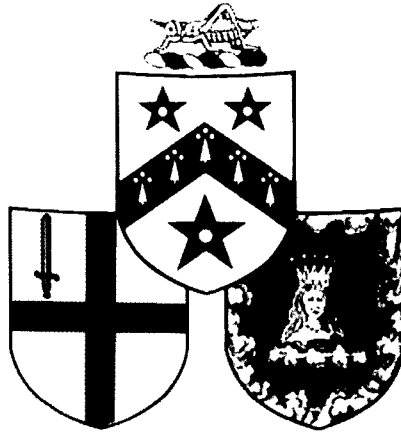


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THE SOLAR SYSTEM:  
OUR LOCAL NEIGHBOURHOOD IN SPACE

Lecture 4

THE SEARCH FOR PLANET X

by

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4 February 1994

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THE SEARCH FOR PLANET X  
Lecture given by Professor Heather Couper at Gresham College  
on February 4 1994

Throughout most of history, people were familiar with a Solar System comprising the Earth and five other planets. Shining by reflected sunlight as bright, slow-moving points in the sky, these five worlds had been known since antiquity - as their names attest. Mercury, Venus, Mars, Jupiter and Saturn were all named after important deities, each being given a name appropriate to a particular planet's appearance and behaviour. The fast-moving and elusive innermost planet was named Mercury, after the gods' fleet-footed messenger. Blood-red Mars took on the name of the god of war. Regal Jupiter took its name from the king of the gods.

In 1781, William Herschel - a professional musician and amateur astronomer - became the first man in history to discover a new planet. As a result, the scale of the Solar System doubled at a stroke, and the cosy familiarity all changed. No-one could be certain any more just where our Solar System's outer boundaries might lie.

Herschel had not been looking for a new world when he stumbled over what would later be called Uranus. He was using one of his excellent home-made telescopes to make a thorough survey of the sky, in an attempt to discover just how the stars were distributed through space. When he first saw a greenish disc that crept slowly against the background of stars, he thought he had discovered a comet. But friends calculated the orbit and pointed out that it could only be a planet lying way beyond the orbit of Saturn.

King George III, a man with immense enthusiasm for science, was delighted with Herschel's discovery. In his eagerness to please the King further, Herschel proposed calling the planet George - but fortunately, classical traditions prevailed! It was named Uranus, after Saturn's father.

Herschel himself discovered two moons circling his new planet. We now know that they are among 15 in orbit about Uranus, which also has a set of eleven very faint rings. The planet itself - a gas-giant about four times wider than the Earth - is disappointingly bland and featureless, even seen in closeup from the Voyager 2 spaceprobe. It has none of the storm activity of Jupiter, or the high winds of Saturn. But it does boast a very strange axial tilt, with its axis of rotation tipped up at  $98^\circ$  to the vertical. As a result, it effectively rolls around the Sun on its side.

A couple of generations on from Herschel's discovery of Uranus, astronomers started having suspicions that it might not be the outermost world of the Solar System. The problem was that Uranus, in its 84-year trek around the Sun, was not moving quite as it should. It seemed as if it was being "pulled out of position" by the gravity of another planet lying beyond.

John Couch Adams - a young Cambridge mathematics student - set himself the task of calculating where the mystery planet might lie. He communicated his position to the then Astronomer Royal, George Airy - but for one reason or another, Airy was just not interested. At the same time, the French mathematician Urbain Leverrier communicated his calculated position to Johann Galle at the Berlin Observatory, who was able to locate the new world immediately, on 23 September 1846. (Fortunately, time heals; and today both Adams and Leverrier are jointly credited with the discovery).

The blue-green planet was named Neptune, after the god of the sea. No-one at the time could have imagined what an appropriate name it would be, because Neptune turns out to be made almost entirely of water. Very slightly smaller than Uranus, Neptune is also a much more exciting place. When Voyager 2 visited in 1989, it found a world with fleecy-white cirrus clouds floating in the blue atmosphere. But, as Voyager found, Neptune is also home to the highest winds in the Solar System, plus some spectacular storms - one as big as the whole Earth. Like all the gas-giant planets, it is encircled by rings (four in Neptune's case) and a large family of moons (eight). One of these - Triton - has active volcanoes that spew out nitrogen gas and black dust, despite the fact that it is the coldest object in the Solar System.

By the end of the nineteenth century, astronomers were watching Neptune like a hawk in order to see if it strayed from its path. And sure enough, it seemed to be gradually drifting off-course. The hunt was on again for a planet beyond.

No-one took the search more seriously than Percival Lowell. He has already cropped up in this series of lectures as the rich Boston businessman who built an observatory under the clear skies of Arizona, especially to observe the "Martian canals". He was also obsessed with the search for the planet beyond Neptune, but he died in 1916 without ever finding it.

