

Hamlet's Transformation

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In 1543, the book *De revolutionibus* by Nicholas Copernicus (1473-1543) completely revised the cosmic world view, for it removed the Earth from the center of the planetary system and placed the Sun there instead. As early as 1556 the heliocentric model had started to take root in England¹ and was thus already in place at the time of William Shakespeare (1564-1616).

Authors cite this revolution in astronomical thought as evidence that Shakespeare lived and wrote at a time of great change. Yet if he did appreciate these profound changes in world view, no-one can say exactly where in the canon such appreciation is to be found. Astronomy is one of Shakespeare's many specialties² yet no obvious evidence exists that he saw the universe in anything but geocentric terms.³ That he could fail to notice this transformation in world view must rank as a major mystery in the history of the Renaissance.

This essay addresses the problem by reference to the text itself and to the Amleth legend of Saxo Grammaticus (fl. 1188-1201) in *Historia Danica*.⁴ It is supplemented by scientific and historical fact. I have proposed an allegorical interpretation based on parallels that exist between the events of the play and the development and competition between the four chief world models extant at the turn of the sixteenth century. ⁵ I conclude that Shakespeare was quite

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aware of the astronomical revolutions of his time, and that in coming down on the side of the Copernican Revolution and its Diggesian corollary, Shakespeare defines poetically the new universal order. If the present interpretation has merit, Hamlet would manifest an astronomical cosmology that is no less magnificent than its literary and philosophical counterparts.

Interpretation

Among all of Shakespeare's "problem plays", *Hamlet* is "one of the most puzzling"⁶ and "the most enigmatic of the tragedies."⁷ No play "has been analyzed as extensively"⁸ yet "has always been a mystery."⁹ Consensus on the meaning of *Hamlet* has not yet been reached despite nearly four centuries of effort. The complexity and apparent impenetrability of *Hamlet* makes it a particularly popular target for new interpretations and has resulted in an immense range of viewpoints.

For present purposes I take "interpretation" to mean "criticism whose primary goal is a statement of . . . meaning".¹⁰ Unfortunately the intent of an artist in the creation of original work can never be fully known,¹¹ while at the same time a particular interpretation is not wholly without presuppositions. The difficulty is that reading becomes misreading when it mirrors the reader and not the artist.¹² On the other hand, without new reflections, no progress can occur. Here I make an heuristic attempt to overcome this hermeneutic dilemma in order to gauge the extent to which an astronomical interpretation of *Hamlet* will "work."¹³

Appearances vs. Reality

In 1.2 when Hamlet says: "Seems, madam? Nay, it is. I know not 'seems'", he is addressing the age-old problem of appearances versus reality.¹⁴ This distinction represents a basic difficulty in the development of world views, be they celestial or terrestrial, physical or metaphysical. Thus Hamlet's issue of "seems" *versus* "is" is fundamental to our interpretation of the world.

From the standpoint of the development of astronomical cosmology, eyesight rules on the strength of appearances, sometimes giving the impression that appearance is reality, and that seeing is believing. Thus in early times the sense of sight fooled observers into believing themselves to be at the cosmic center. The course of the development of the centerless cosmic world view has been a protracted struggle to overcome this tyranny of location.

It is not surprising therefore that the first cosmic models were geocentric, reaching an advanced state of refinement in the *Almagest* of Claudius Ptolemy (fl. 140 AD). In this model the Earth is fixed at the center of the universe while the seven Ancient Planets (Sun, Moon, Mercury, Venus, Mars, Jupiter, and Saturn) revolve about it. The entire arrangement is encased in a shell of stars beyond which is the abode of the Prime Mover. The sky appears to move continuously westward relative to the horizon, but the Sun and Moon appear

to move eastward relative to the stars. Most of the time, the other Ancient Planets also move eastward relative to the stars; but sometimes they undergo “retrograde motion”, moving westward instead before resuming their eastward drift.

Retrograde motion set the stage for a confrontation between appearance and reality. Early attempts to account for the phenomenon reached a high degree of sophistication in Ptolemy’s *Almagest*. But retrograde motion complicated the action of the Prime Mover and contradicted the simplicity of Platonic geocentricity. Arcane geometric complexity was needed to account for the phenomenon, and through the centuries no permanent solutions were found.

In 1541 Rheticus (1514-1576) visited Copernicus in order to learn of his new heliocentric model. Therein only the Moon’s orbit was geocentric; the Earth was relegated to the status of a planet that orbits the Sun. A virtue of the Copernican model over the Ptolemaic was its ability to account for appearances with an economy of assumptions.¹⁵ In particular, the appearance of retrograde motion was explained in essence by the reality of a new planetary order. This reality necessitated both a transformation of the center from Earth to Sun, and the revolution of the Earth about the Sun. As in the Ptolemaic model, a shell of stars encased this system too. These changes in world view are paralleled in *Hamlet*.

