

The Meaning of Dark, Light and Shadows: Inferences in Art, Materiality and Cultural Practices

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Abstract. Our visual awareness relies on light acting on the eye to perceive materiality and colour. Medieval thought wrestled to articulate and comprehend its nature. The notebooks of Leonardo Da Vinci, for example, included his descriptions to define light and make comparisons so as to differentiate between light and shadow. His focus was on the illumination of surfaces from the perspective of a painter, seeing shadows as ‘the diminution of light by the intervention of an opaque body’ and ‘the counterpart of luminous rays’. In his mind, a shadow ‘stood between light and darkness’, with darkness being ‘the absence of light’. The anthropological record provides another gateway to such enquiry, holding oral and textual evidence on the meaning of light and cast shadows in the belief systems of some cultures. In one such example, recorded in the late nineteenth century, an observed reflection of the self in water was regarded as the person’s spirit and, significantly, the shadow cast by the body was imagined as the person’s soul. And how might such phenomena have been comprehended and used in the prehistoric past? Without ethnographic evidence the answer is unknowable and any conclusions are potentially conjecture. Researchers strive to overcome such hurdles using a suite of scientific tools and reasoning, and by drawing on the diversity of architecture and art. This paper follows a similar methodological trajectory to explore the qualitative nature of these phenomena using case studies spanning five millennia.

*Is light an energetic ray, a beam, the illumination of surfaces, an atmosphere? Is it the shining of the sun, the moon and the stars? Is it a flickering flame, a lamp or torch, the glowing embers of a fire? Is it whiteness, or a spectrum of colour? Is it a release from darkness, an enlivening of the spirit, divine presence, the power of reason?*¹

¹ Timothy Ingold, ‘Commentary I: On Light’, in *The Oxford Handbook of Light in Archaeology*, ed. Costas Papadopoulos and Holley Moyes (On-line: Oxford University Press, 2017).

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Introduction

If we gaze at the heavens after sunset we can observe what seems like an infinite number of distant stars, each a visible pinpoint of light interspaced in regions of apparent darkness. Contemporary wave theory states that starlight is a form of electromagnetic radiation to which the human eye is sensitive.² Expansion of the Universe, however, causes this type of light to be shifted into wavelengths which we cannot see with our eyes. Furthermore, the light from sufficiently distant galaxies, which are travelling so fast compared to us in an expanding universe, will never reach us. Current scientific thinking (although constantly evolving) is that prior to circa 13.8 billion years ago the universe consisted of an opaque plasma of hydrogen atoms, and total darkness prevailed. Light therefore could not and did not exist at that time. Following the Big Bang, protons and neutrons slowly began to gravitationally combine into ionized atoms of hydrogen.³ This happened during what is termed the Cosmic Dawn, an age which lasted an estimated fifty million to one billion years. During that time, total cosmic dark ended and the first sources of light appeared, related to the gravity-driven formation of stars and galaxies.⁴ The European Space Agency Planck space telescope mission has generated a detailed map of the cosmic background radiation, thought to be the first light in the universe, a mere 250,000–400,000 years after the Big Bang.⁵ These facts and theories provide a scientific foundation for the ensuing discussion on dark, light and shadows and their role in culture. In the ‘conversation’ here, the author will pursue the broadest of perspectives on the cultural meaning of dark, light and shadows, mindful of the need for, as Gabriel Cooney cautions, ‘Recognising the widespread cultural variability in the interpretation of darkness and the need to be wary of any simple binary division of light and dark...’.⁶

² Grant R. Fowles, *Introduction to Modern Optics*, 2nd edn (New York: Dover, 1989); Eugene Hecht, *Optics*, 5th edn (New York and London: Pearson, 2016).

³ Peter Coles, *Cosmology: A Very Short Introduction* (Oxford: Oxford University Press, 2001).

⁴ NASA, ‘Science–Early Universe’, <https://www.jwst.nasa.gov/content/science/firstLight.html>.

⁵ Robert Perkins, ‘Scientists Generate Map of the Universe’s First Light’, <https://news.usc.edu/48354/scientists-generate-map-of-the-universes-first-light/>.

⁶ Gabriel Cooney, ‘Coming in and out of the Dark’, in *The Archaeology of Darkness*, ed. Marion Dowd and Robert Hensey (Oxford: Oxbow Books, 2016).

The enigma of darkness

St Augustine's (354–430 CE) numerous texts include the *Confessions* (397 CE) in which, *inter alia*, he ponders on the nature of time. In Book XI of XIII he writes, 'What then is time? If no one asks me I know what it is; if I wish to explain to him who asks, I do not know'.⁷ His thinking on dark and light, in comparison, was more certain, inspired by his conversations with God. St Augustine perceived these interdependent entities as apparent oppositions. In his mind, dark and light could be equated to good and evil, or to knowing and not knowing. In Book VII he describes how those who came to believe in God would emerge out of the pit of darkness and be illuminated by His light. More than sixteen hundred years later, the origin and nature of dark and light and its natural manifestations are now better understood, informed by advances in science.

White light

When solar radiation from outer space strikes the earth's atmosphere it scatters as photons, each of which is a quantum of electromagnetic radiation. The result is termed 'white light' with a particulate character which can be perceived by the human eye. White light has two properties – intensity (brightness) and colour. Each enable visual awareness of our environment.⁸ Light intensity is related to the square of the amplitude of the light wave itself. Light colour is dependent on wave frequency and wavelength and is a perceived sensation to light of different wavelengths falling on the retina. White light is also a blend of every visible wavelength, having a total range, denoted by sigma, Σ , of about three-hundred and fifty nanometres (Figure 1). The spectrum of light visible to our eyes is bracketed by light in the ultraviolet and infrared, having shorter and longer wavelength ranges respectively, each beyond the sensitivity of human vision.

The different wavelengths of white light passing through any translucent material are bent according to the refractive index of the material. The emergent light is then dispersed, or spread, into a spectrum of colours. The rainbow is the most obvious and spectacular natural example of this phenomenon. For it to form, white light must strike spherical droplets of rainwater where it is refracted on entry, internally reflected, and refracted

⁷ William Alexander Hernandez, 'St. Augustine on Time', *International Journal of Humanities and Social Science* 6, no. 6 (2016).

⁸ John Daintith and Elizabeth Martin, eds, *A Dictionary of Science*, 6th edn (Oxford: Oxford University Press, 2010).

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again on exit.⁹ As shown in Figure 1, the top of the rainbow is always red because this colour is bent least and reaches the eye of the observer from water droplets which are highest in the sky. The colour violet is bent most and, for similar reasons, is always at the bottom of the rainbow. According to Anthony Stevens, the rainbow ‘has an emotional impact which generates a symbolism of rich complexity’ and is an ‘expression of heavenly glory,... the throne of the sky gods and, like the Cosmic Tree, is a bridge between Heaven and Earth’.¹⁰ It is likely that for these reasons the rainbow culturally features in many religious belief systems. Buddhism and Hinduism, for example, regard the rainbow as a representation of the highest mental plane of enlightenment. In Irish folklore, populist notions of there being any link between the rainbow and the mythical ‘crock of gold’, always in the possession of the mischievous *leprechaun*, is best summed up by T. K. Whittaker, a former Governor of the Bank of Ireland. His writing on the economic state of the nation in 1966 began with the following reference to the rainbow:

There is, I am afraid, still current a partly romantic, partly pathetic picture of the Irish as ineffectual dreamers, living in a green picturesque land of thatched cottages and heavy rainfalls with leprechauns and crocks of gold at the end of every rainbow (a leprechaun is a kind of fairy sometimes observed in the Irish countryside, especially after a party!).¹¹

⁹ Bill Casselman, ‘The Mathematics of Rainbows’, American Mathematical Society

<http://www.ams.org/publicoutreach/feature-column/fcarc-rainbows#:~:text=Descartes%20theory%20explains%20the%20main,with%20so me%20paler%20greenish%20bands>.

