


Illuminating Eclipses: Astronomy and Chronology in *King Lear*

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ohann Gottfried Herder wrote his famous essay *Shakespeare* in 1772. He was (as Wieland, Lessing and, of course, Goethe and Schiller) one of the 18th century German writers “who first embraced Shakespeare and welcomed his genius as a dramatist.”¹ In his 1980 introduction to Herder’s essay, Konrad Nussbächer wrote: “Shakespeare is not, as it appeared in the 18th century, a natural genius growing up in the wild, but a highly cultured, artful Renaissance poet and practitioner of the stage.”

Astronomy was one of the liberal arts and sciences a “highly cultured” man of Renaissance England was expected to know. This essay will review a few illuminating examples of Shakespeare’s profound knowledge of astronomy, and will examine a new astronomical reference that could shed significant new light on Shakespearean chronology.

Shakespeare’s Astronomy

In many regards Shakespeare had a better knowledge of the relationship between the moon and the tides² than his distinguished contemporary Galileo (1564 - 1642), who tried to explain the tides by the two motions of the earth, correlating to the day and the year.³ This was an erroneous explanation for ebb and flow. But while Galileo refused to acknowledge any tidal influence of the moon, Bernardo knew better, referring to the moon as the

moist star

Upon whose influence Neptune's empire stands
(*Hamlet*, I.1.135)⁴

To Prince Henry, likewise, the moon commands the tides:

The fortune of us that are moon's men doth ebb and flow like the sea,
being governed as the sea is by the moon.....Now in as low an ebb as
the foot of the ladder, and by and by in as high a flow as the ridge of the
gallows.

(*1 Henry IV*, I.2.10)

As it does for Camillo:

you may as well
Forbid the sea for to obey the moon.
(*Winter's Tale*, I.2.497)

Shakespeare was also aware of the major difficulty of describing the precise orbit of Mars — an unsolved astronomical problem in his day:

Mars his true moving, even as in the heavens,
So in the earth, to this day is not known.
(*1 Henry*, VI I.2.3)

It was only in 1609 that Johannes Kepler (1571 – 1642) solved the problem on the basis of Tycho Brahe's (1546 – 1601) observational data (*Astronomia Nova, Physica Coelestris, tradita commentariis de Motibus Stellae Martis*). Kepler proved "Mars true moving in the heavens" to be an elliptical path.⁵

Although astronomy is far from being a major theme in his dramas, Shakespeare makes frequent references to it, often in a pictorial sense, occasionally in a casual way, but never incorrectly in astronomical terms, as this example illustrates:

Hel. Monsieur Parolles, you were born under a charitable star.

Par. Under Mars, I.

Hel. I especially think under Mars.

....

Par. When he was predominant.

Hel. When he was *retrograde*, I think rather.

Par. Why think you so?

Hel. You go so much backward when you fight.

(*Alls Well*, I.1.109-117)

This obvious reference to the *retrograde motion* of a planet is used correctly from the astronomical point of view. The retrograde motion of planets had been known ever since ancient times and was already well documented. It applies to *all* of

the planets and is a visible phenomenon during the time of opposition (Mars, Jupiter and Saturn) or before and after the inferior conjunction (Mercury, Venus).

If one wished to assert that concrete references to astronomy were only used glibly with poetic licence and without a genuine background, it would be hard to justify. Shakespeare was familiar with the discussion on the current issues in science. In *Troilus and Cressida* Ulysses deals with celestial order in his soliloquy:

The heavens themselves, the planets, and this center,
Observe degree, priority, and place,

.....

And therefore is the glorious planet Sol
In noble eminence enthron'd and spher'd
Amidst the other

(I.3.88-94)

To call the sun a center seems to be heliocentric, but the term “planet Sol” is incompatible with the heliocentric-Copernican world view, in which the sun no longer can be regarded as a planet. On the other hand it is impossible to describe the sun as a “spher’d” center in the geocentric-Ptolemaic view. Only the earth was the center in this system, the center for all planetary spheres, including the spheres



Figure 1: “This centre...the glorious planet Sol...enthroned and spher’d” *Mundi Totius Tychonius Braheum* - Tycho’s Worldsystem, from Andreas Cellarius, *Harmonia macrosoma*, Amsterdam, 1661.

of the “planets” sun and moon as well, and there was no room for a center in the “heavens.” The speech thus contradicts both systems.

