**Article:**

Carlin, Neil, Smyth, Jessica, Frieman, Catherine J. et al. (5 more authors) (2025) Social and Genetic Relations in Neolithic Ireland:Re-evaluating Kinship. Cambridge Archaeological Journal. ISSN 0959-7743

https://doi.org/10.1017/S0959774325000058

*Cambridge Archaeological Journal* (2025), 1–21
doi:10.1017/S0959774325000058

Research Article

# Social and Genetic Relations in Neolithic Ireland: Re-evaluating Kinship

Neil Carlin[1], Jessica Smyth[1], Catherine J. Frieman[2], Daniela Hofmann[3], Penny Bickle[4], Kerri Cleary[5], Susan Greaney[6] & Rachel Pope[7]

[1]School of Archaeology, John Henry Newman Building, University College Dublin, Belfield, Dublin 4, Ireland; [2]School of Archaeology and Anthropology, Australian National University, Canberra ACT 2600, Australia; [3]Department of Archaeology, History, Cultural Studies and Religion, University of Bergen, Postboks 7805, NO-5020 Bergen, Norway; [4]Department of Archaeology, University of York, The King's Manor, York YO1 7EP, UK; [5]Archaeological Consultancy Services Unit, 21 Boyne Business Park, Greenhills, Drogheda, Co. Louth, A92 DH99, Ireland; [6]Department of Archaeology and History, University of Exeter, Amory 202, Amory Building, Rennes Drive, Exeter EX4 4RJ, UK; [7]Department of Archaeology, Classics and Egyptology, University of Liverpool, 12–14 Abercromby Square, Liverpool L69 7WZ, UK

## Abstract

This paper re-evaluates recent kinship studies in Neolithic Ireland through a close analysis of biomolecular and fine-grained archaeological data. It outlines the rich possibilities these datasets offer when interwoven to enhance our understanding of diverse webs of social relationships. We synthesize a range of archaeological and scientific data to form a new model of kinship and its relationship to shifting traditions of megalith building and funerary and cosmological practices. This model is put in dialogue with recently published genetic data and used to test a variety of explanations for the patterns of biological relatedness revealed using these methods. We argue that the detected genetic patterning is best interpreted as reflecting a reconfiguration of social relations after 3600 BC linked to the consolidation of emergent social and religious communities.

(Received 3 July 2024; revised 2 December 2024; accepted 28 December 2024)

## Introduction

The application of ancient DNA data is currently undergoing fundamental change. From the initial interest of identifying large-scale population histories (Fernandez *et al.* 2014; Haak *et al.* 2015; Hofmanova *et al.* 2016; Olalde *et al.* 2018; 2019; Papac *et al.* 2021), there is now an increasing trend in providing period-, region- and site-specific narratives addressing social relations at a smaller scale, notably centred on kinship (Booth *et al.* 2021; Fowler *et al.* 2022; Knipper *et al.* 2017; Mittnik *et al.* 2019; Rivollat *et al.* 2023; Seersholm *et al.* 2024) and social inequality (Cassidy *et al.* 2020; Rivollat *et al.* 2022). These developments are pushing archaeologists to be much clearer about how social processes in the past operated. In particular, the incorporation of aDNA into narratives about power deserves further consideration, if we are not to repeat patterns already critiqued for earlier aDNA studies. These include an insufficient awareness of traditions of interpretation in archaeology; an elision of key details of archaeological context; and a tendency to emphasize the spectacular, rather than engaging fully with the complexity of the evidence (Blakey 2020; Booth 2019; Brück 2021; Brück & Frieman 2021; Crellin & Harris 2020; Eisenman *et al.* 2018, 6–7; Ensor 2021; Ensor *et al.* 2017; Frieman & Hofmann 2019; Frieman *et al.* 2019; Furholt 2018; 2019; 2020; Hakenbeck 2019; Jones & Bösl 2021). Thus, although aDNA methodologies are now robustly and rigorously applied and their results show exciting relational connections between biological kin, the full potential of aDNA data to inform us about the past is not yet realized (see also Smyth *et al.* in press a).

To contrast with approaches to date, we illustrate in this paper the richer possibilities of integrating biomolecular data with fine-grained archaeological data, even when these are complex and non-contiguous. We do so with reference to Neolithic Ireland (Table 1), focusing from the outset on the relevant archaeological evidence, especially for mortuary practices and megalithic monuments, rather than less immediately relevant strands like historical or ethnographic parallels. We summarize the findings from genetic investigations of Neolithic Ireland and Britain, focusing on a recent aDNA study by Cassidy *et al.* (2020) which claimed—to significant media attention—the existence of a dynastic

**Corresponding author:** Neil Carlin; neil.carlin@ucd.ie

**Cite this article:** Carlin, N., *et al.* (2025). Social and Genetic Relations in Neolithic Ireland: Re-evaluating Kinship. *Cambridge Archaeological Journal* 1–21. https://doi.org/10.1017/S0959774325000058

**Table 1.** Chronology for Neolithic Ireland used in the text.

| | | | |
|---|---|---|---|
| Early Neolithic | *c.* 3900–3600 cal. BC | | |
| | | *c.* 3900–3300 cal. BC | Earlier Neolithic |
| Middle Neolithic | *c.* 3600–3100 cal. BC | | |
| | | *c.* 3300–2500 cal. BC | Later Neolithic |
| Late Neolithic | *c.* 3100–2500 cal. BC | | |

hereditary network, that is, a series of leaders from the same elite family who had restricted access to 'burial' in passage tombs during the latter part of the fourth millennium BC and beyond (Cassidy 2020; 2023). Here, we present an alternative interpretation that takes fuller account of the archaeological and genetic evidence to argue that the deposition of human remains within passage tombs was not primarily driven by biological connections (see also Smyth *et al.* in press a). Instead, the genetics indicate the emergence of more expansive forms of relatedness, spanning ever-greater parts of the island during the fourth millennium BC, that were enabled and reflected by the construction, use and modification of these monuments.

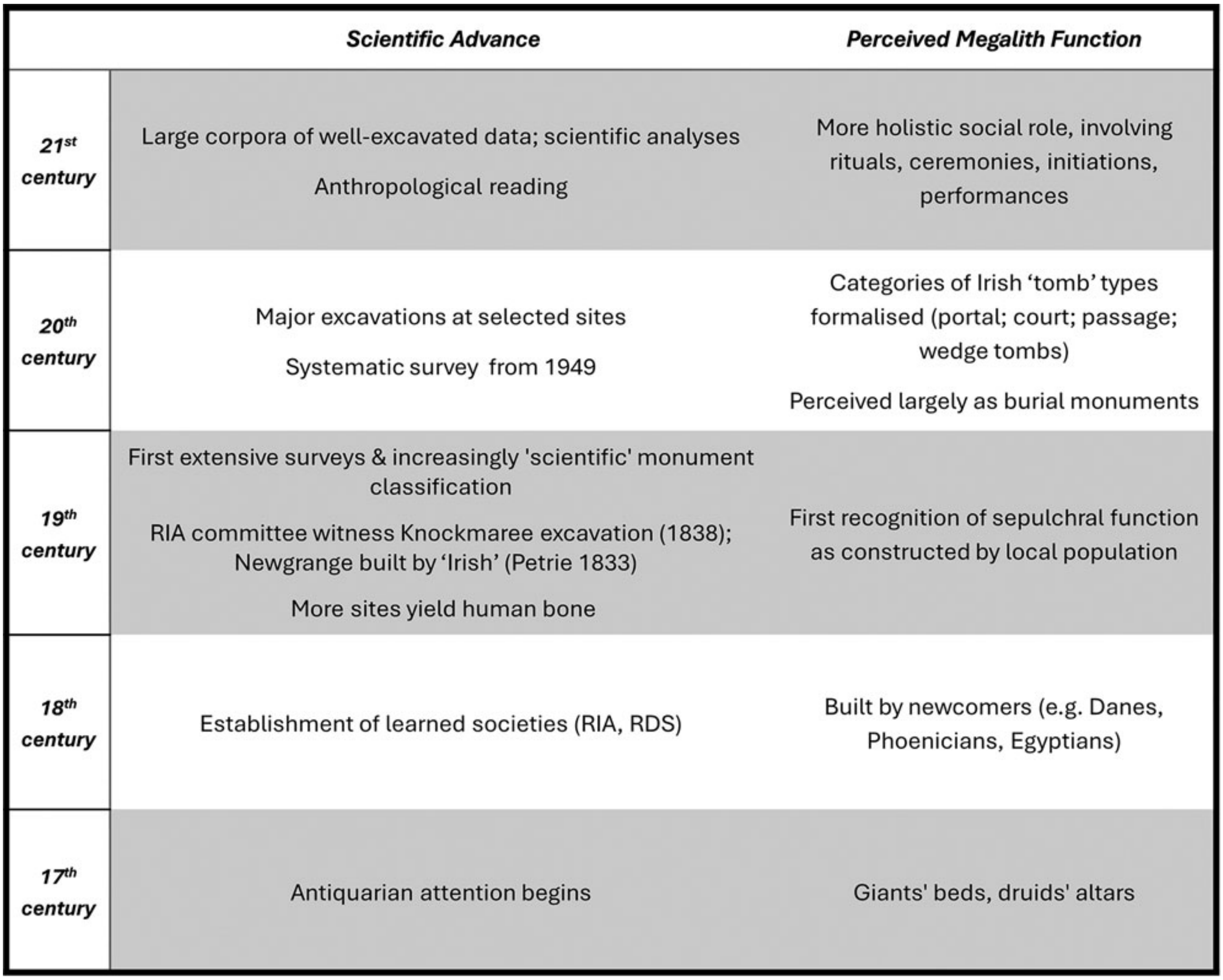
### *Accessing the dead: where do aDNA samples come from?*

