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Rediscovering the Winter Solstice Alignment at Newgrange, Ireland

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Abstract and Keywords

Newgrange was the first prehistoric site in Ireland to have its astronomical alignment widely accepted, and since its discovery in 1967 has remained the best-known astronomically oriented archaeological monument on this island. This chapter investigates the discovery of the winter solstice orientation at this key light-centred site. It proposes a possible new explanation for the astronomically oriented ‘roof-box’: that its origins can be found in a previously unidentified extension to the passage during a phase of enlargement. Additionally, the chapter attempts to answer several fundamental questions. Is it conceivable that knowledge of the solstice was retained in the local community from the Late Neolithic? Could the solar orientation at Newgrange have been observed before its modern discovery through excavation, perhaps more than once? Finally, to what extent may pre-excavation reports of a winter solstice connection with Newgrange have influenced the reconstruction of the monument’s ‘roof-box’ and outer passage?

Keywords: Newgrange, Michael J. O’Kelly, passage tomb, archaeoastronomy, winter solstice, roof-box

Introduction

Newgrange, Co. Meath, located in eastern Ireland, is an internationally important site for a variety of reasons: its scale and sophistication, its megalithic art, and not least its significant archaeological context. The monument forms part of the Boyne Valley passage tomb complex, which incorporates approximately 40 Neolithic passage tombs as well as numerous other prehistoric sites (O’Kelly 1982; Cooney 2000; Stout 2002; Hensey 2015). It is referred to as ‘Brú na Bóinne’ in ancient literature, usually translated as ‘palace’ or

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'mansion on the Boyne' (Royal Irish Academy Dictionary 1975: 212), and is associated with a substantial corpus of medieval mythology, featuring ancient deities such as the Dagda, Oengus, and Bóand (the latter a personification of the Boyne River, which surrounds much of the complex) (Waddell 2014: 15–32). Arguably, however, it was the discovery of its orientation to sunrise on the winter solstice in the late 1960s which propelled Newgrange to the notoriety it has today, and made it the most accepted and best-known astronomically oriented prehistoric monument in Ireland.

This chapter is focused on the roof-box at Newgrange. It begins with a re-examination of the reasons for its construction in the Neolithic, proposing a new idea: that this unique structure was a response to a structural problem which arose during a phase of expansion at the monument. This is followed by a detailed discussion of Newgrange in myth and memory, concentrating on late nineteenth- and early twentieth- century investigations at the roof-box and early accounts of the monument's winter solstice orientation. Possible Iron Age entry into the monument is also discussed.

The roof-box

When Michael J. O’Kelly began to excavate Newgrange in the summer of 1962, the monument was in a dilapidated state (Figure 1). Trees grew around its cairn; displaced cairn material was amassed at its base, hiding much of the art on the surrounding kerbstones; its passage orthostats leaned precariously inwards, hampering entry into the monument; and the unusual feature positioned above the passage, known as the ‘roof-box’, was largely obscured. Degradation of the monument meant that the archaeological community and the wider public were unaware of the monument’s astronomical capability (though see below).



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Figure 1 Newgrange in 1962 before excavation and restoration

(O’Kelly 1982, plate 17, © National Monuments Service, Dept. of Arts, Heritage and the Gaeltacht, courtesy O’Kelly).

Professor O’Kelly’s brief from *Bord Fáilte Éireann* (the Irish Tourist Board) was primarily that of ‘restoration and conservation’ (O’Kelly 1982: 10). As the excavation progressed, a decision was made that the inward-leaning orthostats comprising the outer third of the passage would have to be vertically corrected. Nine orthostats on the left side of the passage and ten on the right were

straightened (p. 97). This work necessitated that the stone structure which lay above the passage, the roof-box, be completely disassembled and reconstructed after the orthostats were corrected (Figure 2).



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Figure 2: The roof-box and passage in the course of reconstruction. Prof. O’Kelly second from the right.

(© National Monuments Service, Dept. of Arts, Heritage and the Gaeltacht, courtesy O’Kelly).

Viewed externally, the roof-box is one metre wide and 90cm high, set 2.5m back from the entrance above the passage, and

highlighted by a lintel decorated with lozenges carved in high relief (Figure 3). The structure sits partially on the first roof slab of the passage (RS1) and partly on the next roof slab (RS2). The roof-box is central to the astronomical functioning of the monument, and to much of what is discussed here. According to O’Kelly’s detailed description of the structure’s morphology,

The two sides to left and right (west and east) of the open front were made up of low dry-built stone walls standing on RS1, and a slab, something over 1m in length, lay along the top of each wall. The walls decreased in height from front to back (i.e. from 55cm to 40cm) and the slab laid on them had a corresponding downward slope. These walls and slabs formed the lateral supports for a large slab, which we named the back corbel [*which closed the back of the roof-box*].

(see O’Kelly 1982: 93–96 for the full description, and Figure 7).

In antiquarian accounts, the feature had only been recognized by the highly decorated protruding lintel. This had been referred to as a ‘false lintel’ in the belief that it was actually a relieving beam or support for the passage entrance, though for some it also suggested the possibility of a second undiscovered passage (e.g. Wilde 1849: 193; see C. O’Kelly 1978: 5). In 1872 the Scottish architectural historian James Fergusson noted the unusual architectural arrangement at Newgrange, including the roof-box, which he referred to in passing as a ‘carved string-course’: ‘The position of the entrance so much within the outline of the Tumulus, is a peculiarity at first sight much more difficult to account for. [T]he ornamented threshold, and the carved string-course above, and other indications, seem to point out that the tumulus had what may be called an architectural facade at this point’ (Fergusson 1872: 205). This ‘architectural façade’, added to the monument, he envisaged as a ‘secondary or nearly contemporary’ envelope added to the initial cairn.

O’Kelly (1982: 93) coined the term ‘roof-box’, which has since become standard. When discovered during the excavations it would have resembled a box, but over time it became clear that the structure had an open-ended design (which allowed sunlight to enter the monument). Consequently, the word ‘box’ is perhaps less fitting than it might originally have been, as it calls to mind a container sealed at the base. Herity’s (1974: 27, 97) preferred term, ‘fanlight’/‘fanlight lintel’, is also less than ideal, but at least had the merit of suggesting that light passed through the structure.