¹⁰ Anthony Stevens, *Ariadne's Clue: A Guide to the Symbols of Humankind* (Princeton, NJ: Princeton University Press, 1998), pp.251–52.

¹¹ T. K. Whitaker, ‘The New Ireland: Its Progress, Problems and Aspirations’, *Chronique de politique étrangère* 19, no. 2 (1966), pp. 169-83. .

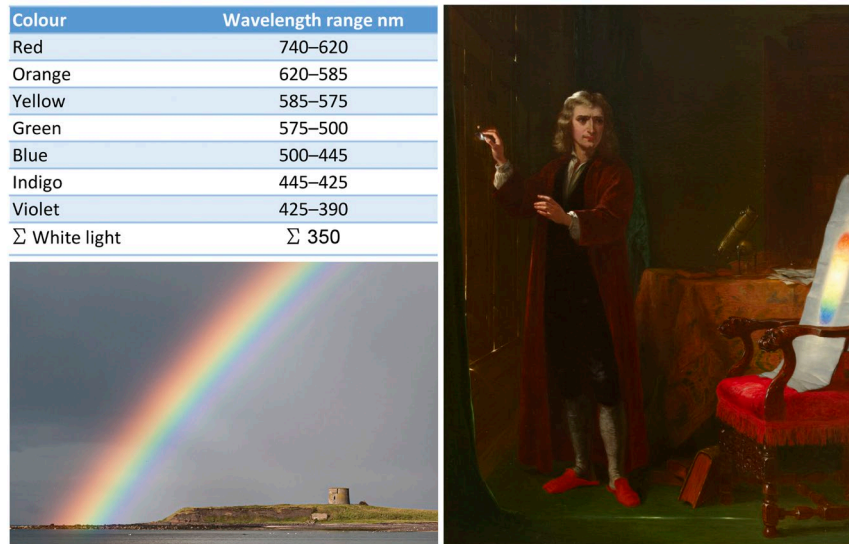


Figure 1. Above left, wavelength ranges for seven colours in the visible spectrum; below left, rainbow over Shenick Island and Martello Tower, Skerries, Co. Dublin (Photo: The Outdoor Studio). Right, Sir Isaac Newton’s prism experiment c. 1704 (Permission: British Optical Association Museum).

Sir Isaac Newton (1642–1727 CE) scientifically explored the nature of light by experimenting with a glass prism in controlled conditions of dark and light.¹² His published findings in *Optics* (1672) state ‘By the Ray of Light I understand its least Parts’. He further describes one investigation in more detail:

In a very dark Chamber at a round hole about one third part of an Inch broad made in the Shut of a Window I placed a Glass Prism, whereby the beam of the Sun’s Light which came in at that hole might be refracted upwards toward the

¹² Fara Patricia, ‘Newton Shows the Light: A Commentary on Newton (1672) “a Letter...Containing His New Theory About Light and Colours...”’ *Philosophical Transactions of the Royal Society A*, no. 373 (2015).

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opposite Wall of the Chamber, and there form a coloured Image of the Sun.¹³

Newton's first test revealed a stretched image (of the Sun) on a sheet of white paper having a red upper edge and a blue lower edge. His second attempt produced the representation portrayed in Figure 1. He concluded that different colours must have different refractive indices – a concept which he understood. Newton drew from prior work on the nature of the rainbow by the French philosopher and scientist René Descartes (1596–1650 CE). That had been published almost a century earlier in 1637 as a short technical essay, *L'arc en ciel*.¹⁴ Descartes similarly describes how a light ray penetrates and exits raindrops to produce the rainbow phenomenon. Nonetheless, and by his own admission, he (Descartes) failed to comprehend that each colour had a different refractive index. That discovery is credited to Newton.

What then is the dark?

Radiometry is the study of light (visible, ultraviolet and infrared). Photometry is concerned with the human visual response to white light. When the eye is adapted to viewing in bright light, this is termed *photopic* vision and the cones in the retina are the dominant receptors. In dark conditions we experience *scotopic* vision – and here the rods in the retina are the dominant receptors. Vision in conditions when the eye is dark adapted requires a luminance threshold level below about 0.001 cd/m².¹⁵ The dark and darkness can be physiologically defined in these terms. Alternatively, a physicist might think of darkness as being what is perceived after the last photons of light arrive, i.e., the absence of light. In that branch of science, darkness logically must travel at the speed of light and cannot 'exist by itself as a unique physical entity'.¹⁶ Such definitions

¹³ Isaac Sir Newton, *Optiks: Or, a Treatise of the Reflections, Refractions, Inflections and Colours of Light*, 4th edn (London: William Innys, 1704), 18.Prop. 2 Theor. 2

¹⁴ René Descartes, 'De L'arc-En-Ciel', in *Discours De La Méthode Pour Bien Conduire Sa Raison Et Chercher La Vérité Dans Les Sciences, Plus La Dioptrique, Les Météores Et La Géométrie Qui Sont Des Essais De Cette Méthode* (<https://gallica.bnf.fr/ark:/12148/btv1b86069594/f335.item.r=.langEN>, 1637).

¹⁵ Alma E. F. Taylor, *Illumination Fundamentals* (<http://www.lrc.rpi.edu/resources/publications/pdf/illuminationfund.pdf>: Lighting Research Centre and Rensselaer Polytechnic, 2000).

¹⁶ Christopher Baird, 'What Is the Speed of Dark?',

of dark and light provide clarity and rigour to the scientific mind. But what of our emotional responses to, and the mental challenges and complexities of, trying to grasp the intangibility of dark and light? Arguably, these require alternative interdisciplinary approaches in order to bring broader perspectives to invigorate more meaningful discussion of these antithetical binary phenomena.

Theoretical perspectives and early textual sources

Epistemology is the branch of philosophy which deals with knowledge and ontology is concerned with the nature of being and reality. As defined by Michael Crotty, epistemology addresses the question ‘what it means for the individual to know’ and ontology is concerned with ‘the true nature of reality’.¹⁷ Crotty also cautions that epistemological and ontological issues tend to merge in many research discourses and writers often have difficulty in keeping them apart conceptually, adding ‘It would seem preferable to retain the usage of “theoretical perspective” and to reserve the term “ontology” for those occasions when we need to talk about “being:”’.¹⁸

Taking a theoretical perspective on dark and light then, the relationship between reality and meaning are obviously formed in the mind. This is graphically illustrated by Katie Moon and Deborah Blackman, who show how empirically observed non-physical and physical realities undergo a process of reasoning so as to confer cognitive meaning in the mentality of the observer.¹⁹ St Augustine’s conversations with God, described earlier, are an example of such rational processing of the dualism of dark and light, with each being a non-physical reality upon which a value was conferred (in his mind).

In searching for conceptions and depictions of dark and light in early religious figurative art, Richard Greenfield selects how the Devil is portrayed in the Byzantine art tradition.²⁰ He explains by what method artists who wished to depict him invariably did so by employing a generic winged human form, always smaller in scale than Jesus and habitually coloured dark to emphasise the power of evil. Demons were similarly

<https://wtamu.edu/~cbaird/sq/2013/06/20/what-is-the-speed-of-dark/>.

¹⁷ Michael Crotty, *The Foundations of Social Research: Meaning and Perspective in the Research Process* (London: Sage, 1998), p. 10.

¹⁸ Crotty, *The Foundations of Social Research*, p. 10.

