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SEVEN NEW WORLDS

Ken Tapping, 7th March, 2017

The main over-coffee discussion subject among astronomers for the last few days has been the discovery of a star system with at least seven more-or-less Earth-sized planets. Moreover, at least three of them are at the right distance from their star to have surface temperatures that would allow liquid water. Since this is an essential ingredient for life as we know it, we have a particular interest in worlds where there might be lakes, rivers and oceans. To have liquid water an atmosphere is needed too, and in an atmosphere we can have a water cycle, with clouds and rain. Most of the planets we have found have been gas giants like Jupiter and Saturn, because they are easier to detect. However the searches are now coming up with planets that are more Earth-like.

This particular star and planet system has been named TRAPPIST-1, after "The Transiting Planets and Planetesimals Small Telescope" in Chile. In 2016, researchers using TRAPPIST announced they had discovered three planets in that system. A number of telescopes, including the Spitzer Space Telescope confirmed two of the planets and then went on to discover another five, so we have a system with at least seven planets. Three may qualify as Earthlike; the others are more marginal. This system is only 40 light years away, which in cosmic terms is on our doorstep.

Every star has a so-called habitable zone; the range of distances from a star where liquid water might exist on the surface of a planet. Bright stars have broad habitable zones, located at a good distance. For dimmer stars the zone lies closer in and is narrower. Therefore, planets are less likely to lie in the habitable zones of dim stars. However, bright stars consume their fuel more rapidly and may end up burning out in too short a time for life to develop and evolve. Some really bright stars shine for only a few million years before blowing themselves up. The earliest signs of life yet found on Earth date from about a billion years after our world formed. Average yellow dwarf stars like the Sun will last maybe ten billion years. Red dwarf stars are very stingy with their fuel consumption, so although they are not very bright, they can keep shining for a very long time, tens of billions of years. Any planets in their habitable zones will have lots of time to develop life and have it evolve to advanced forms. The dwarf star in the TRAPPIST-1 system is exceptionally dim, so dim its rate of fuel consumption is low even by red dwarf standards. It glows dull red in the skies of its planets, which huddle closer to their star than does Mercury, the closest planet to our Sun.

Life as we know it can only thrive on planets with atmospheres. At this point we don't know whether any of those planets have them. It is early days yet and the search has only just begun. We can look for atmospheres by analyzing the starlight as the planets move in front of their star. If we detect signatures of molecules, such as carbon dioxide or methane in the light, we know those come from the atmospheres of the planets, because stars are too hot for such molecules to exist. Of course what we would really like to find are highly reactive gases like oxygen. These are so reactive that they vanish quickly from an atmosphere unless continuously topped up. The only process we know that produces large amounts of oxygen is photosynthesis, by plant life. There are other highly-reactive gases that could be part of life processes, such as chlorine. In a way it would be more intriguing to detect that, because then we would be considering lifeforms that are very definitely alien. However, oxygen is more common, and maybe more likely to be a basis for life.

Mars and Venus lie in the Southwest after sunset. Venus is very bright. Mars, redder and fainter, lies to its left. Jupiter rises around 10pm and Saturn in the early hours. The Moon will be Full on the 12th.

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