

TOWARDS A PHENOMENOLOGY OF SHAKESPEARE'S SKY

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Abstract

This paper begins with a phenomenological analysis of the sky as understood by early modern beholders via its synonyms: 'sky', 'welkin', 'element', 'vault', 'heavens', and 'firmament'. These words fall into roughly two categories. The first group conveys the experiences of the sky through primary perceptions of seeing, sensing or breathing. To recall the distinction between 'apprehension' and 'comprehension' in *Midsummer Night's Dream*, they apprehend the sky as an immense, mysterious, and unapproachable domain resistant to human incursion, rather than comprehending it as an object of knowledge. By contrast, the second group are comprehending words dependant on concepts originating in Aristotelian and Ptolemaic cosmology. While all six words might have functioned roughly as synonyms of each-other throughout the period, the gap between the two groups becomes progressively wider until the new Galilean philosophy of c.1610. The paper goes on to explore the response to this gap in Shakespeare even though he is not normally considered to have been (in Empson's words) a 'space man' like his contemporary Donne. It concludes by suggesting that in Shakespeare (primarily *Hamlet*) the perception of the visible sky was negatively impacted by the skepticism and anxiety leeching down from what Marjorie Hope Nicholson once called 'the breaking of the circle'.

Keywords: *sky, phenomenology, early, modern, Shakespeare, Donne, Melanchthon.*

We can begin with what I tentatively call a phenomenology of the sky in early modernity. ‘Phenomenology’ is a contested philosophical term. Some dictionaries of philosophy decline to recognize it as a distinct discipline, restricting themselves to the history of a movement. (Audi 578-79) For our purposes however, the Stanford (SEP) definition will suffice:

The discipline of phenomenology may be defined initially as the study of structures of experience, or consciousness. Literally...the study of ‘phenomena’: appearances of things, or things as they appear in our experience, or the ways we experience things, thus the meanings things have in our experience [which is to say] from the subjective or first person point of view. (Smith)

My interest is in the way in which the sky was ‘beheld’ in the archaic and nigh-prehensile sense of that word (OE *bihaldan*). To ‘behold’ is ‘much richer in content than mere sensation’ (Smith). It implies the embrace of an object by the embodied subject; the coloration or intentionality or thrust of that object within the ‘life world’. Embodiment in turn implies a kind primordially arising at the intersection between thinking subject and living body (*lieb*). Because this primordially is sedimented within language, my approach will be via the various words by which ‘sky’ was commonly called in the period. Beholding however is about more than just perceiving. As in the act of looking, it is bound by a horizon of concepts. This is not to say that perceiving is necessarily conceptual, simply that it is normal; not lost in wonder (‘the child of ignorance’) where it is as if one sees something for the first time or without conceptual precedent.

There appear to be more early modern words for ‘sky’ than commonly used today: ‘sky’, ‘welkin’, ‘vault’, ‘heavens’, ‘firmament’, and ‘element’. These words differ sharply from each-other in some respects, while overlapping in others. For all this they appear to fall into roughly two categories. The first, comprises words that are more immediately intuitive to sense (‘sky’, ‘welkin’, ‘element’) and thus to phenomenological exploration. As a group, such words describe the experience of the sky as seen with the naked eye, sensed on the surface of the skin, breathed into the lungs. They define the sky less as an object to be known or comprehended than as

apprehended (as literally beyond our reach). Quite literally for this class of words, the sky outstrips our view and is yet, in Eliot's phrase, 'closer than the eye'.

In the second class of words – 'heaven/s', 'vault', 'firmament' – the sky is taken to be an object of knowledge, an object more of comprehension than apprehension, of settled 'beholding' rather than immediate experience, something within our virtual if not our actual grasp. In making this distinction I am mindful of the distinction drawn by Shakespeare's Theseus in *A Midsummer Night's Dream*¹ between apprehension and comprehension (5.1.2-22). Where 'apprehension' grasps its object in an intuitive, ungrounded and possibly flighty way, 'comprehension' grasps it in a way that is grounded, conceptual and masterful. Having drawn this distinction – between the sky as apprehended by the senses and the heavens as comprehended or conceptualised by the mind – I shall go on to explore how the gap between them grows in the course of the 16th century, to the point where the concept disintegrates, and a best case of knowledge becomes a best case of skepticism.