Unlike contemporary genetic research which studies living populations, aDNA analysis relies on accessing unburnt human remains from archaeological contexts. The availability of this material is constrained by a variety of cultural and taphonomic factors, each particular to different places and times, which influence the results of such analysis. In Neolithic Ireland, there is little evidence for human remains from settlement or domestic contexts (Smyth 2014; 2020), though some come from caves and pits (Dowd 2015; Dowd *et al.* 2020; Smyth 2012). The inhumed child burials from around the settlements at Lough Gur remain unique (Cleary 1995; 2018, 95–100; Grogan & Eogan 1987; Ó Ríordáin 1954). Acidic soils across large parts of the island also affect the survival of inhumed unburnt bone (Cooney 2023, 33 & 120). This means that most Neolithic human bone recovered in Ireland has been partially protected, either through the cremation process and/or by deposition within megalithic monuments.

Megalithic monuments, in turn, are not simply seen as containers for 'burials', and it is important to trace how understandings of these sites have emerged (Fig. 1). Their upstanding and frequently imposing remains have been the focus of antiquarian attention from at least the seventeenth century, and variously interpreted as the beds of fleeing heroes, burial places of giants, or edifices of the 'Danes' (Jones 2007; Waddell 2005). In the earlier nineteenth century, as more sites yielded human bone, we see increasing consensus that even the smaller, more denuded monuments were not druids' altars but sepulchral chambers (McGuinness 2010). This occurred alongside growing recognition of local input into their construction, rather than recent newcomers such as 'the Danes' (e.g. Petrie 1833), even if named creators were still occasionally plucked from mythology (Betham 1838/40). The subsequent turn to a more 'scientific' view of megaliths in the late nineteenth century led antiquarians to concentrate on describing, classifying and comparing monuments, with the first extensive surveys undertaken in the 1880s and 1890s (Borlase 1897; Wood-Martin 1888). Systematic survey appeared in the mid twentieth century with the work of the Megalithic Survey, commencing in 1949 and overseen by the Ordnance Survey of Ireland (e.g. de Valéra & Ó Nualláin 1961). This work formalized the now traditional categories of Irish megalithic tomb 'types'—portal tomb, court tomb, passage tomb and wedge tomb. Most recent archaeological thinking, informed by an increasingly large corpus of well-excavated data and the results of scientific analysis, recognizes that these 'tombs' served multiple purposes including rituals, ceremonies, initiations and performances (e.g. Cooney 2023, 135–8; Cummings & Richards 2021; Hensey 2015; McFadyen 2006).

Traditional megalithic monument 'types' were in part based on a presumed sequence of construction and use by distinct social groups (e.g. Herity & Eogan 1977). However, their chronological distinctiveness has been substantially blurred with the widespread adoption of AMS radiocarbon dating and more source-critical sample selection showing significant chronological overlaps between them (e.g. Bayliss & O'Sullivan 2013; Cooney *et al.* 2011; Whitehouse *et al.* 2014). Extensive dating of human and animal bone and teeth from the portal tomb at Poulnabrone, Co. Clare (Cassidy *et al.* 2020, SI1; Lynch 2014) provides the earliest evidence so far of Neolithic mortuary activity, seemingly confirming this monument type as the earliest form to appear on the island, *c.* 3880–3700 cal. BC. However, deposition of human and animal remains at Poulnabrone stretches into the thirty-fourth and thirty-third centuries cal. BC.

Similarly, recent dating of archive material now shows that passage tombs emerge as early as *c.* 3750 cal. BC (Bergh & Hensey 2013; Eogan & Cleary 2017; Hensey 2015; Schulting *et al.* 2017a), overlapping with the initial use of court tombs between 3700 and 3560 cal. BC (95 per cent probability; Schulting *et al.* 2012, fig. 9). Another Neolithic mortuary tradition, the so-called 'Linkardstown-type' tombs, comprise large earthen mounds over a central stone cist containing one to four unburnt mostly male bodies (articulated or disarticulated), occasionally with children and cremated remains (Brindley & Lanting 1989/90; Cooney 2000, 97; 2023). These are often accompanied by a single highly decorated pottery vessel and occasional additional items, such as bone toggles or shell necklaces. Only 10–12 examples—mostly in the east and southeast of the island—have been identified



| | ***Scientific Advance*** | ***Perceived Megalith Function*** |
|---|---|---|
| ***21st century*** | Large corpora of well-excavated data; scientific analyses<br>Anthropological reading | More holistic social role, involving rituals, ceremonies, initiations, performances |
| ***20th century*** | Major excavations at selected sites<br>Systematic survey from 1949 | Categories of Irish 'tomb' types formalised (portal; court; passage; wedge tombs)<br>Perceived largely as burial monuments |
| ***19th century*** | First extensive surveys & increasingly 'scientific' monument classification<br>RIA committee witness Knockmaree excavation (1838); Newgrange built by 'Irish' (Petrie 1833)<br>More sites yield human bone | First recognition of sepulchral function as constructed by local population |
| ***18th century*** | Establishment of learned societies (RIA, RDS) | Built by newcomers (e.g. Danes, Phoenicians, Egyptians) |
| ***17th century*** | Antiquarian attention begins | Giants' beds, druids' altars |

**Figure 1.** A timeline of megalith studies in Ireland.

to date, compared to the approximately 230 passage tombs recorded (Hensey 2015), and are modelled as probably emerging 3710–3560 cal. BC (68 per cent probability; Cooney *et al.* 2011, 637, fig. 12.44). This leaves us with a scenario of potentially three or four very different funerary traditions in use on the island at the same time (Fig. 2). Only between 3300 and 3000 BC do the now famous monuments at Newgrange, Knowth and Dowth appear, part of what is termed the 'developed' phase of the passage-tomb tradition (Bayliss & O'Sullivan 2013; Cooney 2000; Hensey 2015; Schulting 2014a; Schulting *et al.* 2017a,b; Sheridan 1986). The similarly dated sites of Ballynahatty and Millin Bay, both in Co. Down, display clear 'developed' passage tomb traits in terms of architecture, pecked art motifs and pottery types, but here human remains were deposited in sub-surface stone structures alongside above-ground settings (Collins & Waterman 1955; Hartwell *et al.* 2023; MacAdam 1855; Murphy 2003).

