Shakespeare's Universe

Michael Rowan-Robinson

> 'I could be bounded in a nutshell and count myself a king of infinite space'.[1]

It's a real pleasure to be invited to give the keynote lecture for this INSAP meeting in Corfu, especially as my great grandmother was born in Corfu, so I can claim to be one-eighth Corfute. I gave an earlier version of this talk, entitled 'Shakespeare's Astronomy' at *INSAP IX* at Gresham College in London in 2015, and that talk was reprised at the London Museum in 2016. In the interim I've become especially interested in Shakespeare's links with the English supporters of Copernicus, who had discovered that the earth orbits the Sun. There are two themes of this lecture. The first theme is Shakespeare's knowledge of the night sky and how important it was to him in his plays. The second theme is whether Shakespeare shows us that he knew about the new world-system of Copernicus. Discussion of Shakespeare's astronomy goes back to the nineteenth century but there has been an upsurge in interest in the last twenty years.[2]

---

[1] William Shakespeare, *Hamlet*, Act 2, Scene 2, Lines 256-257. https://shakespeare.mit.edu/hamlet/index.html.

[2] D.W. Olson, M.S. Olson, R.L. Doescher, 'The Stars of Hamlet', *Sky and Telescope*, 1988, 96, 68; J. R. Voulkel, *Johannes Kepler and the new astronomy*, (Oxford: Oxford University Press, 1999); Peter Usher, 'Advances in the Hamlet Cosmic Allegory', *Oxfordian IV*, 2001, 25; Peter Usher, *Hamlet's Universe* (Aventine Press, 2006); A. Mosley, *Bearing the heavens: Tycho Brahe and the Astronomical Community of the Late Sixteenth Century* (Cambridge: Cambridge University Press, 2007); Michael Rowan-Robinson, *Shakespeare's Astronomy* (Southwold Organ, 2008); H. Wember, *Illuminating Eclipses,* Brief Chronicles, 2010, II, 31; D.H. Levy, *The Sky in Early Modern English Literature, 1572-1620*, (New York, Springer, 2011); D. Falk, *The Science of Shakespeare* (Thomas Dunne Books, 2014); D.W. Olson, *Celestial Sleuth* (New York: Springer, 2014),

Michael Rowan-Robinson, 'Shakespeare's Universe', *Culture and Cosmos,* Vol. 29 no 1 and 2, Spring/Summer and Autumn/Winter 2025 (Papers from the INSAPXII conference, Corfu, 2024), pp. 135-158.
www.CultureAndCosmos.org

In the time of William Shakespeare, England was a hot-bed of Copernicanism. Nicolas Copernicus had set out to reform Ptolemy's earth-centred model of the solar system, but in the end he came up with a completely new picture, with the earth spinning on its axis once a day and orbiting the sun once a year. This marked the beginning of the end for the whole Aristotelean world-view with the earth at the centre of the universe. Copernicus published his results on his death-bed in 1543 in *de Revolutionibus*, On the Revolution of the Celestial Spheres. This came under fire from Catholic theologians soon after its publication and found few supporters amongst continental mathematicians and philosophers, though many were willing to use the planetary tables based on the new model, which were decidedly superior to Ptolemy's *de Revolutionibus* was to end up on the Index of banned books in 1616. Luther too despised Copernicus and all that he represented so the reception was no better in the continental Protestant world.

England was really the only safe place to discuss these new ideas and it was in the circle of the Elizabethan mathematician and magus John Dee that discussion of Copernicus's ideas flourished. John Dee (1527–1608) is a perplexing figure. He was tutor and adviser to Queen Elizabeth and amassed one of the largest libraries in Europe. In 1570 he published a *Mathematicall Praeface to Euclid*, which gives a survey of mathematics and its applications, and he trained a number of the navigators of his day. He was interested in astronomy, but also in astrology, alchemy and the occult. It has been suggested that John Dee was the model for Shakespeare's Prospero. It was in England and through Dee's circle that the Italian maverick friar Giordano Bruno encountered the Copernican revolution and incorporated it into his radical philosophy. As we will see, there is a direct link between Shakespeare and leading Copernicans. Was Shakespeare influenced by this new world-view?

A rival pro-Copernican group was centred on the Earl of Northumberland and the Earl of Southampton, and included Sir Walter Raleigh, Sir Philip Sidney, the scientist Thomas Harriott, and John Florio. They were known as the 'School of Night', because of their atheistic tendencies. Shakespeare had links to the Earl of Southampton, to whom *The Rape of Lucrece* and *Venus and Adonis* were dedicated, and to John Florio, who was Southampton's secretary. It has been suggested that Shakespeare may be satirising the School of Night in *Love's Labour's Lost*. Writer's linked to both Dee and Northumberland include Spenser, Sidney, Marlowe and Donne.

The plays of Shakespeare are rich in astronomical references. Of course that's in the nature of Shakespeare, because his plays are also rich in allusions to falconry, agriculture, medicine, or almost any other aspect of Elizabethan life. But Shakespeare's astronomy is quite deeply interesting.

