Biographical Encyclopedia of Astronomers

Sampson, Ralph Allen

Born Schull, Co. Cork, Ireland, 25 June 1866

Died

Bath, England, 7 November 1939

British astronomer Ralph Sampson made his mark with an analysis of the dynamics of the interactions of Jupiter's four large (Galilean) satellites. As Astronomer Royal for Scotland, he also encouraged major instrumental innovations, including the development of the Shortt Free Pendulum Clock and the use of micro-photometers.

Sampson was the fourth of five children of James Sampson from Cornwall and Sarah Anne (née Macdermott) Sampson, an Irish woman of Huguenot descent. When he was five, the family moved to Liverpool, England, and suffered from deprivation when his father became ill and his investments in the Cornish tin mines failed. As a result, Sampson had little education until the age of 14, when he entered the Liverpool Institute He won a scholarship to Saint John's College, Cambridge, where his tutor was John Adams, and graduated as the third wrangler in the mathematical tripos of 1888. Sampson then took up a lectureship in mathematics at King's College, London, and in 1889 was awarded the first Smith's Prize and a Fellowship of his college in Cambridge. He returned to Cambridge in 1890 and became the first holder of the newly established Isaac Newton Studentship in Astronomy and Physical Optics. Sampson worked for two years on astronomical spectroscopy with H. F. Newall and in 1893 published a paper, "On the Rotation and Mechanical State of the Sun." This was a highly significant publication as it demonstrated for the first time the importance of radiation compared to convection in the outward transport of heat generated in the Sun's interior.

In 1893, Sampson was appointed professor of mathematics at Durham College of Science in Newcastle upon Tyne. Two years later, he moved to the chair of mathematics in Durham itself and became director of Durham Observatory. Sampson's interest in this observatory led to the installation of the Durham almucantar, an instrument in which transits of stars were observed across a horizontal circle instead of a vertical wire in the meridian. The instrument attracted much interest and was used for some years for observations of the variation of latitude.

It was in Durham that Sampson undertook his greatest work, the dynamical theory of the four largest satellites of Jupiter. At that time, there were serious discrepancies between the theoretical predictions and actual observations of the four satellites. Sampson used a series of accurate observations from Harvard College Observatory to amend the existing theory of the satellite orbits, but the disagreement between theory and observation persisted. He worked out a new dynamical theory and published in 1910 *Tables of the Four Great Satellites of Jupiter*, giving the positions of the satellites from 1850 to 2000. His *Theory of the Four Great Satellites of Jupiter* appeared in 1921 and earned him the Gold Medal of the Royal Astronomical Society in 1928

Quite a different task that Sampson worked on at Durham was the editing of the unpublished manuscripts of his old tutor, Adams, for Cambridge University Press. These were published as *The Scientific Papers of John Couch Adams*. Sampson's varied achievements were recognized by his election to the Royal Society in 1903.

In 1910, Sampson was appointed Astronomer Royal for Scotland and professor of astronomy at the University of Edinburgh. During his tenure of 27 years in Edinburgh, he made notable contributions in three main areas: the determination of time, the optical performance of telescopes, and objective methods for photometry and spectrophotometry of stars.

Sampson recognized that an observatory's clock was one of its most important instruments and deserved proper attention. At the Royal Observatory, he introduced a system for monitoring the performance of the clocks to an accuracy of one thousandth of a

Second. Sampson improved the temperature control of the clock chamber, and he installed radio equipment for comparing time signals from clocks in other institutions. His interest in clocks led to several substantial papers on the subject in the publications of the Royal Society of Edinburgh.

Among the clocks in the observatory was one better than all the others. It had been designed by a civil engineer, W. H. Shortt, in association with the Synchronome Company. This Shortt-free pendulum clock was so accurate that it could detect, for the first time, small irregularities in the Earth's rotation. Shortt clocks were adopted as the standard timekeepers in many observatories until they were replaced by quartz clocks. Sampson's fundamental contributions to precise time determination were recognized by his election as the first president of the Commission de l'Heure, the international organization founded to study the problems of astronomical timekeeping

When Sampson tried to bring into use an old 24-inch reflector at the Royal Observatory, an old interest in theoretical optics was revived. His studies of optical aberrations resulted in two papers in the *Philosophical Transactions of the Royal Society* (1913, 1914). In the latter of these, he suggested that the optical aberrations of a Cassegrain reflector could be reduced by inserting a pair of suitable lenses in the outgoing beam. Sampson suggested a similar approach for correcting the field of a Newtonian reflector. These innovative ideas were later developed by others to good effect

In an effort to make some use of the 24-inch reflector where its poor image quality would not matter, Sampson decided in 1915 to use it for photoelectric photometry of stars using alkali metal detectors that had recently been developed in Germany. Most of the laboratory work to support this project was carried out by E. A. Baker. In 1920, the program was modified by replacing direct measurement of each star at the telescope with microphotometry of the densities of star images on photographic plates. This method was extended to scanning the spectra of stars, and the recording microphotometer became a standard instrument for stellar photometry.

Sampson applied the forgoing techniques to the analysis of objective prism spectra with a view to determining the spectral distribution of intensity of various types of stars. This led to

estimates of stellar temperatures in a range of spectral types from BO to MO. These results were published by the Royal Society of Edinburgh in 1925 and 1928

Sampson's desire to renew the equipment of the Royal Observatory was frustrated by World War I and its aftermath. It was only in 1936 that a 36-inch reflector made by Grubb Parsons was installed in the East Dome, and a versatile Hilger spectrograph was added the following year. This new equipment allowed the spectrophotometric program to be extended to much fainter stars.

In 1937, failing health compelled Sampson to retire at the age of 71. He and his wife Ida (*née* Binney), whom he had married in 1894, settled in Bath. Sampson was survived by his wife, a son, and four daughters

Sampson was deeply involved in the affairs of the Royal Society of Edinburgh, being a member of council for 20 years, including some years as general secretary. He served as president of the Royal Astronomical Society of London from 1915 to 1917. Sampson was awarded the honorary degrees of Sc.D. from Durham and LLD from Glasgow. The International Astronomical Union named the lunar crater at 29.7°N and 16.5°W in his honor.

Ian Elliott

Selected References

Brück, Hermann A. (1983). *The Story of Astronomy in Edinburgh from Its Beginnings until 1975*. Edinburgh: Edinburgh University Press.

Greaves, W. M. H. (1940). "Ralph Allen Sampson." *Monthly Notices of the Royal Astronomical Society* 100: 258-263.

Sampson, Ralph A. (1895). "On the Rotation and Mechanical State of the Sun." *Memoirs of the Royal Astronomical Society* 51: 123-183.

—— (ed.) (1896-1900). *Scientific Papers of John Couch Adams*. Vol. 2, pt. 1. Cambridge: University Press.

—— (1909). "A Discussion of the Eclipses of Jupiter's Satellites 1878-1903." *Annals of the Astronomical Observatory of Harvard College* 52: 149-343

—— (1910). "On the Old Observations of the Eclipses of Jupiter's Satellites." *Memoirs of the Royal Astronomical Society* 59: 199-256.

—— (1910). *Tables of the Four Great Satellites of Jupiter*. London: Published by the University of Durham.

—— (1921). "Theory of the Four Great Satellites of Jupiter." *Memoirs of the Royal Astronomical Society* 63