

The Argentinean attempts to prove the Theory of General Relativity: the total solar eclipses of 1912, 1914 and 1919

Santiago Paolantonio¹, Leonardo Pelliza², Claudio C. Mallamaci³,
Néstor Camino⁴, Mariana Orellana⁵ and Beatriz García⁶

¹Observatorio Astronómico de Córdoba - Museo Astronómico, Argentina.
email: paolantoniosantiago@gmail.com

²Instituto Argentino de Radioastronomía - CONICET

³Universidad Nacional de San Juan, Facultad de Filosofía, Humanidades y Artes

⁴Complejo Plaza del Cielo CONICET-FHCS UNPSJB

⁵Universidad Nacional de Río Negro, Sede Andina – CONICET

⁶ITeDAM-CONICET-CNEA-UNSAM, UTN Mendoza, Lab. Pierre Auger

Abstract. The aim of this work is to provide new information about the history of astronomical science and the efforts of the people that have enriched our discipline, often coming from anonymity. Here we compile the attempts made in our country to prove the theory of General Relativity through experiments that, as they were without success, fell into oblivion.

Keywords. History of astronomy, eclipses, General Relativity

1. Introduction

The year 2019 marks a century since the first corroboration of one of the predictions of the Theory of General Relativity, on the occasion of the total solar eclipse of May 29, 1919. While this event has been widely documented by historians, much less has been written about the attempts made before it. Several years earlier many astronomers and institutions were involved in the same challenge. They have often been left aside and forgotten, as a result of an over-simplistic view of the history of science. This is the case for the attempts to verify Albert Einstein's theory which were carried out by the Argentine National Observatory (ONA) in the decade from 1910.

2. 1912

After Einstein engaged Erwin Freundlich of the Berlin Observatory to take charge of the experimental confirmation of his prediction relating to the deviation of light by gravity, the young astronomer wrote in 1911 to Charles D. Perrine, at that time director of the ONA, to ask for his help (see Figure 1). Over the course of his career, Perrine gathered a wide experience in the observations of solar eclipses, mostly thanks to a stay at the Lick Observatory. When the letter from Freundlich arrived, Perrine was in Europe attending a meeting of the *Carte du Ciel* Committee. During a stopover in Berlin he was personally contacted by Leopold Courvoisier and Freundlich, who informed him of their intentions to verify Einstein's predictions.

Freundlich intended to use the plates of eclipses existing in the Lick Observatory to carry out the verification, but as Perrine had anticipated, they did not serve for that purpose. At the beginning of 1912, Freundlich asked the director of the Argentine

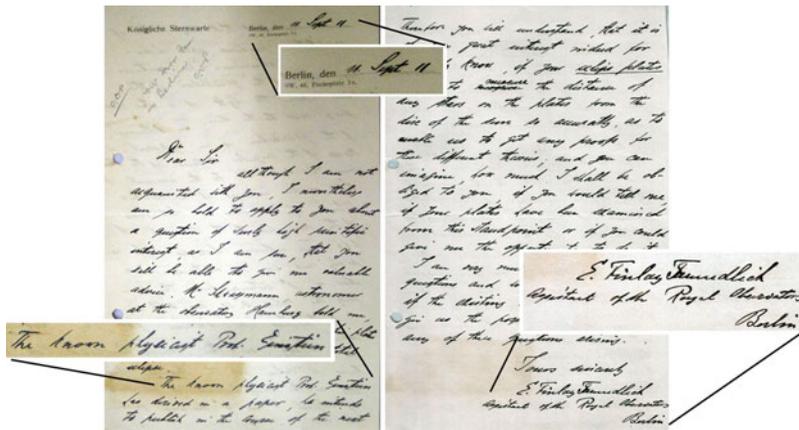


Figure 1. Letter from Freundlich to Perrine, 9/11/1911, preserved at the Museum of the Astronomical Observatory of the National University of Córdoba, Argentina.



Figure 2. Cristina, state of Mina Gerais, Brazil, was the designated site to observe the eclipse of 1912. The path of totality is shown at the left, as published in the newspaper *La Argentina* from a manual plot (9/10/1912). The photograph at the right shows the cameras installed and ready to be used (Credit: Archive of Plates. OAC Library).

Observatory to take the necessary photographs during the eclipse that would be seen in Brazil on October 10 of that year. Perrine accepted the challenge and included this investigation in the expedition that was being arranged for the study of the aforementioned eclipse.

The cameras destined to obtain the photographs to confirm the predictions of Einstein can be seen in the Figure 2. The objectives of 335.3 cm focal distance, were provided by W.W. Campbell, director of the Lick Observatory, and were those used for the search of the hypothetical planet Vulcan between the Sun and Mercury.