To illustrate Shakespeare's interest in the stars, the Penguin Dictionary of Quotations gives 99 references to 'star' or 'stars'.[3] Of these 12 are from Shakespeare. The next most prolific, at 5 each are Milton, Byron, Wordsworth and Shelley, with Keats on 4 and Coleridge and Tennyson on 3 each. The Shakespeare Concordance shows an astonishing 128 references to star or stars. At first sight the Shakespeare quotations are simple metaphors: 'one particular bright star', 'cut him out in little stars', 'you chaste stars', 'Two stars keep not their motion in one sphere' or they are astrological references: 'it is the stars, the stars above us', 'there was a star danced', and 'the yoke of the inauspicious stars'. Similarly astrological is another famous quotation from *Julius Caesar*

> 'When beggars die there are no comets seen,
> The heavens themselves blaze forth the death of princes',[4]

but that is more interesting because it connects to definite phenomena of the night sky, comets. A more lurid version appears in Act 1 scene 1 of *Hamlet*, when Horatio says:

> 'A little ere the mightiest Julius fell,
> The graves stood tenantless, and the sheeted dead
> Did squeak and gibber in the Roman streets;
> As, stars with trains of fire, and dews of blood,
> Disasters in the sun'.[5]

In *Henry VI*, Part I, the Duke of Bedford says:

> 'Comets, importing change of time and states,
> Brandish your crystal tresses in the sky'[6]

---

[3] J. M. Cohen and M. J. Cohen, *The Penguin Dictionary of Quotations* (Harmondsworth, Middlesex: Penguin, 1960), p.632.
[4] William Shakespeare, *Julius Caesar*, Act 2, Scene 2, Lines 30-32. https://shakespeare.mit.edu/julius_caesar/index.html.
[5] Shakespeare, *Hamlet*, Act 1, Scene 1, Lines 113-118.
[6] William Shakespeare, *Henry VI*, Part 1, Act 1, Scene 1, Lines 2-3. https://shakespeare.mit.edu/1henryvi/index.html.

And in King John (V.2) Louis the Dauphin says:

> 'But this effusion of such manly drops,
> Startles mine eyes, and makes me more amazed
> Than had I seen the vaulty top of heaven
> Figured quite o'er with burning meteors.'[7]

Shakespeare even seems to know about meteorites. In Richard II (II.iv) Salisbury says:

> 'Now, I see thy glory like a shooting star
> Fall to the base earth from the firmament'[8]

And that is where Shakespeare shows the superiority of his observation and imagination over those later writers who like the stars. He knows about comets, meteor showers, the constellations and the motion of the sky:

> 'The wind-shak'd surge, with high and monstrous mane
> Seemed to cast water on the burning Bear,
> And quench the guards of th'ever fixed pole'[9]

the violence of the storm encountered by Othello on his way to Cyprus indicated by the fact that the Great Bear (or Plough or Wain), which never goes below the horizon from UK latitudes, seems to disappear below the waves (amusingly, not quite such a good metaphor at the latitude of Cyprus).

> 'Heigh-ho! An't be not four by the day,
> I'll be hanged; Charles' Wain is over the new chimney
> And yet our horse not packed'[10]

---

[7] William Shakespeare, *King John*, Act 5, Scene 2, Lines 49-53. https://shakespeare.mit.edu/john/index.html.
[8] William Shakespeare, *Richard II*, Act 2, Scene 4, Lines 19-20. https://shakespeare.mit.edu/richardii/index.html.
[9] William Shakespeare, *Othello*, Act 2, Scene 1, Lines 13-15. https://shakespeare.mit.edu/othello/index.html.
[10] William Shakespeare, *Henry IV*, Part 1, Act 2, Scene 1, Lines 1-3. https://shakespeare.mit.edu/1henryiv/index.html.

the porters in the inn-yard in *Henry IV* part 1 realizing they are running late from the position of the Wain, or Plough, in the sky. In *Julius Caesar*, Brutus however fails to tell the time in this way (II.1):

> 'I cannot by the progress of the stars
> give guess how near to day.'[11]

There is a lovely couplet in *Two Nobel Kinsman*, a joint work by Shakespeare and John Fletcher. The Jailer's Daughter says:

> 'I am very cold, and all the stars are out too,
> 'The little stars and all, that look like aglets'[12]

the implication of the exceptionally cold night that the sky is especially clear so much fainter stars can be seen.

In *Timon of Athens* (IV.3) Shakespeare shows that he is aware that the moon shines by reflected light:

> The moon's an arrant thief,
> And her pale fire she snatches from the sun.[13]

In *Macbeth* he shows that he knows that one half of the earth is illuminated by the sun at a time:

> Now o'er the one-half world
> Nature seems dead, and wicked dreams abuse
> The curtained sleep.[14]

And in *Henry IV*, Part 1, Prince Hal shows that he knows the moon controls the tides:

---

[11] Shakespeare, *Julius Caesar*, Act 2, Scene 1, Lines 2-3.
[12] William Shakespeare and John Fletcher, *The Two Noble Kinsman*, Act 3, Scene 4, Lines 1-2. https://www.folger.edu/explore/shakespeares-works/the-two-noble-kinsmen/read/.
[13] William Shakespeare, *Timon of Athens*, Act 4, Scene 3, Lines 439-440. https://shakespeare.mit.edu/timon/index.html.
[14] William Shakespeare, *Macbeth*, Act 2, Scene 1, Lines 49-51. https://shakespeare.mit.edu/macbeth/index.html.

> For the fortune of us that are the moon's men doth ebb and flow like the sea, being governed, as the sea is, by the moon.[15]

Julius Ceasar says 'I am constant as the northern star', so Shakespeare knew the night-sky rotates about Polaris, the Northern Star, although Ceasar himself is unlikely to have said this because in his time, due to the precession of the equinoxes, the pole was not particularly near Polaris.

Shakespeare again refers to the Pole Star in *Sonnet* 116

> O no, it is an ever fixed mark
> That looks on tempests and is never shaken;
> It is the star to every wand'ring barque,
> Whose worth's unknown, although his height be taken.[16]

Shakespeare knows that mariners can use the elevation of the Pole Star to estimate their latitude.