Rheticus returned to the University at Wittenberg bringing the mathematical content of the model with him. Wittenberg became the first center of heliocentricism, and thus the first site where a student might find the appearance of retrograde motion explained by heliocentric revolution.¹⁶

The hybrid system of Tycho Brahe (1546-1601) first appeared in 1588 in *De Mundi aetherei recentioribus Phoenomenis Liber secundus*.¹⁷ Tycho’s system had five planets revolving about the Sun as in the Copernican model, but the Sun and the Moon revolved about the Earth as in the Ptolemaic model. The Earth remained fixed and a sphere of the stars turned daily as in Ptolemy’s model.

Within one-third of a century of the death of Copernicus, the English mathematician Thomas Digges (c.1546-1595) shattered the last and outermost sphere of the stars. In *A perfit description of the caelestiall orbes* of 1576, Digges embraced Copernicanism and advanced beyond it to a new and revolutionary vision — an infinite universe of stars like the Sun. Thus Digges was the first Renaissance writer to propose a physically infinite universe. His model restored the earlier Epicurean-Lucretian cosmology,¹⁸ for his new cosmic reality replaced the appearance of starry encapsulation that was a feature of all earlier models.¹⁹ Within a decade of the Diggesian advance, the philosopher Giordano Bruno (1548-1600) had advanced the similar ideas.

These four attempts to model appearances were in contention at the turn of the sixteenth century, but I believe that the Bard knew full well which was correct.

Tycho Brahe, Thomas Digges, and Shakespeare

In 1590, Tycho wrote to one of England's most learned men²⁰ Thomas Savile (d. 1593), enclosing two copies of his 1588 book along with four copies of his portrait that had been engraved in copper in Amsterdam in 1586.²¹ The portrait depicts Tycho framed by a stone portal comprising an arch supported by columns on either side. The structure supports heraldic shields bearing the names of Tycho's ancestors Sophie Gyldenstjerne and Erik Rosenkrantz.²² Tycho asked Savile to be remembered to John Dee and to Digges, and suggested that some excellent English poets might compose witty epigrams in praise of him and his work.²³ Eventually a copy of Tycho's portrait ended up in the possession of Thomas' son, Dudley Digges.²⁴

According to Honigmann,²⁵ Hotson has proved Shakespeare's connection to Thomas Digges.²⁶ The connection is corroborated by Rowse.²⁷ Not only was Dudley Digges involved in relaying information that prompted the writing of *The Tempest*, but his younger brother Leonard praised the Bard in a poem in the Folio edition of 1623. Shakespeare lived near to the Digges' home when he was in London and after the death of Thomas Digges in 1595, his widow Anne married Thomas Russell whom Shakespeare had appointed as overseer of his will.

The conventional wisdom is therefore that Shakespeare learned of Tycho through Digges, and gained access to Tycho's portrait, prompting him to select the names of Rosencrantz and Guildenstern. Certainly it seems unlikely that Shakespeare chose these "mouth-filling trifles of nomenclature"²⁸ simply because distant relatives of the Danish astronomer happened to be visiting England in the late sixteenth century.²⁹ Hotson cites instances that show that Digges' works played a significant role in several Shakespearean plays,³⁰ and it seems plausible that they play a role in *Hamlet* too. Moreover, Shakespeare gathered his military information from Digges' treatise *Stratoticos*³¹ and it would be stretching credulity to believe that he would ignore his other works. In Section 10 below I suggest that Shakespeare used Digges' *Pantometria* too.

In his student days abroad, Tycho visited Wittenberg and in 1566 went to Rostock where an embarrassing astrological prediction³² may have triggered a dispute with a cousin. In the resulting sword fight, Tycho suffered the loss of his nose.³³ The dispute was symptomatic of family violence of the late sixteenth century which in Denmark in 1576 led to the passage of legislation prohibiting a nobleman who killed his brother from inheriting any part of his brother's estate.³⁴ These events parallel a central theme of *Hamlet*.

Other passages in the text may refer to Tycho too. In 2.2 Hamlet argues with Rosencrantz and Guildenstern, saying:

... the earth, seems to me a sterile promontory; this most excellent canopy, the air, . . . appeareth nothing to me but a foul and pestilent congregation of vapors. 2.2.282-6

Here the words “promontory” and “air” are uttered (so to speak) in the same breath. According to the OED, the word “promontory” was in use in the sixteenth century to mean both a point of land that juts out much like Jutland itself, or anything that resembles this. In fact, the “Promontory of Noses” is where Tycho is thought to have gone for a prosthetic nose.³⁵ Also, in 4.3 Hamlet directs Claudius where to seek the body of Polonius: “You shall nose him as you go up the stairs into the lobby” (4.3.35).

Tycho had two artificial noses which he attached with a salve. One was made of gold and silver blended to a flesh tone, but for everyday use (and for his burial) a lighter alloy of copper and other metals was used.³⁶ In *Troilus and Cressida*, Cressida says (1.2.105-107):³⁷ “I had as lief Helen’s golden tongue had commended Troilus for a copper nose . . .”

After the players have arrived in 2.2, Hamlet refers to his “uncle-father” and “aunt-mother” (2.2.345-6). When about 2 years old Tycho was kidnapped by his uncle Jorgen Brahe and his wife Inger who raised Tycho as their own son.³⁸ Thus in real life Jorgen and Inger doubled as uncle-father and aunt-mother respectively. Perhaps these events are mirrored in Hamlet’s disapproval of his uncle who claims to be his “father” but whose incestuous marriage has turned his mother into his “aunt”.

