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The 1919 eclipse results that verified general relativity and their later detractors: a story re-told. (English summary)

Notes and Rec. **76** (2022), *no. 1,* 155–180.

The mathematical astronomer Arthur Stanley Eddington was instrumental in verifying one of the key predictions of Albert Einstein's general theory of relativity (GR): that the path of starlight is altered when it passes close to the Sun's limb. He led the British eclipse expedition to Principe in 1919 that captured the background star field on photographic plates, and performed an analysis of the apparent displacement of stars. Eddington and his coauthors found the shifts to confirm the GR prediction better than that of Einstein's 1911 theory of gravitation, referred to then as the "Newtonian" prediction [F. W Dyson, A. S. Eddington and C. Davidson, Philos. Trans. Roy. Soc. A **220** (1920), no. 571-581, 291–333, doi:10.1098/rsta.1920.0009]. Three years later, a team led by W. W. Campbell of the Lick Observatory measured the star field during the solar eclipse in Western Australia and confirmed the British result. Over a half-century later, Geoffrey M. Harvey remeasured and reduced most of the Sobral plates with automated techniques, again confirming the GR prediction [G. M. Harvey, Observatory **99** (1979), 195–198].

Soon after, however, the physicists C. W. F. Everitt, J. A. Lipa, and G. J. Siddall [Precis. Eng. **1** (1979), no. 1, 5–11, doi:10.1016/0141-6359(79)90070-9], and independently, the philosophers John Earman and Clark Glymour [Hist. Stud. Phys. Sci. **11** (1980), no. 1, 49–85, doi:10.2307/27757471] reexamined the published data from 1919, and suggested that personal bias had skewed Eddington's reduction in favor of the GR prediction. At issue is a decision to reject one of the two sets of measurements obtained in Sobral. The philosophers claimed that to confirm the GR prediction it was necessary to neglect this particular dataset. The science historians Matthew Stanley [Isis **94** (2003), no. 1, 57–89, doi:10.1086/376099] and Daniel Kennefick [in *Einstein and the Changing Worldviews of Physics*, 201–232, Einstein Stud., 12, Birkhäuser Boston, Boston, MA, 2012, doi:10.1007/978-0-8176-4940-1˙9] studied the historical case in depth, and found no reason to question the scientific probity of Eddington or his senior collaborator, coauthor, and leader of the Sobral expedition, Frank Dyson. Both Stanley and Kennefick felt the reasons given by the British astronomers for excluding one of the Sobral measurement sets answered in full the charge of bias leveled against Eddington by Earman and Glymour, albeit without considering the statistical soundness of the reductions.

The latter question is taken up by the authors, who suggest Earman and Glymour erred in assuming, with respect to the rejected dataset, that the internal dispersion of results represents an underlying normal distribution (p. 163). The authors re-reduce the original published data, calculate the statistical significance of the results for all three measurement sets, and quantify the effect of including the Sobral dataset rejected in 1919. Contrary to Earman and Glymour, inclusion of the latter dataset—with now-standard weighting—results in a value "slightly, but not significantly, larger" than the GR prediction of 1.75 arcsec (p. 164). In fact, the new reduction of the rejected dataset (1.61 ± 0.45) nearly coincides with that of Harvey's remeasurement (1.55 ± 0.34).

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