The conspirators in *Julius Caesar* show that they are aware that the direction of sunrise varies with the season (II.1):

> 'Decius: Here lies the east. Doth not the day break here ?
> Casca: No.
> Cenna: O pardon, sir, it doth; and yon grey lines
> That fret the clouds are messengers of day.
> Casca: You shall confess that you are both deceived.
> (he points his sword)
> Here, as I point my sword, the sun arises,
> Which is a great way growing on the south,
> Weighing the youthful season of the year.
> Some two months hence up higher towards the north
> He first presents his fire, and the high east
> Stands, as the Capitol, directly here.
> (he points his sword)'[17]

[15] Shakespeare, *Henry IV*, Part 1, Act 1, Scene 2, Lines 30-33.
[16] William Shakespeare, *Sonnet* 116, Lines 5-8 https://shakespeare.mit.edu/Poetry/sonnet.CXVI.html.
[17] Shakespeare, *Julius Caesar*, Act 2, Scene 1, Lines 100-110.

In *Midsummer Night's Dream* the mechanicals consult an almanac to determine whether there will be a moon on the night of their impending performance.

> Snout Doth the Moon shine that night we play our play?
> Bottom A calendar, a calendar! Look in the almanac; find out moonshine, find out moonshine.
> Quince Yes, it doth shine that night.[18]

Richard the Third checks a calendar for the time of sunrise, just before the Battle of Bosworth:

> (Clock strikes)
> Richard: Tell the clock there. Give me a calendar.
> Who saw the sun today? (a book is brought)
> Ratcliffe: Not I, my lord.
> Richard: Then he disdains to shine, for by the book
> He should have braved the east an hour ago.
> A black day will it be to somebody[19]

And of course the play's opening lines

> Now is the winter of our discontent
> Made glorious summer by this fair son of York[20]

contains a pun on son/sun. So Richard foresees his doom in the darkened sun and unconsciously refers back to his gleeful opening words.

Other intriguing or resonant astronomical quotes are Claudius's remark to Hamlet 'That is most *retrograde* to our desires', apparently referring to the occasional retrograde (or backwards) motion of the planets. 'Retrograde' can have an ordinary meaning of 'contrary' but in *All's Well That Ends Well* Shakespeare uses retrograde explicitly in the context of the motion of Mars.

Another technical astronomy term comes in Prospero's

---

[18] William Shakespeare, *A Midsummer Night's Dream*, Act 3, Scene 1, Lines 46-50. https://shakespeare.mit.edu/midsummer/index.html.
[19] William Shakespeare, *Richard the Third*, Act 4, Scene 6, Lines 6-10. https://shakespeare.mit.edu/richardiii/index.html.
[20] Shakespeare, *Richard the Third*, Act 1, Scene 1, Lines 1-2.

> and by my prescience
> I find my *zenith* doth depend upon
> A most auspicious star.[21]

The zenith is the highest point in the sky reached by a star during its nightly rotation.

A highly perplexing speech occurs in *King John*:

> My lord, they say five moons were seen tonight:
> Four fixed and the fifth did whirl about
> The other four in wondrous motion[22]

This was written in 1596, well before Galileo's announcement of the four moons of Jupiter, so seems just to be fantastical. But it could just possibly be an allusion to the upheaval in the planetary system being talked about by some of Shakespeare's friends. On the other hand, in Cymbeline, written in 1610, the year of Galileo's announcement, Shakespeare has four ghosts dance around the sleeping Postumus in Act V, Scene 5, until they are dispersed by Jupiter. Some have taken this as an allusion to Galileo's discovery of the four moons of Jupiter. The context does not really support this but there is another curious fact about *Cymbeline*. There are twelve references to Jupiter in *Cymbeline*, far more than in any other Shakespeare play. The references are to the Roman god Jupiter, not to the planet, so you might say that this is natural in a Roman play. Yet there are no references to Jupiter in *Julius Ceasar* and only three in *Antony and Cleopatra*. Was Jupiter on Shakespeare's mind as he wrote *Cymbeline* because he had heard or read about Galileo?

Milton, writing seventy years later, and having actually met Galileo in his youth, explicitly mentions Galileo in *Paradise Lost*:

> As when by night the glass
> Of Galileo, less assured observers
> Imagined lands and regions in the moon.[23]

[21] William Shakespeare, *The Tempest*, Act 1, Scene 2, Lines 181-183. https://shakespeare.mit.edu/allswell/index.html.
[22] William Shakespeare, *King John*, Act 4, Scene 2, Lines 183-185.
[23] John Milton, *Paradise Lost*, Book 5, Lines 261-263.

The Shakespeare Concordance shows over 500 references to Sun, Moon or stars. To compare this with another rich source of imagery for Shakespeare, the theatre, there are just 106 references to theatre, stage, actors or players.