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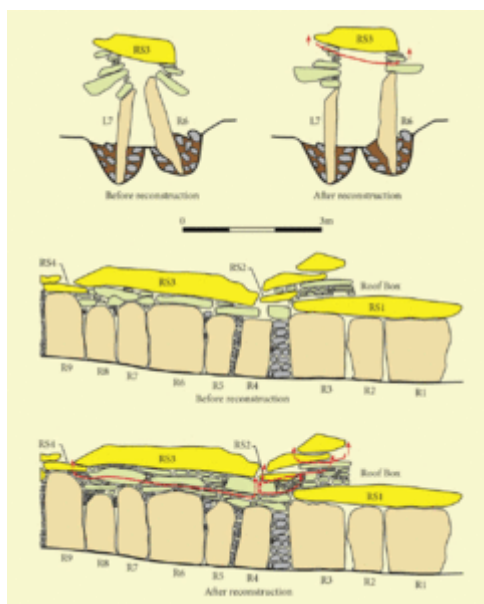
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Figure 3: The restored roof-box and decorated lintel (photograph: Robert Hensey).

From a functional perspective, the structure might be better compared to a funnel rather than a box or window. Essentially, the roof-box is a stone conduit or duct, designed to enable entry of the sun's light from the exterior of the monument to its interior. If one was to describe it in anatomical terminology or compare it to a model from the

natural world, it is akin to a stone 'mouth', which allows the sun to pass through a narrow throat-like opening (between the passage roofstones), and to progress through a gently twisting passage and into the chamber interior.

It was this refined and carefully positioned feature that O'Kelly had to dismantle, without full knowledge of its true role. This he did with great care. He notes, 'An eight-layered plan of the roof was drawn on which the position of every roofstone and corbel was plotted and as the roof was being dismantled, each stone was numbered in sequence and the same number affixed to the corresponding stone in the plan'; this ensured that the roof was restored with 'complete accuracy' (1982: 112). There was one important difference between the unreconstructed passage and the restored one, however: the space between RS1 and RS2, at the base of the roof-box, was now primed to allow light to pass into the chamber (see Figures 4, 6, and 7).



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Figure 4: Post-reconstruction changes to the roof-box

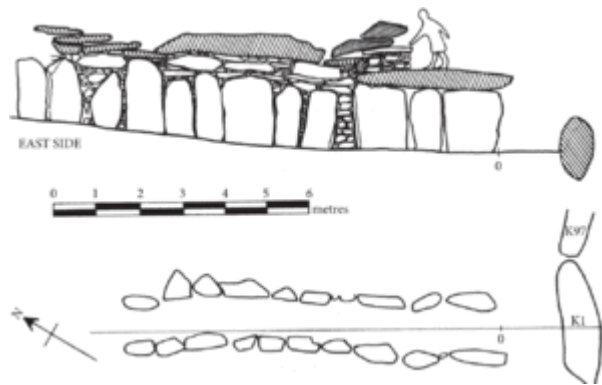
(illustration: Stout and Stout 2008, fig. 31, after O'Kelly 1982, fig. 17).

O'Kelly (1982: 125) declared that this arrangement provided a 'feasible solution to the problem of orientation at

Newgrange'. The 'problem', ultimately, was the 2m difference between the elevation of the passage floor at the monument's entrance and that of the chamber floor farther upslope. He explained that the function of the roof-box was to counteract the effect of the rising ground by directing the winter solstice sunlight through the elevated roof-box portal (rather than through the passage below). A question which has perhaps not been clearly articulated, however, is why the Neolithic builders chose to design a monument that necessitated such a device; or rather, why they did not construct a monument at which the light would come through the entrance as at other passage tombs. Recent research has highlighted that there are potentially two dozen astronomically oriented passage tombs in Ireland (Prendergast 2011), and an equivalent roof-box device is not present at any of those sites (though see Lynch 1973, and below). Could the builders of Newgrange not have built their monument differently so that a roof-box was not required? For instance, could they have opted for constructing a shorter passage, which would have made for a successful orientation without necessitating the roof-box feature?

Of significance in this regard is a comment by O'Kelly (1982: 98) that: 'From observation of the way in which the front part of the passage had been constructed it was clear that it had been erected as a free-standing structure independent of the main cairn mass and of the remainder of the tomb.' Significantly, directly beneath the roof-box is the only place where a substantial gap between the passage orthostats is found (now refilled with dry-walling) (Figure 5). O'Kelly (p. 34) remarked, 'Why this space, about 60 cm wide and sufficient to accommodate another orthostat, was left is not known.' He does, however, highlight that the roof-box appears to have a constructional relationship with this gap: 'It may or may not have been a coincidence that its eastern end is directly over the space between passage orthostats R3 and R4' (p. 96). I would like to suggest here that the outer section of the passage is indeed a separate free-standing structure as intimated by O'Kelly, because it was an extension to the original passage constructed during a phase of enlargement of the monument (see Hensey 2015: 132-136 for additional evidence of remodelling at Newgrange). The proposed extension is therefore represented by the three outermost orthostats on either side of the passage, the roof slabs above them, and the roof-box. It may be significant that the three outermost orthostats on either side of the passage have a noticeably greater girth than the preceding examples.

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Figure 5: Outer section of the passage with proposed free-standing extension. Note dry-walling between the third and fourth orthostats

(illustration after O'Kelly 1982, fig. 19, courtesy Eve O'Kelly).

An extension to the passage would explain why the roof-box is set 2.5m back from the passage entrance—something that has long been noted as curious (Fergusson 1872: 205–206). The monument's features are configured in this way because the roof-box marks the position of the old passage entrance. If individuals or communities in the Boyne Valley wanted to enhance

their monument through a phase of enlargement, naturally it would have been difficult to do so without extending the passage. Adding to the passage would have posed a major problem however as, critically, the new passage roof slabs would have obscured the existing winter solstice orientation. The solution was the so-called roof-box. The genius of the device was that it permitted beams of sunlight to pass through the barrier represented by the additional passage roofstones (Figure 6). This contrivance was particular to Newgrange: as the chamber is located on the rise of a hill, an extension of the passage would have progressed not only outwards but downwards (towards the river), thereby angling the passage away from the sun's beam. The roof-box was a structural solution which facilitated the continued entrance of the sun into the monument, as the passage was enlarged. That is, the sun could continue to enter the chamber every winter solstice by passing through a gap between the old and new passages, rather than progressing through the entrance doorway and then along the passage (as at other passage tombs with a solstitial orientation).

