Prediction of the Planet—*Continued*

more in the weapon than in the uncertain bases on which it rests. But to learn of the general solution and the limitations of a problem is really as instructive and important as if it permitted specifically of exact prediction.

For that, too, means advance.

Summary

69. This investigation establishes the following:

1. By the most rigorous method, that of least squares throughout, taking the perturbative action through the first powers of the excentricities, the outstanding squares of the residuals from 1750 to 1903 have been reduced 71% by the admission of an outside perturbing body.

2. The inclusion of further terms yielded solutions in accordance with the first.

3. Solutions taking the years 1690-1715 also into account agreed substantially with those from the years 1750-1903.

4. So did those in which the additional years to 1910 were considered.

5. The second part of the investigation, in which the solutions were made for the second powers of the excentricities as well, gave conformable results.

6. When the probable errors of observation were reckoned, the outstanding squares of the residuals of theory excluding an outside planet proved to have been reduced by its admission from 90% to 100% nearly, the solutions seeming to confirm one another. . . .

7. Though this would indicate an absolute solution of the problem, it must be remembered that the actual as against the probable errors of observation might decidedly alter the result; and so might the terms above the squares in e and e' necessarily left out of account.

8. The investigation disclosed two possible solutions in each case, one with the mean longtitude of the epoch around 0°, one with it around 180°; and that this duality of possible place would necessarily always be the case.

9. On the whole, the best solutions for the two gave: mean longitude of epoch around 0°: epoch 22°.1; semi-axis 43.0; mass 1.00; excentricity .202; place of perihelion 203°.8 heliocentric longitude July 0, 1914—84°.0: mean longitude of epoch around 180°: epoch 205°.0; semi-axis 44.7; mass 1.14; excentricity .195; place of perihelion 19°.6; heliocentric longitude July 0, 1914—262°.8: the unit of mass being 1/50,000 the mass of the *Sun*.

10. It indicates for the unknown a mass between *Neptune's* and the *Earth's;* a visibility of the 12-13 magnitude according to albedo; and a disk of more than 1″ in diameter.

11. From the analogy of the other members of the solar family, in which excentricity and inclination are usually correlated, the inclination of its orbit to the plane of the ecliptic should be about 10° This renders it more difficult to find.

12. Investigations on the perturbation in latitude yielded no trustworthy results. This is probably because the excentricity as well as the planet's other elements enter as data into the latitude observation equations.

13. The perturbative function is not discontinuous at the commensurability of period points, a fact hitherto in doubt.

14. That when an unknown is so far removed relatively from the planet it perturbs, precise prediction of its place does not seem to be possible. A general direction alone is predictable.

Science News-Letter, March 22, 1930

New Comet

BEYER'S comet, discovered on March 11 by an astronomer at the Hamburg Observatory in Germany, has been observed by Prof. George Van Biesbroeck, at the Yerkes Observatory, Williams Bay, Wis. This announcement was made by the Harvard College Observatory.

Prof. Van Biesbroeck observed it on the night of March 13. Then it was in the constellation of Auriga, the charioteer, now high in the southwestern evening sky. Astronomically, its position was 6 hours 5 minutes 10 seconds right ascension and 33 degrees 25 minutes and 14 seconds north declination. It is still moving northwards, and is of the tenth magnitude, visible only in a medium-sized telescope.

According to word received at the Harvard Observatory from Europe, it has been found that photographs of this part of the sky made by Prof. Prager at the University of Berlin's Observatory also showed the comet, though it was not recognized until Dr. Beyer's discovery. These early positions, however, will greatly aid in calculating the comet's path. Three separate observations are required to compute an orbit, and the farther apart they are, the more accurate is the result.

Astronomy
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