¹⁹ Katie Moon and Deborah Blackman, ‘A Guide to Understanding Social Science Research for Natural Scientists’, *Conservation Biology* 28 (2014).

²⁰ Richard Greenfield, ‘Fallen into Outer Darkness: Later Byzantine Depictions and Conceptions of the Devil and the Demons’, *Etnofoor* 5, no. 1/2 (1992).

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represented as a dark-skinned man. Perversely, Satan could disguise himself as an ‘angel of light’ for the purpose of deception and temptation which attests to the enduring belief that goodness is embodied in light. Hence, dark and light are antithetical, i.e., they are in unequivocal opposition. If proof were needed, the perception that light is a negation of the dark is a widely shared experience. This is readily encountered at dawn when fear of dark, in the minds of some, is banished by the light of the rising Sun with the hope of a bright new day.

My search for culturally meaningful examples of figurative/textual references to dark and light in the Irish tradition begins with the Early Medieval (400–1169 CE). The first is found in what is one of Ireland’s greatest literary treasures.

The Book of Kells

The *Book of Kells* contains three-hundred and forty folios of vellum featuring the four Gospels written in Latin in insular majuscule style accompanied by whole pages of decoration.²¹ Since circa 1661 CE it has resided in the Old Library of Trinity College Dublin (MS 58).²² Scholars generally regard this book as a metaphor for the emergence of western European civilisation from the darkness of paganism into the light of revelation associated with the spread of Christianity. Its origin can be traced to St Colm Cille (520–593 CE), who left Ireland in 562 CE to found a monastery on the island of Iona, off the west coast of Mull, Scotland.²³ Françoise Henry considers the book to belong to a distinctive regional group of similarly decorated manuscripts chiefly connected with Ireland, Scotland and the monastery of Lindisfarne in northern England.²⁴ Most such manuscripts are unsigned and undated, thereby requiring different contexts and textual sources to date them. The *Book of Kells* was commenced in Iona and completed at the sister Columban monastery in Kells, Ireland, by circa 800 CE. This followed its safe removal from Scotland as a result of continuing Viking raids on Iona. The decorated

²¹ Unattributed and Trinity College Dublin, *The Book of Kells*, <https://www.tcd.ie/library/manuscripts/book-of-kells.php>.

²² Unattributed, *The Book of Kells*, <https://digitalcollections.tcd.ie/concern/folios/k643b140q>; *The Book of Kells*.

²³ Brian Lacey, *Pocket History of Irish Saints* (Dublin: The O’Brien Press, 2003), pp.64–72.

²⁴ Françoise Henry, ‘The Book and Its Decoration’, in *The Book of Kells. Reproductions from the Manuscripts in Trinity College Dublin*, ed. Trinity College Dublin (London: Thames & Hudson, 1974), p.150.

pages were completed by just three artists and the texts copied down by four scribes. The iconography found on one particular leaf is relevant to the theme of dark and light.

In Folio 202v, Christ is shown at the apex of a temple-like structure flanked by two angels (Figure 2a). A black winged human-like figure is shown standing on His left side. The scene is commonly interpreted as representing the ‘Temptation of Christ’, with the Devil portrayed as a lanky dark anthropomorphic creature. All others in the scene, the angels and the crowd who witness the dialogue between the Devil and Christ, are brightly coloured. Henry provides additional evidence of this qualitative opposition of dark and light by citing two other Early Medieval manuscripts. The first is the Stuttgart Psalter, compiled approximately between 820 and 830 CE, which depicts the ‘Temptation of Christ on the Mountain’. The second example in the Carolingian psalter known as the *Codex Aureus of Echternach* (Golden Gospels) was compiled approximately 1030–1050 CE and shows ‘The Temptation of Christ on the Temple’, where the Devil is similarly depicted using a dark colour. Collectively all three examples use colour symbolism to emphasise the adversarial opposition of dark and light. The Dark represents evil and malevolence while the inferior scale of the Devil versus that of Christ symbolises the power of good over evil. To the eye of the author, the illustration in Figure 2a reveals a further opposition – the Devil is positioned on the left-hand side of Christ. Such sidedness is synonymous with evil, the Latin word for ‘left’ being *sinister*. These interwoven depictions forcefully amplify the ominous character of the scene by equating dark with dread, showing how light triumphs over the dark and the sinister symbolism of the left-side.

The *Book of Dimma* provides the second Irish textual reference to dark and light or, more explicitly, night and day. This small volume of the four gospels was written in Latin on 148 leaves of vellum in the late eighth century CE at a monastery founded by St Crónán in Roscrea, Ireland in the seventh century (St Crónán died in 619 CE).²⁵ In a modern translation of the manuscript, Charles Plummer describes how the spirit of St Crónán instructed his chief scribe Dimma to write down all of the gospels in a single day – an impossible task. The legend is that Dimma prevailed upon his divine connections to suspend darkness for forty nights so that the Sun would perpetually shine ‘for one day’, enabling the book to be completed

²⁵ Catherine Yvard, ‘The Book of Dimma’, <https://www.tcd.ie/library/early-irish-mss/book-of-dimma/>.

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Figure 2. (a) The Temptation of Christ, *Book of Kells* MS58 Folio 202v (© The Board of Trinity College Dublin); (b) Detail from the *Book of Ballymote*, MS 23, P12, folio 196v (By permission of the Royal Irish Academy © RIA); (c) First crescent of the new moon and earthshine by Leonardo da Vinci c. 1510 (Public Domain: httpscommons.wikimedia.org/wiki/File:Vinci_-_Hammer_2A.jpg); (d) Major lunar phases (Photos: Frank Prendergast).

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as commanded.²⁶ Plummer's translations contain supporting key phrases from the original manuscript. For example '*En ait ei sanctus: Scribe sine cessacione, usque dum sol tibi occubuerit*', meaning 'The Saint added: Write without resting until the Sun has died' (translation is by the author). The other key text is '*quadraginta dierum et noctium*', meaning 'forty days and nights'. It should be mentioned here that the book was not written by Dimma whom the book is named after but by another scribe, Dianchríde. This is revealed by a mention of the latter's name in folio 103 of that book.²⁷

The third textual example was recently discovered in the *Book of Ballymote*, an Irish annal which dates to the Medieval (1169–1550 CE). The focus here is on poetic composition and illustrates how the dark, conversely, has power over light.

The Book of Ballymote

The *Book of Ballymote* was written on vellum in circa 1390 CE and is now in the library of the Royal Irish Academy, Dublin. The use of vellum predates that of paper as a medium for texts with paper only coming into use here after circa 1600 CE. The manuscript contains genealogical, topographical, biblical and hagiographical material mostly in Medieval Irish; some content is in Latin. The three authors belonged to respected wealthy hereditary professional families and were adept in civil law/ancient history (*seanchas*), divine law (*reacht*), traditional healing/medicine (*leigheas*) and poetry (*filíocht*). Dark and light is mentioned in the last category as is next described.

Figure 2(b) shows a detail from folio 196v of the *Book of Ballymote*. A translation of the text by John Carey, a scholar of Early and Medieval Irish, has discovered how one poet (*filí*) sets out to write a description of the topography around Dublin. However, instead of first making the journey to view the landscapes of interest, he instead withdraws into a darkened room to write a poem which records his mental visions of places and placenames. As Carey describes it, the voice of the poet is speaking to us from the distant past about how landmarks are 'clearly visible' (*imréil*) and

²⁶ Charles Plummer, *Vitae Sanctorum Hiberniae, Partim Hactenus Ineditae* 2 vols, Vol. 2 (Oxford: Clarendon Press, 1910), 24 ix.