Table: Shakespeare Concordances Statistics

	Sun	Star/s	Moon	Total	Date of Composition	Collaborator
TOTAL	**252**	**128**	**130**	**510**		
Midsummer Night's Dream	2	2	23	27	1595	
Hamlet	8	10	5	23	1599-01	
Romeo and Juliet	14	6	3	23	1595	
Love's Labour's Lost	6	5	10	21	1594-95	
Sonnets	11	7	3	21	1609	
Taming of the Shrew	9	3	8	20	1590-91	
Antony and Cleopatra	5	6	7	18	1606	
Winter's Tale	7	6	4	17	1609-11	
King Lear	5	5	6	16	1605-6	
Henry IV, Part 1	7	4	5	16	1591-92	
Venus and Adonis	11	3	1	15	1593	
Cymbeline	9	4	1	15	1610	
Henry V	9	3	2	14	1599	
Richard III	9	3	1	13	1592-93	
Richard II	8	3	1	12	1595	
Pericles	4	6	2	12	1607-8	Wilkins
Coriolanus	4	1	6	11	1608	

All's Well That Ends Well	2	8	0	10	1604-5	Middleton
Tempest	4	1	5	10	1610-11	
Titus Andronicus	7	1	2	10	1591-92	Marlowe
Othello	4	1	4	9	1603-4	
Macbeth	4	2	3	9	1596-97	Middleton
King John	7	2	0	9	1596	
Timon of Athens	7	0	2	9	1605-6	Middeton
Merchant of Venice	3	0	4	7	1606	
Julius Caesar	2	3	1	7	1599	

Comparison between Shakespeare and his contemporaries:

		References to sun/moon/stars
Shakespeare	1564-1616	510
Marlowe	1564-1593	57 (5 plays)
Jonson	1572-1637	42 (7 plays)
Donne	1572-1631	55
Milton	1608-1674	118 (86 from *Paradise Lost*)

Marlowe is definitely interested in astronomical phenomena:

> And kindle heaps of exhalations
> That being fiery meteors, may presage
> Death and destruction to th'inhabitants.
> Over my zenith hang a blazing star …[24]

but when Faustus asks Mephistopheles about the structure of the heavens, he gets a strictly Aristotelean answer.

> Learned Faustus to find the secrets of Astronomy …
> He views the cloudes, the planets, and the Starres …

[24] Christopher Marlowe, *Tamburlaine*, Part 2, Act 3, Scene 2. https://marloweshakespeare.info/farey/tam1.html.

Even to the heights of Primum Mobile.[25]

Donne is definitely aware of the changing world order, and is filled with regret

And new philosophy calls all in doubt,
The element of fire is quite put out,
The sun is lost, and th'earth, and no man's wit
Can well direct him where to look for it.
And freely men confess that this world's spent,
When in the planets and the firmament
They seek so many new; they see that this
Is crumbled out again to his atomies.
'Tis all in pieces, all coherence gone,[26]

In his youth Milton met the aged Galileo, but in *Paradise Lost* it's still a strictly Aristotelean world that is described. As we shall see, only Shakespeare had the courage to talk about and embrace the new universe of Copernicus and Thomas Digges

Shakespeare is, however, not very complimentary about astronomers. Biron in *Love's Labour's Lost* (I.1) says:

Study is like the heavens' glorious sun,
That will not be deep searched with saucy looks.
Small have continual plodders ever won
Save base authority from others' books.
These earthly godfathers of heaven's lights,
That give a name to every fixed star,
Have no more profit of their shining nights
Than those that walk and wot not where they are.
Too much to know is to know naught but fame,
And every godfather can give a name.[27]

[25] Christopher Marlowe, *Fautus*, Part 2, Act 3, Scene 1. https://genius.com/Christopher-marlowe-the-tragical-history-of-doctor-faustus-chorus-1-full-text-annotated.
[26] John Donne, *An Anatomy of the World*, https://genius.com/John-donne-an-anatomy-of-the-world-annotated.
[27] William Shakespeare, *Love's Labour's Lost*, Act 1, Scene 1, Lines 84-93. https://shakespeare.mit.edu/lll/index.html.

To which the King wittily replies:

> How well he's read, to reason against reading.[28]

Obviously there is almost always a strong astrological content and Shakespeare makes no distinction between astronomy and astrology. In *Cymbeline*, Imogen says:

> 'O, learn'd indeed were that astronomer,
> That knew the stars as I his characters;
> He'd lay the future open.'[29]

And in Sonnet 14:

> Not from the stars do I my judgement pluck,
> And yet methinks I have astronomy;
> But not to tell of good or evil luck,
> Of plagues, of dearths, or seasons' quality.[30]

Ben Jonson is even more scathing about astronomers:

> SORDIDO. Tut, these star-monger knaves, who would trust them? One says dark and rainy, when 'tis as clear as chrystal; another says, tempestuous blasts and storms, and 'twas as calm as a milk-bowl; here be sweet rascals for a man to credit his whole fortunes with! You sky-staring coxcombs you, you fat-brains, out upon you; you are good for nothing but to sweat night-caps, and make rug-gowns dear! you learned men, and have not a legion of devils 'a votre service! a votre service!' by heaven, I think I shall die a better scholar than they:[31] (*Everyman Out of his Humour*)

---

[28] Shakespeare, *Love's Labour's Lost*, Act 1, Scene 1, Line 94.
[29] William Shakespeare, *Cymbeline*, Act 3, Scene 2, Lines 27-29. https://shakespeare.mit.edu/cymbeline/index.html.
[30] William Shakespeare, *Sonnet* 14, Lines 1-4. https://shakespeare.mit.edu/Poetry/sonnet.XIV.htm. l
[31] Ben Johnson, *Everyman Out of his Humour*, Act 3, Scene 2. https://genius.com/Ben-jonson-every-man-out-of-his-humour-introduction-annotated.

Both Shakespeare and Jonson think that astronomers name stars and claim to predict the weather.