We can begin with the first class of words. The first and dominant meaning of 'sky' in the OED is, 'the region of the atmosphere...seen from the earth in which the sun, moon, stars, and clouds appear (esp. in early use) regarded as having the appearance of a vast vault or canopy'. The key aspect of this definition is its stress on our necessarily earth-bound perspective. The next aspect is the 'appearance' of the sky as 'a vast vault or canopy'. There would seem to be two components of this impression: the curvature of the visible horizon (the apparent line dividing earth and sky) and the celestial horizon (the apparent semi-circle of the sky above us). There is perhaps also a third: an ages-old and religiously inflected idea of the sky as a dome. The first two components are intuitive and unavoidably phenomenological, the third results from the sedimentation of the second in an ancient and enduring architectural form. E. Baldwin Smith (1950) speaks to the antiquity of the domed roof and its incorporation into temple design in respect of an entirely circular building or an apse conjoined to a rectangular shape. V. Scully (1962) too testifies to the association of temple design and heavens. Cicero refers to the skies as 'this temple' (*hoc templo*)

¹ All quotations from William Shakespeare's plays are from Stephen Greenblatt et al. (2016).

in a passage incorporated by Ortelius into the *Typus Orbis Terrarum*, his world map of 1575, where the perspective is downwards upon the earth from the heavens rather than the other way round. In its fourth sense as given by the OED, 'sky' can indeed mean 'heaven, the celestial abode of God or gods', but this sense is figurative, literary and 'now somewhat rare'. It is not the primary signification of the word even in early modern usage. The word 'welkin' ('the apparent arch or vault of heaven overhead', OED) has much the same spectrum of meaning as 'sky'. Again it is primarily perspectival and secondarily (in a figurative sense), 'considered as the abode of the Deity, or of the gods' (OED). The word 'element' is rather different; presupposing in the OED's sense 10.a, ('the sky also the atmosphere') not an act of earth-bound looking, but a feeling of being environed by air, one of the four elements.

All three of these words – 'sky', 'welkin' and 'element' – convey their object primarily through an act of sensing or apprehension; an act of not quite grasping. What then do we behold when looking at the sky? With some help from the mind's eye, we 'see' a diaphanous blue expanse that extends as far beyond us as the visible horizon permits. Is it an object? If so it is one that is completely unlike any object that we encounter on earth. It cannot be defined by the eye. Like Shakespeare's Ariel, it cannot be grasped or held or wounded. It defeats our object-defining power of prehension. If it is a region, then it is one that cannot be entered or journeyed upon or navigated in the assisted way that we traverse that other great alien region, the sea. Thus we speak of the sky or element or air as 'ambient'. The root of this word (the Latin verb *ambio*) means a 'going round', where the normal presupposition is that *we* go around something (a territory) rather than something (the element) 'going round' *us*. For Shakespeare, as we shall see, this contrast is pregnant in poetic meaning. In registering this aspect of the sky we might be said to register the limits of our 'ambition' (the Latin verb *ambitio*, which in Republican times meant 'the going about of candidates for office in Rome'). Lacking wings, our bodies are incapable of 'going round' the sky in all the ways that they are capable of 'going round' earthly milieux. Something of this primary contrast informs Macbeth's soliloquy before the murder of Duncan in which the riot of heavenly portents ('heavens cherubim horsed / On the sightless couriers

of the air', 1.7.22-23) presages the odd futility of, 'vaulting ambition, which o'er leaps itself / And falls o' the other' (1.7.25-26). In respect of the heavens, 'ambition' is a contradiction in terms: it is literally going nowhere.