Hamlet and the Infinite Universe

In 1.2 Hamlet stays at Elsinore to please his mother, but his “obstinate condolment” prompts Claudius the King to seek the help of Rosencrantz and Guildenstern. After they arrive in 2.2 they soon enter into argument with Hamlet. Denmark is “too narrow for your mind” says Rosencrantz, to which Hamlet replies:

O God, I could be bounded in a nutshell and count myself a king of infinite space, were it not that I have bad dreams. 2.2.243-4

“Infinite space” is a direct reference to Digges’ vision of a firmament filled with stars like the Sun.³⁹

“Bad dreams” may refer both to the oppressiveness of Elsinore and to a fear of persecution,⁴⁰ for within a few lines Hamlet says: “By my fay, I cannot reason” (2.2.251-2) meaning that free inquiry about the universe is proscribed. This explanation is textually supported, for in 3.1.179-80 Polonius advocates imprisonment if Hamlet does not divulge his schemes to his mother. The evidence suggests that Shakespeare was prudent to disguise the underlying meaning of Hamlet. In the sixteenth century imprisonment and execution were common punishments, a well-known case being the persecution of Giordano Bruno whose impieties included belief in an infinite universe.⁴¹ Shakespeare would have known of Bruno’s death in 1600 at the time of writing *Hamlet*.

“Nutshell” seems intended to contrast with the word “infinite”, for the smallness of the solar system in the bounded models of Ptolemy and Copernicus can be seen in the “mind’s eye” (1.1.112; 1.2.185) by imagining that the stars are suns that stretch indefinitely outward beyond the flux limit of the naked eye. This suggests use of an optical aid (see Section 13 below). The *OED* cites the very passage above to exemplify the meaning of “nutshell” as “something of extremely small size.” Though “nut” is a fruit with a hard shell, from the fourteenth century it is also “a symbol of something of trifling value.” The “thing” of small size would then be the shell of stars supposedly encasing all of creation in all but Digges’ model. At the same time it may express the encasement of Tycho who is framed by a stony portal whose arch symbolizes the shell of the stars overhead.

Thomas Digges was born c. 1546, and was thus a contemporary of Tycho. The text supports this fact when Claudius says of Hamlet’s boyhood chums:

. . . being of so young days brought up with him
And sith so neighboured to his youth and havior. 2.2.11-2

Available evidence is that Digges was about thirty years old when he published his *Perfit Description* in 1576. In Act 5 Shakespeare makes it quite clear that Hamlet is thirty years old at the time when Rosencrantz and Guildenstern have just been slain, and when Claudius is about to be. Digges’ *Perfit Description* killed the Tychonic and the Ptolemaic models. Just so, Hamlet is responsible for the deaths of the Rosencrantz and Guildenstern duo, and of Claudius. It follows that the allegorical date of the events of 5.2 is the year 1576.⁴² The suggestion of Olson, Olson, and Doescher,⁴³ that the “star that’s westward from the pole” in 1.1 is Tycho’s supernova of 1572, is therefore consistent with this date, suggesting that the duration of *Hamlet* is from 1572-1576.

Retrograde Motion

In 1.2 Claudius and Gertrude beg Hamlet to stay at Elsinore. Claudius states the royal opposition.

. . . your intent
In going back to school in Wittenberg,
It is most retrograde to our desire. 1.2.112-4

Gertrude agrées: “I pray thee” she says, “stay with us, go not to Wittenberg.” (1.2.119). The astronomical metaphor refers to Hamlet’s retrograde or contrary - motion to the seat of Copernican cosmology.

According to *OED*, “retrograde” means “opposed, contrary, or repugnant to something.” Astronomical use of the word in English dates back to Chaucer in the fourteenth century, while the sense of “tending or inclined to go back to

an inferior or less flourishing condition” and the more literal sense of “moving backward” or “returning upon a previous course” were in use at least by 1564. Shakespeare’s only other use of the word “retrograde” is in an exchange between Helena and Monsieur Parolles in *All’s Well That Ends Well* (1.1.190-200). The humor of that passage reveals the double meaning, suggesting similar usage in *Hamlet*.

Retrograde motion is most readily observed at the time of Opposition when a planet lies in a direction opposite to the Sun. The double meaning of “retrograde” is further established when the term “opposition” precedes it by a mere fourteen lines:

Why should we in our peevish opposition
Take it to heart? 1.2.100-1

According to the OED, the earliest meaning of “opposition” is astronomical, as used by Chaucer c. 1386. Meanings that connote the “action of setting against” or of “being contrary” appear in later centuries, so both categories of meaning were in use at the time of writing *Hamlet*.

Shakespeare employs the word “conjunctive” to complete the metaphor of planetary alignment. Claudius explains his need both for political and marital alignment with Gertrude:

She is so conjunctive to my life and soul,
That as the star moves not but in his sphere,
I could not but by her. 4.7.14-6

The *OED* uses these lines to illustrate that “conjunctive” can mean “having a relation of conjunction or union.” Thus “conjunctive” refers to the social and political union of Claudius and Gertrude. Even though the earliest use of “conjunction” is by Chaucer c.1374 to mean “the action of conjoining” (i.e. of joining together for a common purpose), the astronomical meaning is in use virtually at the same time, in 1375. These two meanings are the first recorded usages and it seems plausible that Shakespeare intended both meanings simultaneously.