²⁷ Dianchríde, *Book of Dimma* (TCD MS 59: TCD MS 59 (c. 800 CE) <https://digitalcollections.tcd.ie/concern/works/9306t370s?locale=en&page=2> [accessed 23 May 2021]; Dianchríde, *Book of Dimma*.

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‘illuminated’ (*imshuilsí*).²⁸ On close examination of the first word in line 4 of Figure 2b, *imréil* is evident. According to Carey, poets in Medieval Ireland sometimes composed their verses in rooms without windows to deliberately block out the light of day to help enhance and focus inspiration. Carey continues, ‘the mind’s gaze sees in a different kind of light; and in order to experience this light the glare of the day must be shut out.’

More than a century after the *Book of Ballymote* was written down in Ireland, the mind of one Italian Renaissance thinker was directing his gaze at the most obvious celestial phenomenon in the night sky, i.e., the lunar phase cycle. In doing so, he would arguably become the first to bridge the art and science of dark with that of light.

Leonardo da Vinci – the dark and light ‘Of the Moon’

Leonardo da Vinci (1452–1519 CE) was an Italian painter and polymath. In his time the Ptolemaic geocentric model of the universe prevailed. The true heliocentric nature of the solar system would only be discovered in 1543 CE by Copernicus, twenty-four years after the death of da Vinci. His numerous drawings and texts addressed all aspects of art and science, including the nature of dark, light and shadows (shadows are discussed in the final section of this chapter). His records, kept on sheets of loose papers, were later bound into twenty-two notebooks now kept in the British Library.²⁹ Book XIV illustrates dark and light as he observed it in the sky – specifically the illuminated fraction of the lunar disc immediately following a new moon. At such a time in the synodic cycle, as much as 96% of the Moon is still dark with only the first illuminated crescent barely visible to the naked eye. Da Vinci’s drawing shows the crescent when the age of the Moon is about 1–2 days old with the greater darker portion of the lunar disc described by him as *lumen cinereum*, meaning light with the colour of ash, a ghostly glow (Figure 2c). To his eye, mistakenly, the Moon had an atmosphere and oceans each of which were thought to reflect sunlight back to Earth. He also supposed sunlight was reflected from the

²⁸ John Carey, ‘Dark Places and Supernatural Light in Early Ireland’, in *The Archaeology of Darkness*, ed. Marion Dowd and Robert Hensey (Oxford: Oxbow Books, 2016), p.101.

²⁹ Leonardo da Vinci, ‘Notebook - Codex Arundel’, in *British Library* (Arundel MS 263, 1478–1518).

Earth's oceans onto the lunar surface.³⁰ Modern science now terms this astronomical phenomenon 'earthshine' caused by sunlight reflected not by the Earth's oceans but by oceanic clouds.

The Moon's monthly waxing and waning, partly drawn by da Vinci, is an obvious naturally recurring spectacle of alternating dark and light. Figure 2d shows three lunar phases – the first waxing crescent after new moon (age 1–2 days), full moon (age 15 days) and, lastly, the final visible waning crescent (age 26–27 days) just prior to the three-day period of invisibility when it passes in front of the Sun – hence the term 'dark moon'. The astronomical new moon occurs during this time, being the instant when the geometric centres of the Moon and Sun have the same celestial longitude, i.e., conjunction. Angular variability in the Moon's orbital plane causes its celestial latitude to vary from month to month so that it will mostly pass above or below the Sun. The only time when the new or dark moon can be 'seen' is during a partial or total solar eclipse when the celestial latitude of both bodies are close or of similar value. Such events are not common and cannot be predicted without recourse to astronomical ephemerides or long-term record keeping.

The interval between successive luni-solar conjunctions is 29.53 days. This defines the mean synodic period, the lunar month or lunation. The number of integer days in one lunation can therefore typically be 29 or 30 days if counted by an observer. Bradley Schaefer, drawing on Huber's observations, shows how a lunar month can vary from 29 days (46.94%) to 30 days (53.00%) and occasionally be 31 days (0.06%).³¹ These data will become relevant to later discussion relating to the first sighting of the lunar crescent for time-keeping purposes which predate the first millennium BCE.

Examples of dark and light phenomena have so far been scientific and textual. Broadening the canvas to include artistic examples, two works have a fortuitous connection to Ireland and exemplify ground-breaking approaches in their respective *genres*. The first is Medieval in date and the second is contemporary.

³⁰ 'Book Xiv (902): No Solid Body Is Less Heavy Than the Atmosphere', in *The Complete Notebooks of Leonardo Da Vinci (Translated by Jean Paul Richter)* ed. Jean Paul Richter (New York: Dover Publications, Inc., c. 1510 & 1888).

³¹ Bradley E. Schaefer, 'The Length of the Lunar Month', *Journal for the History of Astronomy* 23, no. 17 (1992).

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Artistic depictions

The Taking of Christ (1602 CE) is a masterpiece by the Italian painter Michelangelo Merisi da Caravaggio (1571–1610 CE). It remained with the descendants of Marquis Ciriaco Mettei, a city official in Rome who commissioned the work, for about 200 years. Caravaggio's name had by then become detached from the painting, leading to its incorrect attribution to the Dutch artist Gerrit van Honthorst. It was later sold in 1802 and brought to Ireland in 1924, still attributed to van Honthorst. Here, the work was reassessed and correctly attributed to Caravaggio in 1990 following its discovery in the dining room of a house belonging to the Jesuit Fathers in Dublin. It now hangs in the National Gallery of Ireland (Figure 3a). The painting illustrates the betrayal of Jesus by the apostle Judas to the Roman temple guards.

The *Taking of Christ* is renowned for the high degree of dark and light contrast across the whole composition so as to give the scene the strongest sense of drama.³² This technique is termed *chiaroscuro*. Caravaggio is credited as being its instigator and this new visual approach would be emulated by many painters from the Renaissance onwards. Two sources of illumination are evident in the painting. Faint light from a hand-held lantern is visible at the top of the work. But the main source of light is provided by moonlight shining on the faces of the apostles and guards in the Garden of Gethsemane at the foot of the Mount of Olives, Jerusalem. To the eye of the author, the positioning of Judas on the left side of Jesus again symbolises sidedness, synonymous with the sinister theme of the work.

³² National Gallery of Ireland and Michelangelo Merisi da Caravaggio, 'The Taking of Christ', <https://www.nationalgallery.ie/art-and-artists/highlights-collection/taking-christ-michelangelo-merisi-da-caravaggio>.



Figure 3. (a) Dark and light in Baroque art: *The Taking of Christ* by Michelangelo Merisi da Caravaggio c. 1602 (© National Gallery of Ireland); (b) Light and Shadow Photo Drawings 1978 by Nancy Holt (© Holt/Smithson Foundation / IVARO, Dublin).

The second example is by Nancy Holt (1938–2014), an American noted for her sculptures, installation art and land art. Selected examples of Holt’s many investigations involving light creations are currently (2021) on display in the exhibition ‘Light and Language’ at Lismore Castle,

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Waterford, Ireland.³³ In a triptych entitled *Light and Shadow Photo Drawings*, Holt focussed on light cast through three curved cut-outs and photographed the resulting dark and light shapes projected on an opposing wall (Figure 3b). This piece ‘distils the photographic medium to its essence’, ‘examines the common principles of visual art as a whole’, and with no recognisable form or object of reference, ‘the images invite the viewer to observe the interplay of light and shadow and grapple with the process of their own perception’.³⁴

The chronology of Holt’s earliest work places her at the very beginning of the so-called Land Art movement. Holt was the wife of Robert Smithson who created the first such installation, entitled *Spiral Jetty*, in 1970. That has gigantic form and is constructed from mud, basalt rocks and salt crystals which connect the land and sea while simultaneously symbolising dark and light as oppositions conveyed in the contrasting colours of the geological materiality comprising the structure. Other well-known Land Artists would follow in the tradition of Holt and Smithson such as Richard Long and James Turrell. Turrell’s *Dark Space* features a closed room with no perceivable light. The concept is not about what you can or cannot see in the space but, as Turrell puts it, ‘seeing yourself see’.³⁵ This has an uncanny link with the Irish Medieval poet described earlier who sought inspiration in a darkened room. The sculptor Anthony Gormley describes how ‘Turrell shows us that light itself can be the subject of art – the idea that light itself is numinous and worthy of attention: its intensity per se, its substance’.³⁶ To emphasise Gormley’s point, exactly fifty years ago a very special sighting of planet Earth suspended in the blackness of space above the extra-terrestrial surface of the Moon would yield one of the most profound and mystical images ever recorded in the history of mankind.