The different instruments were installed in the outskirts of Cristina, next to a church. The main camera had a focal length of 12 metres. The cameras used to make the photographs for the verification of Einstein's theory are shown in Fig. 3. Sadly, a storm that took place some days before the event prevented the observations. The confirmation of Einstein's proposal, an historical milestone of science, could have occurred seven years in advance of 1919. In the newspaper *La Argentina*, 10/10/1912, it is possible to read *The continuous rain made the observations fail almost completely...*, and *The astronomers were very upset...* (Córdoba Astronomical Observatory Library).

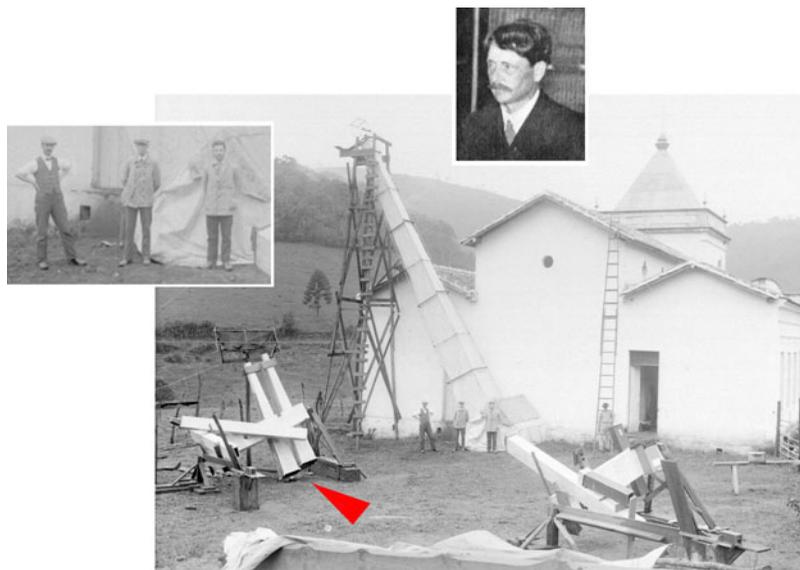


Figure 3. The ONA delegation consisted of Charles D. Perrine as manager (detail above), the photographer Roberto Winter, the mechanic James O. Mulvey and one assistant astronomer, Enrique Chaudet (detail on the left) (Credit: Archive of Plates. OAC Library).



Figure 4. Set of instruments of the ONA; at the right back, Feodosia. (Archive of Plates. OAC Library).

3. 1914

At the time of the total solar eclipse of August 21, 1914, the ONA organized a new expedition, where Einstein's theory could have been confirmed. The expedition was installed in Feodosia, Crimea, on the shores of the Black Sea. The phenomenon occurred along with the start of the Great War, so the expeditions of different observatories with the same purpose were all precluded.

Once more, the clouds blocked the observations and only a few photographs without scientific value were taken.

4. 1919

Dr Perrine planned ahead the observation of the eclipse that would occur on May 29, 1919, visible from Brazil. For this purpose he exchanged numerous letters with



Figure 5. The ONA delegation consisted of Dr. Perrine (1) and James Mulvey (2). They were helped by some residents and officers of an English vessel unauthorized to leave. The photograph also identifies members of other expeditions, such as Hugh F. Newall of the Cambridge Observatory (3) (Credit: Archive of Plates. OAC Library).

the director of the observatory of Rio de Janeiro, H. Morize. Those letters are preserved in the Museum of the Astronomical Observatory of Córdoba. Although everything was prepared, the National Government did not authorize this expedition. The large expenditures made in the previous cases without results, and the particular moment of the relations between the Executive Power and the ONA frustrated this initiative.

5. Conclusion

In this presentation, we shared a history of failures that could have resulted in a successful observation at the right place and time. The storyline is (as today?) crossed by the need for continuity in scientific projects of the effort required when working towards any result. Yet, we plan to celebrate the centenary of the 1919 eclipse in Argentina, for a total solar eclipse will cross all the territory on July 2nd, 2019. It will be a year of simultaneous celebration with the centenary of the International Astronomical Union's foundation.

Acknowledgements

All photos and plates shown in the poster and in these proceedings were identified and digitized by S. Paolantonio. We are grateful to Silvina Perez for the design of the poster.

References

- Minniti, E.R., Paolantonio, S. 2009, *Córdoba Estelar. Historia del Observatorio Nacional Argentino*, Observatorio Astronómico de la Universidad Nacional de Córdoba. Córdoba: Editorial de la Universidad. Available in Spanish at www.cordobaestelar.oac.uncor.edu
- Paolantonio, S. & Minniti, E.R. 2007, *Argentinean attempts to prove the Theory of Relativity*, *Boletín de la Asociación Argentina de Astronomía*, 50, 359–362, Available in Spanish at adsabs.harvard.edu/abs/2007BAAA...50..359P
- Paolantonio, S. 2010, *De Córdoba al Mar Negro*. Available in Spanish at historiadelaastronomia.wordpress.com/documentos/de-cordoba-al-mar-negro
- Paolantonio, S. 2012, *A un siglo del primer intento de verificar la Teoría de la Relatividad*. Available in Spanish at historiadelaastronomia.wordpress.com/documentos/primerintento