By opposing Hamlet’s return to Wittenberg, Claudius opposes heliocentricism and identifies himself with the model of his namesake, Claudius Ptolemy. In fact, only in Shakespeare’s version of *Hamlet*⁴⁴ does the usurper king bear Ptolemy’s first name. By expressing a desire to return to Wittenberg in 1.2, Hamlet allies himself with Copernicanism. When in 2.2 Hamlet yearns to be a king of infinite space, he further identifies himself with Digges’ model. Thus Hamlet is identified with Copernicanism and its corollary, the Infinite Universe, and thus opposes Claudian and Ptolemaic geocentricism. The personifications of the Ptolemaic and Diggesian models is further supported in

5.2 when Claudius and Hamlet are referred to as “mighty opposites” (5.2.62). Rosencrantz and Guildenstern have come between these worthies, but from 2.2 Hamlet is seen to oppose them too, i.e. to dispute Tyconic geocentricism. In keeping with the Saxo tale, Hamlet disposes of Rosencrantz and Guildenstern before he slays the King. Thus there is little doubt in the end which world view has Shakespeare’s support.

Elsinore, Ven, and Wittenberg

As Tycho was constructing his observatory Uraniborg on the island of Ven in the years 1579-1581, the King of Denmark was building Helsingor Castle a short distance away at the northern end of the Oresund Sound.⁴⁵ There is general agreement that Elsinore is named for Helsingor Castle. Moreover, the Castle Platform affords an unobstructed view of the heavens, as astronomical observatories like Uraniborg must do.

Helsingor Castle is noteworthy too for its dungeons in which prisoners were confined,⁴⁶ while Tycho also maintained penal cells in the depths of his castle to detain peasant debtors.⁴⁷ When Hamlet calls Denmark a “prison” he is referring not just to these castles but the whole country which is one of the worst in the world in which “there are many confines, wards, and dungeons.” (2.2.236-7).

Hamlet: I am but mad north-north-west. When the wind is
southerly, I know a hawk from a handsaw. 2.2.347-8

contains two directions: that from Ven to Helsingor is almost exactly north-north-west (22-1/2 degrees west of north), whereas that from Ven to Wittenberg is about one-half of this amount west of south. The compass is boxed in 32 rhumbs of 11-1/4 degrees, but only every other one is described in terms of three or fewer cardinal directions. Thus the direction of Wittenberg from Ven is roughly between “south” and “south-south-west,” so with expressive efficiency it is merely “southerly,” whereas the direction of Helsingor is almost exactly north-north-west. When the wind is southerly i.e. from the general direction of Wittenberg, someone on Ven could correctly interpret what he sees (“knows a hawk from a handsaw”), but would be “mad” when the direction is north-north-west. Tycho’s Ven is unambiguously identified with “madness” associated with Elsinore, and Claudius and reality with Wittenberg. The two prevailing winds may be seen also as a metaphor for the two influences on Tyconic cosmology, only one of which makes sense to Hamlet. Thus Hamlet is like any other political animal: how he feels depends on which way the wind is blowing.

To overcome the difficulty of extracting reality from appearance, the empirical method of progressively testing theories by observations and experiments was advocated early on by Digges.⁴⁸ I have suggested that the author of

Hamlet was cognizant of this scientific methodology.⁴⁹ He may well have chosen the Amleth legend because it contained evidence of a primitive empiricism by which underlying realities were revealed. The twelfth century legend relates the tale of two of the earliest practitioners, the King of Britain whose wait-and-see attitude toward Amleth is a way to gain empirical knowledge about him, while Amleth himself is not fooled by the apparent splendor of his reception in Britain, nor by conditions in Jutland, but seeks the underlying realities even if he has to feign madness to do so. For Hamlet as for Amleth, “madness” is merely a tool for the acquisition of knowledge. In fact, Hamlet assures his mother that he is “not in madness, / But mad in craft” (3.4.188-9), i.e. crafty in eliciting truth. Despite appearances though, Polonius fears that there might be “method” in Hamlet’s “madness” (2.2.200), a reference to (what I call simply) the “scientific method of empirical inquiry.” The characterization of scientists as “mad” is popular even today, but is here seen to be a consequence of superior methodology.

The Sun and Sky

That the sky is at issue is clear when Claudius refers to Hamlet’s “mourning duties” (1.2.88), referring not just to Hamlet’s grieving but to the time of the Ghost’s apparition after midnight. When Hamlet refers to his “inky cloak” and “suits of solemn black” (1.2.77, 78) he is talking both about the weeds of mourning and the canopy of the night sky. When Claudius asks why Hamlet is still so dejected at the death of his father, Hamlet puns with “sun” and “son”:

King: How is it that the clouds still hang on you?