The NASA Apollo 15 mission set out to explore the lunar surface in July 1971. Astronaut Alfred Worden remained on-board the command module. During that time, Worden photographed an earthrise crescent from above the surface of the Moon (Figure 4a).³⁷ Imagery of earthrises had been

³³ Lismore Castle Arts, ‘Light and Language: Nancy Holt with A.K. Burns, Matthew Day Jackson, Dennis McNulty, Charlotte Moth, and Katie Paterson’, <https://www.lismorecastlearts.ie/nancyholt/>.

³⁴ Nancy Holt and Holt/Smithson Foundation, ‘Light and Shadow Photo Drawings 1978’, <https://holtsmithsonfoundation.org/light-and-shadow-photo-drawings>.

³⁵ James Turrell, ‘Dark Spaces’, <http://jamesturrell.com/work/type/dark-space/>.

³⁶ Anthony Gormley and Martin Gayford, *Shaping the World: Sculpture from Prehistory to Now* (London & New York: Thames & Hudson, 2020), pp.96, 103.

³⁷ NASA and Alfred Worden, ‘Earthrise’,

previously recorded from the 1960s but none had ever captured the Earth as a crescent mimicking the inverse case of viewing the Moon from Earth as drawn by da Vinci centuries before. In a conversation with the author, Worden described his experience as profoundly meaningful, connecting his vulnerable self to home by an invisible chord piercing through the black void of space. For Worden, the light reflected from his home planet was indeed numinous.

Back on Earth, the first appearance of the thin lunar crescent after dark moon can trigger a primordial response and explains why sighting it has played such a significant role in many ancient religions and calendars. According to Clive Ruggles, the dark moon likely shaped many cosmologies and rituals as far back as the Palaeolithic and regulated a diverse range of human behaviour which became institutionalised as customs and myths.³⁸ It is little wonder then that changing phases of the lunar crescent across the sky has been used as a perpetual timekeeping device. The mere act of observing the dark and light of its waxing and waning phases gives an observer the ability to discern time in every lunar month to a repeatable accuracy of about two days. This pragmatic use of celestial dark and light, which has inspired humans since the dawn of time, is now considered in more detail.

Ancient light and lunar calendars

Following the monthly conjunction of the Moon and Sun, the first crescent predictably appears low in the western sky soon after sunset. The age of the Moon will then be 1–2 days old, barely discernible as a thin waxing arc with an illumination typically of 2–4% (see Figure 2). Schaefer's analysis of the factors affecting visibility of the first crescent shows the age of the Moon at first sighting can be 'as young as 20 hours or as old as several days'.³⁹ The young crescent can signify rebirth and renewal in many cultures and explain why it is regarded as a temporal *initium* and propitious for reckoning time. Sighting it was, and still is, of particular importance for the operation of many traditional calendars, especially for Islam and Karaite Judaism. Because of this, those communities who wish to avoid calendrical uncertainty due to astronomical or weather related factors can

<https://history.nasa.gov/alsj/a15/images15.html#Mag98>.

³⁸ Clive Ruggles, *Ancient Astronomy: An Encyclopaedia of Cosmologies and Myth* (Santa Barbara, CA; Denver, CO; Oxford: ABC CLIO, 2005), pp.235–36.

³⁹ Schaefer, 'The Length of the Lunar Month'.

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even avail of a scientific first crescent prediction service provided by some astronomical observatories.⁴⁰

The administrative and calendrical importance of sighting the first lunar crescent after the darkness of new moon in the late first millennium CE is described by Frans Bruin, who had access to the Book of Astronomy compiled by the foremost Arab astronomer Al-Battānī (c. 858–929 CE).⁴¹ Al-Battānī not only analysed the elliptical orbit of the Moon but used his theories to predict the dates of first crescent sighting. Earlier still, some Graeco-Roman temples constructed at the end of the first millennium BCE feature lunar and solar symbols on their walls and ceilings. Gyula Priskin shows how this parietal art portrays deities and gods processing towards a disc known to symbolise the Moon.⁴² Priskin also claims the Ancient Greeks associated specific divinities with a lunar phase cycle of thirty days, and symbolised the waxing crescent with birth and renewal, and the waning phase with death.

Evidence of a luni-solar calendar pre-dating the Graeco-Roman period is found in Anatolian Hittite architecture of the Ancient Near East. Their complex religion is well understood from the wealth of translated documents and fragments dated to circa 1600 BCE. These reveal numerous festivals and cults, the most important of which were timed in relation to the lunar phase cycle and horizon directions of the Sun at significant astronomical declinations. The arrangements of rock-cut reliefs of 64 deities found in Chamber A of the rock sanctuary of Yazılıkaya, Anatolia, in modern-day Turkey, show that nights not days were counted during a synodic month based on the lunar phase cycle.⁴³ Remaining in the Ancient Near East, the next example of a first lunar crescent sighting being used to trigger the beginning of the month is likely to be the earliest known in that region.

⁴⁰ J. A. R. Caldwell and C. D. Laney, 'First Visibility of the Lunar Crescent', *African Skies* 5 (2001).

⁴¹ Frans Bruin, 'The First Visibility of the Lunar Crescent', *Vistas in Astronomy* 21 (1977).

⁴² Gyula Priskin, 'The Depictions of the Entire Lunar Cycle in Graeco-Roman Temples', *The Journal of Egyptian Archaeology* 102 (2016).

⁴³ Eberhard Zangger et al., 'Celestial Aspects of Hittite Religion, Part 2: Cosmic Symbolism at Yazılıkaya', *Journal of Skyscape Archaeology* 7, no. 1 (2021).

The Hash-hamer Cylinder Seal

Shortly before 1840, a small inscribed cylindrical seal made of greenstone (jasper) was discovered in Babylon, Iraq. The object was fabricated in circa 2100 BCE and yielded what may be the earliest figurative and textual evidence for the new lunar crescent being used to time the beginning of a new lunar month in the Mesopotamian calendar.⁴⁴ Mohammad Llyas describes how the astronomical criterion for determining the first visibility of the lunar crescent was established in the Babylonian era; the age of the Moon had to exceed 24 hours after conjunction to the time of first evening sighting.⁴⁵ An impression taken from the cylinder wall of the finely-worked Hash-hamer seal by its keepers in the British Museum measures just 5 cm x 9.5 cm and shows three figures in procession towards Ur-Nammu, a deified king (Figure 4b). He is depicted as bearded, wearing a plain robe with a double-rolled hem with a bracelet on his raised right wrist. He is seated on an elaborate throne whose legs are carved like those of a bull. Leftmost in the scene is a goddess with both hands raised, wearing a multi-horned head-dress and striped robe. Next in line is a bald clean-shaven worshipper with raised right-hand being led by another goddess. She wears a flounced robe, a multi-horned head-dress and has her left-hand raised. The borders of the seal are inscribed with cuneiform, the writing system of the Ancient Near East at that time. With greatest relevance for this discussion on dark and light in culture, the king is shown seated beneath a symbol depicting the first crescent moon.