The sky is thus strange: unapproachable, immense and apparently uniform. Its quality is to extend upward and away from the grounded human subject in all directions above the plane. Aside from birds and clouds, the sky is empty. Birds traverse it but do not dwell there. The thought of flight is merely wishful (Gaston Bachelard [19] points out that *volo* the Latin for 'I fly' is equivalent to 'I wish'). Apart from the sun, moon and stars – all of which are incalculably distant and which do not behave as earthly things like birds and clouds – it is almost entirely unpopulated by objects. The sky is more spatial than placial. If it has regions these are derived by observation and measurement from the few permanent objects that we do behold in the sky: the sun, the moon, the stars and the planets. Perhaps the primary datum imparted by the sky to our understanding is that it is *not* our home. We cannot enter, traverse, possess or inhabit it. Roomy to the point of infinity, it has no 'room' for us. There is another primary datum however. Two directions (east and west) are primary as distinct from being derived (like north and south). East and west take their character from a primaeva contrast between the rising and the setting sun. Our bodies respond to the rising and setting sun through a primary intuition arising from their bilateralism (their right and left handedness): this intuition we call direction, keyed to the primary directions of east and west. Beyond this, the sky gives us no 'data', nothing to grip, stand upon (understand), or cling to. The sky stands for what we are not. Our attitude towards it is not as towards an object we can manipulate. Unmastered, it asks of us piety and reverence. The association between religion and the sky is not just ancient but intuitive. We join our hands in prayer and look upwards, perhaps to acknowledge our lack of grip upon the object of our gaze.

Words belonging to the second group ('vault', 'heavens', 'firmament') are inferential rather than directly perceived. 'Vault' (in the OED's sense 1.c) means 'the apparent concave surface formed by the sky'. The first two senses however refer primarily to a vault in the material and architectural sense. Hence to refer to the sky as a vault is primarily to invoke this sense. In

Macbeth's, 'The wine of life is drawn and the mere lees / Is left this vault to brag of' (2.3.92-93), we are simultaneously in an empty wine cellar and beneath the sky, but primarily in the former. 'Heaven' is nearly identical to 'sky' in its first two OED senses. From the third sense however it begins to diverge. Sense 3a is, 'the region of space beyond the clouds or the visible sky; chiefly in collocation with *earth*, denoting the whole universe'. Sense 3b is, 'the region of space in which celestial objects move'. Sense 4 denotes the 'spheres' of Ptolemaic cosmology. Sense 5 'the abode of God, etc.' Beginning as a percept, in other words, 'heaven' rapidly takes on the sense of a mental construct. 'Firmament' is similar. Like 'vault' and 'heaven', it begins as a percept of what appears to be 'overhead' but rapidly takes on an objective sense as of a kind of building. The etymology (stemming from *firmus* or 'firm') adds to this suggestion. The firmament is, as it were, both solid (perhaps mirroring Macbeth's 'sure and firm-set earth', 2.1.56) and structural. For all its solidity however, it is a structure that nobody directly perceives or experiences. How then is it 'known' to be there? The answer must be by the authority of Aristotle or Ptolemy of Alexandria or immemorial piety. In whatever form the 'firmament' is known, piety – an attitude arising from the body's felt impotence to negotiate the sky – would seem to be a factor in this idea. The 'firmament' is essentially premodern and essentially pre-rational. It is so to speak an already completed structure that requires nothing further by way of rational contribution. Modern usage however typically presumes a far greater role for reason: as of a builder that (in a spirit of skepticism) demolishes what was there before and then constructs a whole new building, everything that is, apart from the 'ground' upon which he and the building stand. The firmament's obsolescence in other words consists in its already-built and undemolishable quality.

