Discovery of Neptune
And the Search for New Planets

By J.V. NARLIKAR

THE astrologers tell us that there are nine "planets" out there that control our destiny, not only of isolated individuals but even of institutions and political parties. Such claims have repeatedly failed the tests of scientific scrutiny and even school students will tell you that not all of the above nine are, in fact, planets. Of those, the sun is a star and the moon a satellite while the supposedly fearsome Rahu and Ketu are not material objects but geometrical nodes.

But, judging by the mail I receive, some students go a step further and tell me that there are ten planets in our solar system. Evidently, some textbooks are spreading this misinformation. While this is deplorable, going by the level of accuracy of some of our school books, this is not surprising. But the bottom line is that there are only nine confirmed planets in our solar system.

This, of course, does not mean that there cannot be a tenth planet. There may be planets circling the sun, farther out than Pluto, our remotest known planetary neighbour. But they would not be so easy to detect, being very faint and moving very slowly across the sky. Indeed, the stories of how the two outermost planets, Neptune and Pluto, were found make interesting reading today.

By the early 1840s astronomers were becoming concerned that the planet Uranus, discovered in 1781 by William Herschel, did not appear to follow the orbit expected on the basis of Newton's law of gravitation.

Newton's Law

Since the motion of Uranus had been monitored for several years, it seemed unlikely that observations were at fault. Could Newton's law also be proved blameless? Two young theorists, John Adams at Cambridge in England and Urbain Le Verrier in Paris, both independently thought of a solution that guaranteed this outcome. If, they argued, there was a new planet in the same part of the sky, its gravitational pull could disturb Uranus from its orbit and produce the observed discrepancy. Using Newton's laws of dynamics and gravitation one could work out the location of such a planet.

Adams solved this problem in 1843-45 and informed two leading astronomers in England about the likely site in the sky for the hypothesised planet. Both Challis, director of the Cambridge observatory and Airy, director of the Royal Greenwich observatory, however did not take this information seriously and as a result no search for the new planet was made from their telescopes.

A little later, Le Verrier arrived at similar conclusions as Adams and tried to get directors of observatories in France to institute a search for the planet. He too fared no better. But then he asked the Berlin observatory and there an astronomer named Galle took Leverrier's ideas seriously. He looked for the planet and found it. This is how Neptune was discovered in 1846.

Le Verrier may have been lucky; for, it has since been known that when his request for a search arrived at the Berlin observatory, the director was away. In his absence Galle took the initiative. Who knows how the director would have reacted to such a suggestion from a young and inexperienced scientist?

The story has a moral for directors of observatories or for committees allocating times on telescopes even today.

Short Note

In 1911 Vyankatesh Bapuji Ketkar from this country published a short note in the Paris journal, *Societe Astronomique de France*, conjecturing that two new planets (whom he named Brahma and Vishnu) might exist beyond the orbit of Neptune. It is not known on what basis Ketkar made this prediction, but his estimate of the period of the inner of the two planets of about 242 years comes very close to the actual period of Pluto, of 248 years.

Earlier in 1909 William Pickering and later, in 1914, Percival Lowell from Arizona had also predicted the existence of a new planet from arguments similar to those of Adams and Le Verrier. He felt that there was a deviation in Neptune's orbit which must be due to the attraction of the new planet. Search for the planet in the sky was instituted by Tombaugh who found and confirmed it during 1929-30.

This new planet, Pluto, turned out, however, to have a very small mass: some 440 Plutos make one Earth. With such a low mass it couldn't have disturbed Neptune. And so Lowell's reasoning turned out to be wrong although it may have inspired the discovery.

Astronomers believe that planet formation is not a rare phenomenon and that when a star forms from condensation and contraction of a vast interstellar cloud it also is accompanied by a planetary system. If the cloud was initially spinning about an axis, it would bulge out in the shape of a disc in the equatorial zone. Out of this disc the planets may eventually form.

In 1983 the infra-red astronomy satellite (IRAS) found a new stars with such pro-planetary discs. The stars, like Beta Pictoris, are typically young, compared to our sun, and so it stands to reason that they have the discs which still have to produce the planets. The IRAS discovery therefore gave a boost to this hypothesis.

In 1991, however, came an announcement from the radio astronomers of Jodrell Bank, U.K., of a planet being found in an altogether different scenario. They found evidence that a planet was circling around a pulsar.

A pulsar is a very compact star, not more than 50 kms across (the sun's diameter is 1.4 million kms), which is believed to have formed from the debris of a gigantic stellar explosion. A typical pulsar emits radio pulses with a period of the order of a second or even less. The pulses, in radio waves are, however, extremely regular so much so that in their accuracy they surpass even the best atomic clocks.

This regularity enables the astronomer to monitor the movement of the pulsar. Using such a nature-given clock the Jodrell group thought that they detected a slight modulation in the pulses which could be explained by the assumption that a planet was circling the pulsar. If the planet were sufficiently massive, its gravitational force would cause the pulsar to wobble.

This announcement was greeted with great excitement as well as consternation. The latter, because here was a planet around a star which was the remnant of an enormous explosion. It could not have existed before the explosion.

Concept Stays

The result was, however, withdrawn the following year as it turned out to be based on an error of data interpretation. But the concept of a planet around a pulsar did not go away. In 1992 another example was reported by Aleksander Wolszczan of the Arecibo Observatory and this one seems to be real. Here the pulsar has at least two planets going round it with periods of nearly 67 and 98 earth days. So the theorists must grapple with that one.

Meanwhile the optical astronomers are also trying in their own ways. They of course can't see a planet around a distant star, as it would be too faint; but they can have indirect evidence for its existence. Imagine a Jupiter-like planet orbiting close to a sun-like star. As in the case of the pulsar, the planet would make the star wobble and that can be picked up from a detailed spectroscopy of the star. In this way in 1995 the 1.9 metre telescope at the Heute Provence observatory in France picked up a planet at least half as massive as Jupiter around a sun-like star named 51-Pegasi.

For the common man these searches may bring the hope that with planets found around ordinary stars, the possibility of locating habitats for extraterrestrial life and intelligence also becomes more focussed.