Peter Moore discovered that we have here Tycho Brahe’s world view, which was made public in 1588, and must have been known to the author of *Troilus and Cressida*.⁶ Brahe sought to achieve a synthesis between the Ptolemaic and the Copernican world views: In his system the earth is the center for the orbit of the sun, but the planets are centered on the sun. By this the sun is both: planet and center (Fig.1).

The description in *Troilus and Cressida* is a unique one, which becomes more obvious when compared with Wallenstein’s soliloquy in Schiller’s trilogy (1798), where we have — as versified by Coleridge —

The circles in the circles, that approach
The central sun with ever-narrowing orbit.⁷

This obviously keeps to the modern heliocentric-Copernican view. The sun is the only center; spheres are replaced by circles and orbits. Schiller may have known the Ulysses soliloquy, as the complete Wieland /Eschenburg translation had been in print since 1775, and while writing his historic plays he was deeply influenced by Shakespeare. It seems not to be mere coincidence, when both soliloquies pursue certain aspects of the heavenly hierarchy, but in Schiller’s time there was no longer any basis to look at Brahe’s system (if he was aware of its description at all).

The unique view in *Troilus and Cressida* becomes obvious when compared with the one given in Marlowe’s *Tragicall History of D. Faustus* by Mephistophilis:

Such are the heavens,
Even from the moon unto the empirial orb,
Mutually folded in each others spheres,
And jointly move upon one axle-tree,
Whose termine, is termed the world’s wide pole...
(II.2.37)

Here we find a strictly geocentric view almost reduced to a mere observable phenomenon, as it does not refer to a center but to the polar axis, which is close to what can simply be seen.⁸ The critical literature contains numerous additional examples of Shakespeare’s extensive and sophisticated knowledge of astronomy.⁹

Shakespeare’s Eclipses

“Eclipse” occurs three times in a concrete or figurative astronomical sense in the Sonnets and six times in the dramas, including three instances in *King Lear*.

Glou. These late eclipses in the sun and moon portend no good to us.
(*Lear*, I.2.57)¹⁰

Peter Moore goes into the chronology of Shakespeare's dramas in detail and also deals with the issue of dating by drawing on political or other generally known events, in so far as there are indications or allusions to these in the dramas. He also mentions this citation in connection with a possible date of origin of *King Lear*, albeit without using it for the dating, and merely observes that "such (eclipses) happen almost every year."¹¹ This is evidently correct, but this does not clarify the issue. On closer observation, much more precise statements are possible, and this brief passage contains more regarding the question of dating¹² than might be expected at first glance. A solar *and* a lunar eclipse *may* occur with an interval of 14 days (but if so, both cannot be total).

A solar *and* a lunar eclipse *may* moreover occur with an interval of half a year, more precisely, with an interval of 177 ± 14 days.¹³ These are the shortest time intervals possible, and longer time intervals are more typical.

In the absence of predictions, the occurrence of eclipses is unexpected and surprising in daily life, and without comprehensive astronomical knowledge, their occurrences do not reveal any regularity.

"These late eclipses..." would most probably be applicable to a pair of eclipses, one occurring shortly after the other. A time separation of half a year would seem to be less suitable and would appear plausible only if it were preceded by a long "eclipse-free" period.

The conspicuousness of an eclipse, and hence its entry into the general consciousness of a population, is very different for lunar and solar eclipses. A lunar eclipse will attract attention even with a small partial phase, since the familiar image of a round full moon fallen into the earth's shadow looks very unusual.

Solar eclipses often go unnoticed¹⁴ because unless the eclipse is more than 90% of totality, it dims the sun's light no more substantially than does a cloudy day:

Clouds and eclipses stain both moon and sun.

(*Sonnet 35*)

For a given period, it is thus only a matter of investigating all eclipses to determine whether there are any cases of a sequence of a solar and a lunar eclipse within a time interval of 14 days. As shall be seen, the condition of this short time interval between two eclipses "in the sun *and* moon" greatly limits the possible relevant cases.

Since on a local scale, i.e. for a given area, solar eclipses are much rarer than lunar eclipses, the search should begin with them. And since only solar eclipses with a large phase (>90%) are of interest, the possibilities are rapidly limited even further, as will become clear.¹⁴ Only one total solar eclipse was visible in England during the second half of the 16th and the start of the 17th centuries — on March 7, 1598. The line of totality ran through Cornwall in Southern England up to Scotland (Fig. 2).



