

Preface – 1st Edition

Theodor von Oppolzer's 1887 *Canon der Finsternisse* (Canon of Eclipses) stands as one of the greatest accomplishments in computational astronomy of the nineteenth century. It contains the elements of all 8000 solar eclipses and 5200 lunar eclipses occurring between the years –1207 and +2161, together with maps showing the approximate positions of the central lines of total, annular and hybrid solar eclipses.

To make this remarkable achievement possible, a number of approximations were used in the calculations and maps. Furthermore, the 19th century ephemerides for the Sun and Moon, which are critical to eclipse predictions, cannot compare to the accuracy and precision of modern ephemerides. Finally, the 1887 canon did not include the shifts in longitude and timing of ancient eclipses due to Earth's variable rotation rate and the Moon's secular acceleration.

Nevertheless, von Oppolzer's canon remained the seminal reference on predictions of eclipses until well into the 20th century. With the arrival of the electronic computer, the time was ripe to produce updated solar¹ and lunar eclipse canons. In 1979, Meeus and Mucke published *Canon of Lunar Eclipses: –2002 to +2526* containing the Besselian elements of 10,936 lunar eclipses. It was intended mainly for historical research and served as the modern day successor of von Oppolzer's great canon.

The Meeus-Mucke work also contains data on penumbral eclipses that are not included in von Oppolzer's canon. Neither of these publications offers diagrams or maps to illustrate the geometry or visibility of each eclipse. Espenak's *Fifty Year Canon of Lunar Eclipses* (1989) includes individual Moon-shadow geometry diagrams and eclipse visibility maps of all lunar eclipses, but it covers a relatively short period from +1986 to +2035.

Both of these recent lunar eclipse canons are based on *Newcomb's Tables of the Sun* (1895) and Brown's lunar theory (1905), subject to later modifications in the *Improved Lunar Ephemeris* (1954). These were the best ephemerides of their day but they have since been superseded.

The *Canon of Lunar Eclipses 1500 B.C.–A.D. 3000* (Liu and Fiala, 1992) uses modern theories of the Sun and the Moon prepared by the *Bureau des Longitudes* of Paris. However, it does not contain individual eclipse geometry diagrams or maps. Instead, it offers a series of map templates to approximate the geographic regions of eclipse visibility, and an optional computer program do generate these figures for any eclipse in the document.

The *Five Millennium Canon of Lunar Eclipses: –1999 to +3000* (NASA TP–2009–214172, Espenak and Meeus, 2009) contains individual eclipse geometry diagrams and visibility maps for every lunar eclipse (12,064 eclipses) over a period covering 5000 years from –1999 to +3000. It is based on the modern *Bureau des Longitudes* theories of the Sun and the Moon and uses the most current determination of historical values of ΔT in the eclipse visibility maps.

The present work is a catalog to supplement the 12,064 eclipse diagrams and visibility maps in the *Five Millennium Canon of Lunar Eclipses*. It includes additional information for each eclipse that could not be included in the lunar eclipse canon because of size limits. The data tabulated for each eclipse include the catalog number; canon plate number; calendar date; Terrestrial Dynamical Time of greatest eclipse; ΔT ; lunation number; Saros number; eclipse type; Quincena Solar Eclipse parameter; gamma; penumbral and umbral eclipse magnitudes; durations of penumbral, partial, and total eclipse phases; and the geographic coordinates of greatest eclipse (latitude and longitude).

A primary goal of this work is to assist historians and archeologists in the identification and dating of eclipses found in references and records from antiquity. For example, an ancient mechanical calculator known as the Antikythera mechanism was apparently designed to calculate eclipses and other astronomical phenomena (Freeth, et. al., 2008).

¹ Several new solar eclipse canons were published in the second half of the 20th century. Meeus, Grosjean, and Vanderleen published *Canon of Solar Eclipses* (1966) containing the Besselian elements of all solar eclipses from +1898 to +2510, together with central line tables and maps. The aim of this work was principally to provide data on future eclipses. The Mucke and Meeus work *Canon of Solar Eclipses: –2003 to +2526* (1983) was intended mainly for historical research and served as a modern day successor of von Oppolzer's great canon. Espenak's *Fifty Year Canon of Solar Eclipses* (1987) includes individual detailed maps and central path data for all solar eclipses from +1986 to +2035. Finally, the Espenak and Meeus work *Five Millennium Canon of Solar Eclipses: –1999 to +3000* (2006) contains individual maps of every solar eclipse and uses modern ephemerides of the Sun and Moon.