A few years later, Lowell's nephew bought the observatory, and reopened it in the hope of finding "Uncle Percy's planet". Clyde Tombaugh, a 23-year-old amateur astronomer from Kansas, was hired to make the search. He was trained to take photographs with a specially-bought new telescope, and the next day, to compare photographs of the same region taken on different nights. To make life easier in searching thousands of tiny images for one that had moved, Tombaugh used a 'blink comparator' - a device that optically superimposed the plates in rapid succession, so that any moving object would "blink" on and off.

After several months of searching Lowell's favoured positions without success, Tombaugh widened his net to the whole of the zodiac - the band of constellations against which the planets appear to move. And on February 18 1930, when comparing plates that had been taken on January 23 and 29, he saw it. From the tiny extent of the "jump", he knew he had found Lowell's planet.

At the suggestion of an 11-year-old Oxford schoolgirl, Venetia Burney, the planet was called Pluto. This made nearly everyone happy. For classicists, Pluto was the god of the underworld; and for the Percival Lowell admirers, the first two letters of the new planet's name were Lowell's initials. But Tombaugh was not happy. The planet he had found was much fainter than he had expected; surely it was too small and distant to have any effect on Neptune? So for the next 13 years, Tombaugh continued to search - without success - for a larger world.

The clinching evidence that Pluto could not be having any effect on Neptune came in 1978. This was when Jim Christy of the US Naval Observatory noticed that Pluto looked rather elongated on some old images they had in their archive. Was the telescope at fault? The camera? Or was there another explanation? There was. The elongation was caused by the presence of a moon so close to Pluto that the two looked like one body.

Christy, perhaps unfamiliar with the classical tradition of naming astronomical objects, wanted to name his new discovery after his wife, Charlene (whom he calls "Char", pronounced "Shar"). Fortunately, an ideal compromise was reached. The moon was named Charon, after the boatman who rows the souls across the River Styx to the Underworld - but in respect for Jim Christy's wishes, most astronomers pronounce it "Sharon"!

Astronomers now investigated the way Pluto and Charon moved around each other. From this, they could find out just how heavy each body was. Pluto weighed in at less than one-fivehundredth the mass of the Earth. It is by far and away the least substantial planet in our Solar System - even Mercury is thirty times heavier. There is no way that it could have any gravitational effect whatsoever on Neptune.

When astronomers finally concluded that Pluto could not be Lowell's mystery planet, they turned their attention even further afield. For instance, Jim Christy's boss Bob Harrington commenced a detailed photographic survey of the sky using much larger telescopes than Tombaugh ever had access to. He even has a pet name for his planet, should he ever find it - Humphrey - although it's hard to see how you'd "classicise" that!

There are other ways in which "Planet X" may reveal itself. There is a very small chance that it might turn up on an as-yet unanalysed datatape from the IRAS satellite. IRAS, a British-Dutch-American spacecraft, was launched in 1983 to look at "lukewarm" objects in space - those that emit a little heat, but hardly any light. Young stars, comets, dust clouds and Planet X all come into this category - but there has been no sign of any planets in the data analysed so far.

Planet X may even be winkled out by our robot explorers. We have now sent four spaceprobes into the distant reaches of the outer Solar System: Pioneers 10 and 11, and Voyagers 1 and 2. They are now well beyond all the nine planets, but are still being tracked as they speed through space. Should any of them feel the gravity of a distant world

lurking at the boundaries of our Solar System, they will respond by drifting slightly off-course.

But can we be so sure that Planet X really exists? After all, the entire reason for supposing it was there in the first place was the fact that Neptune - in the late nineteenth century - appeared to straying from its path. But was it? Since Voyager 2 visited Neptune, we have been able to get much more refined measurements of its orbit. The measurements of the late nineteenth century just do not fit with these. Could someone have made a genuine mistake? Whatever the answer, there now appears to be no "phantom pull" we need to account for.

So, unless it is very small - or very distant - Planet X is unlikely to exist. But the region beyond Pluto can hardly be said to be devoid of interest. In the last few years, astronomers using the giant telescopes on Mauna Kea in Hawaii have discovered over half a dozen small bodies living well beyond Pluto. Pluto itself may be related to them: the largest in a new, distant asteroid belt entirely made of "ice dwarfs".

Looking at the very frontiers of our Solar System is difficult from our cosy position so close-in to the Sun. But things may soon change. Of all the planets in our Solar System, Pluto is unique in never having been visited by a spaceprobe. With a new breed of "faster, better, cheaper" probes being designed by NASA, it will not be long - perhaps less than 10 years - before a spacecraft is despatched to this tiny, frozen world. It will be time for Pluto to come in from the cold.

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