Figure 2: Solar Eclipse, March 7, 1598 zone of totality cuts through central England.

Before this, the only total solar eclipse in England was in 1440, and after it not until 1652. In the period in question, there were nevertheless two other eclipses with significant occultation phases¹⁵ — on December 24, 1601, an annular solar eclipse with a central line in central England, and on October 12, 1605, a solar eclipse with a line of totality in Southern France/Pyrenees (Fig. 3).

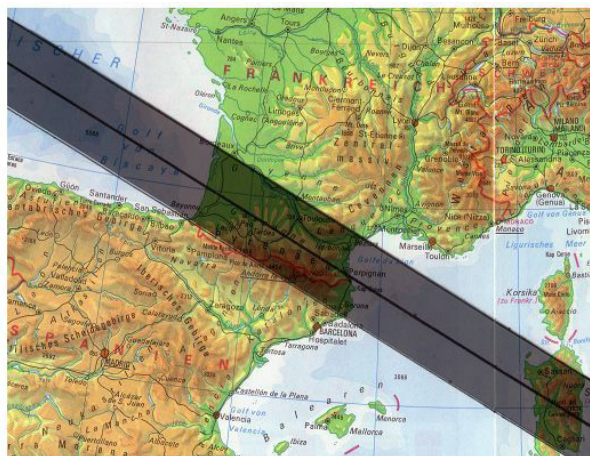


Figure 3: Solar Eclipse, Oct. 12, 1605, zone of totality cuts through southern France: a “Shakespearean eclipse?”

Critically, although the latter was total in France, it was visible in England only as a partial eclipse.¹⁶

The London occultation phases of these three solar eclipses are shown in Figure 4:¹⁷

1598	93%
1601	80%
1605	85%

Figure 4

The eclipses of 1601 and 1605 significantly fail the criterion “occultation phase > 90%” and may therefore be excluded as not relevant. There is thus only one eclipse, namely that of 1598, which could correspond to the *Lear* references.¹⁸

With regards to the “>90%” criterion, it could nevertheless be maintained that it is an arbitrary one. For this reason, it may not be entirely persuasive. Concurrent to all three solar eclipses, moreover, lunar eclipses also appeared within an interval of 14 days (Fig. 5).

Solar Eclipse	Lunar Eclipse (Within a distance of 14 days)
7 March, 1598	21 February, (partial, 98%)
24 December, 1601	9 December, (partial, 88%)
12 October, 1605	27 September, (partial, 58%)
Figure 5: Correlative Solar and Lunar Eclipses visible in England, 1598-1605.	

If we now use Gloucester’s remark for a possible dating of the drama, we determine surprisingly that there are apparently three eclipses proposed for such a narrow period of time.¹⁹ For Stratford, the eclipse of 1605 is regarded as the “Shakespeare eclipse,” since it fits the orthodox dating scheme, which awards *King Lear* a composition date of 1605/06 and is incompatible with Edward de Vere’s 1604 death. But is this attribution plausible? Only if the eclipse of 1598 is intentionally ignored, since it has far stronger arguments in its favor.

It is not only the much higher proportion of occultation, which would have made these particular eclipses an impressive event in London itself, that commends the 1598 events to our attention. The totality area ran throughout England. Within a short period of time, news could have spread to London that it had already become pitch black in the central zone. What could this portend? Corresponding reports for 1605 from the South of France, if any, would have been scanty and would hardly have had a major impact in the theatrical world, the more so because the event was familiar now, unlike in 1598 — when no one living in England could have remembered such a phenomenon.

But the context of the Gloucester quotation is also highly significant. For the development of the plot it is meaningless, but gives Edmund the cue for

his subsequent soliloquy deriding the superstitions of astrology. The recently observed eclipses, which had terrified many, supplied the occasion for touching on a contemporary theme.

When Edmund ironically mentions the “dragon’s tail”(I.2.58), this is no malapropism of a known constellation (*Draco* /dragon), but the correct astronomical expression for the descending node of the lunar orbit, *a decisive reference point for the occurrence of an eclipse*. The term is also found in Richard Eden’s *Dedication to Sir Wyllyam Wynter* (1574).²⁰ Eden was a well-read author.²¹ He had written one of the first books in English on America and translated Peter Martyr’s reports on the voyages of Vespucci, Pigafetta, etc.²²

The whole Edmund-soliloquy is a searing critique of astrology, which is made to look ridiculous, and this at a time when famous scientists such as Cardano²³ and Dee were still seeking to establish a scientific foundation for the field. Edmund puts different things together: A constellation — Ursa Major — and a reference point like a node. But a well informed listener will know that “Dragon’s Tail” does not refer to a constellation. To put a “nativity under Ursa Major” is of course intentional nonsense, as the Great Bear is not a part of the zodiac, but it is appropriate when used ironically by Edmund.