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Figure 6: Passage of winter solstice light through the roof-box, bisecting the passage roof slabs

(illustration: Stout and Stout 2008, fig. 29, after O'Kelly 1982, fig. 4).

The most crucial part of the roof-box was not its external design, but rather the connection between its inner extremity and the roof slabs below. A one-metre wide, 20–25cm high gap or slit is found between the passage roofstones—the space through which sunlight enters the chamber (see Figure 7). From the point of view of the passage extension proposed here (and indeed, O'Kelly's reconstruction), ensuring this gap was present and correctly spaced was the most crucial part of the

work if the monument were to fulfil its astronomical role. RS2 (over the proposed older passage) forms one side of the gap and is adjoined to the next major roof slab RS3. The innermost part of RS1 (capping the proposed extension orthostats) forms the other. As noted, the roof-box straddles these roof slabs, in doing so uniting the older passage with the newer extension.



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Figure 7: Interior of the roof-box

(photograph: Frank Prendergast).

The distance/ height differential between RS1 and RS2 was of the utmost importance if light was to shine into the chamber, and as O'Kelly (1982: 125) envisaged, the builders may have spent some time experimenting to ensure this was correct. It is notable that RS1 rests directly on the passage orthostats and hence was placed at a lower level than the other passage

roofstones which, in contrast, rest on smaller corbel stones (which in turn rest on their respective passage orthostats). Presumably, the builders knew that getting the correct

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spacing between RS1 and RS2 would be a much easier proposition if RS1, the slab over the extended passage, was at a slightly lower height than the earlier-constructed roof slabs (see Figures 4 and 5).

An extension in this location would imply a radical reshaping of the cairn. Space precludes a more complete discussion, but the excavated area either side of the passage uncovered lines of boulders, three courses high, beneath the cairn and approaching the roof-box on both sides of the passage and the proposed extension (see O'Kelly 1982: figs 6A, 13B, and 14). O'Kelly (1982: 86) suggested that the boulders were a supportive footing to 'retain or revet' cairn stones, but it is difficult to see these stones would be sufficient to fulfil that purpose. They may represent the edge of an older, smaller cairn. It should be kept in mind that an older, more diminutive, cairn may have had a less impressive kerb; that is, in envisaging a possible older Newgrange we should not try to project back today's one back to this earlier stage.

It is notable that the cairn has an unusual shape in plan (O'Kelly 1982: fig. 3); it appears front-heavy. The shape and appearance of the cairn may find explanation in an extension at the front of the monument. Additionally, it may be significant that Newgrange is built on a discrete envelope of land, and that the ground falls away rather quickly behind the monument to the northwest; if the site was to be expanded, the area to do this was the southern side.

Another implication is that the form of the monument's kerb would have been finalized at this time too (around the southern half of the monument at least). When this possible extension may have taken place is not clear. O'Kelly (1972; 1982: 230–231) retrieved a radiocarbon date on samples associated with burnt soil and caulking at either end of RS3, but that part of the passage, by this account, would represent the pre-extension passage (see Figure 5). As the proposed extension would necessarily postdate other elements of the structure, we can at least say it was built after conventional dates for the Newgrange's construction, the last centuries of the fourth millennium BC, as established by O'Kelly's work and largely confirmed by more recent radiocarbon dating (Schulting in Lynch 2014). Though we cannot firmly date the extension at present, by inference it is contemporary with the kerb on the southern side of the monument, which is decorated with art commonly considered Neolithic. A Late Neolithic date (3100–2500 BCE) is likely.

Though the roof-box at Newgrange has occasionally been considered in terms of approximate design similarities at other passage tombs, for instance Newgrange Sites L and K, Cairn G, Carrowkeel, Co. Sligo, and Maeshowe in the Orkney Islands (e.g. Lynch 1973; O'Kelly et al. 1978; Mackie 1997: 356; Ruggles and Barclay 2000: 70; Challands et al. 2005: 246; Hensey 2008), such parallels are unconvincing on direct comparison with the arrangement at Newgrange. These are not equivalent features because in each case the opening for the sun is located at the passage entrance, while the unique aspect of the Newgrange roof-box is that it is not found at the beginning of the passage, but rather 2.5m back along it. Its design allows light to cut through the passage roof slabs, a function which makes it structurally atypical. The roof-box device is a unique response to

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a unique situation: an extension to a monument with a pre-existing astronomically orientation, built on the rise of a hill. No similar requirement or situation occurs at these other Irish and Scottish sites.

Remarkably, it was only after the deconstruction and reassembly of this carefully calibrated part of the structure that O'Kelly witnessed the winter solstice phenomenon in the chamber for the first time, in 1967. He could not claim to be completely surprised however: for several years, over the course of the excavations, people in the locality had mentioned to him and others working at the site that light shone into the monument 'at some unspecified time' (C. O'Kelly 1978: 111; O'Kelly 1982: 123). Indeed, he notes it was these accounts that prompted him to consider the matter further (O'Kelly 1982: 123). This raises a question which will be the subject of the rest of this chapter: how could local people have known about the astronomical aspect of the monument before the reconstruction? A second and related question, which will be touched on later, is to what extent these accounts by visitors to the excavations might have influenced O'Kelly's thinking about the roof-box as the restoration work progressed.

The solstice alignment in myth?

The interpretation of events at Newgrange presented in the excavation report (O’Kelly 1982) infers that the winter solstice sun had not been seen in the chamber between the collapse of the cairn in the Late Neolithic and the reconstruction of the outer passage and roof-box in the late 1960s. Yet people from the locality informed the excavators that light from the rising sun shone into the monument and ‘used to light up the three-spiral stone (C10) in the end recess’ (C. O’Kelly 1978: 111; O’Kelly 1982: 123). O’Kelly (1982: 123) states that he did not give too much credence to these accounts; at that time Stonehenge was the subject of much speculation about its summer solstice alignment and other astronomical potentialities, and he felt that visitors might have unintentionally conflated ideas about the two sites (Hawkins 1965; Atkinson 1966). We know now that confusion with Stonehenge was unlikely to have been the source of these accounts, as Newgrange possesses its own astronomical orientation to the winter solstice. But this raises a critical issue: if the visitors to the excavation were correct about the astronomical nature of the monument, had awareness of the orientation somehow survived in the area over several thousand years?