## Mortuary practice at Irish megalithic monuments

Just as our understanding of megalithic monuments has become more nuanced, so too has our appreciation of the treatment of human remains at these sites. Once barely recorded in publications, cremated bone is now recognized as a key component, alongside unburnt bone, in portal, court and passage tombs in the Irish Neolithic (Cooney 2016; 2017; cf. Cooney 2023, 120). Notwithstanding that human remains from some tombs may not have been fully recovered during excavation or are now undergoing modern osteological (re)analysis (Smyth *et al.* in press b), the proportions of cremated to unburnt bone seem to vary from site to site, with cremated bone generally dominating in passage tombs (see Table 2). Both burnt and unburnt human bone of adults and children was certainly deposited contemporaneously and in combination (e.g. Kuijt & Quinn 2013; Schulting *et al.* 2017a), but we do not yet fully understand the possible taphonomic bias imposed by acidic soils and the complex processes of transforming bodies into bones.

Nevertheless, it is clear that multi-stage activities (excarnation, dismemberment, disarticulation and cremation) were conducted at many locations prior to the eventual deposition of some bones in tombs, often resulting in large, commingled deposits of whole and fragmented human remains (Beckett 2011; Beckett & Robb 2006; Cooney 2000; 2017; Fowler 2010; Geber *et al.* 2017; Kador *et al.* 2018; Kuijt & Quinn 2013; Murphy 2003;

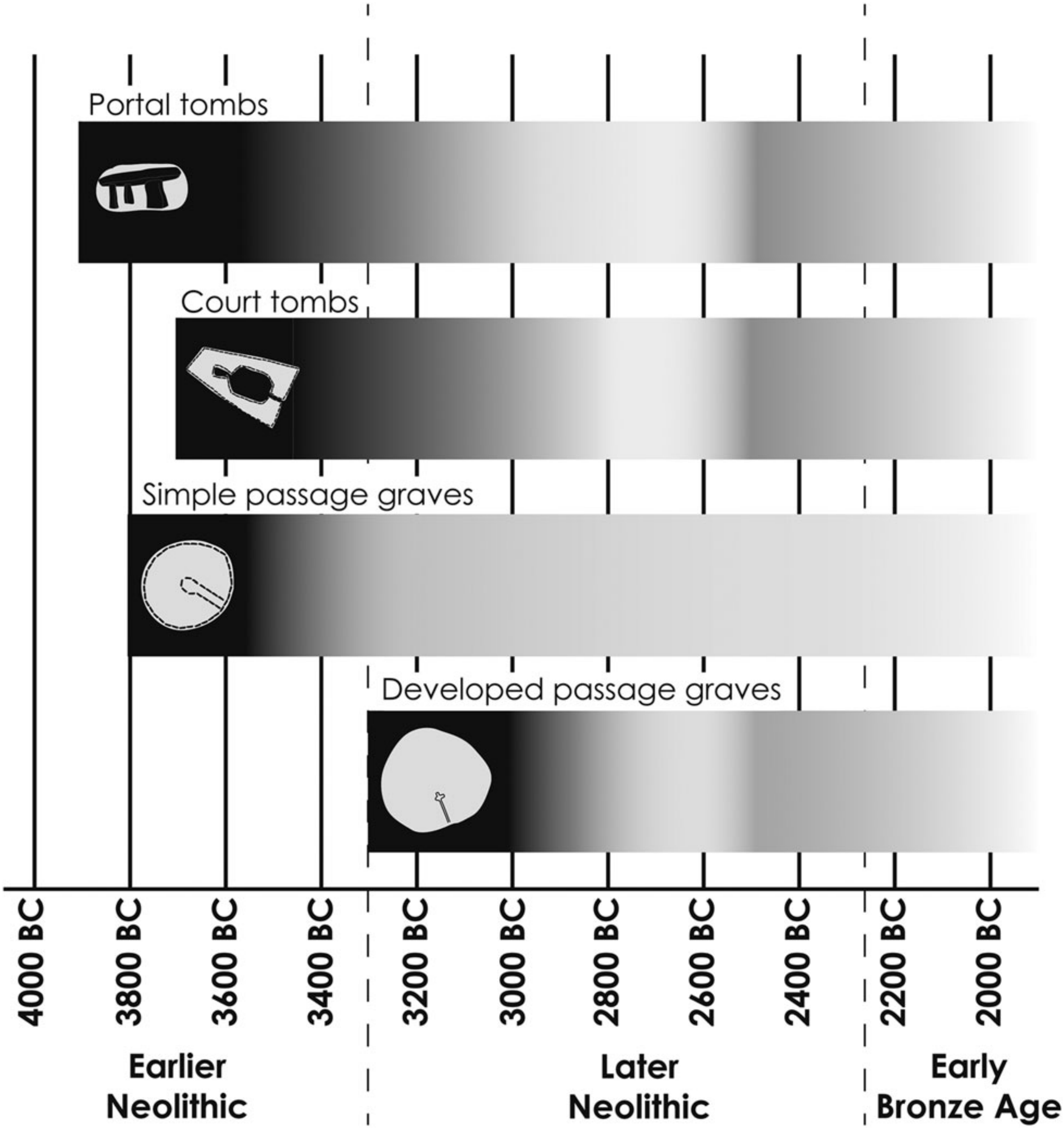


**Figure 2.** Date ranges for the construction and intensity of use (represented by shading) of the major megalithic traditions in Neolithic Ireland.

O'Donnabháin & Tesorieri 2014; O'Sullivan 2005). Radiocarbon dates from multiple sites show that this deposition extended over a few centuries at least (Bayliss & O'Sullivan 2013; Bergh & Hensey 2013; Schulting 2014b; Schulting *et al.* 2017a,b). Further interaction with these human remains continued within tombs like Poulnabrone for centuries (e.g. Becket 2011; O'Donnabháin & Tesorieri 2014; Cooney 2023). As bodies may have been disarticulated before cremation (e.g. Cooney 2017), a key outstanding issue is whether bone from the same individual was processed in different ways, i.e. a portion cremated and a portion remaining unburnt. This has been argued for human remains at Fourknocks I, where unburnt skulls and long bones were placed within spreads of cremated bone (Hartnett 1957, 269; cf. Cooney 2017, 403). Purposefully placed unburnt skulls and long bones have also been recorded at other sites, e.g. at Millin Bay (Collins & Waterman 1955) and Poulnabrone, where skulls seem to have been removed from bodies and placed against the chamber walls (O'Donnabháin & Tesorieri 2014). The practice of placing unburnt skeletal elements into larger deposits of cremated bone continues into the first half of the third millennium BC, but almost exclusively within passage tombs (Carlin 2017).

**Table 2.** Varying ratios of cremated to unburnt bone at various passage tombs.

| Tomb | Cremated:Unburnt | Source |
|---|---|---|
| Fourknocks I | 90:10 | Hartnett 1957; J. Geber pers. comm., 2024 |
| Mound of the Hostages | 80:20 | O'Sullivan 2005 |
| Knowth Tomb I | 80:20 | Buckley *et al.* 2017 |
| Knockroe | 100:0 | Smyth *et al.* in press b |

The protracted and complex nature of funerary activities in the Neolithic, as well as post-depositional manipulation, means that we are left with an incomplete set of evidence likely representing only a fraction of the deposits from each tomb (Becket 2011; O'Donnabháin & Tesorieri 2014; Robb 2016). However, social practices can still be inferred. The ongoing deposition of human remains and the singling out of specific bones for special treatment (e.g. possible circulation of skulls), in conjunction with the way that many megaliths enabled continued access to these deposits, are generally accepted as indicating a strong concern with ancestral rites in the Irish Neolithic (see Barrett 1988; Fowler 2010). The placement of human remains was not simply 'burial' (Cooney 2023, 135–8). Instead, their complex mortuary treatment implies an extended transition from life to death and a period when the deceased remained an active member of the community before and after deposition. What proportion of the community underwent this mortuary treatment remains unresolved (e.g. Bradley 2007; Quinn 2015; Whittle *et al.* 2011, 871–5), and may well have varied based on differing rites and practices (perhaps represented in different monumental forms), but some form of selection was undertaken to produce the low numbers of what have been termed the 'visible dead' (Bradbury & Scarre 2017). These selected individuals were clearly valued by society, although we do not know how such values were defined. It should not be automatically assumed that special was equivalent to high status, or that the status of the 'visible dead' as ancestors-in-circulation mirrored their relations in life (see Smyth *et al.* in press a).