According to John Steele, ‘all calendars used for cultic and everyday use throughout Mesopotamia in the second and third millennium BCE appear to have used real lunar months’.⁴⁶ Steele further reports the extensive evidence for Babylonians having moon gods such as *Hanna* and *Sin*, how sighting the new lunar crescent defined the beginning of a month, and how their festivals were timed using the half-moon on the seventh day and full moon on the fifteenth day. The Babylonians also tracked the remainder of the phase cycle until its disappearance and conjunction on the 29th or 30th day.

⁴⁴ British Museum, ‘Greenstone Seal of Hashhamer C. 2100 BCE.’, https://www.britishmuseum.org/collection/object/W_1880-1009-1.

⁴⁵ Mohammad Llyas, ‘Lunar Crescent Visibility Criterion and Islamic Calendar’, *Quarterly Journal of the Royal Astronomical Society* 35 (1994).

⁴⁶ John M. Steele, ‘The Length of the Month in Mesopotamian Calendars of the First Millennium BC’, in *Calendars and Years: Astronomy and Time in the Ancient Near East*, ed. John M. Steele (Oxford: Oxbow Books 2007), pp.133–48.

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Figure 4. (a) Earthrise viewed from the Apollo 15 command module in lunar orbit *c.* 31 July 1971 (Earth Science and Remote Sensing Unit, NASA Johnson Space Center); (b) Hash-hamer cylinder seal (impression), Third Dynasty of Ur, Babylon, *c.* 2100 BCE (© 2021 The Trustees of the British Museum); (c) Kerbstone K52, Knowth 1 passage tomb, Boyne Valley, Ireland *c.* 3200 BCE (laser scan © The Discovery Programme: Centre for Archaeology and Innovation Ireland, with additions).

Culture and Cosmos

Dark and light recorded in stone—an Irish case study

Megalithic tomb building began in Ireland during the early centuries of the fourth millennium BCE and continued until the Bronze Age, ending sometime after 2400 BCE. Four main traditions are well known, each differing in their chronology, material culture, tomb architecture and relative patterns of spatial distribution in the landscape.⁴⁷ The Boyne Valley archaeological landscape in eastern Ireland is a World Heritage Site, comprising an assemblage of passage tombs including the three megalithic tombs known at Dowth, Knowth and Newgrange. Each has a round cairn covering internal cruciform burial chamber(s) richly embellished with megalithic art. Externally, the cairns are each delimited by an enclosing ring of contiguous transversely-set kerbstones. The majority (87) of the 124 kerbstones at Knowth passage tomb are decorated with megalithic art, broadly categorised as figurative ornament.⁴⁸ The *corpus* of Irish parietal megalithic art is undoubtedly the most comprehensive in Western Europe. The style is almost exclusively abstract or geometrical in form and thus non-representational, i.e., it depicts neither human, animal nor utilitarian implements such as axes or arrow heads. But one kerbstone in particular provides the strongest evidence from the Irish Neolithic of representational symbolism associated with the dark and light of the lunar phase cycle.

Knowth passage tomb was constructed during the Irish Middle Neolithic in circa 3200 BCE. The aspect of kerbstone K52 is south-facing in the kerb, seeming to embrace the moon's passage and transit. The motifs on the obverse face of K52 were diligently recorded by the artist Martin Brennan in the early 1980s and it was he who first suggested that the sequence of 29 crescents and circles depicted the lunar phase cycle.⁴⁹ Since that time, a considerable body of scholarly archaeological writing on Irish megalithic art has largely avoided any engagement with the lunar paradigm. This is likely as a result of Brennan's proposition being submerged in a sea of

⁴⁷ Elizabeth Shee Twohig, *Irish Megalithic Tombs*, 2nd edn (Princes Risborough: Shire Publications, 2004); Frank Prendergast, 'Irish Neolithic Tombs in Their Landscape', in *Handbook of Archaeoastronomy and Ethnoastronomy*, ed. Clive L. N. Ruggles (New York: Springer New York, 2014).

⁴⁸ George Eogan and Elizabeth Twohig (Archaeological Editor), *Excavations at Knowth 7: The Megalithic Art of the Passage Tombs at Knowth, County Meath* (Dublin: Royal Irish Academy, 2021).

⁴⁹ Martin Brennan, *The Stones of Time: Calendars, Sundials, and Stone Chambers of Ancient Ireland (First Published as the Stars and Stones, Great Britain, 1983)* (Rochester, VT: Inner Traditions International, 1994).

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‘much nonsense’ as described by Douglas Heggie.⁵⁰ Nonetheless, Heggie was the first astronomer to agree that the pattern of symbols on K52 likely represented ‘a rough representation of the phases and of their relative prominence’ in the synodic cycle. Several eminent astronomers and archaeoastronomers concur with this interpretation.⁵¹

The lunar-like symbolism depicted on K52 is shown in Figure 4c using a high resolution laser scan. This technology significantly enhances the definition of the finely picked detail, now much eroded due to weathering. An examination of the lower half of the kerbstone shows crescent-like motifs 27, 28 and 29 are layered beneath a centrally placed double-spiral. Expressed differently, the double-spiral appears dominant above the three crescents and was depicted afterwards. Fair use of these data suggest that these three motifs symbolically represent the Moon when it ‘disappeared’ from view to hide behind the Sun – conforming to the observed reality and probable world view of the Neolithic artist who inscribed this kerbstone.

Examining the curvilinear motifs on K52 in greater detail, crescent 1 could represent the first visible sighting of the Moon with crescents 1–8 symbolising subsequent waxing phases until first quarter when half of the disc is illuminated as depicted by crescent 9. This is emphasised by the spiral motif nested within the crescent. Circles 10–13 may depict the nightly increase in the Moon’s illumination prior to full moon. Nested circles 14–16 coincide with the three-day period when the Moon appears full to the naked-eye.⁵² Crescents 17–26 complete the waning cycle until its apparent disappearance from the night sky as depicted by crescents 27–29.

Any attempt at decoding or translating the glyphs of pre-literate societies is fraught with danger and difficulty. Relevantly, Muiris O’Sullivan has written prodigiously on the meaning of Irish megalithic art with wider

⁵⁰ D. C. Heggie, ‘Megalithic Astronomy: Highlights and Problems’, in *Archaeoastronomy in the Old World*, ed. D.C. Heggie (Cambridge: Cambridge University Press, 1982), p.19.

⁵¹ E. C. Krupp, *Echoes of the Ancient Skies: The Astronomy of Lost Civilizations* (New York and Oxford: Oxford University Press, 1994), pp.301–02; D. H. Kelley and E. F. Milone, *Exploring Ancient Skies: An Encyclopedic Survey of Archaeoastronomy* (New York ; London: Springer, 2005), p.172; Ruggles, *Ancient Astronomy*, p.47; C. L. N. Ruggles, *Astronomy in Prehistoric Britain and Ireland* (New Haven, Conn. ; London: Yale University Press, 1999), p.129.