It has been noted that archaeologists should be wary of rejecting mythological and folkloric accounts or oral history (e.g. Gavin-Schwartz and Holtorf 1999). We can point to examples of long-lived retention of knowledge in oral history and myth—for example, how a modern Mayan myth pointed to the location of previously unrecorded 1,000-year-old burials (Levi 1988); or the possibility that an Iron Age trackway across a bog, such as the Corlea Track (148 BCE), could have been referred to in an early medieval tale (*Tochmarc Étaíne*: Raftery 1994: 98). Equally, Tlingit oral history, recorded in the early twentieth century, appears to point to events which took place in part of southeast Alaska at least 850 years previously—before glacial ice covered the area (Crowell and Howell 2013). These are striking instances of the transmission of knowledge, potentially stretching back up to 1,000 years in some instances. But could folk memory really sustain for 5,000 years?

Waddell (2014: 24) contends that certain kinds of information were more likely to transfer through time, and notes that for a prehistoric person, the rebirth of the sun may have been equivalent to the resurrection for medieval Christians—thus significantly increasing the likelihood for the survival of knowledge of Newgrange’s solar associations. He further suggests that it is ‘quite conceivable that figures such as the Dagda, ... Óengus and Bóand or their precursors—and events associated with them—were part of the beliefs of those who frequented Newgrange over such a long timespan’, even allowing that ‘Aspects of their myths may well be incorporated in constructional and morphological elements of the monument’ (p. 30).

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Like O’Kelly, John Carey (1990 with references) has argued that the unique motifs in myths centred on Newgrange (and Dowth) in medieval Irish manuscripts (see below), viewed in light of the discovered solar orientation at Newgrange, suggest that elements from these stories may have Late Neolithic origins, or at least ‘cannot be dismissed as mere coincidence’ (p. 29). These literary tales, in several cases directly connected with Newgrange, contain an intriguing set of references to the manipulation of time, specifically to the manipulation of time over one day, and the control of, or temporary stopping of, the sun. Furthermore, as observed by O’Kelly (1982: 47; also see Ó hÓgáin 1999: 60), these tales feature recognized solar deities, in particular the Dagda, keeper of the Brugh, and his son Oengus.

In *De Gabáin int Síde* (The Taking of the Otherworld Mound) and *Tochmarc Étaíne* (The Wooing of Étaín), Oengus wins Newgrange from its owner by a conceptual ruse. He argues for possession of Newgrange for a day and a night, and when the owner comes to claim the site back, he explains that the world is composed of days and nights, concluding that his ownership should be made permanent. In a third story, *Altram Tighe Dá Mheadar* (The Fosterage of the House of Two Vessels), Oengus again uses a ruse involving the manipulation of time to force the mound’s incumbent to depart for eternity. Likewise, Oengus’ birth is owed to another time-trick. His father, the Dagda, sends Elcmar, the owner of Newgrange, on a one-day errand, during which time he impregnates Elcmar’s wife, Bóand. He casts an enchantment on Elcmar that nine months would seem to him as one day, so that when he returns his wife is no longer pregnant and the infidelity would pass unnoticed. Bóand summarizes the happenings with a statement apt to the winter solstice event: ‘Young is the son who has been begotten at the beginning of a day and born between it and evening’ (see Carey 1990: 26 for references). A final *dindsenchas* (toponymic) tale relates to the construction and naming of Dowth (*Dubad*), one of the triumvirate of exceptionally large passage tombs in the Boyne Valley. In this story, the daughter of the mounds owner makes the sun stand still so that the day is lengthened and hence the construction work completed more quickly (Carey 1990: 27). Interestingly, Dowth appears to have a winter solstice sunset orientation associated with its southwestern passage tomb (Moroney 1999; Prendergast and Ray 2002: 34).

These myths, according to Carey, are unlikely to be derived from a single earlier source, and are uncommon literary themes: ‘I am aware of no Irish legends associating the control or construction of sacred sites with the manipulation of time other than those which concern the tumuli of the Boyne Valley’ (1990: 27). This extraordinary group of tales, so fitting to the astronomical aspect of Newgrange, are certainly significant enough to warrant further explanation. They seem to suggest that knowledge of the solstice event—albeit in abstract form—remained in communal memory for approximately 4,000 years, until it was encoded in text in the medieval period. It has to be taken into account that one, and possibly two, major language shifts probably occurred over this time period; the most recent, the introduction of a language ancestral to Gaelic (conceivably early in the

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first millennium BCE), and potentially an earlier change coinciding with the introduction of Grooved Ware to Ireland in the Late Neolithic (Mallory 2013: 272–286).

O’Kelly (1982: 43–64) was struck by the coincidence of mythology featuring solar deities such as the Dagda and Oengus—mythology directly associated with Brú na Bóinne—together with local people’s statements about Newgrange’s astronomical arrangement, and then of course the winter solstice event at Newgrange as revealed through excavation. Indeed, he and Claire O’Kelly dedicated the third chapter of the Newgrange excavation report to discussing the mythology and deities associated with the monument. He asked whether it could be that the people who built the Boyne tombs had ‘planted the first seeds of Irish oral literature’ and ‘should one begin to think of this not as a window on the Iron Age but as one on the Late Neolithic?’ (O’Kelly 1982: 48). He notes that archaeology has seen other great shifts in perspective, especially as regards chronology; ‘Perhaps a similar lengthening of perspective is overdue in respect of Irish mythology and heroic saga’ (p. 48).

If we think it difficult to accept that knowledge could be preserved over such a lengthy period, even surviving multiple language changes, then we find ourselves in an unsatisfactory situation: disregarding an intriguing and unique group of medieval stories which refer to solar deities and the control of time and dismissing the information from visitors that prompted O’Kelly to investigate the astronomical potential of the site. But are there any other plausible ways of explaining these myths, or how visitors to the excavations had knowledge of the solstice phenomena at Newgrange? Several possibilities are explored in the following sections.