This second class of words for the sky, then, requires a conceptual admixture of a solidly objective character. The objectivity of 'the heavens' or 'firmament' is either solid or hollow depending on which end of the 16th century we are talking about. In the earlier part of the century and for quite a long time afterwards, prior to the real impact of Copernicus, the gap between sensual percept and mental concept is small. Though the full architecture of the heavens must be inferred, the mind credits and affirms that inference immediately upon making it. In the 1530s, the Reformer

Philip Melanchthon promoted the science of astronomy in full confidence that it would bring men closer to heaven and so to God. The church 'should take the order and regularity of the heavens as a model' (Methuen 393). Astronomy may even add wings to the soul, not only in the sense of the heroic virtue that Plato thought necessary, but in the vision of divine order that astronomy makes possible: 'astronomy and geometry are, therefore, the wings of the human mind' (Methuen 394). For the reason that the heavens, 'must be regarded as the pristine creation of God, more perfect than the sublunar sphere', astronomical flight must afford a vision of the *mens architectrix* or the mind of God (Methuen 395, 398). Hence, Melanchthon concludes, astronomy is, 'as appropriate to human nature as is swimming to a fish or singing to a nightingale' (qtd. in Methuen, 401).

In the later part of the sixteenth century – or certainly after Galileo (1610) – the gap between percept and inference would gape open. Strictly speaking, the old 'heavens', 'firmament' and 'vault' would crumble. The words remain of course, but emptied of the substantive meaning they possessed in the geocentric cosmos. The breakage of the geocentric cosmos memorably informs the poetry of Donne's *Anniversaries*. In 'The First Anniversary', the 'heavens' are a mathematical fiction:

For of meridians, and parallels,
Man hath weaved out a net, and this net thrown
Upon the heavens, and now they are his own.
Loath to go up the hill, or labor thus
To go up to heaven, we make heaven come to us. (ll.278-82)

The ambience of the heavens is as it were outflanked, enticed to earth – hunted like a prey animal – by the ambition and impiety of man.

In 'The Second Anniversary', Donne transposes the Platonic idea of the winged soul from the geocentric cosmos of Melanchthon's account to a cosmos in chaos. Unlike the serene progress of those souls, 'to heaven, delighting in the company of and conversation with God' (qtd. in Methuen 393), the winged soul of the 'Second Anniversary' is completely disorientated amid the crumbling architecture of the old cosmology. The joyful meditation of spiritual flight up through the spheres is gone. What remains is a

disconcerting speed and a blind homing instinct amid a cosmos beholding less to the mind of God than the audacity and skepticism of man.

If the wreckage of the old cosmos informs Donne's *Anniversaries* its emptiness is registered – doubtfully and with plausible deniability so to speak – in Shakespeare's *Hamlet*. Again Melanchthon is a touchstone. Melanchthon contrasts Plato's winged souls with, 'those souls from which the wings have departed', souls which, 'wander on the ground and seek impure pleasures from terrestrial things; for they do not see the most beautiful light of celestial things' (qtd. in Methuen 394). Is it in reference to this Platonic thought (if not necessarily to Melanchthon) that Hamlet imagines himself aimlessly, 'crawling between heaven and earth' (3.1.129-30)? Earlier in the same passage, Hamlet cites the teeming lowness of his mind: 'very proud, revengeful, / ambitious, with more offences at my / beck than I have thoughts to put them in, imagination to give them shape' (3.1.126-29). The abjection stems from the 'sullied flesh' that Hamlet imagines himself sharing with Gertrude, leading him to forswear begetting more such offspring. Ophelia, once eulogized as 'the celestial and my soul's idol' (2.2.109) is now a prospective 'breeder of sinners' (3.1.123-4).

The 'celestial' designation of Ophelia is anything but inert. The eulogy is cited by Polonius from an earlier love letter. Hamlet's use there of the term 'beautified' draws Polonius's disapproval: 'That's an ill phrase, a vile phrase. 'Beautified' is a vile phrase' (2.2.110-12). It does seem 'an ill phrase' but was Hamlet half thinking of 'beatified' ('declared to be in the enjoyment of heavenly bliss' OED, sense 2)? If so, the follow-up verses may suggest why the thought was left incomplete:

Doubt thou the stars are fire.
 Doubt that the sun doth move.
 Doubt truth to be a liar.
 But never doubt that I love. (2.2.116-19)

To doubt that the stars are fire is to doubt their place – as composed of the purest and lightest element – in the uppermost sphere of the Ptolemaic cosmos. To 'doubt that the sun doth move' is to doubt that the sun circles the earth as it must in the old cosmos. Effectively it is to entertain the

thought that the sun does *not* move which is to say that the geocentric cosmos has become heliocentric. To doubt ‘truth to be a liar’, is not to doubt an almost self-evident proposition (as in the two previous lines) but to entertain a contradiction: by definition truth cannot lie. To doubt that truth might lie however is to doubt the best-case of truth represented by thousands of years of accepted cosmological authority. Yet to doubt these three truisms (Hamlet claims) is not to doubt his love of Ophelia. But this love is precisely what is thrown into question.

