THE TOTAL SOLAR ECLIPSE OF 9 MAY 1929: THE FRENCH EXPEDITIONS TO POULO CONDORE ISLAND IN FRENCH INDOCHINA

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Abstract: Internationally, the total solar eclipse of 9 May 1929 was an important event as it offered astronomers yet another opportunity to confirm Einstein's Theory of General Relativity. The path of totality crossed what at the time were the Dutch East Indies, the Unfederated Malay State of Kedah, Siam and the southern tip of French Indochina. With totality lasting a generous 5 minutes or thereabouts, the eclipse was a target for European expeditions. This paper examines the French expeditions that were dispatched to Poulo Condore Island, just off the coast of what is now southern Vietnam, with two appendices devoted to a small Swiss–Siamese expedition in Siam and to the successful German expedition in Sumatra.

Keywords: Total solar eclipse, 9 May 1929, eclipse expeditions, Poulo Condore Island, Vietnam, Siam, Sumatra.

1 INTRODUCTION

Figure 1 and Figure 2 show that in the South-East Asian region the path of totality of the 9 May 1929 eclipse crossed northern Sumatra, the Malay Peninsula, the southern tip of French Indochina, and islands in the Philippines. Between them, American, British, Dutch, French, Japanese and German eclipse expeditions were based at each of these locations (see Table 1).

The exceptional length of the totality (more than 5 minutes) was very promising, explaining the large number of expeditions. However, in Southeast Asia the month of May is traditionally a difficult period for astronomers as the changeable weather means that clear skies are likely much less than 50% of the time (Stratton, 1928). In addition, topography plays a key role: a coastal or near coastal site is more likely to experience clear skies than an inland mountainous site that usually would attract clouds. We see these unfavorable meteorological conditions reflected in the various attempts to observe the 9 May 1929 total solar eclipse listed in Table 1.

This paper focuses on the French expeditions to Indochina (now Vietnam), which were partly successful. Two were astronomical (Section 2), but there was another one at the same location devoted to radio propagation (Section 3). In addition, I include two appendices, one devoted to a single-man Swiss expedition to Siam and to the other to a successful German expedition in Sumatra. For other expeditions, see the references in Table 1.

2 THE STRASBOURG OBSERVATORY EXPEDITION

2.1 Introduction

As for most expeditions for the 9 May 1929 eclipse, the main goal of the French one was to confirm the deflection of light by the mass of the Sun, an effect of relativity that was first observed during the total eclipse of 29 May 1919. Indeed,

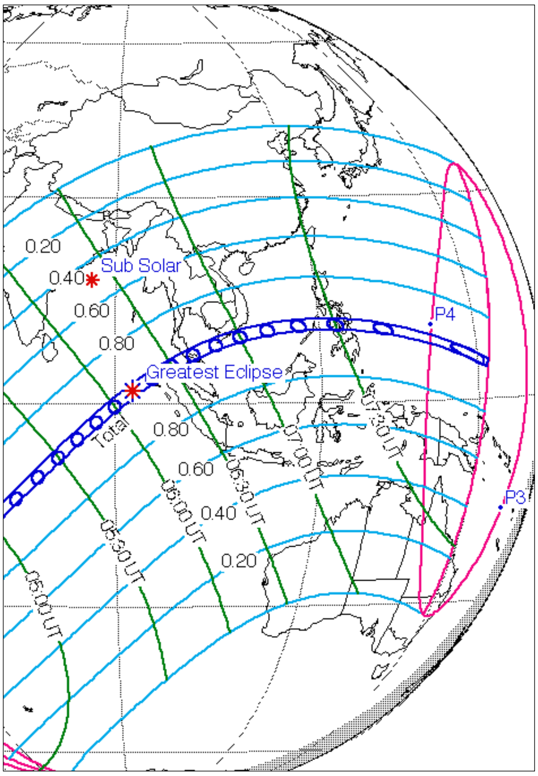

Figure 1: Map showing the path of totality of the 9 May 1929 total solar eclipse across SE Asia (https://en.wikipedia.org/wiki/Solar_eclipse_of_May_9,_1929#/media/File:SE1929May09T.png).

Figure 2: A map showing the locations of the various Western eclipse camps in Sumatra, the Malayan Peninsula, and Indochina; missing are sites in the Philippines (base map: Google; map modifications: Wayne Orchiston).

