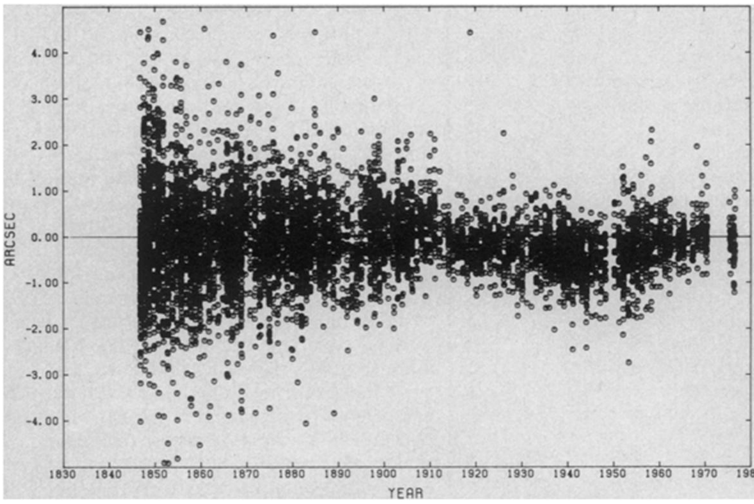
What's Bothering Neptune?

The possibility that there may be a massive planet beyond the orbit of Neptune has been discussed by astronomers since the very year of Neptune's discovery, 1846. Neptune itself, in fact, was found from a prediction calculated on the basis of observed irregularities in the position of Uranus, the next planet in. Similar irregularities have been reported in Neptune's position, to such an extent that no regular orbit has been derived for Neptune that fits all the observations, and the planet Pluto was discovered in 1930 during a search for an object that could account for the reported Neptunian as well as Uranian perturbations. As has become increasingly clear in recent years, however, the mass of Pluto is far too low — perhaps by a factor of hundreds — to produce the cited effect.



Variations over time in Neptune's observed declination from USNO ephemeris are in part due to systematic errors and other uncertainties, but may also indicate some perturbing influence.

The latest attempt to explain Neptune's seemingly perturbed orbital motion is being conducted by a group of astronomers at the U.S. Naval Observatory's Nautical Almanac Office in Washington, analyzing the 6,000-odd observations on record to see if they indeed indicate the presence of some yet-unknown influence.

Such an influence, the researchers emphasize, need not necessarily be a planet. In the nineteenth century, astronomers spent years searching for a planet inside the orbit of Mercury in hopes of explaining why the longitudes of Mercury's successive orbital close approaches to the sun got ahead of their calculated positions by a cumulative total of 43 arc-seconds per century. The answer turned out to be not a planet at all but an effect explained by relativity theory, which was simply unknown at the time.

Still, the Naval Observatory group feels, if one assumes that Neptune's "perturber" is indeed a planet, it is possible to draw some tentative preliminary conclusions about it. According to Robert S. Harrington and Thomas C. Van Flandern of USNO, a planet with two to five times the mass of the earth could produce the observed irregularities if it is currently at a distance of 50 to 100 astronomical units from the sun. (Earth's mean solar distance is 1 A.U.; Neptune's is about 30.) The object's orbit could also be significantly inclined from the plane of the ecliptic.

One potential aid to the researchers could be the recent discovery that the pioneering astronomer Galileo may have unwittingly observed Neptune in 1612 and 1613, more than 230 years before its discovery (SN: 10/11/80, p. 231). The evidence is Galileo's own notes, in which he recorded the presence of an object where modern star catalogs indicate that there would have been no star bright enough for him to have seen it; he also noted that on two observing nights, the object was in different positions relative to a now-established "fixed" star, presumably indicating the object's unstarlike motion. Neptune would have been near the line of sight to Jupiter (the target of Galileo's observations) on those nights, and the astronomer's sketch of the two planets seems to indicate a 1-arc-minute difference from Neptune's calculated position on that night. The precision of his drawing is not known, although, notes Van Flandern, Jupiter's apparent diameter would also have been about an arc-minute, and Galileo's representation of Neptune's position seems to differ from the calculated one by about the diameter of Jupiter's disk in the sketch.

If the sketch is trustworthy — one of many assumptions involved in the painstaking quest — it more than doubles the timespan over which Neptune's positions have been recorded. Furthermore, it expresses the position of Neptune with reference primarily to Jupiter rather than to the surrounding stars, whose imprecisely determined locations in nineteenth-century star catalogs pose problems in analyzing about half of the post-discovery Neptune observations. To be on the safe side, the Naval Observatory group is carrying out its analysis both with and without the Galileo sightings.

Two star-referenced Neptune observations by Lalande in 1795 also show positional discrepancies, says Van Flandern, who gives them credibility because the indicated reference stars are shown with positional "errors" only 20 to 25 percent as large as Neptune's. Other astronomical observations from the seventeenth and early eighteenth centuries, meanwhile, are also being combed to see if they too included the yet-undiscovered Neptune. Much of the analysis, however, involves simply "cleaning up" the early post-discovery sightings, correcting for star-catalog uncertainties and systematic errors. The search — whether it turns out to have been for an unknown planet or some heretofore unconsidered influence — is not easy. □

A specter haunting physics

Fractional electric charge is the spook that simply will not go away. It is now almost four years since William Fairbank of Stanford University announced to a packed room at an American Physical Society meeting that he and his associates, Arthur F. Hebard, George S. LaRue and, more recently, James D. Phillips, were finding evidence that electric charge exists in fractions of about one-third of the charge of the electron (SN: 4/30/77, p. 276). It had been an accepted fact of twentieth century physics that electric charge comes only at integral multiples of that quantum, the charge of the electron, which is the minimum amount of charge any object was supposed to be able to have. Fairbank announced to the most recent meeting of the American Physical Society, held in New York this week, that the evidence for fractional charge continues to mount. He and his associates are now convinced that fractional electric charge exists, and they are publishing a statement to that effect in a paper recently submitted to THE PHYSICAL REVIEW.

The experiment measures the charge on little balls of superconducting niobium. The advantage of having them superconducting is that they can be levitated in a magnetic field to counteract gravity. They are thus loaded between two large flat