telescope shows, in space there is no light pollution, no air currents nor interference from man made devices... yet.

The writer is an eminent astrophysicist and astronomer