## Neolithic Ireland through the lens of genetics

In Ireland, analyses of ancient DNA have both confirmed prior knowledge on the Irish Neolithic, and provided important new information relating to people's genetic ancestry and biological relationships. Genomes have now been sequenced for at least 55 out of a possible Minimum Number of Individuals (MNI) of 140 (Tables 3 & 4) from a variety of funerary contexts in Ireland including caves, portal tombs, court tombs, Linkardstown-type and passage-tomb tradition monuments (Cassidy *et al.* 2016; 2020; Sánchez-Quinto *et al.* 2019). The analysis of multiple individuals from some of these monuments has enabled micro-scale analyses of biological relationships, though this is partially impeded by both the character of the Irish evidence and the fact that some sites, especially passage tombs, only have aDNA information for one or two individuals (Tables 3 & 4). Direct radiocarbon dates on these individuals range broadly from 3800 to 2400 cal. BC (see Table 4). Most of these data were published by Cassidy *et al.* (2020), with additional discussion in other publications (Cassidy 2020; 2023; Dowd *et al.* 2020; Kador *et al.* 2018), and are based on sequencing whole genomes, rather than SNP capture which only targets a limited proportion of the genome (see Cassidy 2023, 154–6).

One key finding is that the appearance of Neolithic things and practices, including monument building, cattle rearing and cereal cultivation in Ireland, coincided with the arrival of newcomers with ultimately Near Eastern genetic ancestry, who had intermixed with hunter-gatherers as they migrated across Europe. A similar pattern has been identified in Britain (Brace *et al.* 2019; Olalde *et al.* 2018; Sánchez-Quinto *et al.* 2019) and elsewhere in western and northwestern Europe (Allentoft *et al.* 2024; Ariano *et al.* 2022; Brunel *et al.* 2020; Rivollat *et al.* 2020; Seguin-Orlando *et al.* 2021), highlighting the key role of migrations in the Mesolithic/Neolithic transition. Neolithic newcomers to Ireland and Britain probably had little awareness of their Anatolian/Aegean genetic ancestry: analysis of their haplotypes reveals considerable homogeneity, suggesting they came to both islands from a range of similar source locations, probably in present-day northern France (Ariano *et al.* 2022; Brace & Booth 2023, 125; Brace *et al.* 2019; Cassidy 2023; Cassidy *et al.* 2016; Olalde *et al.* 2018). That the presence of distinctive 'farmer' genomes coincides with a decline in the genetic signatures typical of pre-existing 'hunter-gatherer' populations in Ireland has been seen as evidence of large-scale maritime colonization (Cassidy 2023, 148; Cassidy *et al.* 2020). However, important questions remain about the scale, suddenness, timing and impact of such movements, and ongoing interactions with 'hunter-gatherers' including gene-flow as indicated by an individual at Parknabinnia court tomb (see Brace & Booth 2023, 132; Carlin & Cooney 2020a; Cassidy *et al.* 2020; Cummings *et al.* 2022; Thomas 2022).

## Kinship and society

While the genome is a powerful tool for revealing biological relationships, we do not know how family or kinship was defined throughout the Neolithic. Biological relations are not kinship facts and in many societies genetics, blood or biology are neither a determining nor necessary factor of

https://doi.org/10.1017/S0959774325000058

**Table 3.** Quantities of multiple directly dated sequenced genomes and detected levels of confirmed relatedness from highly partial burial assemblages (based on Cassidy *et al.* 2020; Sánchez-Quinto *et al.* 2019).

| Site | MNI | Burnt | Unburnt | Sequenced | Year excavated | Recovery of bone | Span of 'primary' use | Closely associated bone group | Intrasite related individuals | Reference |
|---|---|---|---|---|---|---|---|---|---|---|
| Poulnabrone portal tomb | 36 | Unquantified | 36 | 12 (33%) | 1986–88 | 100% | 100–260 years | Some bones still in articulation, but many bones manipulated & removed (50% of bodies represented) | Two ≥6th degree: PN04 & PN107 | O'Donnabhain & Tesorieri 2014; Lynch 2014 |
| Parknabinnia court tomb | 22 | 2 | 20 | 11 (55%) | 1998–2001 | 100% | 185 years | Primary inhumations (*in situ* articulations) disturbed by subsequent interments (57% of bodies represented) | Two 4th degree: PB675 & PB357 | Snoeck *et al.* 2020; Beckett 2011; Jones 2019 |
| Primrose Grange court tomb | 40 | Unquantified | 40 | 11 (28%) | 1996–8 | 100% | 700 years | Skeletal cluster (layer II including prs002 & prs017) under stone packing in the northeast corner of Cist A | Two 1st degree: prs002 & prs017; two possible 2nd degree: prs017 & prs018; two 5th degree: prs002 & prs018 | Davidsson 1997 |
| Carrowkeel Cairn K passage tomb | 21 | 9 | 12 | 4 (22%) | 1911 | Unknown | 1000 years | Not recorded | Two ≥6th degree: CAK530 & CAK533 | Geber *et al.* 2017 |
| Carrowkeel Cairn H passage tomb | 8 | Unquantified | 8 | 1 (13%) | 1911 | Unknown | 1000 years | Unknown | n/a | Geber *et al.* 2017 |
| Carrowmore 51 (Listoghil) passage tomb | 7 | Unquantified | 7 | 1 (14%) | 1996–1998 | 100% | *c.* 300 years | Unknown | n/a | Sánchez-Quinto *et al.* 2019, S2 |
| Newgrange passage tomb | 5 | 3 | 2 | 1 (20%) | 1967 | 100% | *c.* 600 years | Highly disturbed | n/a | O'Kelly 1982 |
| Ballynahatty passage tomb-associated | 10 | Unquantified | 3 | 3 (33%) | 1855 | Unknown | Unknown | Unknown | None | Schulting *et al.* 2012 |
| Glennamong Cave | 8 | 0 | 8 | 2 (25%) | 2016 | 100% | *c.* 1000 years | Highly disarticulated & commingled – majority of skeleton removed | Two 5th degree: GNM1076 & GNM1007 | Dowd *et al.* 2020 |
| Millin Bay passage tomb-associated | 16 | 1 | 15 | 1 (6%) | 1953 | 100% | *c.* 300 years | 'Disarticulated jumble of bone' | n/a | Schulting *et al.* 2012 |

**Table 4.** The relatedness of ancient DNA samples from Neolithic Ireland arranged in chronological order. *=Measurements calibrated using OxCal v4.4 and IntCal20 (Bronk Ramsey 2017; Reimer *et al.* 2020); measurements with error >25 years BP are rounded out to nearest 10.