The astronomical universe that Shakespeare refers to is, naturally enough, a strictly Aristotelian one:

> 'Doubt that the stars are fire,
> Doubt that the sun doth move
> Doubt truth to be a liar
> But never doubt I love.'[32]

So this letter from Hamlet to Ophelia assumes his contemporaries all know that the stars are made of fire and that the sun moves around the earth. Any deviation from the motion of the spheres must be associated with magic:

> 'And certain stars shot madly from their spheres
> To hear the sea-maid sing'.[33]

I mentioned Shakespeare's references to the stars controlling our fates and these seem like the conventional astrological view of the period. But there is one very dramatic counter to this, in *Lear*:

> 'This is the excellent foppery of the world … we make guilty of our disasters the sun, the moon and the stars, as if we were villains by necessity, fools by heavenely compulsion, knaves, thieves and treachers by spherical predominance, drunkards, liars and adulterers by enforced obedience of planetary influence. …
> I should have been that I am had the maidenliest star in the firmament twinkled on my bastardizing.'[34]

This is an amazing assault on the astrological fatalism that we hear from the mouths of so many of Shakespeare's characters. Of course it comes from the mouth of the villain of the play, Edmund, so does not necessarily represent Shakespeare's own sceptical view.

Earlier in the scene, the Earl of Gloucester has piously remarked:

---

[32] Shakespeare, *Hamlet*, Act 2, Scene 2, Lines 116-119.
[33] Shakespeare, *A Midsummer Night's Dream,* Act 2, Scene 1, Lines 153-154.
[34] William Shakespeare, *King Lear*, Act 1, Scene 2, Lines 117-130. https://shakespeare.mit.edu/lear/index.html.

> 'These late eclipses in the sun and moon portend no good to us. Though the wisdom of nature can reason it thus and thus, yet nature finds itself scourg'd by the sequent effects.'[35]

Edmund ridicules the idea that eclipses portend anything. Gloucester knows very well that there is a natural explanation for eclipses, but still thinks they must mean something.

Othello invokes eclipses to express his anguish (V.2):

> 'O insupportable, O heavy hour!
> Methinks it should be now a huge eclipse
> Of sun and moon, and that th'affrighted globe
> Should yawn at alteration.'[36]

Bit of an astronomical blunder here, because the sun and moon could not be simultaneously eclipsed (they can be eclipsed two weeks apart and this happened in 1598 and, less impressively, in 1605 when Lear was being written).

In *Antony and Cleopatra* III.13, Antony uses an eclipse metaphor to express his sense of impending doom:

> 'Alack our terrene Moon is now eclipsed,
> And it portends alone the fall of Antony.'[37]

Cleopatra also uses an astronomical metaphor as she resolves to die (V.2):

> 'now from head to foot
> I am marble-constant: now the fleeting Moon
> No planet is of mine.'[38]

Time and again Shakespeare calls on astronomical phenomena to convey the emotional state of his characters. One of the most famous is Juliet in the balcony scene

> 'O, swear not by the moon, the inconstant moon,

[35] Shakespeare, *King Lear*, Act 1, Scene 2, Lines 101-104.
[36] Shakespeare, *Othello*, Act 5, Scene 2, Lines 107-110.
[37] William Shakespeare, *Antony and Cleopatra*, Act 3, Scene 13, Lines 156-158. https://shakespeare.mit.edu/cleopatra/index.html.
[38] Shakespeare, *Antony and Cleopatra*, Act 5, Scene 2, Lines 235-237.

> That monthly changes in her circled orb,
> Lest that thy love prove likewise variable.'[39]

This reliance on astronomical metaphor for emotional effect at key moments is surely unique to Shakespeare.

A more measured critique of astrological fortune-telling comes from Pandolf in *King John* (III.4):

> 'No natural exhalation in the sky,
> No scope of nature, no distempered day,
> No common wind, no customed event,
> But they will pluck away his natural cause,
> And call them meteors, prodigies, and signs,
> Abortives, presages, and tongues of heaven
> Plainly denouncing vengeance upon John.'[40]

And in *All's Well That Ends Well*, Helen says (I.1):

> 'Our remedies oft in ourselves do lie
> Which we ascribe to heaven. The fated sky
> Gives us free scope, only doth backward pull
> Our slow designs when we ourselves are dull.'[41]

And of course Cassius says to Brutus in *Julius Caesar* (1.2)

> 'The fault, dear Brutus, is not in our stars
> But in ourselves, that we are underlings.'[42]

Apart from these critical asides, Shakespeare seems at first sight unaware of the new astronomy that had burst into European consciousness with Copernicus in 1543. And why should he, he was not a university man.

Even Christopher Marlowe, Shakespeare's exact contemporary, has Mephistopheles explain the Ptolemaic system when Faustus asks him about the structure of the heavens. Writing two hundred years later, the romantic poets, incidentally, show little evidence of ever having much

[39] William Shakespeare, *Romeo and Juliet*, Act 2, Scene 1, Lines 151-153. https://shakespeare.mit.edu/romeo_juliet/index.html.
[40] Shakespeare, *King John*, Act 3, Scene 4, Lines 153-159.
[41] Shakespeare, *All's Well That Ends Well*, Act 1, Scene 1, Lines 212-215.
[42] Shakespeare, *Julius Caesar*, Act 1, Scene 2, Lines 141-142.

looked at the night sky and write about the stars in rather general terms. Of course they inhabit a very different, post-Aristotelian universe. In Byron's great poem 'Darkness' we get a real feel of the evolution of stars and of the universe. Tennyson and Hardy are the two writers who, after Shakespeare, demonstrate a real love, and deep knowledge of, the night sky. Of his predecessors Dante and Chaucer both used astronomy extensively in their work.