Hamlet: Not so my Lord. I am too much in the sun. 1.2.66-67

In Elizabethan iconography Kings are usually associated with the Sun,⁵⁰ and here early on in the play Shakespeare establishes that it is Hamlet who is associated with the Sun, as befits a rightful heir. The battle of Claudius versus Hamlet, which is allegorically the struggle between heliocentricism and geocentricism (or between reality and appearance, truth and falsity, right and wrong, rightful heirs and usurpers) is manifest early in the play through the Sun-Earth icons.

Geocentricism

In 3.3, Guildenstern points out that geocentricism is associated with the royal establishment, and that with kingly centrality comes a duty to maintain those that depend upon it:

Most holy and religious fear it is
To keep those many many bodies safe

That live and feed upon Your Majesty. 3.3.8-10

Rosencrantz warns that “the cess of majesty / Dies not alone” (3.3.15-16) because the King:

... is a massy wheel
Fixed on the summit of the highest mount,
To whose huge spokes ten thousand lesser things
Are mortised and adjoined . . . 3.3.17-20

i.e. Rosencrantz and Guildenstern argue that when the King is imperiled so are all who rely upon him.⁵⁰¹

These “ten thousand lesser things” are the approximately 10,000 stars visible to the limit of the naked eye,⁵² a fact available to Shakespeare (one presumes) through Digges. In the Ptolemaic model, these stars are part of the outermost sphere that is centered on the Earth, so if the King who personifies geocentricism were to fall, so would these 10,000 lesser lights. Along with the planets the epicyclic machinery would fall too: “Each small annexment, petty consequence / Attends the boisterous ruin.” (3.2.20-22). But such multiple dependencies have consequences, for: “Never alone / Did the king sigh, but with a general groan.” (3.3.22-23). In the geocentric universe all stars and Ancient Planets revolve about the Earth just as all subjects are beholden to the false King who is struggling to maintain his sway in the face of the new cosmology.

Hamlet’s Transformation

Claudius makes it clear from the very moment that Rosencrantz and Guildenstern arrive that Hamlet’s affectations — his “transformation” — is the reason for the summons:

Something have you heard
Of Hamlet’s transformation, so call it,
Sith nor th’ exterior nor the inward man
Resembles that it was. 2.2.4-7

At the outset of 2.2 where so much of the astronomical groundwork is laid, we learn that Hamlet is associated with a “transformation.”

According to the *OED*, “transformation” was used in the fifteenth century to mean “the changing in form, shape, or appearance”. The first scientific use was in the sixteenth century and is attributed to none other than Thomas Digges whose *Pantometria* of 1571 was started by his father Leonard Digges (c.1521-c.1559). The mathematico-scientific meaning of the word is “change of form without alteration of quantity or value,” the change occurring in accordance with a definite set of rules. In other words, through “substitution of a new set

of coordinates, involving a transformation” of the geometry, we may convert from one center to another.

Hamlet suffers from two transformations which together represent the Diggesian world view. One is “exterior” and one is “inward,” such that neither the “exterior nor th’ inward” resembles what went before. The “inward transformation” is the Copernican substitution of the Sun for the Earth as the center of the Solar System proper. The “exterior transformation” refers to the Diggesian substitution of an outermost shell of fixed stars with their uniform dispersal through space. Thus there has been a complete transformation of world view, and neither the planetary system nor the starry firmament “resembles that it was.” In short, “Hamlet’s Transformation” is a two-step operation that changes Ptolemaic geocentricism into the Infinite Universe. Thus it is easy to see why Claudius is so concerned by Hamlet’s transformation, because a change in the origin of coordinates will end up transfiguring the hierarchy of the solar system, dethroning and decentering the geocentricist Claudius.

Hamlet’s transformation is further evidence that an astronomical allegorical meaning may be attributed to *Hamlet*. Transformation is the central issue in *Hamlet* whether we are referring to social, political, or cosmic change; and it is a word and a phenomenon directly linked to Digges.

Digging

In 5.1 as the gravediggers clown around, one says: “. . . Adam digged. Could he dig without arms?” (5.1.31). “Adam digged” may refer to Adomarus Digges, an ancestor of Digges and a judge under Edward II.⁵³ One clown calls the other “goodman delver” (5.1.12), or “master digger.”⁵⁴ The gravedigger digs and sings: “A . . . spade, a spade . . .,” but his “arms” connote more than somatic prerequisites for spade-work. The first clown says that Adam “was the first that ever bore arms.” There are other instances: Hamlet refers to “My father’s spirit, in arms!” (1.2.254) and debates “whether ’tis nobler . . . to suffer the slings and arrows of outrageous fortune or to take arms . . .” (3.1.58-9). Hamlet offers words which are too light for the “bore” of the matter (4.6.22). Such technical words occur in *Stratiticos*⁵⁵ wherein the Digges father and son refer to “men at armes” and the “bore” of guns. The multiple word plays identify Digges, the military scholar and author of the Infinite Universe.