⁵² Tests carried out with volunteer sky-watchers (who had no knowledge of the exact date of full moon) show that the Moon can appear c. 100% illuminated for three successive nights.

applicability to the tradition encountered beyond these shores. O’Sullivan stresses the need for introducing insights ‘outside traditional sources’, how ‘any attempt to define the meaning of the art exclusively from one perspective is a recipe for distortion’ and that ‘collaboration represents the best approach’.⁵³ Julian Thomas suggests such symbols can constitute a type of formal material language and, in a collective context, ‘may condense a whole range of meaning’, ‘make up the basic units of ritual practise’ and be ‘multi-referential’.⁵⁴

The iconography on K52 is a unique and convincing insight on prehistoric depiction of the primary celestial manifestation of alternating dark and light phenomena in the night sky. This raises several key questions, notwithstanding that this is a one-off and unique example with no known parallel in the Irish archaeological record, at least. Was the sequence of crescents intended to track diurnal time in harmony with the number of nights in a real lunar month? Is the nature and spatial sequence of the motifs on K52 communicating the use of a simple tally system for reckoning time in the Neolithic? If so, was time and time interval in the Neolithic measured using nights rather than days, regulated by the contrasting dark and light of the Moon? Might such conclusions allude to a ceremonial or ritual role for K52?

To answer the first question, the number of crescents and circle motifs fit with Schaeffer’s criteria for the perceived length of the lunar month in different cultural traditions, the frequency being 29 days (47%) or 30 days (53%) as previously discussed. Secondly, epigraphic evidence in the form of tally marks and astral signs, lunar and solar, are depicted on short swords from the later Iron Age found in Gaul. Literary sources attributed to Caesar and Pliny support this claim and show that by that period a considerable body of astronomical knowledge existed.⁵⁵ Vincent Gaffney’s recent discovery of Late Neolithic pit structures associated with Durrington Walls Henge, England, indicate their spatial regularity over distances of almost a kilometre apart is likely explained by a tally system being used to count paces.⁵⁶ Thirdly, Caesar records that the Gauls adhered to traditions handed

⁵³ Muiris O’Sullivan, ‘On the Meaning of Megalithic Art’, *Brigantium* 10 (1997).

⁵⁴ Julian Thomas, ‘Ambiguous Symbols: Why There Were No Figurines in Neolithic Britain’, *Documenta Praehistorica* XXXII (2005).

⁵⁵ A. P. Fitzpatrick, ‘Night and Day: The Symbolism of Astral Signs on Later Iron Age Anthropomorphic Short Swords’, *Proceedings of the Prehistoric Society* 62 (2014).

⁵⁶ Vincent et al Gaffney, ‘A Massive, Late Neolithic Pit Structure Associated with Durrington Walls Henge’, *Internet Archaeology* 55 (2020).

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down by the Druids. On the matter of time-keeping amongst the Gauls, Caesar writes:

For that reason they compute the divisions of every season, not by the number of days, but of nights; they keep birthdays and the beginnings of months and years in such an order that the day follows the night.⁵⁷

Barry Raftery suggests probable contact in the Iron Age between the Irish and the Druidic Centre in Anglesey, Wales, based on the presence of Irish artefacts in the famous metalwork hoard found at Lyn Cerrig Bach on that island. Raftery speculates on the ‘shadowy ritual world of the Celts’ at that time and encourages the archaeologist to ‘at least ask questions and offer tentative solutions’ on those topics.⁵⁸ Knowing that the Druids reckoned calendrical time by counting nights, it is legitimate to hypothesise here that similar practises existed in Ireland – at the very least during the Iron Age and, perhaps, before that too. The idea that the megalithic art on kerbstone K52 at Knowth is a symbolic realisation and record of how the lunar phase cycle was perceived in the Neolithic is tenable. At the very least, this may be the earliest record on stone in northwest Europe of celestial ‘cosmovision’ – a regionally local way of viewing the world and comprehending the universe.⁵⁹

Shadow—the ‘child’ of dark and light

Cognitive science has a standard terminology to describe the three constituents necessary for shadow casting – caster, screen and the light source.⁶⁰ The caster, sometimes termed a *gnomon*, blocks light from the source. The screen is the surface onto which the shadow falls or is cast. This can be a scene in a painting (see Figure 3a), the ground, or the stone surface element of a built structure (see Figure 5). If the Sun is the light source and the caster and screen are considered to be fixed, watching or

⁵⁷ Julius Caesar, *De Bello Gallica; the Gallic Wars* (Translated by W. A. Mcdevitte and W. S. Bohn), Vi, 18 (<http://classics.mit.edu/Caesar/gallic.6.6.html> Accessed June 2021, 58–49 BCE).

⁵⁸ Barry Raftery, *Pagan Celtic Ireland : The Enigma of the Irish Iron Age* (London: Thames and Hudson, 1994), p.179.

⁵⁹ Oxford University Press, ‘Oxford English Dictionary’, <http://www.oed.com/>.

⁶⁰ Hannah M. Dee and Paulo E. Santos, ‘The Perception and Content of Cast Shadows: An Interdisciplinary Review’, *Spatial Cognition & Computation* 11, no. 3 (2011).

measuring the shadow's motion enables information to be extracted and inferences read into the purpose or related cultural meaning of the construct. This includes astronomical properties which are dependent on instantaneous azimuth and time.

The shadow constructs of interest in this discussion are located at the Neolithic passage tomb complexes of Knowth and Newgrange in the Boyne Valley, eastern Ireland. The caster in each case is a standing stone situated in close proximity (<25 m) to the tomb entrance. For shadow casting purposes, entrance kerbstones lavishly embellished with megalithic art constitute the screens with the Sun acting as the light source. Shadow casting in these terms can then be empirically described as the area of darkness falling on the kerbstones due to a nearby prominent standing stone blocking the direct light of the Sun (see Figure 5). Because the Sun has an appreciable size (is not a point source of light) the cast shadow has two regions termed the umbra and penumbra. The former is the region of full shadow. The latter is the minor region of half-shadow fringing the umbra and is not of interest here. A brief consideration of shadow casting ontology is first warranted before discussing shadow casting phenomena in the Boyne Valley archaeological complexes

The science of neuropsychology tells us that the darkness of shadows is essential for comprehending our own environment. On this point, Roberto Casati writes:

If light is the instrument of vision, shadow must be its great antagonist. One hides in the shadows because the searcher's gaze cannot penetrate the darkness. But it's also true that vision can't do without shadow: the information carried by shadow is a fundamental aid to seeing.⁶¹

Other studies claim that the shadow cast by our own body is in a very distinct class. According to Francesco Pavani and Giovanni Galfano, body-shadows retain a 'special status for cognitive processing' and direct attention to self in a highly specific manner.⁶² Moreover, ethnographic studies of the cultural traditions of indigenous communities described by Mircea Eliade mention how belief in a 'soul-shadow' is linked to an individual's power, especially shamans or sorcerers, how it disappears on

⁶¹ Roberto Casati, *Shadows: Unlocking Their Secrets, from Plato to Our Time* (New York: Vintage Books, 2004).

⁶² Francesco Pavani and Giovanni Galfano, 'The Multisensory Body Revealed through Its Cast Shadows', *Frontiers in Psychology* 6, no. 666 (2015).

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death and can even transfer to another living being.⁶³ Boyle Somerville's study of the pre-literate people of New Georgia, Solomon Islands, found their beliefs in life and the after-life included how the shadow was linked to the soul or spirit. He records:

Each person consists of a body, what may be roughly termed a spirit, and a soul. The spirit is one's reflection - as in still water or a looking glass - the soul is one's shadow, as thrown by the sun, or artificial light; the former is evil, and the latter good; each person, supposedly, being a combination of both,⁶⁴

Three millennia prior to Somerville's account, perception of the afterlife by the Ancient Egyptians included a conviction that the soul was a 'shadow image, an unsubstantial and idealized shape of the body'.⁶⁵ Collectively, these cases signpost a way to explore the cultural meaning of shadow casting at two of the passage tombs in the Boyne Valley, Ireland.