I now want to say a bit more about the great Polish astronomer, Nicolas Copernicus, and the reception in Europe of his new world-system, with the Sun at the centre of the solar system, and the earth spinning on its axis and orbiting the Sun. The main events of his life were:

1473 Copernicus born in Torun
1496 Goes to Bologna to study with Domenico Novara
1500 Invited to Rome to lecture on his new model (Pope Gregory VI)
1510 Publishes *Commentariolis,* brief account but with all 37 circles
1512 Invited by Pope Leo X to Rome to discuss reform of calendar (declines)
1533 Encouraged by Pope Clement VII to publish his book (prevaricates)
1539 Attacked by Martin Luther
1541 Condemned by Protestant theologian Philip Melanchthon
1543 Publishes *de Revolutionibus*, receives copy on his deathbed

Copernicus was immediately attacked by the Catholic Church's chief censor, Bartolommeo Spina. But Copernicus was not discussed at the Council of Trent (1545–63), so was not seen as a threat. Copernicus received limited support on continental Europe (Rothmann 1580, Kromer 1581, Bruno 1584, Kepler 1596, Galileo 1610, Maestlin 1620). The Wittenberg school (Melanchthon, Rheinhold, Rheticus, Peucer) were definitely interested in Copernicus's model and the mathematical predictions based on it, but they mostly did not support the idea that the earth orbits the sun. Rheticus visited Copernicus, wrote a summary of the theory, *Narratio* Primo in 1540, and helped Copernicus publish *de Revolutionibus.* Rheinhold published the Prussenic Tables in 1550, based on Copernicus's model, but did not support heliocentrism. In 1616 *de Revolutionibus* was placed on the Index.

I've already said something about the English Copernicans, especially John Dee (1527–1608), who was interested in astronomy, but also in astrology, alchemy and the occult. He wrote a preface to Thomas Field's

1556 almanac saying he wants to promote the Copernican system for all astronomical calculations. This is pretty remarkable, just 13 years after the publication of *de Revolutionibus.* And Thomas Digges (1546–1595), brought up by John Dee following the death of his father. He was a noted mathematician and Copernican. Digges and Dee studied the new star of 1572 (Tycho's supernova). In 1576 Digges published *A perfit description of the caelestiall orbes*, taking the Copernican system to its logical conclusion and asserting that the stars extend to infinity. Digges lived in Philip St, Aldermanbury, next to Shakespeare's friends Heminges and Condell. On his death his wife Anne married Thomas Russell, who Shakespeare appointed as an overseer of his will. His son Leonard wrote a touching poem about Shakespeare in the Folio of 1623.

The reason I comment on Shakespeare's seeming lack of awareness of the new astronomy is that he does seem to have a link to the English Copernicans and it would be surprising if he had not heard their ideas. The evidence for this link is also a key piece of evidence that the actor William Shakespeare of Stratford is truly the author of the plays of Shakespeare. It seems hard to doubt this when we read the eulogy of Ben Jonson, but people do persist in doubting that Will S. could have written these great plays. The evidence is in the names of those two treacherous friends of Hamlet, Rosencrantz and Guildenstern. These are not random names, but are in fact the names of two of the ancestors of the great Danish astronomer, Tycho Brahe, who was a contemporary of Shakespeare. Tycho was in correspondence with the leading English Copernicans and in 1590 wrote to Thomas Savile enclosing his 1588 book describing his hybrid model of the solar system (in which the planets orbit the sun, but the sun orbits a stationary earth), along with four copies of his portrait, which is framed by a stone arch with heraldic shields bearing the names of his ancestors Sophie Gyldenstierne and Erik Rosenkrantz. Tycho specifically asks Savile to remember him to John Dee and Thomas Digges. The astronomer Thomas Digges (1546–1595), a member of John Dee's circle and whose guardian John Dee had become after the death of his father, had in his 1576 pamphlet *A perfit description of the caelestiall orbes*, taken the Copernican system to its logical conclusion and asserted that the stars extend to infinity.

Thomas's father Leonard was a well-known mathematician and has been credited with the invention of the telescope prior to Galileo. Thomas published new editions of his father's mathematical and scientific works and added material of his own. He was also an MP from 1572–1586 and a friend of the poet Sir Philip Sidney.

One copy of Tycho's portrait ended up in the possession of Thomas Digges' younger son Leonard. Now the Digges and Shakespeare families were connected. Leonard Digges Jnr praised Shakespeare in a rather touching poem in the Folio edition of 1623. After Thomas Digges's death, his widow Anne married Thomas Russell, whom Shakespeare appointed overseer of his will. It seems likely that Shakespeare got the names for these two characters in his Danish play from Thomas Digges. They are in fact among the few characters in the play with Danish-sounding names. This link would make the Stratford actor Will Shakespeare definitively the author of Hamlet. However there is another route for Shakespeare to have encountered these names. In 1592 two members of a Danish diplomatic mission to London were Frederick Rosenkrantz and Knud Gyldenstierne, two cousins of Tycho's, and perhaps Shakespeare came across these names then.

A quotation which suggests the influence of Thomas Digges is Hamlet's famous remark:

> 'I could be bounded in a nutshell and count myself king of infinite space'.[43]

To us this sounds like natural, if dramatic, imagery. But the idea of infinite space, introduced by Thomas Digges in 1576, was extremely novel and revolutionary to times which were still drenched in centuries of Aristotle's finite universe. Infinite space would have been a mind-blowing idea in the late sixteenth and early seventeenth century. Here perhaps we do have a reference to the new astronomy of Copernicus and Digges. Is it a coincidence that Hamlet is a student at Wittenberg, where Georg Rheticus, who helped Copernicus finish and publish his great book, and Erasmus Rheinhold, who published the first Copernican planetary tables, both lectured?

