Why 29 May 1919 – and why two expeditions

A rare alignment, long preparation, and the best chance that would come for decades

EARLIER ECLIPSE ATTEMPTS HAD FAILED

1912 Brazil
Clouded out.

1914 Crimea
War intervened; partial eclipse only.

1918 North America
Weather defeated observation.

1917 Greenwich eclipse plates examined
Showed that stars of the required faintness could be photographed.

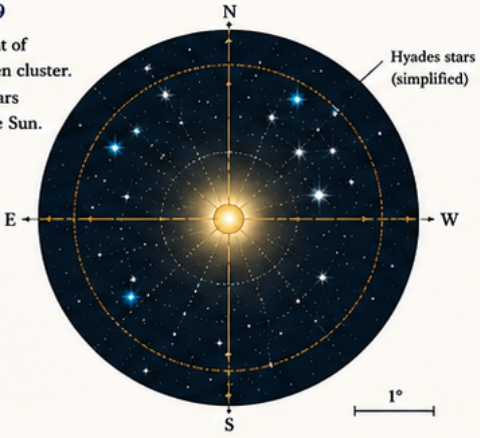
WHAT THEY KNEW BEFORE THEY LEFT

- Catalogue positions and photographic magnitudes of ~12 candidate stars in the Hyades.
- Einstein 1915 prediction for the deflection of each star.
- Totality would last long enough for multiple exposures.
- Two geographically separated stations would provide an essential check.

"The experiment is delicate in the extreme. A fraction of an arcsecond is all we hope to measure."
— A. S. Eddington

AN EXCEPTIONAL ALIGNMENT: THE HYADES BEHIND THE SUN

29 May 1919
The Sun in front of the Hyades open cluster. ~12 suitable stars within 2° of the Sun.



PREDICTED DEFLECTION PATTERN (EINSTEIN 1915)

Radial from the Sun; magnitude decreases ~ 1 / r

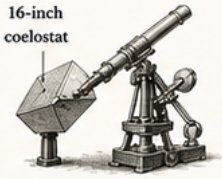
PATH OF TOTALITY
29 May 1919

TOTALITY DURATION
Sobral ~ 310 s
Príncipe ~ 200 s

WHY THE REDUNDANCY AT SOBRAL MATTERED
Two independent optical systems photographing the same field meant that a consistent result from both would be decisive. It proved to be the key to the success of the expedition.

TWO EXPEDITIONS – ONE OBJECTIVE

SOBRAL, Brazil
3° 41′ S, 40° 20′ W



Astrographic telescope (13-inch obj.) stopped to 8-inch aperture

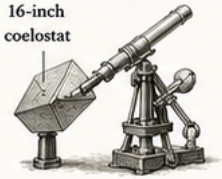
4-inch telescope (f/19 ft)

8-inch coelostat

Personnel:
A. Crommelin – Astronomer
C. R. Davidson – Assistant

Two instruments, same star field. Independence was the strength.

PRÍNCIPE (Príncipe Island)
1° 40′ N, 7° 24′ E



Astrographic telescope (13-inch obj.) stopped to 8-inch aperture

Personnel:
A. S. Eddington – Scientist
E. Cottingham – Observer

Independent station ~ 3000 km away. Essential check on weather, instruments and results.

THE INSTRUMENTS AT A GLANCE

Carte du Ciel astrographic objective (Greenwich & Oxford) achromatic doublet (crown & flint glass)

Glass plate in precision holder

Temporary horizontal telescope tube ~ 3.43 m long

Coelostat feeds light into stationary tube (16-inch at Sobral; 16-inch at Príncipe)

Photographic plate records the field during totality

Measured later in the laboratory to obtain x, y coordinates

The entire enterprise pushed the technology of precision astronomy to its limits.

A signal of only a few tens of micrometres on a glass plate was all that separated two theories of gravity.