| Site name | Date (cal. BC) | 14C lab code | Age (BP) | aDNA id | Element (DNA) | Molecular sex | Site type | Genetic relatedness | 'Passage tomb' gene cluster | aDNA reference |
|---|---|---|---|---|---|---|---|---|---|---|
| Poulnabrone | 3950–3650 | OxA-25950 | 5004±31 | PN10/113 | Petrous | Female | Portal tomb | None | No | Cassidy *et al.* 2020 |
| Poulnabrone | 3950–3650 | UBA-38312 | 4999±48 | PN04 | Petrous | Male | Portal tomb | ≥6th degree (PN107) | No | Cassidy *et al.* 2020 |
| Poulnabrone | 3950–3650 | UBA-38308 | 4992±40 | PN05 | Petrous | Male | Portal tomb | None | No | Cassidy *et al.* 2020 |
| Poulnabrone | 3940–3650 | OxA-26052 | 4983±30 | PN107 | Tooth | Male | Portal tomb | ≥6th degree (PN04) | No | Cassidy *et al.* 2020 |
| Primrose Grange | 3790–3640 | Beta-446171 | 4950±30 | prs002 | Tooth | Female | Court tomb | 1st degree (prs017), 5th degree (prs018) | No | Sánchez–Quinto *et al.* 2019 |
| Primrose Grange | 3780–3640 | Beta–446181 | 4940±30 | prs017 | Tooth | Male | Court tomb | 1st degree (prs002), possible 2nd degree (prs018) | No | Sánchez-Quinto *et al.* 2019 |
| Primrose Grange | 3760–3640 | Beta-446178 | 4930±30 | prs012 | Tooth | Male | Court tomb | None | No | Sánchez-Quinto *et al.* 2019 |
| Primrose Grange | 3770–3640 | Beta-446182 | 4920±30 | prs018 | Tooth | Male | Court tomb | Possible 2nd degree (prs017), 5th degree (prs002) | No | Sánchez-Quinto *et al.* 2019 |
| Primrose Grange | 3770–3640 | Beta-468277 | 4920±30 | prs003 | Tooth | Male | Court tomb | None | No | Sánchez-Quinto *et al.* 2019 |
| Ashleypark | 3770–3530 | UBA-38310 | 4876±34 | ASH3 | Petrous | Male | Linkardstown tomb | None | No | Cassidy *et al.* 2020 |
| Poulnabrone | 3710–3520 | UBA-39199 | 4854±33 | PN13 | Petrous | Male | Portal tomb | None | No | Cassidy *et al.* 2020 |
| Poulnabrone | 3710–3520 | OxA-25949 | 4845±29 | PN112 | Tooth | Male | Portal tomb | None | No | Cassidy *et al.* 2020 |
| Poulnabrone | 3710–3520 | UBA-38313 | 4834±45 | PN02 | Petrous | Male | Portal tomb | None | No | Cassidy *et al.* 2020 |
| Primrose Grange | 3660–3520 | Beta-446180 | 4830±30 | prs016 | Tooth | Male | Court tomb | None | No | Sánchez-Quinto *et al.* 2019 |
| Annagh | 3710–3370 | GrA-1707 | 4810±60 | ANN2 | Tooth | Male | Cave | None | No | Cassidy *et al.* 2020 |
| Cohaw | 3650–3380 | UBA-35070 | 4790±41 | CH448 | Petrous | Male | Court Tomb | None | No | Cassidy *et al.* 2020 |
| Primrose Grange | 3640–3510 | Beta-446176 | 4780±30 | prs010 | Tooth | Male | Court tomb | None | No | Sánchez-Quinto *et al.* 2019 |
| Carrowmore 51 (Listoghil) | 3640–3380 | Beta-468275 (Ua-11581) | 4770±30 (4625±60) | car004 Merged | Tooth | Male | Passage tomb | 1st degree (prs007), ≥6th degree (CAK533, MB6, NG10) | Yes | Sánchez-Quinto *et al.* 2019 |

(*Continued*)

**Table 4.** (*Continued.*)

| Site name | Date (cal. BC) | 14C lab code | Age (BP) | aDNA id | Element (DNA) | Molecular sex | Site type | Genetic relatedness | 'Passage tomb' gene cluster | aDNA reference |
|---|---|---|---|---|---|---|---|---|---|---|
| Jerpoint West | 3710–3360 | OxA-2680 | 4770±80 | JP14 | Petrous | Male | Linkardstown tomb | None | No | Cassidy *et al.* 2020 |
| Ashleypark | 3640–3380 | GrN-11036 | 4765±40 | ASH1 | Petrous | Male | Linkardstown tomb | None | No | Cassidy *et al.* 2020 |
| Parknabinnia | 3640–3380<br>3780–3630 | UBA-38307<br>UBA-39192 | 4762±37<br>4917±40 | PB357 | Petrous | Female | Court tomb | 4th degree (PB675) | No | Cassidy *et al.* 2020 |
| Parknabinnia | 3640–3380<br>3600–3190 | UBA-35067<br>UBA-39193 | 4765±32<br>4636±45 | PB672 | Petrous | Male | Court tomb | Possibly ≥6th degree (PB754) | No | Cassidy *et al.* 2020 |
| Parknabinnia | 3650–3370 | UBA-39197 | 4764±54 | PB1794 | Petrous | Female | Court tomb | None | No | Cassidy *et al.* 2020 |
| Parknabinnia | 3640–3370 | UBA-38309 | 4751±55 | PB768 | Petrous | Male | Court tomb | None | No | Cassidy *et al.* 2020 |
| Primrose Grange | 3640–3370 | Beta-446177 | 4740±30 | prs006 | Tooth | Female | Court tomb | Unconfirmed possible 2nd degree (prs007) | No | Sánchez-Quinto *et al.* 2019 |
| Parknabinnia | 3640–3370 | UBA-38303 | 4739±35 | PB443 | Petrous | Male | Court tomb | None | No | Cassidy *et al.* 2020 |
| Baunogenasraid | 3640–3370 | GrN-11362 | 4735±35 | BG72 | Petrous | Male | Linkardstown tomb | None | No | Cassidy *et al.* 2020 |
| Poulnabrone | 3640–3370 | UBA-38317 | 4732±43 | PN03 | Petrous | Male | Portal tomb | None | No | Cassidy *et al.* 2020 |
| Poulnabrone | 3640–3370 | UBA-38311 | 4731±42 | PN06 | Petrous | Male | Portal tomb | ≥6th degree (PB186) | No | Cassidy *et al.* 2020 |
| Poulnabrone | 3630–3370 | UBA-39202 | 4719±38 | PN16 | Petrous | Female | Portal tomb | None | No | Cassidy *et al.* 2020 |
| Parknabinnia | 3630–3370 | UBA-38304 | 4712±35 | PB2031 | Petrous | Male | Court tomb | None | No | Cassidy *et al.* 2020 |
| Parknabinnia | 3630–3370 | UBA-39194 | 4707±42 | PB675 | Petrous | Male | Court tomb | 4th degree (PB357) | No | Cassidy *et al.* 2020 |
| Poulnabrone | 3640–3370 | UBA-35065 | 4697±32 | PN07 | Petrous | Male | Portal tomb | ≥6th degree (PB186) | No | Cassidy *et al.* 2020 |
| Primrose Grange | 3610–3370 | Beta-446179 | 4690±30 | prs013 | Tooth | Male | Court tomb | None | No | Sánchez-Quinto *et al.* 2019 |
| Parknabinnia | 3630–3360 | UBA-38316 | 4679±48 | PB581 | Petrous | Male | Court tomb | None | No | Cassidy *et al.* 2020 |
| Ardcrony | 3600–3360 | GrN-9708 | 4675±35 | ARD2 | Petrous | Male | Linkardstown tomb | None | No | Cassidy *et al.* 2020 |
| Annagh | 3640–3190 | GrA-1703 | 4670±70 | ANN1 | Petrous | Male | Cave | None | No | Cassidy *et al.* 2020 |
| Parknabinnia | 3620–3360 | UBA-39195 | 4667±54 | PB1327 | Petrous | Male | Court tomb | None | No | Cassidy *et al.* 2020 |

(*Continued*)

Table 4. (*Continued.*)