Another remarkably modern-sounding line is the Chorus's prologue to the fourth Act of *Henry V*:

> Now entertain conjecture of a time
> When creeping murmur and the pouring dark
> Fills the wide vessel of the universe.[44]

[43] Shakespeare, *Hamlet*, Act 2, Scene 2, Lines 256-257.
[44] William Shakespeare, *Henry V*, Act 4, Prologue, Lines 1-3. https://shakespeare.mit.edu/henryv/index.html.

I'll return to this later.

There is a strong hint of Copernicanism in Ulysses' famous speech on degree in *Troilus and Cressida* (I.3):

> 'The heavens themselves, the planets and this centre
> Observe degree, priority and place,
> Insisture, course, proportion, season, form,
> Office and custom, in all line of order;
> And therefore is the glorious planet Sol
> In noble eminence enthroned and sphered
> Amidst the other; whose medicinable eye
> Corrects the ill aspects of planets evil,
> And posts, like the commandment of a king,
> Sans cheque to good and bad:'[45]

This closely mirrors the first page of Thomas Digges' *A perfit description of the Celestiall Orbs (1576):*

> 'the Earth …. is carried yearly round about the Sun, which like a king in the midst of all reigneth and giveth laws of motion to the rest, spherically dispersing his glorious beams of light through all this sacred Celestial Temple.'[46]

Although he's describing an Aristotelean order of the heavens, the sun seems to be enthroned in the centre and controlling the planets.

I've admitted that Edmund's assault on astrology in Lear does not come from a reliable witness. But perhaps we have to look again at Hamlet's letter to Ophelia. He writes:

> 'Doubt that the sun doth move'[47]

meaning that you can't doubt that, therefore you can't doubt my love. However as Polonius and Claudius come to realize, and Hamlet makes pretty clear to Ophelia and the audience, he does not love Ophelia. Is Shakespeare saying to us that perhaps we do have to question whether it is

[45] William Shakespeare, *Troilus and Cressida*, Act 1 , Scene 3, Lines 85-94. https://shakespeare.mit.edu/troilus_cressida/index.html.
[46] Thomas Digges, *A perfit description of the Celestiall Orbs (1576).* https://math.dartmouth.edu/~matc/Readers/renaissance.astro/5.1.Orbs.html.
[47] Shakespeare, *Hamlet*, Act 2, Scene 2. Line 127.

the sun that moves ? That would be amazing, but it would only make sense if Shakespeare was confident his audience would know what he was talking about. How far would Copernicanism have spread from the circles of enthusiasts like John Dee and the Earl of Northumberland?

When Hamlet jumps into Ophelia's grave he says

> 'What is he whose grief
> Bears such an emphasis, whose phrase of sorrow
> Conjures the wand'ring stars and makes them stand still
> Like wonder-wounded hearers? This is I,
> Hamlet the Dane.'[48]

again suggesting that the new world-order, in which it is not the sun and stars that move, is on his mind. o Rosencrantz and Guildenstern he has earlier said:

> 'and indeed it goes so heavily with my disposition that this goodly frame, the earth, seems to me a sterile promontory. This most excellent canopy the air, look you, this brave o'erhanging, this majestical roof fretted with golden fire – why it appears no other thing to me than a foul and pestilent congregation of vapours.'[49]

Is not part of Hamlet's angst the destruction of the old world-order?

And earlier, after meeting the ghost of his father, Hamlet uses an odd turn of phrase

> 'Remember thee?
> Ay, thou poor ghost, while memory holds a seat
> In this distracted globe.'[50]

Footnotes in modern editions suggest that by globe Hamlet means his skull and that certainly makes perfect sense. However on all the other occasions that Shakespeare uses the word globe he means the earth, apart from Prospero's famous speech when he predicts that the great globe itself shall dissolve, where he is referring both to the earth and to the Globe Theatre. Could the 'globe' be 'distracted' because it, the earth, is now forced into orbit around the sun ?

---

[48] Shakespeare, *Hamlet*, Act 5, Scene 1. Lines 150-154.
[49] Shakespeare, *Hamlet*, Act 2, Scene 2, Lines 299-305.
[50] Shakespeare, *Hamlet*, Act 1, Scene 5, Lines 95-97.

Shakespeare's astronomy is rich and diverse, rooted in knowledge of the night sky, permeated with what was still the majority Aristotelian world-view of the day. He seems to be aware of the ideas of Copernicus and Thomas Digges, and was willing to reference them in his plays. It's interesting too that several of his astronomical references come from the mouths of his working-class characters, the porters in the inn yard in *Henry IV Part 1*, the mechanicals in *Midsummer Night's Dream*. He was not just talking to his courtly audience.

From Aristotle he derived much more than just an astronomical world-view. Aristotle's ethics, perhaps imbibed via the French sixteenth century essayist Michel de Montaigne. In his ' *Shakespeare – the invention of the human*', the American literary critic Harold Bloom sees a strong link between Shakespeare and Montaigne. Of Hamlet Bloom writes:

> 'This most extraordinary of all the Shakespearean characters … is, amidst much else, a despairing philosopher whose particular subject is the vexed relationship between purpose and memory. And his chosen mode for pursuing that relationship is the theatre, of which he will display a professional's knowledge and an active playwright's strong opinions. His Wittenberg is pragmatically London, and his university must certainly be the London stage. We are allowed to see his art in action, and in the service of his philosophy, which transcends the scepticism of Montaigne and, by doing so, invents Western nihilism.'[51]