Table 1: List of the expeditions in Asia for observing the total solar eclipse of 9 May 1929. This list might be slightly incomplete. I could not find much information on the Japanese expeditions, except that they were mainly devoted to the effects of the eclipse on the propagation of radio waves.

Country	Expedition	Observing Site	Cloudy or Clear Weather	References
Dutch East Indies (Sumatra, Indonesia)	Dutch	Idi	Partly clear	Minnaert, 1931
	American	Takengon	Clear	Miller and Marriott, 1929
	German			Freundlich, 1930, 1931
	Japanese			
Kedah Unfederated Malay State (Malaysia)	American	Alor Star	Partly clear	Noor and Orchiston, 2020
	British			Anonymous, 1929 Noor and Orchiston, 2020
	Japanese			
Siam (Thailand)	British	Pattani	Cloudy	Soonthornthum et al., 2020
	German	Khok Pho	Partly clear	Soonthornthum et al., 2020
	Swiss–Siamese	Khoke-Bhodi		Brandli, 1929
Indochina (Vietnam)	French	Poulo Condore Is.	Partly clear	Danjon, 1929, 1938 Galle and Talon, 1930
Philippines, Micronesia	American (4)	Iloilo	Partly clear	Anonymous, 1933a Waterfield, 1930 Sollenberger, 1929
	German	Cebu		Schorr, 1929 Deppermann, 1929
	Japanese			

> The verifications made on the occasion of the eclipses of 1919 and 1922 by the English and American astronomers do not escape any dispute, and it will be very interesting to make new observations (Bourgeois, 1929: 750; our translation).

Aside from its exceptional length (around 5 minutes), the 1929 eclipse looked very favorable for this purpose because the eclipsed Sun would be located in a rich star field (Noor and Orchiston, 2021: Figure 11.2). Unfortunately, due to meteorological conditions, only the German expedition in Sumatra was able to perform this observation, as described below in Appendix 2.

The French Bureau des Longitudes consulted the various observatories in France and decided that Strasbourg Observatory would organize a mission in the island of Poulo Condore, in Indochina, then a French colony and now Vietnam. Actually, they first choose a smaller island, Baï-Kan, but it soon became clear that Poulo Condore was more suitable. The Bureau also decided that two astronomers from Marseilles would join this mission, and also members of the Laboratoire National d'Électricité for geophysical observations (Bourgeois, 1929).

2.2 The Expedition Members

André Danjon (1890–1977) was designated as the Head of the Expedition, with André Lallemand (1904–1978) and Gilbert Rougier (1886–1947) as adjuncts. All three were experienced astronomers: Danjon as an astrometrist and photometrist (Lequeux, 2017), who in 1930 would become Director of Strasbourg Observatory, Lallemand and Rougier as builders of photoelectric cells and photometers (Lequeux and Georgelin, 2022: 35–36).

The Marseilles party comprised Jean Bosler (1878–1973), assisted by Charles Gallissot (1882–1956). Both were also experienced astronomers, and Bosler had discovered the red coronal line of Fe X at 637.4 nm during the total eclipse of 21 August 1914 in Strömsund (Sweden).

The geophysical staff consisted of Jean-Baptiste Galle and Captain G. Talon, from the Laboratoire National d'Électricité.

They embarked from Marseilles in February 1929, with all the equipment, and arrived in Saigon on 2 April. The French Navy there put at their disposal two small warships, l'*Inconstant* and the *La Pérouse,* on which the equipment and staff were transferred to the Poulo Condore island on 6 April (Danjon, 1930).

2.3 Installation

General Gustave Ferrié (1868–1932), the well-known pioneer of radio who saved the Eiffel Tower by using it as an antenna, was in charge of the general organization of the French expedition, as he was directly interested in the geophysical part. He arranged for temporary buildings, shelters and supports for the instruments to be constructed under Commandant Villatte before the arrival of the scientists. The scientific staff were housed in the "great village of Poulo Condore", and the school room was used as a laboratory and store for equipment (Figure 3).

Free manpower was abundant in Poulo Condore, which had a convict prison with about 1500 convicts from all over Indochina. The convicts were apparently ready to help, in the vain hope that it would give them a reprieve. However, the buildings were guarded at night because it was feared that the convicts would make rafts with the wood in order to escape. There were also skilled workers locally and on board the warships. Several of the Navy personnel on the *l'Inconstant*, *La Pérouse* and another ship, the *l'Alerte*, were employed during the eclipse observations, after some training (Danjon, 1929a).

