

## The Discovery of Neptune as a case against Strong Popperian Falsificationism.

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**Abstract:** Popper's position that a theory is refuted when one of its conclusions is refuted, is called Strong Popperian Falsificationism. Strictly speaking the refutation of a conclusion means the refutation of the union of the theory and the auxiliary prepositions used to reach the conclusion. Thus, Strong Popperian Falsificationism assumes that these auxiliary hypotheses are beyond doubt. Our study of the original papers of Airy, Adams, Challis and Le Verrier, as well as modern recalculations of the models, show that this is not the case in the the circumstances surrounding Neptune's discovery.

Adams and Le Verrier assumed the validity of Titus-Bode law for their calculations; had to resort in increasing eccentricity for the orbit of Neptune to counteract the large distances the law predicted; assumed that the planet was near its perihelion at the time of the discovery, when it was almost 90° away; supposed a maximum on the perturbation of Uranus by Neptune, while the perturbation had reached a minimum over this period. Adams revised his calculation many times during his research, not being confident with his results; he also noted that a further reduction of the semi-major axis would probably yield better results, even if his model proved not to be sensitive to it. Le Verrier's calculation had an even lesser semi-major axis, but a further reduction would not give so good results without altering other parameters. The calculations of Neptune's position are in good agreement with reality from 1810 to 1850, but not before or after. No one believed that the planet's position would be predicted with the accuracy it was. It was also brighter than suggested, Le Verrier even giving a reasonable estimate for its diameter. Still the astronomers had difficulty recognising the disk. The coordinates of the discovery were just within the new maps of the Berlin Observatory. If the position of Neptune was 1° or 2° away it would not be covered by the map and Challis' search would have been the only way to get results. Earlier, La Lande had observed the planet and catalogued it as a star.

Airy seems to be the only scientist involved in the discovery that has thoughts of a possible modification of Newtonian gravity to explain the irregular movement of Uranus. But nowhere in his memoire is there a statement that the discovery of Neptune is a test, let alone a critical one, of the law of gravitation. It was apparent shortly after the discovery that luck played its part in the easy discovery of Neptune. The whole process is extremely error prone, in both the calculations and the observations, so if the planet were not discovered in the circumstances of 1846, this would not be a refutation of Newtonian gravity, but simply a refutation of the auxiliary prepositions.

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