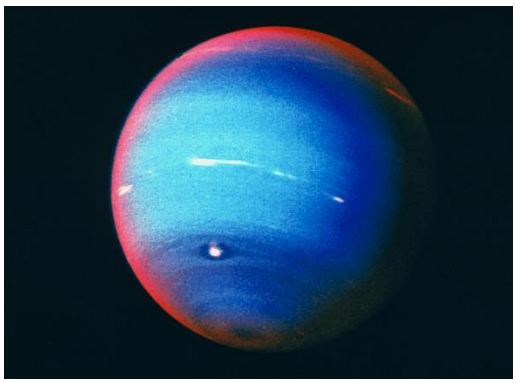
THE PLANET THAT NEVER WAS

==========

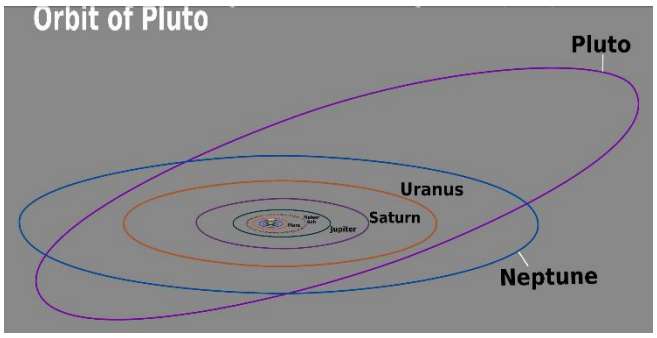
Ken Tapping, 3rd September, 2024

Our ancestors noticed that among the "fixed stars", which remained in unchanging patterns, there were five "wandering stars", or planets, visible to their unaided eyes, which they named Mercury, Venus, Mars, Jupiter and Saturn. Then, on 13 March 1781, William Herschel, using a telescope he had made himself to search the sky, discovered another planet beyond Saturn, Uranus. The next two planets were discovered using a completely different process, by observing their effects on the orbits of the known planets. Isaac Newton introduced the concept of gravity and developed the mathematics to use that concept.

When a single planet orbits around its star, the star pulls at the planet and the planet at the star. The result is the planet moves around the star in a circular or elliptical orbit. Newton had this all worked out. However, if there is more than one planet, things get a bit more complicated, because the planets all tug at each other too. These attractions are much weaker than the attraction between the planet and its star, but they can be enough to slightly perturb the planet's orbit, or even make it slowly change with time. This means that if we calculate the position in our sky at which a planet should be visible without including the perturbations due to the other planets, we could find the planet is not where predicted. Of course this is a powerful method for discovering new planets. We measure the error between the predicted and observed position of a planet, and then estimate the mass and location of the object causing those differences.

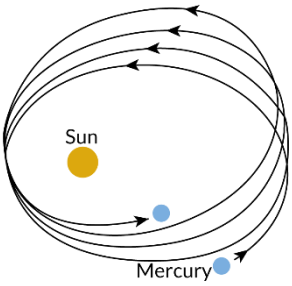


In 1845 astronomers John Couch Adams and Urbain Le Verrier independently looked at errors in the predicted positions of Uranus, and independently concluded these errors were evidence of an unknown planet. In 1846 that planet was discovered and was named Neptune. Then, errors in the predicted positions of Uranus and Neptune led to the prediction of yet another planet. This led to the discovery of Pluto in 1930 by Clyde Tombaugh.



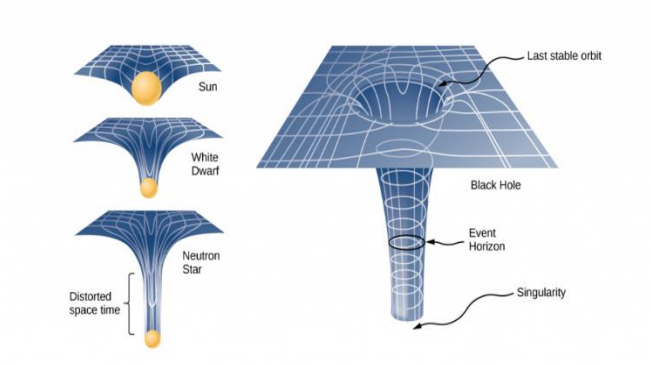
However, Pluto turned out to be too small to explain the perturbations of Uranus and Neptune's orbits, which led to unsuccessful searches for another planet in the cold, dark outer reaches of the Solar System. This search goes on.

The most fascinating search happened not in the outer reaches of the Solar System but close to the Sun. For years astronomers had been trying to explain the strange behaviour of Mercury, the closest known planet to the Sun. In 1859, after a careful examination of Mercury's orbit, Urbain Le Verrier proposed that the perturbations of Mercury's orbit were being produced by another planet, orbiting the Sun closer than Mercury. Le Verrier's prediction of the planet Neptune added a lot of weight to his analysis and the search was on. The new planet was even given a name, Vulcan.



Spotting Mercury in our skies is difficult. It orbits the Sun at about 39% of our distance from our star, in a mere 88 days, and for us spends its time bobbing in and out of the sunset and sunrise glow. A planet even closer to the Sun, and orbiting a lot faster, would be much more elusive. Despite many searches, nobody has found Vulcan, and we now believe the planet does not exist, and that those perturbations of Mercury's orbit have a more fascinating solution, provided by Albert Einstein.

Close to the Sun, our star's great mass distorts the fabric of space-time, and this distortion varies with distance. Mercury's orbit is quite elliptical, so its distance from the Sun varies, as does the distortion of space-time through which it is moving. A planet like Vulcan would be intriguing and bizarre, but seeing direct evidence of the stretching of space-time is even more so.



According to Einstein's theory of general relativity, massive objects cause a distortion in space-time, which is felt as gravity. This distortion is caused by mass warping the fabric of space and time, which Einstein lumped into a four-dimensional entity called space-time. Time passes more slowly close to a massive object than it does in a mass-less vacuum, which is called time distortion. This distortion curves light around stars.

Look for Mercury low in the dawn glow. Around midnight, Saturn lies low in the south, and Jupiter and Mars close together in the northeast. The Moon will reach First Quarter on the 10th.

Ken Tapping is an astronomer with the National Research Council's Dominion Radio Astrophysical Observatory, Penticton, BC, V2A 6J9.