Thus Bloom links Shakespeare with Aristotle, via Montaigne, and makes Hamlet the originator of the existential terror of Pascal and Sartre. The issue of whether Shakespeare was strongly influenced by Montaigne is much debated. There is little dispute that Shakespeare's late play The Tempest was influenced by Montaigne's essay 'On Cannibals'. Gonzalo's description in Act II Scene I of an ideal commonwealth is almost a direct quotation from Montaigne. Montaigne's essays were first translated into English in 1603 by John Florio, who was secretary to Shakespeare's patron, the Earl of Southampton. For Hamlet, written in 1600-1, to have been influenced by Montaigne, as argued by Bloom and others, requires Shakespeare to have seen an earlier draft of Florio's translation. As Bloom writes:

[51] Harold Bloom, *Shakespeare: The Invention of the Human*. New York: Riverhead Books, 1998, pp.383–385.

> 'Presumably, Shakespeare had read Montaigne in Florio's manuscript version. Nothing seems more Shakespearean than the great, culminating essay, 'Of Experience', composed by Montaigne in 1588, when I suspect Shakespeare was finishing his first Hamlet.'[52]

In 1925 George Coffin Taylor examined Shakespeare's plays and matched passages in them to Montaigne's essays. In his *Shakespeare's Debt to Montaigne* Taylor found fifty-one passages in Hamlet and twenty-three in Lear that matched[5]. He assembled a list of hundreds of words and phrases, many obscure, that appear in Florio's 1603 translation of Montaigne and that are used by Shakespeare in plays written after 1603, but which never appear in plays prior to that date. To a scientist this looks likes good evidence that Shakespeare had read Montaigne.

There are two direct references to Aristotle in Shakespeare's plays. In *The Taming of the Shrew* Lucentio's man Tranio says (Ii):

> 'Let's be no Stoics nor no stocks, I pray,
> Or so devote to Aristotle's checks
> As Ovid be an outcast quite abjur'd.
> Balk logic with aquaintance that you have,
> And practise rhetoric in your common talk;
> Music and poesy use to quicken you;
> The mathematics and the metaphysics,
> Fall to them as your stomach serves you.'[53]

Tranio is advising against excessive study but he is aware that Aristotle has written books on Logic, Rhetoric, Poetics and Metaphysics.

Even more interesting is the reference in *Troilus and Cressida*, where Hector says (IIii):

> 'Paris and Troilus, you have both said well;
> And on the cause and question now in hand
> Have gloz'd but superficially; not much
> Unlike young men, whom Aristotle thought

[52] Harold Bloom, *Shakespeare: The Invention of the Human*. New York: Riverhead Books, 1998, pp.xii–xiv.
[53] William Shakespeare, *The Taming of the Shrew*, Act 1, Scene 1, Lines 31-38. https://shakespeare.mit.edu/taming_shrew/index.html.

Unfit to hear moral philosophy.'[54]

Now this is a direct quote from Aristotle's *Ethics*, a work that was freely available in English translation in Shakespeare's lifetime. Perhaps we have been misled by Ben Jonson's famous line in his dedicatory poem to the First Folio:

'And though thou hadst small Latine, and less Greeke'[55]

to assume that Shakespeare was uneducated and unread. When Friar Lawrence eulogizes the benefits of plants and herbs in Romeo and Juliet (IIiii) he is expounding an Aristotelian harmony and balance. At the same time in the character of Holofernes in *Love's Labour's Lost* he parodies the pedantry of the schoolmen.

So Shakespeare encapsulates the intellectual world of Aristotle, but seems to give strong hints at the arrival of the Copernican system. As he was writing his exact contemporary Galileo was plotting the overthrow of Aristotle's physics.

Finally, Shakespeare's invention of the universe;

'Now entertain conjecture of a time
When creeping murmur and the pouring dark
Fills the wide vessel of the universe.'[56]

The Chorus is looking out on the two opposing armies encamped the night before the battle of Agincourt. He is surely talking about both the earth and the night sky above. This is the first use in English of the word 'universe', meaning the whole celestial sphere.

The Oxford dictionary cites several earlier uses of the word 'universe'. Firstly Giordano Bruno's *L'Infinito, Universo e Mundi* 1584, where 'universo' certainly means 'universe', but this work was not translated into English.

Then George Puttenham in *The Arte of English Poesie* 1589

[54] Shakespeare, *Troilus and Cressida*, Act 2, Scene 2, Lines 161-166.
[55] Ben Johnson, *To the Memory of My Beloved the Author, Mr. William Shakespeare,* https://www.poetryfoundation.org/poems/44466/to-the-memory-of-my-beloved-the-author-mr-william-shakespeare.
[56] Shakespeare, *Henry V*, Act 4, The Chorus's prologue, Lines 1-3.

> 'The Roundell or sphere … for his ample capacities doth resemble the world or vnivers'[57]

where he equates 'vnivers' with the world.

Finally Edmund Spenser *An Hymn of Heavenly Beauty* 1589

> 'Looke on the frame
> Of this wyde vniverse, and therein reed
> The endless kinds of creature.'[58]

Where he seems to be talking about the world and its creatures, rather than the heavens. So perhaps we really can talk about Shakespeare's universe.

In conclusion, there can be no doubt about Shakespeare's deep knowledge of, and keen interest in, the astronomical night sky. And I think there is little doubt that Shakespeare knew about, and had the courage to talk about, the new universe of Copernicus and Thomas Digges.

[57] George Puttenham in *The Arte of English Poesie* 1589, II xi 111.
[58] Edmund Spenser *An Hymn of Heavenly Beauty* 1589 .