

## Verrier, Urbain-Jean-Joseph Le

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*Born* Saint-Lô, Manche, France, 11 March 1811

*Died* Paris, France, 23 September 1877

Urbain-Jean-Joseph le Verrier explained the unruly behavior of Uranus by positing the existence of an unknown planet, which was subsequently discovered and named Neptune. His father, Louis-Baptiste le Verrier, a civil servant, and mother, Pauline de Baudre, came from the lower Norman aristocracy. Their only son received his *lycée* education in Cherbourg, and failed the entrance examination to the *École Polytechnique* on his first try but was admitted in 1831. In 1837, he married Lucille Marie Clothilde Choquet, the daughter of his former teacher. They had three children: Léon, Lucille, and Urbain.

In 1837, le Verrier was offered a position in geodesy and machines as an assistant to **Félix Savary** at the *École Polytechnique*. After Savary's death a few years later, le Verrier succeeded him to the chair in astronomy. He devoted his attention to celestial mechanics to reclaim the heritage of **Pierre de Laplace**. His first memoir presented to the Paris Academy of Sciences addressed Laplace's solution to the stability of the Solar System. Later, le Verrier laid the groundwork for a new theory of Mercury's orbit and successfully tackled the theory of several recently discovered periodic comets, on the basis of which he was successful in his bid for a seat at the academy on 19 January 1846.

Two months earlier, le Verrier had published his first memoir on Uranus's orbital irregularities, a work he had undertaken with encouragement by **François Arago**. By revising calculations by **Alexis Bouvard** concerning the perturbations on Uranus's orbit by Jupiter and Saturn, le Verrier lowered the value of the observed anomaly. In his second memoir, read on 1 June 1846, le Verrier boldly asserted the impossibility of explaining the remaining anomaly in terms of gravitation forces exerted by the Sun and the known planets. Without questioning **Isaac Newton's** universal law of gravitation, le Verrier concluded that a hypothetical planet could account for observed irregularities and determined a position based on an orbit in the ecliptic plane and Bode's Law that suggested a radius twice that of Uranus.

In his third memoir, read on 31 August 1846, le Verrier gave more precise limits within which one should look for the new planet and even predicted its apparent size. His letter to Berlin astronomer **Johann Galle** directly led to Galle's discovery of Neptune on 23 September 1846. Even in the controversy surrounding a similar prediction by **John Adams**, le Verrier's sudden fame was not lessened by priority claims about this striking triumph of mathematical physics.

As early as 1847, le Verrier drafted a plan for the future of astronomy that would keep him busy for the rest of his life. Aside from a minor project to reduce the positions of many fundamental stars and correct values given by **Friedrich Bessel**, le Verrier planned to track down every discrepancy between theoretical tables and actual observations of the planets. To determine the motion of planets, he would compute the 469 terms of the perturbation function. For each discrepancy with observation, le Verrier would try to modify the mass of the perturbing planets, or else look for other causes of perturbation. His study of the motions of the Sun and the inner planets led to him to conclude that the secular motion of Mercury's perihelia had to be augmented by 38 s, and revisions of the accepted value for the solar parallax (raised by 1/30th), of the mass of Mars (lowered by 1/10th), and of the Earth's mass (raised in the same proportion).

Mercury's secular anomaly remained as the only significant unexplained discrepancy. In 1859, le Verrier doubted that a planet orbiting closer to the Sun would account for the anomaly, arguing that that it would already have been observed. Considerable excitement was aroused by **Edmond Lescarbault's** alleged observation of a planet transit over the surface of the Sun at the end of 1859. Le Verrier endorsed his observations and led a French party to Spain to observe the total solar eclipse on 18 July 1860 in the vain hope of seeing Lescarbault's planet. Le Verrier had nonetheless firmly established the existence of Mercury's secular anomaly, which would be explained by **Albert Einstein's** theory of general relativity. For this work, he was awarded the Gold Medal of the Royal Astronomical Society in 1868. In 1876, he received it again after having formulated theories on Jupiter, Saturn, Uranus, and Neptune.

In 1854, le Verrier was placed in charge of the Paris Observatory, replacing Arago. At the same time, the imperial regime restructured French astronomical institutions, making the observatory independent from the Bureau des Longitudes and granting its director greater authority. Le Verrier pursued Arago's effort to equip the observatory with the latest precision technology, reorganized work, and established stricter observation routines, emphasizing the reduction and regular publication of observations and encouraging the discovery of new asteroids. Feeling that the Paris environment was a hindrance to some delicate instruments, such as **Jean Foucault's** great telescope, he reorganized the Marseille Observatory in 1862 as a branch of the

Paris Observatory. Le Verrier trained a younger generation of astronomers and meteorologists such as **Jean Chacornac**, **Camille Flammarion**, **Emmanuel Liais**, Édouard Edme Marié-Davy, **Georges Rayet**, **Édouard Stéphan**, and **Charles Wolf**. He endeavored to make the observatory a useful auxiliary to the modern industrial state. Le Verrier organized a meteorological service using telegraphy to gather observations from the whole country and foreign observatories and dispatch daily forecasts. Through the telegraph, he synchronized public clocks in Paris in the 1870s. In 1864, Le Verrier founded the *Association française* to sponsor scientific research and diffuse its discoveries into civil society.

Le Verrier's heavy-handed control over astronomy in France was strongly resisted. In 1854, Arago's former assistants were pushed out, and the Academy of Science and the Bureau des Longitudes were used as strongholds for independent astronomical research. Throughout the 1860s, le Verrier engaged in epic fights at the Academy, in particular with **Charles Delaunay**, whose lunar theory he vigorously attacked. Le Verrier's personnel also resented his autocratic leaning. After Liais and Flammarion were forced out, they fought a public vendetta against le Verrier. By the beginning of 1870, the atmosphere inside the observatory had soured to such a degree that all 14 astronomers working there resigned *en bloc*, and brought on le Verrier's dismissal. After his successor Delaunay's untimely death in 1872, he was called again to the observatory directorship, where his somewhat smoother second term ended with long illness and death on the 41st anniversary of Neptune's discovery.

Le Verrier was nominated to the Bureau des Longitudes, while a chair in celestial mechanics was created for him at the Sorbonne (the University of Paris). After the reestablishment of the Republic in 1848, le Verrier was elected to Parliament, to take care of educational reforms and questions related to telegraphy and railways. In 1852, Emperor Napoléon III called him to the Senate.

David Aubin

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### Keywords

AQ1

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