An early twentieth-century solstice

One potential way of explaining the existence of local information regarding the astronomical role of Newgrange is that the solstice phenomenon had been observed in a more recent period than previously considered. This would of course imply that the mythology discussed above was not directly referencing the solstice alignment at Newgrange (there are, after all, many myths from Ireland and elsewhere with solar motifs and symbolism as their focus). Could light have shone into Newgrange in the recent centuries before O’Kelly’s excavation, and could this, rather than a lengthy oral inheritance, have informed local people of the astronomical event? Late nineteenth- and early twentieth-century records suggest that at various times in the past the roof-box area was probed and investigated (O’Kelly 1982: 36); perhaps a clearing of that area may have been sufficient to allow light (even if only partial) to shine into the monument? This would also require that the passage entrance was open to allow people to enter and view the event.

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We know that the monument was opened in 1699, as demonstrated by Lhwyd's (1700; 1709) ground plan, as it is again in 1746, as testified by Thomas Wright's drawing (Stout 2002). Charles Vallancey's survey in 1776 indicates that disturbance occurred around the entrance area, as the triangular stone he depicted in that location was absent in subsequent illustrations (Stout 2002: fig. 37). The monument also appears to have been open in the early 1900s. O'Kelly (1982: 35) noted, on the basis of Wilkinson's (1845: 53) account and a drawing by Du Noyer, that by 1845 the large slab that once would have sealed the passage entrance had one end resting on kerbstone K1 outside the entrance. This 'doorstone' was laid prone at least by 1892, according to its representation by George Coffey, keeper of antiquities at the National Museum of Ireland (O'Kelly 1982: 35).

Regarding the roof-box, there are indications it was intermittently cleared of material too. As noted earlier, in the mid-nineteenth century, Wilde (1849: 193) observed that the lintel area might represent the opening into yet another chamber, causing it to be the subject of various digs and investigations (O'Kelly 1982: 36). Indeed, when the area was excavated in the 1960s the cairn material was loose because of 'disturbances in the past' (p. 89). O'Kelly (p. 36) refers to Richard Burchett's 1874 account of attempting to move the upper stone of the roof-box, but failing even after engaging 'two men with crow bars' to do the work. Burchett's report to the London Society of Antiquaries states, 'I uncovered its [the lintel's] whole surface' (O'Kelly 1982: 36). Hence, after Burchett's visit in 1874, the roof-box was probably exposed and relatively free of obstructive material. Of interest also is R. A. S. Macalister's investigation in the same area in 1928. He carried out 'some digging' beneath the lintel in search of a possible additional chamber, and upon failing to find one, back-filled the whole area (O'Kelly 1982: 36). Consequently, the roof-box may have been free of material after 1874 and possibly up to 1928. It is unlikely that archaeologists such as Macalister happened by chance to be at the site at 21 December to witness the solstitial phenomena (nor would solar alignments have been part of their archaeological enquiries or perspective), but it cannot be entirely dismissed that one or more local people or visitors to Newgrange saw partial solstice sunlight shining into the monument around the solstice during that 50-year period.

During those five decades the site would have received many visitors, inspired initially by guidebooks and scenic tour routes, including William Wilde's (1849) famous *Beauties of the Boyne and Blackwater*. The state took over management of Newgrange in 1882, and a considerable amount of clearance work was completed soon after. The Boyne Valley was an area of growing tourism, catering for visitors from Dublin and further afield. By 1896 the Great Northern Railway had established the 'Grand Circular Tour' of the Boyne Valley (Stout and Stout 2008: 105). Increasing visitor numbers in the area brought further attention to Newgrange (O'Kelly 1982: 39).

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It appears that in the late nineteenth and early twentieth century there were intervals when the roof-box was free of obstructive material and—assuming this feature had even partial functionality—this might have allowed some solstice effect to be witnessed in the chamber. Of interest is a poetic account of solar phenomena in what appears to be, the chamber at Newgrange. At the end of the nineteenth century, poet and artist George Russell referred to light within a darkened chamber in a mytho-poetic piece entitled *The Dream of Angus Oge*. In this work, Russell (1897) specifically refers to the palace of Angus, i.e. Newgrange (as previously noted *Brú na Bóinne* is usually translated as ‘palace on the Boyne’ and associated with the deity Oengus/Angus), and furthermore describes it as dramatically receiving the sun’s light:

As he spoke he paused before a great mound, grown over with trees, and around it silver clear in the moonlight were immense stones piled, the remains of an original circle, and there was a dark, low, narrow entrance leading within. He took Con by the hand, and in an instant they were standing in a lofty, cross-shaped cave, built roughly of huge stones. ... And even as he spoke a light began to glow and to pervade the cave and to obliterate the stone walls and the antique hieroglyphs engraved thereon, and to melt the earthen floor into itself like a fiery sun suddenly uprisen within the world ...

The complete piece makes it clear that Russell’s ambitions were primarily metaphorical and spiritual rather than empirical, yet there are several elements in this particular passage which make it abundantly clear it was Newgrange and its archaeology that served as the backdrop. The ‘great mound overgrown with trees’ surrounded by a ‘circle’ is an accurate description of Newgrange before work excavations at the site in the twentieth century (Figure 1). The ‘lofty, cross-shaped cave’ mirrors the cruciform design of the interior of Newgrange. Passage tombs in the Boyne Valley and elsewhere were regularly referred to as caves in the past (O’Kelly 1982: 24; Stout 2002: 202; Dowd 2015: 54–55); and the description ‘built roughly of huge stones’ shows that it is a humanly made structure not a natural feature. The depiction of light striking the ‘antique hieroglyphics’ is likely a reference to the passage tomb art. Even the description of the way the sunlight ‘melts the earthen floor’ is not dissimilar to the actual solstice phenomenon as it occurs today (see Hensey 2015: 66–69).

Might Russell have seen the light entering the mound through the roof-box after Burchett’s digging? Whether or not his account of the sun shining into Newgrange was based on personal observance is of course debatable, but on balance the piece would seem to indicate that he had some knowledge of the monument’s relationship with the sun. Perhaps light was seen by local people and reported to Russell—secondary information which he used to compose this scene in the tomb?

Bob Hickey

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If the roof-box had been backfilled in 1928 or before, first-hand observations of the event from the end of the nineteenth century would be relatively fresh in the memory's of the previous generation at the time of O'Kelly's excavations, thus explaining local accounts. If sunlight had been observed shining into the monument at this time, the idea that local knowledge had preserved the memory of the solstice event for 5,000 years would have to be squarely rejected; it would in fact only have been preserved for a few decades previous to O'Kelly's excavation.