In 1.5 after the Ghost had uttered “swear” for the third time, seemingly from below ground, Hamlet says: “Well said old mole, canst work i’th’earth so fast? / A worthy pioneer.” (1.5.162-3). Hamlet calls his father’s spirit an “old mole” because Hamlet is the personification of Thomas Digges and the Ghost is a “digger” too, as of course he should be if he is Hamlet’s (i.e. Thomas Digges’) father and co-author of *Stratiticos*. Besides, Ghosts are like moles for they work in the dark, as astronomers do. The word “pioneer” means “a soldier responsible for excavations and tunnelling”⁵⁶ which reinforces the pun, as does Hamlet when he says he will “delve” one yard below the mines of the

two courtiers (3.4.209).

The Diggesian Revolution

In the midst of the exhumations of 5.1 Hamlet remarks: “Here’s fine revolution and we had the trick to see’t.” (5.1.75-6). The comment seems irrelevant to digging unless seen in the context of the Digges family.

The *OED* cites this passage to explain that “revolution” means “alteration, change, mutation.” Its astronomical meaning (the orbital motion of Ancient Planets) was in use by 1390. By 1450 the word came also to refer to “great change or alteration in affairs or in some particular thing.” Therefore, when Copernicus made the word “revolution” essentially the entire title of *De revolutionibus*,⁵⁷ the possibility of a double meaning was already in place at least in the English language; and even if Copernicus had not intended a pun, Shakespeare surely would have.

According to the *OED*, “trick” may mean “a clever . . . device, or contrivance,” a “clever contrivance or invention,” as when in *The Taming of the Shrew* (4.3.67) Shakespeare writes: “A knacke, a toy, a tricke, a babies cap.” I suggest that this “trick” or device is none other than the forerunner of the telescope, the so-called “perspective glass” which was invented by Thomas’ father Leonard Digges.⁵⁸ The Diggesian Revolution was made possible by Leonard Digges, as noted by Antonia McLean who writes: “. . . Digges’ conviction of the infinity of ‘stars innumerable’ indicates some kind of optical penetration of space.”⁵⁹

Section 10 shows that “transformation” in 2.2 is associated with Digges and hence (in the allegorical model) with Hamlet. In 5.1 “revolution” is associated with Digges as well. Thus it appears from the present reading that “revolution” is a word as relevant to the Diggesian as to the Copernican Revolution.

Climax

The Tychonic system was never fully worked out and was essentially a minor player in the saga of competing world systems, whereas the Ptolemaic and the Copernican systems were mighty opposites distinguished by their predictive capabilities.⁶⁰ Therefore Shakespeare kills off the Tychonic system first, in accord with the Saxo legend, and Hamlet’s indifference to the deaths of Rosencrantz and Guildenstern is readily understood: “They are not near my conscience . . .” he says (5.2.58).

The Tychonic system (personified by Rosencrantz and Guildenstern) has not earned its way into the company of such worthies as the Ptolemaic and Diggesian systems (personified by Claudius and Hamlet respectively), and the deaths of the two courtiers are thus unworthy of a literary climax. On the other hand, the death of Claudius near the end of the homicidal frenzy of 5.2 is the final confrontation and is thus worthy of a dramatic climax.

Nevertheless the astronomical cosmological climax is significant too.

Shakespeare chose Book 3 of Saxo Grammaticus' *Historia Danica* as the classical foundation of the play because the events recounted there suited his dramatic purpose, whereas in the second part of the Amleth legend (Book 4) Amleth "enters on a wholly new set of adventures which Shakespeare . . . did not need."⁶¹ So the death of Claudius signals the demise of the Ptolemaic system, but instead of following Amleth's misadventures in Book 4, Shakespeare creates a unique ending.

There is no major Polish connection in *Historia Danica*, but Shakespeare needs one because the English cosmological contribution is an outgrowth of the Polish. Shakespeare achieves this goal by terminating his relation to Saxo at the end of Book 3 and with the help of the Fortinbras father and son he fabricates a climax that renders his *Hamlet* unique. The young Fortinbras is readily connected to the Amleth tale because Amleth's father Horvendile (Old Hamlet) kills Koll (Old Fortinbras), so it seems reasonable that young Fortinbras would return seeking restitution of the lost lands. The military forays of Prince Hamlet's contemporary, the young Fortinbras, are credible but necessary Shakespearean embellishments of the classical story.

According to the Captain in 4.4, young Fortinbras goes to Poland to "gain a little patch of ground" which "he would not farm" and which "the Polack never will defend . . ." What is so significant about a patch of Polish soil that is unworthy of military defense and unfit for agriculture?

The text leads to the conclusion that the plot of ground is the grave of Copernicus, for in a demonstration of felicitous timing Copernicus had died in the same year 1543 as his magnum opus was printed; and having died, could not be held accountable to any tribunal of this world for transgressions against geocentricism. He would therefore have no need to defend himself against attack. Besides, the Saxo legend makes clear that it is undesirable to turn graveyards into farmland.

Having "gained" this little plot and having thereby paid homage to its deceased occupant, Fortinbras returns to salute the English Ambassadors (5.2.329-31). The two models favored by Shakespeare, the Copernican from Poland, and the Diggesian from England, are triumphant following the demise of geocentricism. The volley of ordinance and the military context of the final moments are appropriate for the military scientist Thomas Digges.⁶² Shakespeare treats the events of the final struggle as if a battle had occurred, with the deceased hero being accorded full military honors (5.2.374-9). Such honors are not incongruous given the eclectic interests and accomplishments of the man who (we read) is "the leading English astronomer of the time and an ardent supporter of Copernicus".⁶³

Acknowledgements: I thank colleagues for valuable discussions.