The observing station was erected on a sand dune (Figures 3 and 4). The most important construction was an observatory to house a double equatorial (Figure 5).

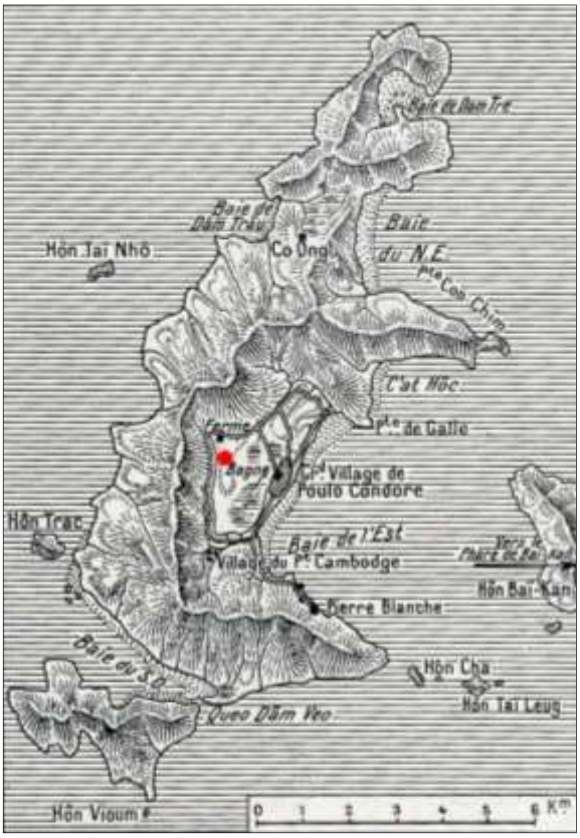

Figure 3: Map of the Poulo Condore island. The site of the Strasbourg expedition is marked by a red dot. '*Bagne*' means convict prison (after *L'Illustration* of 23 November 1929, Library of Paris Observatory).

The instruments of the Strasbourg expedition were as follows (Danjon, 1938):

(1) A double (photographic and visual) equatorial by Mailhat-Prin (Figure 6). Its 24-cm objectives were re-worked by André Couder (1897–1979), an excellent optician who was at Strasbourg Observatory until 1925 and was then Head of the Optical Laboratory at Paris Observatory. The mounting had also been modified and special devices added to point rapidly two stellar fields on both sides of the eclipsed Sun with a guiding eyepiece in each field, as references for measuring the Einstein effect (Danjon, 1938: B6–B7).

Figure 4: The dune where the Strasbourg expedition station was erected. The white building visible on the left is shown in close-up in Figure 5 (after Danjon, 1938: Plate I).

Figure 5 (above): The building for the double equatorial, in front, with its roll-off roof. The smaller building, with a fixed roof, contained the photometry instruments. The people in the photograph could not be identified (after *L'Illustration* of 23 November 1929, Library of Paris Observatory).

Figure 6 (right): The double equatorial in place in Poulo Condore (after Danjon, 1938, Plate II).

(2) A visual photometer to determine the total flux of the corona at three wavelengths. It used the method of Fabry (Lequeux and Georgelin, 2022: 35). Such a photometer had already been used on Mount Blanc to determine the atmospheric absorption and the brightness temperature of the Sun (see Bauer and Danjon, 1923). Here, it was used at the focus of a small telescope to obtain the flux in a 4°-diameter field encompassing the whole corona, by comparison to a stabilized electric lamp.

(3) A photoelectric photometer to determine the total flux of the corona at three visible wavelengths (Danjon, 1938: B22), derived from an instrument described by Lequeux and Georgelin, 2022: 35–36.
(4) Two cameras to photograph the corona in the near infrared, mounted on the double equatorial. A special laboratory was installed to prepare and develop the photographic plates sensitized with neocyanine. There was also a photoelectric photometer for the near infrared.

There is no information about the equipment of the Marseilles staff. They certainly wanted to obtain spectra of the corona (Bourgeois, 1929: 750), but they did not succeed due to the poor atmospheric conditions or for other reasons, and we have been unable to find any report from them.

The two scientists from the Laboratoire National d'Électricité carried radio receivers, and also radio goniometers to measure the displacement of the direction of arrival of the radio waves from distant emitters.

