Biographical Encyclopedia of Astronomers

Freundlich, Erwin

Born Biebrich, (Hesse), Germany, 29 May 1885

Died Wiesbaden, Hesse, (Germany), 24 July 1964

German, later refugee, astronomer Erwin Finlay Freundlich was among the very first exponents of the idea that astronomical observations could test theories of gravity beyond that of Isaac Newton, though his own efforts at providing observational confirmation for general relativity [GR] were generally unsuccessful. He was the son of German manufacturer Friedrich Freundlich and a British mother, Ellen Finlayson, a version of whose surname he adopted during his 20 years at the University of Saint Andrews in Scotland. Following primary schooling in Biebrich and a classical education in nearby Wiesbaden, Freundlich worked briefly at a dockyard and began a course in naval architecture, which was brought to a quick end by a heart condition. He began work on mathematics, physics, and astronomy at Göttingen, receiving, with mathematician Felix Klein, a Ph.D. in 1910 for a thesis on analytic functions.

At Klein's urging, Freundlich applied for, and was appointed to, a position at the Royal Observatory in Berlin, working on positional astronomy, for which his mathematical background was good preparation. But he was already thinking of how astronomical circumstances might affect gravitation, and Albert Einstein, hearing of this, asked for his cooperation in making better measurements of the changing orbit of Mercury (eventually one of the classic tests of general relativity). Freundlich insisted on publishing the non-Newtonian result in 1913, over the objections of the observatory director. (He married Kate Kirschberg that same year.) In 1914, a member of the wealthy Krupp family of German industrialists financed an expedition for Freundlich to go to Crimea to witness the solar eclipse and look for the gravitational bending of light. This phenomenon was, by then, another of Einstein's predictions, though the full theory of general relativity was not ready for another year. The expedition was in Crimea when World War I broke out; Freundlich was briefly interned until he could be exchanged for a Russian prisoner of war held by the Germans.

In 1915, Freundlich published the suggestion that the gravitational redshift of light was responsible for the so-called K term of Edwin Frost and Walter Adams, which is a net positive velocity for a population of stars that were supposed to be, on average, at rest relative to the Sun He was at least half right: The gravitational redshift is about 3 km s^{1}, compared with the 4.9 km s^{-1} they had reported, but Freundlich's suggestion was nevertheless unpopular in the astronomical community. In 1918, he resigned his Berlin position to work full-time on solar observations in support of Einstein's ideas, at a facility generally called the Einstein Tower, financed by the Kaiser Wilhelm Institute. The primary goal was an accurate measurement of the gravitational redshift of the sunlight spectrum. The effort never truly succeeded because of the confounding effects of actual motions on the solar surface (e.g., the Evershed effect), and the measurement remains marginal even today. Freundlich's solar eclipse expeditions of 1922 and 1926 were clouded out, and the 1929 result from Sumatra showed a deflection of light

considerably and (Freundlich thought) significantly larger than the GR prediction. He spent a significant portion of the rest of his career trying to explain the difference as interesting new physics involving the interaction of gravitation and light. Subsequent measurements, particularly at radio wavelengths, have shown that the relativistic prediction is correct and that Freundlich's (and some other) measurements had some systematic errors, probably resulting from the difference between hot daytime eclipse conditions and the nighttime comparison measurements.

Freundlich left Germany for Turkey in 1933, where he wrote what became the first astronomical textbook to be translated into Turkish. He returned as professor of astronomy to Charles University in 1937, but soon departed again for the Netherlands, where he was offered a position at the University of Saint Andrews. There he was to build an observatory and a department of astronomy. Freundlich did this, along with providing wartime instruction on celestial navigation to air ministry cadets Realizing that the Saint Andrews facilities were not suitable for serious research, he oversaw the design and construction of the first Schmidt-Cassegrain telescope. This proved so successful, especially for work on star clusters, that Freundlich commissioned a larger version. Meanwhile, he was among the first to apply the virial theorem to the motions of stars in globular clusters and designed what he hoped would be an improvement on the Albert Michelson interferometer for measuring stellar diameters. Sadly, Freundlich wanted to further his ideas on nonstandard interactions between gravity and light, and his reputation in the community gradually declined. He resigned the Napier professorship, to which he had been appointed in 1951, in 1959.

His successor at Saint Andrews, D. W. N. Stibbs, declined Finlay Freundlich's collaboration in the final commissioning of the 37-inch Schmidt-Cassegrain. The chief optician resigned, too, and the telescope was never entirely a success.

Finlay Freundlich retired to Wiesbaden, near his birthplace, and was an honorary professor at the University of Mainz at the time of his death.

Helge Kragh

Alternate name

Finlay-Freundlich, Erwin

Selected References

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(1972). "Freundlich, Erwin Finlay." In *Dictionary of Scientific Biography*, edited by Charles Coulston Gillispie. Vol. 5, pp. 181–184. New York: Charles Scribner's Sons.

Freundlich, Erwin Finlay (1955). "On the Empirical Foundation of the General Theory of Relativity." *Vistas in Astronomy* 1: 239–246. (Freundlich's own version of his astronomical tests of GR is to be found here; the Michelson interferometer modification is found later in the same volume.)

Hentschel, Klaus (1997). *The Einstein Tower.* Stanford: Stanford University Press. (This is the best study on Freundlich, covering his work until about 1933.)