Did Galileo see Neptune?

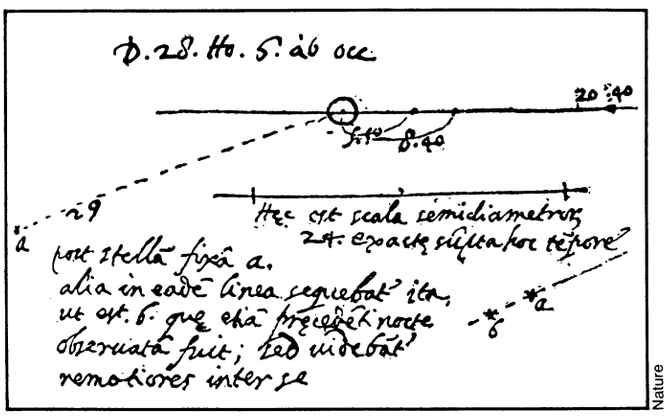
The planet Neptune was officially discovered in 1846, so far from the sun that it increased the diameter of the known solar system (previously defined by the orbit of Uranus) by more than a third. Yet two researchers have now concluded that Neptune was in fact observed by the pioneering astronomer Galileo — nearly a quarter of a millennium before.

In the still-dark morning of Dec. 28, 1612, Galileo trained his telescope on Jupiter, studying the motions of the giant planet's four major moons, which he had discovered about three years earlier. According to his careful notes, he also saw (and sketched the relative position of) a "fixed star" near the direction of Jupiter. But Charles T. Kowal of Palomar Observatory and Stillman Drake of the University of Toronto report in the Sept. 25 NATURE that backtracking from the prints of the Palomar Sky Survey shows no star in the vicinity at the time that would have been bright enough for Galileo to see. Neptune, on the other hand, would have been not only bright enough (it is never fainter than magnitude 8, the authors say, and Galileo with his early telescope could see down to 9), but in almost exactly the same direction from Jupiter as the supposed star. (Five nights later, he again observed a star in the vicinity, but this one, according to Kowal and Drake, clearly fits the position of a known bright star, SAO 119234.)

The following month, Galileo apparently observed Neptune again, and this time even noted what might have been interpreted as signs of the object's nonstarlike motion. In his notes for Jan. 28, 1613, he sketched two objects — identified as "star *a*" and "star *b*" — on the same line from Jupiter. Star *a* seems to be an actual star (SAO 119234 again), while star *b* is apparently Neptune. The night before, he had shown only a single object — apparently the real star — but he must have seen more than he drew. A notation from his Jan. 28 sketch, translated from the Latin, reads: "Beyond fixed star *a*, another followed in the same straight line. This is *b*, which was also observed on the preceding night, but they [then] seemed farther apart from one another." Galileo, then, had evidence before him that his so-called star *b* had moved considerably more than would a true star. Unfortunately, Kowal and Drake point out, "without an adequate telescope mounting it would have been impossible for him to follow up this observation after Jupiter had moved on, even if he had thought of doing so."

But Galileo's unwitting accomplishment may have more than just historical value. Neptune takes nearly 165 years to circle the sun, so it has not been around even once since its discovery, and its exact path is only imprecisely known. Galileo's Jan. 28 drawing, apparently to scale (he even drew a line marked to represent 24 times the radius of Jupiter — the first time, says Kowal, he had ever included such a calibration), shows Neptune about one arcminute closer to Jupiter than a Jet Propulsion Laboratory ephemeris (table of positions) says it should have been. But existing Neptune ephemerides are considerably less than perfect. The JPL ephemeris, derived only from twentieth-century observations, accurately describes the planet's positions during the twentieth century, but Thomas Van Flandern of the U.S. Naval Observatory says it diverges from the observations when extrapolated back through nineteenth-century sightings to the 1846 discovery date. There is also another "pre-discovery observation" besides Galileo's (Lalande, 1795), and backtracking from the JPL ephemeris misses it by 18 seconds of arc. Van Flandern also admits, however, that a Naval Observatory ephemeris derived from all the observations since 1846 is only a "forced-fit" approximation.

Why should Neptune pose such a problem? Perhaps, Kowal and Drake suggest, there is "an unknown perturbation" affecting its orbital motion — a candidate for which, Kowal points out, could be a yet-undiscovered planet whose mass redirects Neptune slightly as it comes by. It would take more observations to be sure, but Galileo's early sightings could help with ephemerides by nearly tripling the span of time over which Neptune has been observed. □



Galileo's notes on his Jan. 28, 1613, observation of Jupiter and two of its major moons, also showing a nearby star (a) *and what may have been Neptune* (b), *234 years before its discovery. Note says that* a *and* b *may have changed relative position since the night before.*

Hepatitis vaccine found

Researchers from the New York Blood Center claim near-total success with a new vaccine against hepatitis B (serum hepatitis), the most common form of viral hepatitis.

Estimates for hepatitis B, which carries a one to two percent mortality rate, range from 80,000 to 150,000 cases each year in the United States. Another 800,000 persons, including some health care professionals, are carriers and are at high risk of developing liver problems.

The vaccine was administered via three intramuscular injections to 549 homosexual men. Another 534 received placebos. These men were used because they are about ten times as likely as the general population to become infected with hepatitis B. The virus is transmitted through contact with infected blood, saliva, semen or dirty needles. It can also enter through tiny cuts.

After six months, 96 percent of the men who had received the vaccine showed antibodies against the virus. Depending on how infection was measured, from 18 percent to 35 percent of the unvaccinated group and only 1.4 percent to 3.5 percent of the vaccinated group were infected during the 18-month study, according to the Oct. 9 NEW ENGLAND JOURNAL OF MEDICINE.

The vaccine, manufactured by Merck, Sharpe, and Dome, is now being tested on health care professionals in Boston, New York and other cities, and on 1,800 kidney dialysis patients and workers in 40 centers. □

Test-tube baby failures

Since the United States' first test-tube baby clinic opened last January at the Eastern Virginia Medical School in Norfolk, its staff has fertilized eight human eggs in laboratory dishes and placed the eggs in women's wombs. None of the eight embryos developed into a fetus, clinic chief Howard Jones reported at a recent meeting of the American College of Obstetricians and Gynecologists.

Jones contends, however, that he and his team are "on the right track" in duplicating the successes of British and Australian physicians in getting *in vitro* fertilized human eggs to implant in the womb, develop into fetuses and survive to term. Since Patrick Steptoe, a gynecologist with Oldham General Hospital in Oldham, England, and Robert Edwards, a Cambridge University physiologist, first succeeded at human test-tube procreation (SN: 7/22/78, p. 51), they have achieved a total of four pregnancies and two births from 32 embryo transfers. Similarly, a medical team at the Royal Women's Hospital in Melbourne, Australia has had two pregnancies and one birth from 14 transfers. □