However, this hypothesis is not without problems. The positive effect of O'Kelly's reconstruction of the roof-box at Newgrange makes it unlikely that the sun had been able to shine through that part of the structure in the decades previous to his excavations—in particular, the resulting lift to passage roofstones RS2 and RS3. The correcting of the corbel stones supporting RS2 and RS3, together with the straightening of the slumped orthostats to an upright position, meant that those roof slabs were positioned nearly 50cm higher when the work was complete. This appears to have enhanced, if not entirely facilitated, the capacity of the solar beam to pass into the chamber (Stout and Stout 2008: 48).

Another obstacle was obstruction of the inner part of the roof-box. When the feature was excavated, an angular quartz block, approximately 20–25cm in cross-section and 30–38cm long, was found at its inner extremity 'a bit thicker than the vertical gap and would not have fallen through it' (F. Lynch, pers. comm, 1973: 149; O'Kelly 1973: 142; 1982, 96). It should perhaps be noted that a 'gap' between the two passage roof slabs was still present before excavation.

Yet even if the roof-box was entirely inoperative previous to O'Kelly's work, it should be noted that around the winter solstice, ambient light enters the monument through the doorway and progresses up to the end chamber. In an account from 1966, author Jakob Streit visited Newgrange and was given information about the solstice orientation by a long-standing guide, Bob Hickey. Hickey pointed out a 'rhomboid symbol' (lozenges feature in the art at Newgrange) carved on a stone inside the tomb and stated 'that he had noticed that every year at the time of the shortest days in December a ray of sun came through the long and narrow entrance after sunrise and fell exactly on this spot' (Streit 1977: 41). It is not clear what art Hickey was referring to, but his comments were based on many years of observation at Newgrange before its excavation and reconstruction. Notably, he had taken over guiding duties from his wife, Anne Hickey, who had previously held that role for 39 years, from 1911 onwards (Limerick Times 1950). Effectively, Anne Hickey and her husband provide a bridge between the late nineteenth- and early twentieth-century material discussed thus far (and below) and O'Kelly's excavation.

The year of Hickey's observation, 1966, is significant, as the Newgrange winter solstice phenomenon was not witnessed by O'Kelly until the following year, 1967. O'Kelly and Hickey knew each other well, and the archaeologist would have been aware of this guide's observations. Bob Hickey appears to have been one of the unnamed people from

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the neighbourhood who reported solar associations with the monument. This has recently been confirmed to the author by an elderly local gentleman, Mr Hugh Russell, who as a young man discussed the action of winter solstice light at Newgrange in detail with Hickey. In this context, it cannot be discounted that significant numbers of local people saw ambient light in the chamber around the winter solstice which explains local knowledge regarding the monument's relationship with the sun.

Lockyer and Evan-Wentz

Another scenario that might explain local accounts of the solar event at Newgrange may simply be that the information given to O'Kelly was the result of archaeoastronomical survey or indeed observation of the solstice light outside of the monument, without direct observation of light within the chamber (hence a functioning roof-box was not required). In 1906 Sir Norman Lockyer, founder of the journal *Nature*, had drawn direct comparison between Newgrange and Gavrinis in Brittany, and Maeshowe in the Orkney islands in his book *Stonehenge and Other British Stone Monuments Astronomically Considered*. In the second edition in 1909, he pointed out that Newgrange had a winter solstice orientation (Lockyer 1909: 430; Ray 1989: 343). Notably, in the same work Lockyer also referred to the solstitial orientation of Bryn Celli Ddu in Wales, which has only recently been confirmed (Burrow 2010).

The winter solstice alignment at Newgrange was also discussed in *The Fairy Faith in Celtic Countries*, a popular collection of Celtic folklore by the American anthropologist Evans-Wentz (1911: 418–426). Evans-Wentz (pp. 419–20) begins by comparing Newgrange to the Great Pyramid at Giza:

It is well known that very many of the megalithic monuments of the Newgrange type scattered over Europe, especially from the Carnac centre of Brittany to the Tara-Boyne centre of Ireland, have one thing in common, an astronomical arrangement like the Great Pyramid, and an entrance facing one of the points of the solstice, usually either the winter solstice, which is common or the summer solstice.

He goes on to suggest that the Great Pyramid may, like Newgrange, have a passage oriented to the winter solstice, and expounds on the universal symbolism of the death of the sun at the winter solstice. In a more typologically secure comparison, he then outlines points of correspondence between Newgrange and the passage tomb at Gavrinis in Brittany (Evans-Wentz 1911: 424–426), noting that 'it opens like Newgrange to the sunrise 43° 60" [sic] to the south-east'.

Educated enthusiasts with an interest in antiquarianism, archaeology, and folklore would likely have been aware of these publications which, long before O'Kelly's excavation, state that Newgrange had a winter solstice orientation. If we consider the great number of people who were taking the Boyne Valley tour at this time, it would be no surprise whatsoever that information from books such as these would find their way to people living in the Boyne Valley. Through publications like those of Lockyer and Evans-Wentz, interest in the Newgrange's winter solstice orientation may have been encouraged, and perhaps re-seeded in the locality.

Discussion

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In this context, it seems fair to conclude that far from the astronomical alignment at Newgrange being unknown previous to O’Kelly’s excavation, it was in fact reasonably well known, especially in the early part of the twentieth century. If light had been observed shining into the monument at his time (even if only ambient light), or conclusions drawn from archaeoastronomical survey, and thus transferred back into the local community, the idea that local knowledge had preserved the memory of the solstice event since the Late Neolithic would have to be rejected. A 5,000-year transference of knowledge may not have been necessary, but instead only recourse to information from 50-year old books (i.e. at the time of the 1960s excavations).

It is notable that O’Kelly does not seem to have been aware of this history of claims for the monument’s solstitial orientation in his primary publications on Newgrange (1964; 1968; 1973; 1979; 1982; O’Kelly et al. 1978). This is surprising given his extensive research into its history, and the many communications he would have had with interested parties over the course of the excavations. His comments are rather brief, as noted above, simply stating that archaeoastronomical claims for the site had been mentioned by visitors to the excavations.