Endnotes

1. Early champions were Robert Recorde (1510-1558) and John Dee (1527-1608). Recorde's *Castle of Knowledge* (1556) hints at the superiority of the heliocentric model. Dee states in John Field's *Ephemeris anni 1557* that he persuaded Field to compile tables based on the Copernican system. See e.g. Dorothea Waley Singer 1968 *Giordano Bruno: His Life and Thought* (New York: Greenwood), 63-4.
2. John Michell 1996 *Who Wrote Shakespeare?* (London: Thames and Hudson), 18.
3. Cumberland Clark 1929 *Shakespeare and Science* (Birmingham: Cornish Brothers). Leslie Hotson 1938 *I, William Shakespeare, do appoint Thomas Russell Esq.*, (New York: Oxford UP), 123. Arthur J. Meadows 1969 *The High Firmament* (Leicester: Leicester UP), 10. Peter D. Usher 1997a "Shakespeare's Cosmic World View," *Mercury* Vol. 26, No. 1, 20-23.
4. Saxo Grammaticus, *The First Nine Books of The Danish History*, transl. Oliver Elton, (London: Nutt, 1894. Joseph Satin 1966 *Shakespeare and his Sources*, (Boston: Houghton Mifflin) 385-95. See also the poem "Feng" in John Wain 1975 *Feng*, (New York: Viking).
5. Peter D. Usher 1996a "Astronomy and Shakespeare's *Hamlet*" *Bull. Amer. Astron. Soc.* Vol. 28, 859; 1996b "A New Reading of Shakespeare's *Hamlet*" *Bull. Amer. Astron. Soc.* Vol. 28, 1305; 1997a; 1997b "Hamlet's Transformation" *Bull. Amer. Astron. Soc.* Vol. 29, No 5, 1262; 1997c "Hamlet and the Infinite Universe" *Research Penn State* 18, No. 3, 6-7; 1997d <http://www.research.psu.edu/rps/sep97/hamlet.html>; 1998 "Amleto e l'Universo infinito" *Giornale di Astronomia* 24, No. 3, 27-30.
6. Barbara Mowat & Paul Werstine 1992 in *The Tragedy of Hamlet, Prince of Denmark*, Barbara Mowat & Paul Werstine, eds. (New York: Washington Square Press), xiii.
7. John F. Andrews 1989 in John F. Andrews (ed.) *Hamlet* (London: Everyman), xxiv.
8. Victor L. Cahn 1991 *Shakespeare the Playwright* (New York: Greenwood Press), 69.
9. Paul Gottschalk 1972 *The Meanings of Hamlet* (Albuquerque: University of New Mexico Press), 2.
10. Gottschalk, 4.
11. W.K. Wimsatt, Jr. & M.C. Beardsley 1946 "The Intentional Fallacy," *The Sewanee Review*, Vol. LIV, No. 3, 468-488; p. 469. For example, James Plumptre believed that *Hamlet* was an indirect censure of Mary Queen of Scots; see William Preston Johnston 1890 *The Prototype of Hamlet* (New York: Belford), 180-6. Plumptre was so enamored of his ideas that every possible

suggestion seemed additional proof to him.

12. Norman Rabkin 1981 *Shakespeare and the Problem of Meaning* (Chicago: University of Chicago Press), 1.

13. Wimsatt & Beardsley, 469.

14. Usher 1996a.

15. Copernicus had recourse to epicycles but their role was secondary; see Arthur Berry 1898 *A Short History of Astronomy* (New York: Dover, 1961), §89.

16. The relation of Hamlet and Horatio to Wittenberg led Cecilia Payne-Gaposchkin to venture that Shakespeare was familiar with Copernicanism. See: Cecilia Payne-Gaposchkin 1954 *Introduction to Astronomy* (Englewood Cliffs: Prentice-Hall), 162.

17. "A Second Volume about Recent Appearances in the Celestial World"; see Berry, §104.

18. Charles A. Whitney 1971 *The Discovery of Our Galaxy* (New York: Knopf), 5-6.

19. Hotson, 113-4. Alexandre Koyre 1957 *From the Closed World to the Infinite Universe*, (Baltimore: The Johns Hopkins UP), 6-8, 35-37. Thomas S. Kuhn 1957 *The Copernican Revolution* (Cambridge: Harvard UP), 233. Colin A. Ronan 1992 *Endeavour, New Series*, Vol. 16, No. 2, 91-94. Singer, 64-65. Nicolaus of Cusa (1401?-1464) had postulated the infinity of the Universe a century earlier. Nicolaus denied the enclosure of the Earth and planets by the walls of the heavenly spheres, but did not assert the "positive infinity" of the Universe, reserving the term "infinite" for God alone; see Koyre, 6-8.

20. *DNB* 1959-60 Leslie Stephen & Sidney Lee, eds. (Oxford: Oxford UP) Vol. XVII, 859.

