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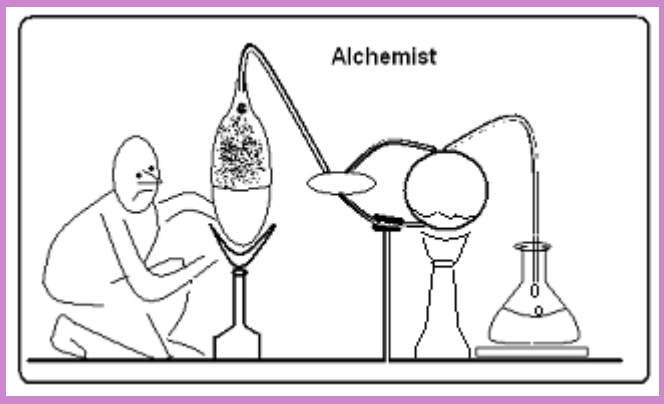
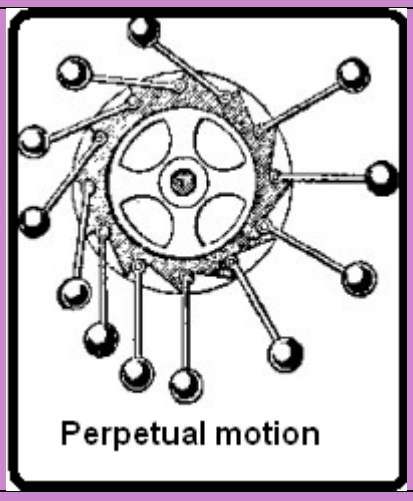
Another place like home

The quest for other ‘earths’ is covering ground, says S.Ananthanarayanan.

Mankind has pursued unusual projects in its day and many of them have led to progress. In the middle ages people sought the ‘***philosopher’s stone*** ‘, which would turn base metal to gold. The effort helped not a little to spur study of alchemy and lay the bases of modern chemistry. The quest for ‘***perpetual motion’*** led to development of the science of mechanics. Seeking a path to India ended in the discovery of America. Developing the ‘death ray’ led to radar and microwaves.





Earth-like planets

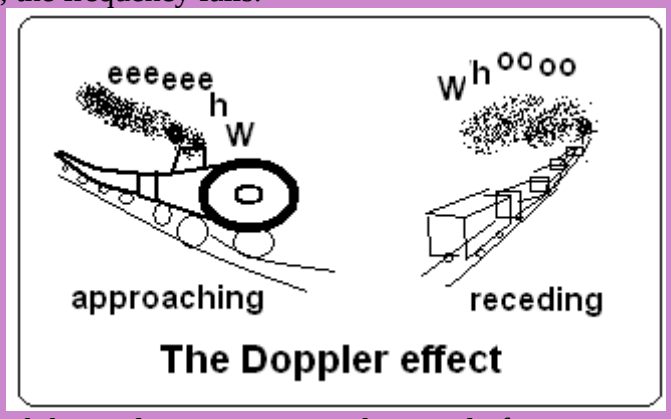
A section of those who study the heavens and the cosmos are now working on finding ***exoplanets***, or ‘earth like’ planets in orbit around distant stars. One clear reason to look for such planets is that we may need such a place to escape from our own earth. Another reason is to search for the possibility of life forms. Yet another reason is that earth-like planets may help us better understand geological processes in our own planet. And yet another reason is that we now dare make such a search because we have the tools and techniques to do so. These planets are all many light years away and we cannot imagine how we may reach them. But the search is sure to prove useful in some way

Michael Mayor, a leading exoplanet researcher, and his colleagues, working in the European Southern Observatory (ESO) at La Silla, Chile, in South America, report the discovery of a planet which is just twice the size of the earth, which is the closest of exoplanets discovered so far. They have also found that another planet in the same system may have surface temperatures such that oceans of water could exist.

Detecting exoplanets

The difficulty in detecting a planet like the earth outside the solar system is the distance and the fact that light from any mother star or sun of the planet would obscure the reflected light from the planet, even if the tiny image could be resolved. Our nearest neighbour star is ***Proxima Centauri***, which is 4.3 light years away. This comes to some 42 trillion km (or 42 followed by 12 zeroes). Viewing the earth-sun separation, which is 150 million km, from Proxima Centauri would be like sighting a pair of objects 3 mm apart from a distance of a kilometer. This is possible in principle but not when the smaller object is a thousand times smaller than the other, apart from the glare from the larger object being a sun. And then, the star systems of interest are many times further away from the earth than our nearest neighbour!

The method that is used to detect planet systems is hence an indirect method. When a planet moves in orbit around a star, the motion of the planet needs to be balanced by a proportionately smaller motion of the star. This slight motion, however, causes changes in the nature of light that the star emits and we do have instruments to detect these changes. Why the light emitted should change can be understood by considering the whistle of a speeding train. As the train comes towards us, the whistle sounds shrill, but as the train recedes, the pitch of the whistle falls to a lower pitch. The same thing happens to the light emitted from a luminous object. When the object is moving towards the observer, the frequency of the light is sharpened and when the object is moving away, the frequency falls.



In the case of stars which have planetary system, the speed of motion caused by the planets may quite small, just a few km/second, but the effect on the colour of light emitted can be made out by modern instruments. With the motion of the star being known, it becomes possible to make many estimates of the nature of the planet system surrounding the star.

Mayor's discovery

The objective of exoplanet researchers is to discover a planet that is rocky and earth-like and within the ***habitable zone***. The habitable zone is when it is possible for the planet to have water in liquid form. The nature and temperature of an exoplanet is deduced from how massive it appears to be and its distance from the mother star. All the many exoplanets discovered so far have been either gaseous and too massive and hence too far from the mother star or rocky and less massive, but too near the mother star for comfort. In fact, it is difficult to detect a small planet except very near the mother star and being close to a star at once places the planet outside the habitable zone.

It is in this context that the discovery at the ESO facility at Chile is significant. The mother star being studied is ***Gliese 581***, twenty light years away and in the constellation Libra (The Scales). The important thing is that Gliese 581 is ***red dwarf***, or a star that is in a cooler phase of its life cycle. Even planets that are relatively close to the mother star can then be in the habitable zone because the temperatures are lower.

Even then, the latest planet, Gliese 581 e, with 1.9 times the mass of the earth, is found to be too close to the mother star to be habitable. The other planets are planet b, with mass 16, planet c with mass 5 and planet d, with mass 7 times the mass of the earth. The planet d, which is the outermost planet is likely to consist only partly of rock and the latest observations indicate that its temperature is right for liquid water. “Gliese 581 d could even be covered by a large and deep ocean – it is the first serious ‘water world’ candidate,” says team member, Stephane Udry.