In the subsequent dialogue with Edgar, the eclipse theme is reinforced, making it clear that Edmund alludes to actual events external to the play:

these eclipses do portend these divisions
(I.2.61)

and

I read the other day, what should follow these eclipses
(I.2.62)

No one will contradict Konrad Nussbächer when he describes Shakespeare as a practitioner of the stage. Even if his “high Renaissance culture” perhaps did not provide him with an advanced knowledge of astronomy, as a good practitioner of the stage, there was one thing that he would never do: bore his audience by claiming something was topical when it no longer was. After a solar eclipse occurred close to a lunar eclipse for the third time in seven years, these would have lost their terror and on the last occasion could no longer have been a topical theme. Had the author perhaps slept through the much more impressive 1598 event? This would be like a stand-up comedian in 2007 making contemporary, topical jokes about Helmut Kohl, Ronald Reagan, or Margaret Thatcher, which would at best raise a tired smile and at worst strike a wrong note.

The solar eclipses of 1601 and 1605 were merely attenuated repetitions of the apocalyptic events of 1598. This was also true for the adjacent lunar eclipses. In 1598, it was almost total (as mentioned above, totality is impossible because of celestial mechanics), in 1605 it passed off with a significantly more minor phase. In other words, an attempt to summon up the horror experienced by Gloucester seeing “late eclipses in the sun and moon” suggests 1598 and not 1605 as Gloucester’s cultural reference point.

The dating of *King Lear* to circa 1598 does not fit the orthodox scheme. The eclipse nevertheless sheds a clarifying light, if a paradoxical formulation regarding the question of dating is permitted. Moore can make datings for 10 dramas: for *Hamlet* c. 1594 and for *Macbeth*, 1600-01.²⁴ In the relative dating of the dramas, which is less controversial, *King Lear* is usually placed shortly before *Macbeth*, but significantly later than *Hamlet*. The dating to 1598 is in perfect agreement with this. This confirms what Peter Moore has extensively argued: The Shakespearean chronology has been consistently dated too late by at least seven years.²⁵



❧ **Endnotes** ❧

- ¹ L. Dunton-Downer, A. Riding, *Essential Shakespeare Handbook*, London 2004, 468.
- ² A. F. Falconer, *Shakespeare and the Sea*, London 1964, 73.
- ³ *Dialogo sopra i due massimi sistemi del mondo, Giornata quarta, Florence 1632 / Dialogue Concerning the Two Chief World Systems, The Fourth Day*. Galileo's knowledge of the tides came primarily from his observation of the Mediterranean, whose small size makes its tides less clearly synchronized with the lunar motions than are those of the Atlantic, which scientists and English mariners seem to have calculated earlier and with greater precision. But here Galileo is not dealing with the tides of the Adriatic Sea, but rather with tides as a global phenomenon. Shakespeare on the other hand is well aware of the absence of tides in the range of the Mediterranean: "Like to the Pontic sea/Whose icy current and compulsive course/Ne're feels retiring ebb" (*Othello*, III.3.508-510).
- ⁴ All Shakespeare citations are from *The Oxford Shakespeare*, ed. W.J. Craig (Oxford UP, 1914)
- ⁵ This particular play wasn't published until the 1623 Folio. Presumably the author, if still living after 1609, could have revised or amended these words with the new science in mind.
- ⁶ Peter Moore, "Shakespeare's Astronomy," *Shakespeare Oxford Society Newsletter* 24: 3 (Summer 1988), reprinted in *The Lame Storyteller, Poor and Despised* (Hamburg, Germany: Verlage Uwe Laugwitz, 2009), 244. Isaac Asimov, astronomer and authority in astrophysics, took this as an indication of the Bard's geocentric sympathies (William Farina, *de Vere as Shakespeare*, Jefferson, N.C. 2006, 63). Peter Moore's view is more convincing. Edward de Vere and Tycho de Brahe could have met, since they stayed in Venice at the same time in 1575 (P. Moore, "Shakespeare's Astronomy," reprint in: *The Lame Storyteller*, 245).
- ⁷ Friedrich Schiller, *Die Piccolomini*, II.6.982.