| Site name | Date (cal. BC) | 14C lab code | Age (BP) | aDNA id | Element (DNA) | Molecular sex | Site type | Genetic relatedness | 'Passage tomb' gene cluster | aDNA reference |
|---|---|---|---|---|---|---|---|---|---|---|
| Primrose Grange | 3520–3360 | Beta-448276 | 4640±30 | prs007 | Tooth | Male | Court tomb | 1st degree (car004), unconfirmed possible 2nd degree (prs006) | No | Sánchez-Quinto *et al.* 2019 |
| Parknabinnia | 3520–3350 | UBA-35072 | 4638±36 | PB186 | Petrous | Male | Court tomb | ≥6th degree (PN06 & PN07) | No | Cassidy *et al.* 2020 |
| Primrose Grange | 3510–3350 | Beta-446174/5 | R-Combine: 4630±22 | prs009 | Tooth | Male | Court tomb | None | No | Sánchez-Quinto *et al.* 2019 |
| Poulnabrone | 3630–3340 | UBA-39198 | 4629±41 | PN12 | Petrous | Male | Portal tomb | None | No | Cassidy *et al.* 2020 |
| Parknabinnia | 3530–3190 | UBA-39196 | 4622±41 | PB754 | Petrous | Female | Court tomb | Possibly ≥6th degree (PB672) | No | Cassidy *et al.* 2020 |
| Glennamong Cave | 3520–3100 | UBA-38829 | 4588±40 | GNM1007 | Petrous | Male | Cave | 5th degree (GNM1076) | No | Dowd *et al.* 2020 |
| Ballynahatty | 3510–3100 | UB-7194 | 4587±34 | BA346 | Tooth | Male | Passage tomb-associated | None | No | Cassidy *et al.* 2020 |
| Newgrange | 3340–3020 | OxA-36079 | 4473±29 | NG10 | Petrous | Male | Passage tomb | ≥6th degree (car004, CAK530; CAK532) | Yes | Cassidy *et al.* 2020 |
| Ballynahatty | 3350–3010 | UB-7059 | 4465±38 | BA64 | Petrous | Female | Passage tomb-associated | None | No | Cassidy et al 2016 |
| Millin Bay | 3500–3030 | UBA-35071 | 4548±51 | MB6 | Petrous | Male | Passage tomb-associated | ≥6th degree (car004) | Yes | Cassidy *et al.* 2020 |
| Glennamong Cave | 3370–2930 | UBA-37807 | 4488±62 | GNM1076 | Petrous | Male | Cave | 5th degree (GNM1007) | No | Dowd *et al.* 2020 |
| Newgrange | 3330–2920 | OxA-36080 | 4421±30 | NGZ1 | Petrous | Female | Passage tomb | None | Yes | Cassidy *et al.* 2020 |
| Carrowkeel Cairn K | 3090–2900 | OxA-35327 | 4360±31 | CAK533 | Petrous | Female | Passage tomb | ≥6th degree (car004, CAK530) | Yes | Cassidy *et al.* 2020 |
| Carrowkeel Cairn K | 3020–2890 | OxA-35326 | 4321±30 | CAK532 | Petrous | Male | Passage tomb | ≥6th degree (NG10) | Yes | Cassidy *et al.* 2020 |
| Carrowkeel Cairn K | 2890–2630 | OxA-35325 | 4170±32 | CAK530 | Petrous | Female | Passage tomb | ≥6th degree (NG10, CAK533) | Yes | Cassidy *et al.* 2020 |
| Ballynahatty | 2880–2630 | UB-6723 | 4165±36 | BA342 | Tooth | Male? | Passage tomb-associated | None | No | Cassidy *et al.* 2020 |
| Carrowkeel Cairn K | 2880–2630 | UBA-38306 | 4160±38 | CAK531 | Petrous | Male | Passage tomb | None | Yes | Cassidy *et al.* 2020 |
| Carrowkeel Cairn H | 2830–2470 | UBA-30808 | 4031±37 | CAK68 | Petrous | Male | Passage tomb | None | Yes | Cassidy *et al.* 2020 |

relatedness (see Abel & Frieman 2023; Carsten 2004; Schneider 1984; Stone & King 2019, 96). People actively make their kin through cultural practices conducted within the particular context of their society, such as caring for one another, gift giving, the sharing of substances and engaging in collective commensal practices, or living, working or burying the dead together (e.g. Brück 2021; Brück & Frieman 2021). Johnston (2020, 13–18) uses the concept of 'kinwork' drawn from feminist anthropology (di Leonardo 1987) to highlight how these activities constituted people as social beings with close relationships, personal identities and a sense of belonging. This is not to deny the existence of non-kin or wider forms of relational work beyond immediate kin, e.g. defining one's group against others. Kin relations play out in complex ways in the funerary sphere. Relationships may be affirmed, created, or broken through the rites and ceremonies surrounding the dead person (e.g. Brück 2009), and the redefinition of that person's own relation to the living community is a regular feature of these rites (Parker Pearson 1999). These processes include decisions about where and with whom to inter deceased kin and community members. Within some societies, a person may be returned to their natal community upon death and it cannot be assumed that those buried together were co-residents in life (see Ensor 2021, 12). Indeed, such movement of human remains after death would have been strongly facilitated by the mortuary practices associated with Irish megaliths (e.g. Brück 2009). This illustrates how the funerary record is composed from aspects of life, rather than directly reflecting it, and was formed through complex practices that transformed a person into another state (such as becoming an ancestor).

As outlined above, megalithic tombs were one of the places where the dead and their relationships were transformed. Depositing human remains in these monuments thus enabled the creation and negotiation of kinship (e.g. Fleming 1972; Powell 2005). At the Early Neolithic long barrow at Hazleton North in southern Britain, combined genetic and archaeological analysis showed that the majority of its occupants came from an extended, but closely biologically related group (i.e. a lineage: Fig. 3): four females who had children with the same male partner, and the immediate descendants of these women (Cummings & Fowler 2023; Fowler 2022; Fowler *et al.* 2022). The monument's dual architectural layout played a key role in the organization of relationships between the human remains over a 100-year period. These were largely placed successively within various parts of the tomb in accordance with their descent from the four key females. However, at least eight non-lineage individuals were also included (Fig. 3), highlighting that while parentage and descent seem to have played a major role in the rites that structured funerary deposition at Hazleton North, biology did not dictate kin relations. These emerged instead from a range of social practices which are archaeologically and biologically invisible. Similarly, many of the burials within the Frälsegården passage tomb in Sweden were interred in particular locations based on their descent from a specific lineage (comprising two sub-lineages) spanning two centuries, though non-lineage individuals were also included (Seersholm *et al.* 2024).

Broader patterns in male genetic relatedness have been used to infer an emphasis on patrilineal ancestry in the Irish Neolithic, i.e. that 'burial' in tombs was associated with descent from a paternal lineage, as argued elsewhere (e.g. Bentley *et al.* 2012; Cassidy *et al.* 2020; Fowler *et al.* 2022; Rivollat *et al.* 2023; Sánchez-Quinto *et al.* 2019; Seersholm *et al.* 2024). Additionally, Cassidy *et al.* (2020) observed that this was supported by the fact that the Y haplogroups (inherited from father to son) of the male interments from two neighbouring tombs, Poulnabrone and Parknabinnia, were distinct from one another and remained so over time. However, three of the eight Parknabinnia males did not belong to the dominant haplogroup in that tomb, so this male genetic homogeneity may just reflect patrilocality (Elliott *et al.* 2022, 203) and evidence for descent from specific lineages (like at Hazleton or Frälsegården) is notably absent from Ireland. Overall, patrilineality likely was one of several factors (including matrilineality) that determined whose remains were interred, and need not correlate with other aspects of social structure, such as patriarchy (see critique in Brück 2021; Fowler 2022, 71–2; Stone & King 2019).

## Biological relatedness in Neolithic Ireland

Importantly, where multiple genomes have been sequenced from Neolithic contexts in Ireland, studies have shown that most of the individuals buried together were not closely biologically related (Tables 3 & 4). This contrasts strongly with the findings from the well-preserved burial deposits of Frälsegården or Hazleton, but matches the general picture emerging from Britain, including Orcadian passage tombs (with their admittedly small sample sets), of people buried together not being closely related, especially in the Later Neolithic (Brace & Booth 2023, 138–9; Brace *et al.* 2019; Olalde *et al.* 2018; Patterson *et al.* 2022). Where such inter- or intra-site relations have been identified from Ireland, they are frequently distant (e.g. fifth degree or further: e.g. second cousins or a great-great-great grandparent) (Cassidy *et al.* 2020), rather than close genetic relationships (e.g. first to fourth degree: parents, children, siblings, grandparents/grandchildren, uncles or aunts or nieces and nephews, or first cousins). Some of these closer genetic relations might more plausibly have been known. Only a very small number of closely biologically related interments are currently known and these are exclusively of Earlier Neolithic date (see Figure 4 and Table 4). At Primrose Grange court tomb in county Sligo, individuals prs002 and prs017 were shown to be a father and daughter and another individual (prs018) was possibly a second-degree relative of prs017 (Sánchez-Quinto *et al.* 2019). No such close genetic relationships were uncovered at the Early Neolithic portal tomb at Poulnabrone or the court tomb at Parknabinnia, even though a higher proportion of their total MNI was sampled compared to Primrose Grange. Indeed, each site featured closely associated bone-groups within