If he did have greater awareness of these sources than he records, the archaeological climate at the time might provide one explanation as to why he chose not to discuss them. The 1970s was a period where ‘New Archaeology’ or ‘Processual Archaeology’ was becoming established (Trigger 1989: 289–328). Processual archaeology demanded a much greater scientific rigour than had previously been required; the employment of the scientific method and testing of hypotheses became an essential part of archaeological practice at this time (Johnson 1999: 34–47). Processual archaeology encouraged a certain distancing from the speculative claims of previous generations too, especially often untrustworthy antiquarian interpretation. In this context it may have appeared rather dubious for O’Kelly to associate his work on the roof-box and passage with antiquated accounts and assertions from non-academic sources.

One also wonders whether O’Kelly had greater belief in local reports of the solstice orientation, such as Bob Hickey’s, than he admits. If he did suspect that the monument had a valid winter solstice orientation, it may have seemed judicious, more scientific, to downplay those sources. From O’Kelly’s perspective, a more convincing presentation of the discovery might have been to simply test the hypothesis without drawing non-archaeological sources or preconceived conclusions into the equation. This is speculation on my behalf, of course, but if such concerns were on his mind, the stance he took may have been the best option in the prevailing archaeological climate. Through his painstaking work he demonstrated the validity of what is undoubtedly a genuine astronomical orientation to a sceptical archaeological community and the wider public in the most effective way possible.

Iron Age Newgrange?

This could be the end of the solstice debate: we could simply conclude, as seems to be the case, that the solstice orientation was known about in the century previous to the 1960s excavations, except for two issues not fully resolved by the early twentieth-century evidence: the specificity of the local accounts of the winter solstice phenomena and the aforementioned mythological sources which seem to betray knowledge of the monuments solar associations.

If local knowledge was based purely on calculation of the orientation of the passage at Newgrange, it would fail to explain the precise detail about the solstice event given to O'Kelly (1982: 123), notably the specific reference to the sun lighting up the three-spiral stone (orthostat C10), located to the front and right-hand side of the end recess. As Lockyer made no direct observation of the winter solstice event, it is unlikely that any abstract observations would have generated such a detailed comment. Though clearly only a fleeting reference—and it would be wrong to place too much weight on it—it may be significant that O'Kelly was *not* told that light shone into the end chamber, which is, in fact, exactly what would have happened in the Neolithic according to Ray's survey (1989: 344). If taken at face value, this would suggest that this particular local memory of the solar event was not a memory of the light phenomena as it would have occurred in the Neolithic, but was of a more recent period, when changes in the obliquity of the ecliptic would have meant the sun could not shine as far into the monument as it had when it was constructed. Against this, one could point out that the local informant did not say the light came through the roof-box/ upper part of the passage. Indeed, the account related by O'Kelly is not that dissimilar to that given by Hickey to Streit: each describes light entering the monument (which may in both cases be ambient light) and striking artwork deeper within.

Even if we were to dismiss the specificity of the local informants' account regarding the monument's astronomical role, the existence of the extraordinary group of tales about the sun and the passage of time, set in the Boyne Valley, cannot be explained by nineteenth- or early twentieth-century probing and visits to the monument. Carey (1990: 29) has noted that the oldest of these myths could possibly have first been committed to manuscript in the eighth century, over 1,000 years before early twentieth-century reports and publications. If this group of tales is to be accounted for, the astronomical aspects of Newgrange would have to have been observed and noted prior to the eighth century.

How might we explain this apparent difficulty? Does it bring us back to advocating a survival of information from the Neolithic? Or could there have been other entries into the chamber in prehistory, as yet unrecognized? For instance, could it be that sunlight was seen shining into the monument at some point in the Bronze Age or Iron Age? In recent publications it has been proposed that changes to Newgrange of one form or another may have taken place in the Iron Age (O'Neill 2013; Gibbons and Gibbons 2016; Carlin forthcoming). These newer interpretations run counter to O'Kelly's (1982: 47) view

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that, unlike Knowth and Dowth, Newgrange 'was not tampered with' in later prehistory. Space precludes detailed discussion of the evidence for Iron Age activity at Newgrange, and at Brú na Bóinne in general, but Stout (2002) and Gibbons and Gibbons (2016) provide useful overviews (see also Eogan 1977; 1990 and Cahill Wilson 2014).

O'Neill (2013) posits 'a significant phase of later modification and/or slighting of the cairn' which explains the copious amount of material found on the south of the monument, around the entrance area. Gibbons and Gibbons (2016) also propose a late prehistoric horizon at Newgrange, including the identification of the remains of a previously unrecognized 'enclosure or barrow' on top of the cairn, speculatively dating from the Iron Age. They argue that Iron Age activity may not only have taken place outside the cairn, as in fact has long been recognized via the copious amount of Roman artefacts found there (Carson and O'Kelly 1977), but also argue for Iron Age presence and depositions within the chamber. Even though cairn slippage may have occurred in the Late Neolithic, sealing the entrance as O'Kelly believed (1982: 68–73), there is nothing to suggest that the monument could not have been reopened subsequently.

Of interest in this respect is a Late Iron Age radiocarbon date from Newgrange. This date (UB-360, 1650 ± 45 BP, 322–536 cal AD, 87.8%) comes from humic acid from the upper sod layer within the cairn of the main tomb, 60–90cm above the old ground surface (Smith et al. 1971: 452), and may indicate activity within or modifications to the site at a later date than O'Kelly (1982: 231) believed. The possibility that this sample had been contaminated cannot be excluded (Schulting in Lynch 2014) but, as O'Neill (2013: 260) has highlighted, the date was from a context sealed beneath several metres of stone and turves. Notably, Iron Age dates have recently been returned for the horse bones found in association with the Beaker settlement at Newgrange (Bendrey et al. 2013). O'Kelly also found two Iron Age horse bits in the course of excavations (Carson and O'Kelly 1977).