The four-fold iteration of the word ‘doubt’ leaves an overpowering sense of skepticism. Earlier, when reeling off the list of his vices, Hamlet had mentioned ‘ambition’ as among their number. Again one senses the tension between ambition and sky. The possibility of an emptied heaven is adverted again in Hamlet’s surreal claim: ‘I could be bounded in a nutshell and count myself a king of infinite space were it not that I have bad dreams’ (231.15-17).² Where does the image of ‘infinite space’ come from? What are its cosmological credentials? The astronomer Michael Rowan-Robinson (2016) has argued a plausible connection between Shakespeare and a group of English Copernicans of the 1590s via a family connection with Thomas Digges (a principal member of the group).³ He further points out that Digges, ‘wrote the first book unequivocally supporting Copernicus and also suggested the logical extension of Copernicus’s picture, that the stars stretched to infinity’ (Rowan-Robinson). It is not implausible that Shakespeare had seen Digges’s famous sketch of a Copernican cosmos in which the outer circle of stars has exploded or opened out indefinitely. If we return to Hamlet’s image – assuming that Shakespeare had taken on board the full extent of Digges’s reading of Copernicus – then the absurdist quality of the image strikes us anew. How could anyone command ‘infinite space’? A space that is both infinite and empty not even circumambient. Hamlet’s conceit sets up a polarity between containment and infinity, but (absurdly again) what contains Hamlet is simply ‘a nutshell’. Another way of reading this conceit is as an acknowledgement of the decisive victory of

² The Norton edition prints the second quarto text of Hamlet with Folio additions numbered as above.

³ ‘When Digges died in 1595, his widow married Thomas Russell, who became the executor of Shakespeare’s will.’ Rowan-Robinson further remarks that Thomas Digges’s son Leonard wrote a verse tribute to Shakespeare for the 1623 First Folio.

the spatial paradigm over the Aristotelian placial paradigm that Edward S. Casey (1997) dates to the early 17th century. Unlike place, which is essentially qualitative, space is unqualified: no weight, no hot nor cold, no up nor down, no fullness or emptiness, no receptiveness. It is featureless and dimensionless – ‘empty’, if that word can be understood in an entirely unqualitative sense, which is to say irrespective of a perceiving and inhabiting body.

Hamlet’s skepticism in regard of the heavens begets a family of Shakespearean skeptics for whom the heavens are a best case of skepticism and worst case of belief. Edmund in *King Lear* rejects the astrological beliefs of Gloucester much as Cassius in *Julius Caesar* rejects the idea that human destiny is written in the stars. The skepticism of both characters stretches further of course: rejection of astrology goes hand in hand with cynicism, manipulateness and atheism. In both these plays it is not just the atheists who disbelieve in God and providence, but the demoralised world of their respective plays. What is rejected is not just astrology, nor just belief but also the piety that is typically associated with the heavens. Such piety is felt in Ulysses’s invocation of degree in *Troilus and Cressida*. There is more riding on this invocation than just piety however. If the heavens did not observe, ‘degree, priority and place’ (1.3.85), then how is social and political order even possible? Yet what sounds like a ringing endorsement both of the old cosmos and political order is ultimately hollow. If social and political order is so profoundly dysfunctional as this play suggests it is, then what is the point of the heavens themselves? *Othello* would seem like a return to the nostalgia of the old cosmic system. ‘Yond marble heaven’ (3.3.454) seems an eminently firm and architectural quantity by which to swear; and also a pious one (reinstating perhaps the Ciceronian equation of heavens with temple). Yet the solidity of the ‘firmament’ is no whit confirmed by this. *Othello* is as a reliable a judge of heavenly integrity as he is of its human counterpart.