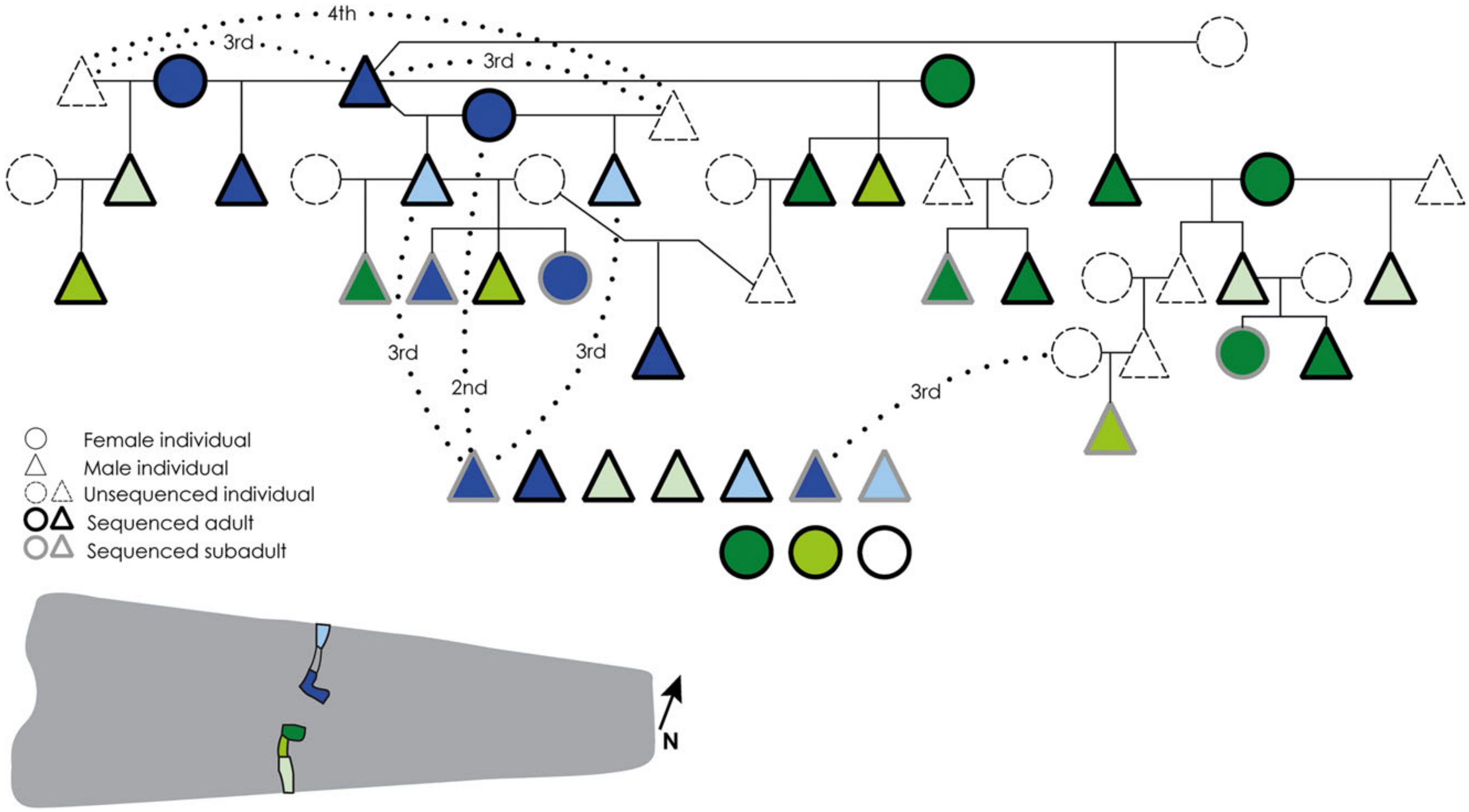


**Figure 3.** Genetic genealogy of individuals interred at Hazelton North, with location of interment indicated by colour and dotted lines representing degrees of relatedness.

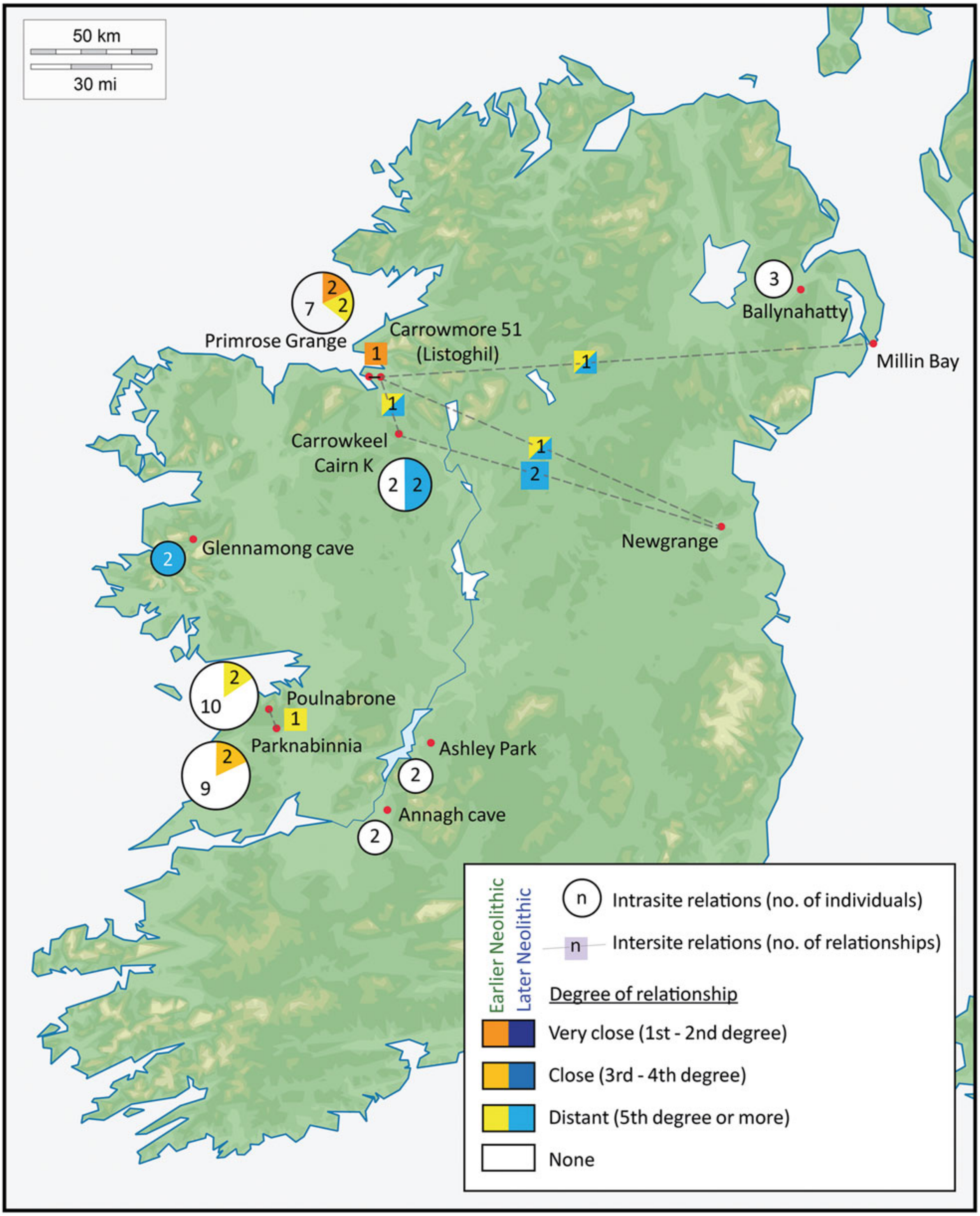


**Figure 4.** Biological kinship in Neolithic Ireland.

comparatively well-preserved deposits, despite centuries of use (Table 3).