Entry into the cairn at Newgrange during the Iron Age, and possible observation of the solstice event, would explain a number of puzzling and seemingly contradictory pieces of evidence. First and foremost, it would explain how medieval texts associated with the Boyne monuments, possibly first committed to parchment in the eighth century, were uniquely focused on the manipulation of time and solar motifs and deities, topics uncannily appropriate to Newgrange. After an examination of the literature and etymology of the various deities featured in that literature, Swift (2003) has argued that this medieval Irish literature, which O'Kelly (1982: 43–64) proposed may have had Late Neolithic origins, is in fact much better explained in the context of a Late Iron Age date and linked to the Roman finds at Newgrange. Furthermore, an Iron Age entry into the cairn would provide additional justification for the subsequent deposition of Roman artefacts outside the tomb. It may be relevant that the roof-box would have been in better condition (less slump of the orthostats and so on) in that period than when rediscovered by O'Kelly in the twentieth century, and hence potentially more capable of fulfilling its astronomical role.

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Lastly, if the solstice orientation was witnessed in the Iron Age, it might provide a more reasonable explanation for how knowledge of the solstice event could have been known locally, and ultimately passed to O’Kelly and his team. Local knowledge of the sun entering the site in this instance (i.e. retained in the locality since the Iron Age), though a considerable period, would be a less extraordinary proposition than the suggestion that astronomical knowledge passed down over 5,000 years. Allowing that motifs from the medieval manuscripts already discussed were connected with the astronomical function of the monument, then two intertwining sources—oral narrative and literary texts—may have combined to ensure the survival of this knowledge, the latter perhaps reigniting the former on occasion. It cannot be ruled out that this knowledge was kept alive until the late nineteenth- and twentieth-century rediscovery and accounts discussed previously.

Final observations

In reviewing O’Kelly’s book on the excavation at Newgrange, Herity (1982: 153) asked a probing question: ‘Suppose, however, that the roof-box had been restored differently, would this phenomenon manifest itself in a significantly different way?’ In a similar vein, Ray (1989: 343) noted that if the gap between the first two roof slabs was greater, the sun would have projected onto the back wall of the tomb and, in his estimation, would have had a less dramatic effect than the ‘glancing beam’ on the chamber floor as it appears today (also see Ruggles 1999: 19). Consideration of differing reconstruction designs raises slightly disconcerting possibilities; and the problem becomes greater if in the course of his work on the outer passage and roof-box O’Kelly anticipated that the winter solstice sun would subsequently enter the monument.

The conventional narrative that the archaeological world has inherited is that O’Kelly discovered that the roof-box and monument had an astronomical function in 1967 after the reconstruction of the outer passage (and first penned a full description of it in 1969). But how much of a surprise was its discovery to him? One might ask, for instance, why O’Kelly had arranged to be in the chamber on that first cold winter solstice morning in 1967 at all, unless he had anticipated that, after the reconstruction, some solstitial effect would be observed inside the monument? He tells us, ‘when we began to think about it, we realized that it might be worth while to investigate the winter solstice when the sun rises in that quarter’ (O’Kelly 1982: 123). The question is: when did he begin to think about it? He notes that ‘many visitors’ had mentioned the idea of a solstitial arrangement at Newgrange ‘particularly in the early stages of the excavations’, presumably 1962 and subsequent years (p. 123). Might O’Kelly have begun thinking more strongly about the astronomical possibility as the roof-box was uncovered in 1963? More importantly, was he thinking about this possibility as he restored the passage roof slabs and corbels above the orthostats in late summer 1966, i.e. as he finalized the width and height of the critical space between RS1 and RS2? He notes that after straightening the orthostats and corbels

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beneath roof slabs 2, 3, and 4, 'the structure of the roof-box took on new meaning as it could now be seen that the slit or gap in the floor between RS1 and RS2 was not adventitious but had been carefully and accurately contrived' (O'Kelly 1982: 97).

What new meaning had it taken on? Was O'Kelly thinking about the monument's possible astronomical role when the most crucial part of the work was being completed—a year before he first investigated the phenomena that morning in 1967? With the benefit of hindsight, it is hard to imagine that he had not had the astronomical potential of the monument in mind as he reconstructed the relevant features of the monument. In 1967 the quartz-covered wall was not yet constructed, nor any of the covering material over the passage roof slabs replaced, yet O'Kelly was present in the chamber at the winter solstice to investigate if sunlight entered the monument.

Finally, could it be that the solar orientation of Newgrange has been rediscovered on more than one occasion? We have seen that Russell, Lockyer, and Evans-Wentz had each published material indicating an awareness of the solar orientation of Newgrange in the late nineteenth and early twentieth century. These publications, and in particular ambient light effects outside and within the monument, provide a more reasonable explanation for astronomical accounts by visitors from the neighbourhood. Still today, the many people who gather outside Newgrange over the solstice period are dazzled by sunlight striking the monument's exterior, especially the area externally around the roof-box.

Tentative evidence also exists for an Iron Age entry into the tumulus, together with considerable Iron Age activity at the front of the monument. Was O'Kelly over-eager to backdate the mythology associated with Newgrange to the Late Neolithic, as Swift has suggested, rather than focus on the Iron Age history of Newgrange? Whatever the truth of the matter, we can perhaps forgive him this leap in the context of what must have been an immensely exciting time. The coming together of folk tradition, mythology, and archaeological discovery on such a dramatic scale must have been a potent brew, one which few archaeologists would ever experience in their lifetime or ever have to account for through their work. Though the restoration and conservation of Newgrange has received criticism, particularly the cairn's sheer façade (e.g. Eriksen 2004; 2006; 2008; Stout and Stout 2008: 1–6), it is only because of O'Kelly's work that the extraordinary astronomical aspect of the site was not lost to posterity and is available for many more people to discover and experience today.

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Rediscovering the Winter Solstice Alignment at Newgrange, Ireland

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Robert Hensey is an Irish archaeologist and author of *First Light: The Origins of Newgrange* (2015) and co-editor of *The Archaeology of Darkness* (2016). His research is primarily focused on the monuments and societies of the northwest European Neolithic with particular reference to Irish passage tomb chronology, art and ritual. Currently, with partners, he is involved in the Human Population Dynamics at Carrowkeel, Co. Sligo project, a multifaceted project which includes osteological analysis, radiometric dating and isotopic analyses of a significant bone assemblage from the Carrowkeel passage tombs. Other ongoing research includes assisting with The biography of megalithic art at Millin Bay, Northern Ireland project, a collaborative project with the University of Edinburgh, using new photogrammetry-based methods to facilitate an in-depth study of the megalithic art from the highly decorated monument at Millin Bay, Co. Down.