3 ECLIPSE DAY: 9 MAY 1929

Danjon (1929b) gives a vivid account of the day. The weather had been clear until 25 April, but then deteriorated, with a violent storm on 5 May. However, the sky began clear the morning of the eclipse day, but was progressively covered with clouds. First contact could not be seen from the station, although it could be observed from a village at 1.5 kilometer away. Fortunately, the clouds soon disappeared, leaving a uniform and stable veil until the first half of totality. Then clouds reappeared so that the last two minutes of totality were not usable.

Five 30-second exposures were obtained of the totally eclipsed Sun, plus one on each comparison region, over a total of 210 seconds. The successive pointings of the telescope and the change of photographic plates needed a total of 64 seconds. Thus, the observation took 274 seconds over the 284 seconds of totality, leaving the observers little time to admire the total eclipse!

However, the seeing was extremely bad during all this time, widening the images of the stars so that the Einstein deviation program gave no result. Only the images of the corona were of relatively good quality (Figure 7). A large prominence was seen by several expeditions: it appeared and started to vanish during the eclipse (Figure 8).

Photometry and infrared photography of the corona were successful, although they could be made only during the two first minutes of totality.

4 RESULTS

As we have seen, no result came out of the double equatorial except for photographs of the corona. However, both visual and photoelectric photometry gave results (Danjon, 1938), as well as observations in radio (Galle and Talon, 1930).

The visual photometer had been calibrated on the full Moon and on the Sun before the eclipse, and it was easy to calculate the flux from the partly eclipsed Sun and to compare it to the observed flux in order to determine atmospheric transmission: it was found stable and equal to 0.71 at all three visible wavelengths. Assuming that absorption remained the same during the beginning of totality, the total flux of the corona was found to be 0.37 that of the full Moon through the three filters, red, green and blue. The photoelectric photometer gave very similar values.

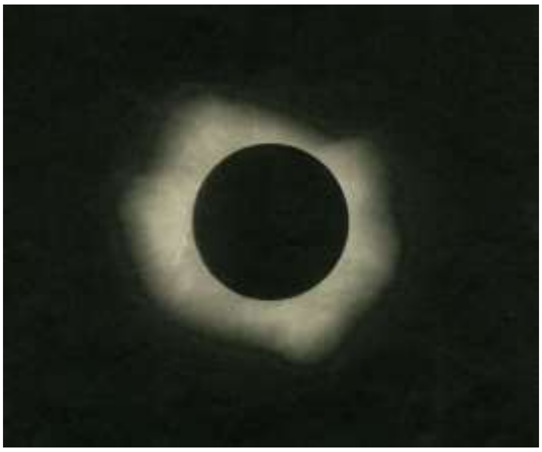

Figure 7: A 30-second exposure of the corona obtained with the double equatorial (after *L'Illustration* of 23 November 1929, Library of Paris Observatory).

However, the photographs in the near infrared showed that the flux was considerably smaller compared to that of the full Moon. Unfortunately, no figure could be given because the infrared photometer did not work due to humidity. No interpretation was given for this decrease.

The scientists from the Laboratoire National d'Électricité observed rapid changes in the propagation of radio waves at the onset of totality: decrease of the intensity of signals from short-wave stations (wavelength 10 to 100 meters), changes in the direction of arrival of these signals and decrease of local atmospherics. This was correctly interpreted