- ⁸This statement is the consequence of keeping methodically to a strict distinction between a “visible phenomenon” and theories or scientific models.
- ⁹Falconer, 93-96.
- ¹⁰The Quarto edition: *The History of King Lear* has an identical text here.
- ¹¹Peter Moore, “The Abyss of Time: The Chronology of Shakespeare’s Plays,” *Elizabethan Review* (Autumn 1997), reprinted in *The Lame Storyteller*, 176.
- ¹²A reference to a single eclipse as the famous “The mortal moon hath her eclipse endured” (*Sonnet 107*) without any further clue can never give a basis for any kind of dating. It can at most strengthen other profound arguments. This is different if more than one eclipse comes into question.
- ¹³The time space is 6 synodic months (a synodic month = 29.53059 days). $6 \times 29.53059 = 177.18354$ days.
- ¹⁴Accidental pinholes in the environment can project the sun’s disc, and foliage might serve the same purpose. These methods have been known since ancient times. They are useful for people with some knowledge in practical astronomy; but are far from affecting the masses. The classical reference manual on eclipses is *Oppolzer’s Canon der Finsternisse* (1887). Today, however, useful software is available, which simplifies the search (*Redshift 7*, 2009 or Antonius Schrode, *AstroBase, Canon of Eclipses*, Version 1.0).
- ¹⁵The magnitude of the eclipse in digits or percentage of the moon’s /sun’s diameter, “occultation phase” ranges from zero to the “maximum phase” which can have any number up to 1.00 (100%). G. D Roth, *Astronomy Handbook*, Cambridge, MA. 1975, 294.
- ¹⁶Louis P. Benezet referred to these eclipses as a possible dating of *King Lear* in *American Shakespeare Fellowship Newsletter*, 4: 4 (June 1943), reprint in *Building the Case for Edward de Vere*, 2: 352, 2009. The eclipses in *King Lear* have recently been discussed in David H. Levy, “Shakespeare’s Eclipses Return,” *Sky & Telescope*, 106, 6. They are more recently mentioned by Richard F. Whalen, “A Dozen Plays Written after Oxford Died? Not Proven!” *The Oxfordian*, 10 (October 2007), 77, and by Howard Schumann, *Shakespeare Matters* (Winter 2009), 6.
- ¹⁷*Canon of Eclipses*, and *Redshift 7*.
- ¹⁸Other solar eclipses in England which reached a significant portion of occultation in London only occurred in 1547 and 1621, both of which were annular. The dates nevertheless exclude the possibility of associating them with the Gloucester quotation.
- ¹⁹A comparative study for Germany (for a similar time span of circa 50 years, at almost the same latitude but in a different century, for an area with circa twice the size of England), shows not a single pair of eclipses which match the Gloucester citation.
- ²⁰Cf. Richard H. Allen, *Star Names, Their Lore and Meaning*. New York: 1963 (1st edition 1899), 208.
- ²¹Stritmatter & Kositsky’s research on *The Tempest* demonstrates that Eden was the author of a primary source text for another play. So Eden would already have

been familiar to Shakespeare. Stritmatter, Roger and Lynne Kositsky, "O Brave New World': *The Tempest* and Peter Martyr's *De Orbe Novo*," *Critical Survey*, Vol. 21, Number 2, Summer 2009, *Questioning Shakespeare*, 7 et seq.

- "Dating *The Tempest*: A Note on the Undocumented Influence of Erasmus' 'Naufragium' and Richard Eden's 1555 Decades of the New World," *The Shakespeare Fellowship* website, <http://www.ShakespeareFellowship.org>, 2005, 2007.

²² Richard H. Allen, *Star Names, Their Lore and Meaning*, New York 1963, 12.

²³ Anthony Grafton, *Cardano's Cosmos – The Worlds and Works of a Renaissance-Astrologer*. Harvard University Press 1999.

²⁴ Peter Moore, "The Abyss of Time," *Elizabethan Review* (Autumn 1997), reprinted in *The Lame Storyteller*, 185-187.

²⁵ Peter Moore, "Recent Developments in the Case for Oxford," *Ever Reader* (October 1996), reprinted in *The Lame Storyteller*, 331.