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(b. Contamines, Haut Faucigny, France, 27 June 1767; d. Paris, France, 7 June 1843)

*astronomy.*

Alexis Bouvard is known chiefly for his *Tables astronomiques* of Jupiter, Saturn, and Uranus (1821). His aim in drawing up the tables was to provide a basis for reliable predictions of future locations of the three planets: unexpectedly, his Uranus tables agitated astronomers for two decades. Those of Jupiter and Saturn were revisions of tables that he had published in 1808 and that had proved satisfactory. Since the discovery of Uranus in 1781 many accurate observations had been made, notably the fine series at the Paris and Greenwich observatories. Uranus, however, has a very long orbital period of eighty-four years. Eleven prediscovery sightings of the planet as a star (including three by Lemonnier) had been traced, scattered over the previous ninety years, but Bouvard needed more prediscovery observations in order to compute a satisfactory orbit. He therefore searched through fifteen folio volumes of Pierre Lemonnier's observations made between 1736 and 1780. Although they were in great disorder and badly written, and many were inaccurately timed, Bouvard found nine more observations of Uranus, besides the three Lemonnier had himself traced, giving a total of twenty prediscovery observations. Using Laplace's formulas for perturbations, Bouvard formed seventy-seven equations of condition, but he was dismayed that no orbit would fit both prediscovery and post-discovery observations. He therefore calculated his Uranus tables from the postdiscovery observations alone, rejecting the others.

Within a few years Bouvard's Uranus tables failed, the planet lagging farther and farther behind the tabular predictions. Earlier than most astronomers, he became convinced that the cause was an unknown perturbing body. Until he died, he held to this belief, which was confirmed three years after his death by the discovery of the planet Neptune. Then it became possible to reconcile prediscovery and postdiscovery observations, and also to show that Neptune had accelerated the motion of Uranus for several years before 1821, thereafter retarding its motion. The very failure of Bouvard's tables was what induced J. C. Adams and U. J. J. Leverrier to solve the problem of Uranus' motion, and thus hastened the discovery of Neptune, probably by several decades.

Bouvard's rise to eminence in mathematical astronomy was dramatic. He arrived in Paris in 1785, an Alpine peasant youth unable to afford school fees. He attended free lectures and soon showed a flair for mathematics. In 1793 he became a pupil at the Paris Observatory and an astronomer there two years later. He taught mathematics, and became a valuable assistant to Laplace, who left to him all the detailed calculations for the *Mécanique céleste*. Through Laplace's support Bouvard became, in 1804, a member of the Bureau des Longitudes, supplying tables to the *Annuaire* (similar to the *Nautical Almanac*) for many years. He was soon elected to the Académie des Sciences. A keen observer, he discovered eight comets and computed their orbits. He annotated Caussin's translation of the work of the medieval Arab astronomer, Ibn-Yūnus.

Brilliant but modest, Bouvard was an indefatigable calculator, and engaged in computation until the eve of his death. It could well be said of him that he ceased calculating only when he ceased living.

## BIBLIOGRAPHY

I. Original Works. Most of Bouvard's work is in the *Annuaire du Bureau des Longitudes* and in Laplace's *Mécanique céleste* (5 vols. and suppl., Paris, 1799–1827). Among works worthy of separate mention are “Nouvelles tables des planètes Jupiter et Saturne”, in *Tables astronomiques publiées par le Bureau des Longitudes* (Paris, 1808), his earlier tables of these planets; “Extrait des registres des observations astronomiques faites par Lemonnier...” in *Connaissance des temps* (1819), pp. 339–347, his account of his search of Lemonnier's registers for prediscovery observations of Uranus; and *Tables astronomiques publiées par le Bureau des Longitudes de France, contenant les tables de Jupiter, de Saturne et d'Uranus, construites d'après la théorie de la Mécanique céleste* (Paris, 1821), with an introduction describing the work and problems.

II. Secondary Literature. Works on Bouvard are a biography in F. Hofer, ed., *Nouvelle biographie universelle*, VII (Paris, 1853), cols. 141–142; G. B. Airy, “Circumstances Connected With the Discovery of a Planet Exterior to Uranus”, in *Monthly Notices of the Royal Astronomical Society*, 7 (1846), 121–152, which includes Airy's correspondence with Eugène Bouvard, nephew of Alexis, about the latter's attempts to revise the Uranus tables; and A. F. O'D. Alexander, *The Planet Uranus* (London, 1965), which contains many details and references regarding the prediscovery observations, Bouvard's work, and the subsequent studies.