21. *A Collection of Letters Illustrative of the Progress of Science in England from the Reign of Queen Elizabeth to that of Charles the Second* 1841 James Orchard Halliwell, ed. (London: R. & J.E. Taylor), 32-3. Hotson, 123. John L.E. Dreyer 1890 *Tycho Brahe* (Edinburgh: A. & C. Black), 263.

22. Victor E. Thoren 1990 *The Lord of Uraniborg* (Cambridge: Cambridge UP), 2.

23. *A Collection of Letters* ed. Halliwell, 33.

24. A.L. Rowse 1988 *Shakespeare The Man* (New York: St. Martin's Press), 226.

25. *The Arden Shakespeare: King John* 1994 E.A.J. Honigmann, ed. (London: Routledge), 52n574. See also Peter D. Usher 1995 "A New Reading of Shakespeare's King John" *Bull. Amer. Astron. Soc.* Vol. 27, 1325; and 1997a.

26. Hotson, Chapter VI.

27. Rowse 1988, 197 & 225-6.

28. Hotson, 124.

29. This genre of explanation is favored by Thoren who speculates that a third cousin of Tycho, Frederick Rosencrantz (1569-1602) "had . . . been immortal-

- ized” along with a “slightly less remote cousin” Knud Gyldenstierne (1575-1627), since both “somehow” made an impression on the young Shakespeare that was sufficient to get them “bit parts” in *Hamlet*; see Thoren, 428-429. Both were scholars at Wittenberg, both returning to Denmark in 1591 and went together to England in 1592 for about a year; see William F. Hansen 1929 *Saxo Grammaticus and the Life of Hamlet* (Lincoln: U of Nebraska Press), 86.
30. Hotson, 117-122 & Chapter IX.
31. Hotson, 118-121. The 1590 edition of *Stratiticos* was widely followed and various passages from it closely resemble some in Henry V. *Stratiticos* was printed by a Stratfordian, Richard Field, who also printed Shakespeare’s *Venus and Lucrece*.
32. Tycho analyzed a lunar eclipse of 28 October 1566 and concluded that it foretold the death of the Turkish Sultan, Suleiman the Great. Unfortunately, the sultan had already died about six weeks earlier; cf. Thoren, 22.
33. Heinrich Matiegka 1901 *Bericht uber die Untersuchung der Gebeine Tycho Brahe’s* (Prague: Gesellschaft der Wissenschaften).
34. Thoren, 23-4.
35. Samuel Crompton 1877 “The Portrait of Tycho Brahe” *Nature* XVI, 501-2.
36. Thoren, 25-6.
37. I am indebted to Peter Nockolds for drawing attention to this; see *The Times* (London) 16 January 1997.
38. Thoren, 4-5.
39. Usher 1996a,b; 1997a,c; 1998.
40. Hilary Gatti 1989 *The Renaissance Drama of Knowledge* (London: Routledge), 145.
41. See e.g. Berry, para 132.
42. Usher 1997b,c,d; 1998.
43. Donald W. Olson, Marilyn S. Olson, & Russell L. Doescher 1998 “The Stars of Hamlet” *Sky and Telescope* Vol. 96, No. 5, 67-73.
44. Of course the situation for *Ur-Hamlet* is not known.
45. Thoren, 6 & 113; Berry, para 101.
46. Clive Holland 1928 *Denmark* (London: A. & C. Black), 96.
47. Berry 101, 134n
48. Francis R. Johnson, and Sanford V. Larkey 1934 *Thomas Digges, the Copernican System, and the Idea of the Infinity of the Universe in 1576* The Huntington Library Bulletin, No. 5, 117. Hotson, 114.
49. Usher 1996a.
50. Martha Hester Fleischer 1974 *The Iconography of the English History Play* (Salzburg: Institut fur Englische Sprache und Literatur), 33.
51. See *The Arden Shakespeare: Hamlet* 1997 Harold Jenkins, ed. (Nelson: Walton-on-Thames), 312n17.
52. Harold Spencer Jones 1951 *General Astronomy* (London: Arnold), 302.

53. *DNB; Biographia Britannica* 1793 Vol. 5 (Second Edition), 238.
54. *Hamlet, Prince of Denmark* 1985 Philip Edwards, ed. (Cambridge: Cambridge UP), 213n12.
55. Leonard Digges & Thomas Digges 1579 *Stratoticos* (Amsterdam: Theatrum Orbis Terrarum; New York: Da Capo Press, 1968), 180-3.
56. Edwards, 113n163
57. See e.g. Anton Pannekoek 1989 *A History of Astronomy* (New York: Dover), 189-90. Berry, para 74.
58. Colin A. Ronan 1992 *Endeavour, New Series* Vol. 16, No. 2, 91-94; and also 1993 *op.cit.* Vol. 17, No. 4, 177-179.
59. Antonia McLean, 1972 "Humanism and the rise of science in Tudor England" (New York: Neale Watson Academic Publishers), 150.
60. Berry, para 66, 94 & 148.
61. Elton, in Saxo Grammaticus *The First Nine Books of The Danish History*, 400.
62. On Thomas Digges' tomb are the words: "muster master of the English Army." Hotson, 125.
63. Johnson & Larkey, 69.