Five Millennium Catalog of Lunar Eclipses: –1999 to +3000 (2nd Edition)
Fred Espenak and Jean Meeus

The decoding of this device was possible in part by comparing its combination of wheel positions with the dates of lunar eclipses.

The *Canon* and the *Catalog* both use the same solar and lunar ephemerides, and values of ΔT . This 1-to-1 correspondence between them will enhance the value of each. The researcher may now search, evaluate, and compare eclipses graphically (*Canon*) or textually (*Catalog*).

— Fred Espenak and Jean Meeus, 2009 January

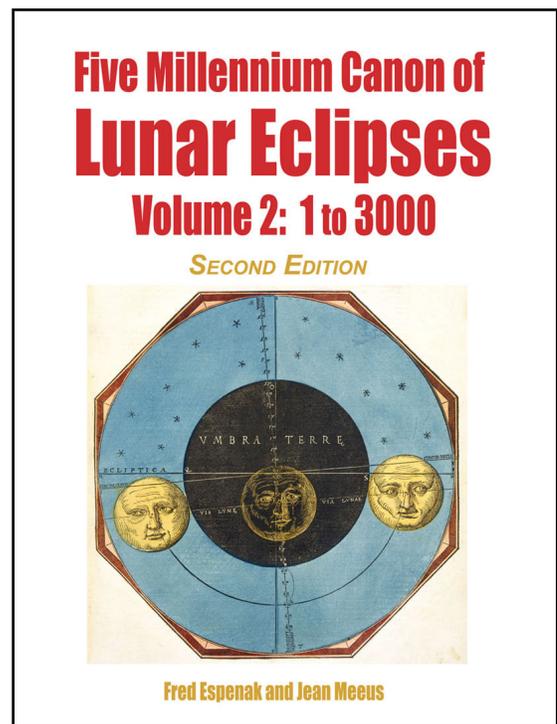
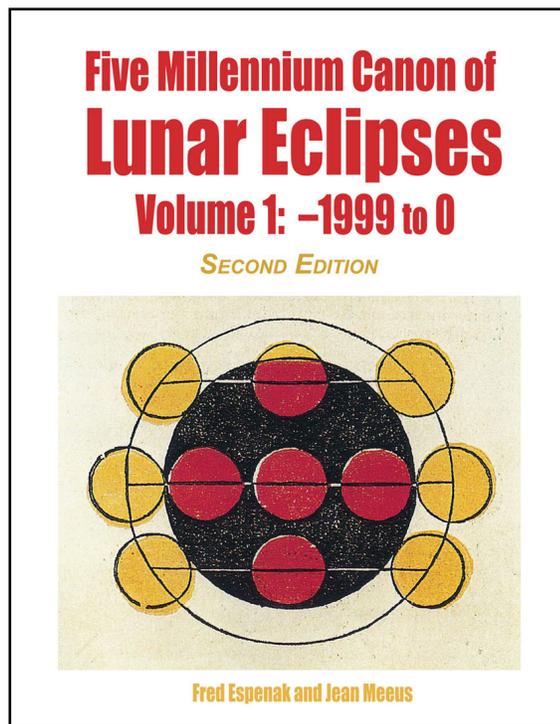
Preface – 2nd Edition

The *Five Millennium Catalog of Lunar Eclipses: –1999 to +3000* was first published in October 2009 (NASA TP-2009-214173). As a NASA Technical Publication it had a limited publication run and distribution. The available supply of hard copies was depleted within 12 months of publication although the PDF version continues to be available.

More than a decade later, the *Five Millennium Catalog of Lunar Eclipses* is available again in hard copy in this Second Edition through Astropixels Publishing. The *Catalog* serves to complement the 2-volume *Five Millennium Canon of Lunar Eclipses* which contains a figure and map of every eclipse. The *Catalog* and the *Canon* both use the same solar and lunar ephemerides as well as the same value of ΔT . This 1-to-1 correspondence between them enhances the value of each..

A new section (Section 4: Eclipses and the Moon's Orbit) has also been added to this second edition.

— Fred Espenak and Jean Meeus, 2021 August



See: <http://astropixels.com/pubs/5MCLE2.html>