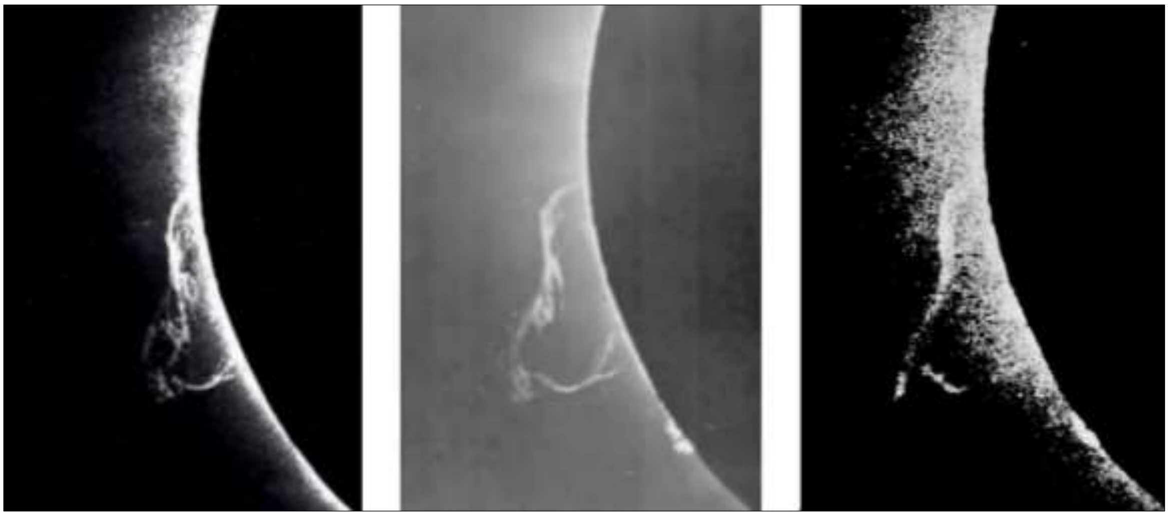

Figure 8: The evolution of a large prominence seen during the eclipse of 9 May 1939. Left, as observed from Sumatra by the Swarthmore College eclipse team (after Miller and Marriott, 1929: Plate XIV). Middle, as observed 10 minutes later from Alor Star (after Anonymous, 1929,: Plate 4). Right, as observed 20 minutes after the previous one by the Strasbourg Observatory team in Poulo Condore (after Danjon, 1938: Plate IV; same scale).

as due to a decrease of ionization of the upper atmosphere when not submitted to solar radiation.

They also studied radio echoes. For this, an emitter at 25-m wavelength was installed on board the *Inconstant*, at 3 km from the receiving station, emitting a brief signal every 30 seconds. An echo was frequently observed during daytime with a delay ranging from 5 to 25 seconds, disappearing at night. The echoes also disappeared 2 minutes before totality, to reappear a little before its end. General Ferrié discussed the possible interpretations as a comment following the paper by Galle and Talon (1930). These echoes are due to reflection phenomena by the ionosphere, but the physics of plasmas was so rudimentary in 1930 that there was much uncertainty in the interpretation. However, there is still at present no completely convincing theory for these delayed echoes.

5 ACKNOWLEDGEMENT

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7 APPENDIX 1: THE SWISS–SIAMESE EXPEDITION IN SIAM

Henri Brandli (or Brändli) was a Swiss engineer who was working from 1920 in Siam as Divisional Engineer in the Royal Irrigation Department (in Anonymous 1929: 134, he is described as a Government meteorologist). An amateur astronomer, he was a founding member of Société Astronomique de France, and had a private observatory in Bangkok equipped with a Secretan equatorial (Stroobant, 1931: 21).

He observed the eclipse from Khoke-Bodi (Siam), close to the German expedition. They were luckier than the English expedition at Pattani, not very distant, but where the sky was entirely covered with clouds (see the detailed map in Brandli, 1927). Brandli was equipped with the equatorial used by the French expedition in Siam to observe the famous eclipse of 18 August 1868, probably the 15-cm diameter Cauche equatorial mentioned by Orchiston and Orchiston (2017). He could only observe the time of the four