One part of this story is familiar: the final (but long telegraphed) collapse of the old cosmology c.1610. One has only to think of books like Marjorie Hope Nicholson’s *The Breaking of the Circle*. The theme is common enough too in criticism of Donne’s cosmological poetry. What is different about this paper however is the focus on Shakespeare, an author who is

not thought of as a 'space man' in the way that Empson thought of Donne, nor thought to have had any serious engagement with the new cosmology. What is also different, I hope, is the attempt to think the obsolescing cosmological concepts in relation to the immediate act of beholding the sky. As we have seen, beholding an object is about more than simply sensing its physical presence. It is a *gestalt* – an immediate completeness of picture – in which percept blends with concept: to behold the sky was in some sense to uphold the firmament. This is why the phenomenology of an apparently simple percept calls for an act of 'phenomenological reduction', stripping the percept of the conceptual residue that it has unwittingly gathered from its ambient thought world.

If I have divided the early modern words for 'sky' into two classes, phenomenological and conceptual, it is strictly for the purposes of analysis. In living usage any one of these early modern words for the 'sky' could have functioned as a synonym of any of the others. The collapse of the old cosmological concepts may not therefore have been without consequence for the immediate perception of the sky. Like the sound of a breaking string in Chekhov's *The Cherry Orchard*, something, somewhere, has obscurely failed. For Hamlet the death of Jove means the dismantling of the firmament: 'For thou dost know, O Damon dear / This realm dismantled was / Of Jove himself, and now reigns here / A very, very – pajock' (3.2.260-63). His cosmological doubt is foreshadowed by a jaundiced experience of the sky: 'this most excellent canopy, the air, look you, this brave / o'erhanging firmament, this majestical roof fretted with / golden fire – why, it appeareth nothing to me but a foul and pestilent congregation of vapours' (2.2.261-64).

Works Cited

- Audi, Robert, ed. 'Phenomenology'. *The Cambridge Dictionary of Philosophy*, Cambridge University Press, 1995, pp. 578-79.
- Bachelard, Gaston. *Air and Dreams, An Essay On the Imagination of Movement*. Translated by Edith R. Farrel & C. Frederick Farel, Dallas Institute Publications, 2002.
- Casey, Edward S. *The Fate of Place: A Philosophical History*, University of California Press, 1997.

- Donne, John. 'The First Anniversary' and 'The Second Anniversary'. *The Complete English Poems of John Donne*. Edited by C.A. Patrides, Dent, 1985.
- Empson, William. 'Donne the space man'. *William Empson: Essays on Renaissance Literature, Volume One, Donne and the new philosophy*. Edited by John Haffenden, Cambridge UP, 1983, pp. 78-128.
- Methuen, Charlotte. 'The Role of the Heavens in the Thought of Philip Melanchthon'. *Journal of the History of Ideas*, 57:3 (July, 1996), pp.385-403.
- Nicholson, Marjorie Hope. *The Breaking of the Circle: Studies in the Effect of the 'New Science' on Seventeenth Century Poetry*, Oxford UP, 1960.
- Rowan-Robinson, Michael. 'Shakespeare's Astronomy: an Introduction'. Cheltenham Science Festival, June, 2016. Manuscript.
- Scully, Vincent. *The Earth, the Temple and the Gods: Greek Sacred Architecture*. Yale UP, 1962.
- Stephen Greenblatt et al., eds. *The Norton Shakespeare*, 3rd Edition. W.W. Norton & Co., 2016.
- Smith, E. Baldwin. *The Dome, a Study in the History of Ideas*. Princeton UP: Princeton N.J., 1950.
- Smith, David Woodruff, 'Phenomenology', *The Stanford Encyclopedia of Philosophy* (Summer 2018 Edition). Edited by Edward N. Zalta. <https://plato.stanford.edu/archives/sum2018/entries/phenomenology>.

BIONOTE

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