Shadow casting at Newgrange passage tomb

Newgrange passage tomb is the most impressive of its type on the island. The entrance and passage leading to the cruciform burial chamber are intentionally aligned with the rising Sun at winter solstice.⁶⁶ Dark and light inside the tomb are thought to have been ritually controlled by the insertion/removal of three small quartz blocks discovered during excavation of the 'roof-box'. The ceremonial and ritual role of quartz in Irish Neolithic lithic traditions are well known.⁶⁷ The roof-box structure is

⁶³ Mircea Eliade, *Patterns in Comparative Religion*. Translated by Rosemary Sheed (London: Sheed and Ward, 1958), pp.21, 205, 376.

⁶⁴ Boyle T. Somerville, 'Ethnographical Notes in New Georgia, Solomon Islands', *The Journal of the Anthropological Institute of Great Britain and Ireland* 26 (1897).

⁶⁵ Paul Carus, 'The Conception of the Soul and the Belief in Resurrection among the Egyptians', *The Monist* 15, no. 3 (1905).

⁶⁶ Michael J. O'Kelly, *Newgrange : Archaeology, Art and Legend* (London: Thames and Hudson, 1982), p.124.

⁶⁷ Killian Driscoll, 'The Role of Quartz in Neolithic Lithic Traditions: A Case Study from the Thornhill Early Neolithic Palisaded Enclosure, Co. Derry~Londonderry, Northern Ireland', *Proceedings of the Royal Irish Academy. Section C: Archaeology, Celtic Studies, History, Linguistics, Literature* (2015).

a unique slot opening positioned above the entrance passage which allows light from the rising Sun to reach the burial chamber.

For this discussion, we now turn to the 12 monoliths which encircle the massive round cairn at Newgrange. These vary greatly in height but the largest ones are prominently clustered adjacent to the entrance to the monument. Their careful positioning results in spectacular shadow casting at sunrise onto the obverse vertical face of the entrance kerbstone K1 – the screen. The astronomically interesting declinations of these alignments and their associated dates suggest intentionality for predicting and determining seasonal time with likely ceremonial purpose. The phenomena have been comprehensively recorded, analysed, and interpreted by the author and are now available online.⁶⁸

Shadow casting at Knowth passage tomb

This monument lies 1.3 km northwest of Newgrange and has comparable chronology and scale. Knowth differs from Newgrange in having two internal unconnected burial chambers, the east and west tombs. Kerbstones K11 and K74 are like sentinels, guarding the entrance to each tomb, respectively. Both such doorways separate the illuminated realm of the living outside the tombs from the darkened interiors where the cremated remains of the dead accompanied with their grave goods were interred during the Middle Neolithic. Fittingly, K11 and K74 are lavishly embellished with megalithic art and additionally have a centrally placed groove running vertically down from the top of the stone. This motif is replicated on the entrance stone K1 at Newgrange passage tomb. The entrance forecourts to Knowth also exhibit a quartz spread as shown in Figure 5. Newgrange has a considerably larger amount of this exotic stone which now covers the entrance facade.

Like Newgrange, shadow casting at Knowth is evident at both entrances. The caster in each case is standing stone ‘D’ and ‘9’ located close to K11 and K74, respectively. The placement of other adjacent exotic smaller stones within the area of quartz spread likely emphasises the ceremonial or ritual importance of these spaces. Figure 5 shows the archaeology of the western entrance and the spatial relationship between K74 and standing stone 9. Stone 9 has human scale, in height at least, and conceivably may have had anthropomorphic qualities imbued upon it the prehistoric past.

⁶⁸ F. T. Prendergast, ‘Shadow Casting Phenomena at Newgrange’, *Survey Ireland* 9 (1991).

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Figure 5. Entrance to the western passage tomb, Knowth, Boyne Valley, Ireland, with standing stone 9 shadow casting on kerbstone K74 (Photo: Frank Prendergast).

The shadow cast by stone 9 seasonally traverses diagonally upwards and clockwise across the face of K74 correlated with the dynamical azimuth and altitude of the descending Sun in the afternoon sky. The phenomenon endures diurnally for several weeks around the times of vernal and autumnal equinox and when the astronomical declination of the sun is about midway between its limiting values at the winter and summer solstice. The phenomenon is also mirrored on the eastern side of the Knowth cairn – specifically at sunrise and on similar dates in the solar cycle. The shadow cast by stone D traverses diagonally down and clockwise across the face of K11 as the morning Sun ascends out of the horizon. Both phenomena were first recorded by Clare Tuffy (pers. comms. 2019–2021) and are the subject of continuing investigations in collaboration with the author.

Ancestors, tomb architecture and ritual

New theories relating to Newgrange being the burial place for an elite are supported by recent research on the aDNA of human bone fragments from five individuals discovered in the burial chamber of that tomb.⁶⁹ This can partially explain the immense effort required in constructing these architectural pinnacles of their type, intimately bound up with ideas of life, death and journeys of the dead into the otherworld – the realm where the ancestors and gods would have prevailed in the Neolithic mind.⁷⁰ Tomb entrances would have demarcated a threshold separating interior and exterior realms characterised by dark and light respectively. Entrances would have consequently signified a rigid physical and psychological barrier, dividing the world of the dead from that of the living. On this point, Robert Krier considers ‘entrance’ to be a symbol of status and power, to be in geometrical harmony with its building, and for preparing the entrant ‘for the spatial event to come’, realised in ritually controlled acts.⁷¹ It is little wonder that impressiveness and embellishment of doorway architecture was therefore paramount in megalithic tombs. Empirical backing for this suggestion is evident in the flattening and indentation of the delimiting

⁶⁹ Lara M. Cassidy et al., ‘A Dynastic Elite in Monumental Neolithic Society’, *Nature* 582 (2020).

⁷⁰ Frank Prendergast, ‘The North Sky and the Otherworld: Journeys of the Dead in the Neolithic Considered’, in *Advancing Cultural Astronomy: Studies in Honour of Clive Ruggles*, ed. Efrosyni Boutsikas, Stephen C. McCluskey, and John Steele (New York: Springer, 2021).

⁷¹ Rob Krier, *Elements of Architecture*, 2nd edn (London: Academy Editions, 1992), pp. 95–98.

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kerb visible around many tomb entrances, amplified by the placement of distinctive kerbstones and standing stones, and the symbolic spread of quartz on the ground or facade.

George Eogan, who excavated Knowth, did address the issue of entrance and meaning in 'Ritual in burial and art'.⁷² Eogan uses speculation here by imagining how the incurving of the kerb created a 'reserved area' which had a possible ritual role for priests who performed ceremonies and rituals at auspicious times for those excluded from this sacred space. Almost certainly, dark, light and shadow casting phenomena would have played a crucial role in those rituals – repeating cyclically to the rhythm of the heavens.

Conclusions

This paper ends with the proposition that dark and light are a dualism, inseparable from shadow and stone in certain cultural contexts and settings. The idea that exotic stone could represent the soul or spirit also makes sense because of its durability, indestructibility and perceived quality of eternal endurance. Standing stones used for shadow casting were hewn, transported and erected, to be later imbued with sacredness to commemorate the memory and spirit of an individual, perhaps. Might such patterns of behaviour be part of a local or regional conviction that drew its power from the supreme cosmic source for illuminating and shadow casting – the Sun? While these questions are clearly unanswerable unless chronologically relevant ethnographic or textual support is available, logic would suggest these inferences are fair use of the available evidence.

Elsewhere, the paper references artistic, scientific and literary sources to illustrate how darkness, light and shadow are fundamental to so many aspects of culture. These collectively illustrate the ways in which humans experience dark, light and shadow in diverse settings, geographies and time, and the manner in which such phenomena have fundamentally influenced our belief systems and creativity on a global scale.

⁷² George Eogan, *Knowth and the Passage-Tombs of Ireland, New Aspects of Antiquity* (London: Thames and Hudson, 1986), pp.177–83.