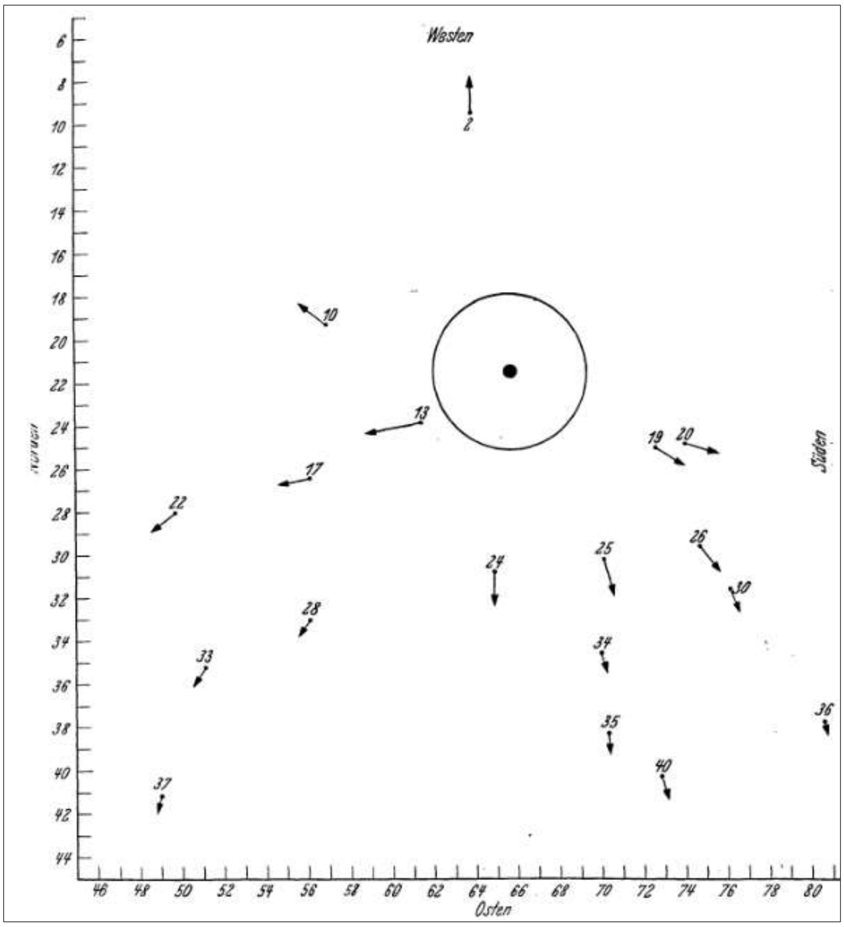

Figure 9: The displacement of stars due to the 'Einstein effect' (after Freundlich et al., 1931).

contacts and missed photographing totality (Brandli, 1929). However, the nearby German expedition did photograph the corona.

Brandli, 1929, published two photographs not related to this paper: one of a Goerz-Zeiss coronagraph that was installed at Khoke-Bhodi (apparently not for the German expedition) and another of a transit telescope with registering equipment "… installled at Khoke-Bhodi by the Siamese expedition …" (our translation). We have not been able to find any mention of the use of these instruments at Khoke-Bodhi or of a Siamese expedition.

After the eclipse, King Rama VII of Siam and the Queen, who were present during the phenomenon, gave a reception on the royal yacht *Maha Chakri* (for details and a photograph of the yacht see Soonthornthum et al. (1921). Brandli was amongst the guests.

8 APPENDIX 2: THE GERMAN EXPEDITION TO SUMATRA

This expedition was the only one which succeeded in measuring the deviation of light by the Sun, the Einstein effect. A long paper (Freundlich, 1930) describes the expedition with its rather sophisticated equipment. A first instrument consisted of two horizontal cameras fed by the same cœlostat, one photographing the solar field and the other a distant star field; the same fine grid was photographed on both plates after the astronomical photographs have been made. The second instrument was a Zeiss astrograph. Freundlich et al. (1931), describes the result obtained with the first instrument. The second one did not give good results, for reasons explained by Freundlich et al., 1933, and Anonymous, 1933b: 43–48.

Four plates were obtained with the first instrument, and the 'Einstein effect' was clearly seen on each. Figure 9 shows the results obtained by averaging the displacements measured on each plate.

However, the effect seemed larger than predicted: 2".24 ± 0".10 at the Sun's limb compared to the 1".75 predicted. When Freundlich presented his results at the Royal Astronomical Society on 11 December 1931 (Anonymous, 1932) in the presence of Eddington, he rejected the possibility of a systematic error and concluded that (1) A deflection existed; (2) It was not Newton's; and (3) It seemed to be greater than Einstein's. But when Astronomer Royal, Sir Frank Dyson (1868–1939) congratulated Freundlich for his excellent results and beautiful equipment he declared: "I cannot say that I feel very confident that the deflection at the limb is really greater then 1".75." And Eddington added: "I find it difficult to believe that 1".75 can be wrong." Presumably, Freundlich had in fact underestimated the systematic errors, but he never acknowledged this and became increasingly bitter.

More recently, the Einstein effect was confirmed with exquisite accuracy by the Hipparcos and Gaia astrometric satellites.

Dr James Lequeux, born in 1934, started a second career in the history of science when he retired in 1999. Before that, he was an astronomer at the Paris Observatory, specializing in interstellar matter and the evolution of galaxies. He has been Director of the Nançay Radioastronomy Station and of the Marseilles Observatory.

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