Post-3640 cal. BC, an individual (car004 dating between 3640 and 3380 cal. BC) from Listoghil, the large central passage tomb at the Carrowmore complex, was initially deemed related in the first or second degree to an individual (prs007, also dating between 3520 and 3360 cal. BC) from Primrose Grange, over two kilometres away (Table 4;

Sánchez-Quinto *et al.* 2019, 9472–3), although this could not be verified by Cassidy *et al.* (2020, supp. info. 50). Increasingly distant biological relations (sixth degree or further: e.g. great-great-great grand uncle or aunt) were detected through analysis of IBD-segment-sharing—using the lcMLkin method (Lipatov *et al.* 2015)—between the male deposited at Listoghil (car004) and other bodies from passage-tomb-related contexts (Fig. 4): Newgrange (NG10), Millin Bay (MB6) and Carrowkeel (CAK533). These individuals have considerable geographic spread (up to 150 km apart) and date to different periods, with most post-dating 3300 cal. BC and the latest (CAK530) dated to 2800–2600 cal. BC, almost a millennium later than car004 (Cassidy *et al.* 2020). An adult male individual from Newgrange (NG10), represented by an unburnt cranial fragment found within the chamber, is the offspring of an incestuous union between either full siblings or a parent and child (Cassidy *et al.* 2020), which in itself is highly unusual given the lack of evidence for consanguinity across prehistoric Europe (Ringbauer *et al.* 2021). Dating to 3340–3020 cal. BC (95 per cent probability; OxA-36079, 4473±29), he lived at least two, and probably more, generations after the Listoghil male (car004). A similarly distant relationship was identified between NG10 and two individuals from Cairn K at Carrowkeel (CAK532 and CAK530), who probably died several generations later than NG10 (Cassidy *et al.* 2020, 386; Kador *et al.* 2018). Interestingly, no first- or second-degree relatives were found among the four Later Neolithic samples from Carrowkeel Cairn K passage tomb, where two individuals (CAK530 and CAK533) were very distantly related (Table 4). A key question remains whether these detected levels of biological relatedness in passage-tomb tradition sites are truly representative. This is considered further below.

On the basis of the shared ancestry among these individuals, as determined by IBD analysis, Cassidy *et al.* (2020) argue that they form a haplotypic cluster of individuals more closely genetically related to each other than the rest of the British and Irish Neolithic population (who had hitherto been genetically undifferentiated). This distinct cluster exclusively comprises individuals postdating *c.* 3640 cal. BC who were associated with the passage-tomb tradition in Ireland. While contemporaneous unburnt bones occur across all other tomb 'types' (including the neighbouring Poulnabrone and Parknabinnia monuments), as well as in caves, none of these form part of this distinct genetic cluster (see Table 4). Intriguingly, other passage-tomb tradition samples, all from Ballynahatty (BA64; BA342; BA346), do not form part of this cluster either, further suggesting that practices differed at this unusual site (Fig. 4).

## Non-random mating and hereditary networks

This genetic clustering of distantly related individuals in passage tombs and related contexts (extending over considerable distances and spanning several generations or centuries) warrants consideration, not least because it has been claimed to represent 'non-random mating', indicating the existence of a dynastic hereditary network with restricted access to 'burial' in passage tombs from the latter part of the fourth millennium BC onwards (Cassidy 2020; 2023; Cassidy *et al.* 2020).

The first issue is the representativeness of the sample. It cannot be assumed that the sampled individuals in a study represent entire living populations (Booth 2019, 588; Furholt 2019)—this is exemplified by genetic analysis of sites like Hazleton North which shows that some members of the local community were absent from that tomb (see Fig. 3). Past cultural practices, including funerary rites and reproductive choices, post-depositional histories and the vagaries of archaeological excavation and curation impact directly on the availability of suitable samples for genetic analysis (Frieman 2023, 59–60). As outlined above, most of the population received a funerary treatment that left no archaeological trace and cremations are dominant among the surviving human remains from Neolithic Ireland. Thus, a restricted sample of unburnt Neolithic material is available for genetic analysis, with only a subset of this sequenced.

As a single individual's genome contains a mosaic of information about several of their genetic ancestors, even a small number of aDNA samples provides insights into the ancestry of a much wider population (Booth 2019, 588; Li & Durbin 2011). Yet if groups only practising cremation (and/or other mortuary treatments that left little archaeological trace) rarely reproduced with those who practised inhumation, then they would not enter the genetic record. Such a scenario has been suggested for Chalcolithic Britain, with descendants of the Neolithic population persisting as a genetically invisible group (practising cremation) in parallel to newcomers (practising inhumation) from continental Europe, until changes in their mating network resulted in them reappearing in the genetic record some centuries later (Booth 2019, 588; Booth *et al.* 2021, 381; Brace & Booth 2023). However, given that inhumation and cremation were both practised in combination and contemporaneously at passage tombs and other megalithic monuments in Ireland, this scenario is unlikely here.

The exclusion of Neolithic people whose bones do not form part of the current genetic record (for the various reasons outlined above) may partially account for the paucity of evidence for close genetic relatives. Additional sampling is needed to confirm this and may yet result in significantly increased detection of biological relations (e.g. Mittnik *et al.* 2023). However, such bias seems to be minimal because neither denser sampling of better-preserved deposits nor lower ratios of cremated:inhumed bone result in greater levels of biological relatedness (see Table 3), thereby suggesting that the consistently detected distant biological relatedness (fifth/sixth degree or further) across a random sample set from passage tombs or related contexts is genuinely representative of social practices at the time in Ireland.

If the deposition of human remains within passage tombs had been primarily biologically driven (as in a dynastic hereditary network), then we would expect to see many more genetic connections and close relatives (like at Frälsegården or Hazleton where lineage was emphasized), over the long timeframe of 3600–2500 cal. BC. Given the power of genome-wide sequencing to infer much of a person's overall ancestry

https://doi.org/10.1017/S0959774325000058

(Booth 2019, 3), it is striking that so little evidence for relatedness has yet been uncovered from passage tombs. For example, a recent aDNA study showed that one-third of samples from Ancient Greece were the product of first-cousin mating (Skourtanioti *et al.* 2023). We do not know how close relations of the analysed individuals within passage tombs were treated after death because, thus far, they are entirely absent. This includes the passage tomb with the most analysed genomes, Carrowkeel Cairn K (n=4). Given the above, we cannot say that these tombs were the final resting-places of a dynastic lineage who restricted access to 'burial' within these tombs to their relatives, contrary to what has been argued by Cassidy *et al.* (2020).

Yet there is certainly something non-random about the genetic relationships of people from passage tombs, even though this distant relatedness may not necessarily have been known or appreciated. Reproductive relationships with immediate and close biological relatives (e.g. first to fourth degree) were largely avoided, while those with non-closely related individuals who also used passage tombs were pursued. This matches the general picture for Neolithic Europe, where people predominantly reproduced with others sharing broadly similar cultural practices and genetic ancestry, but who were not close relatives (Booth *et al.* 2021; Brace & Booth 2023, 139; Brown 2014). Nevertheless, it makes the Irish passage-tomb genetic cluster different from haplotypic groupings identified among other smaller island populations from Neolithic Malta and Orkney, where increased inbreeding and/or restricted population sizes (as indicated by high runs of homozygosity and higher levels of gene-sharing) have been detected (Ariano *et al.* 2022; Ariano & Bradley 2023, 45). In contrast, Ireland had sizeable communities with extensive interaction networks (Cassidy *et al.* 2020, 385), which seem to be particularly focused on Britain, rather than the European continent (e.g. Allentoft *et al.* 2024, fig. 6; Ariano *et al.* 2022, fig. 5; Ringbauer *et al.* 2024). This is also supported by the archaeological evidence.

## Alternative social worlds: kinwork

We do not know if the biological relationships revealed by genetics were known or how they were socially understood, but they do not seem to have played a determining role for 'burial' within passage tombs. Rather than being biologically driven, the patterning in the genetic data fits with what we know archaeologically about social developments across Neolithic Ireland. For instance, fourth-millennium BC tomb 'types' exhibit consistently distinctive characteristics of form, landscape setting, visual and material culture, which suggest that they were associated with particular communities of practice (Cooney 2000, 93–126). These monuments served important roles in making and marking ancestry and social relations within Neolithic society—but in ways and at scales particular to each tomb type (see Cummings & Fowler 2023; Fowler 2022; Powell 2005; 2014).

Prior to 3600 cal. BC, social groups seem to have interacted at a smaller scale, as exemplified by the construction and use of portal or court tombs, as well as 'simple' passage tombs. Compared to later 'developed' passage tombs, these are all smaller, more local monuments. Their siting and architecture made them less visible from afar, while the contents and locations of court and portal tombs are both closely linked to those of contemporary houses (e.g. Case 1969; Cooney 2000, 97; Darvill 1979; Powell 2005, 23). This matches with the closer genetic relationships of the individuals sometimes revealed in them, like the father and daughter at the Primrose Grange court tomb or the pair of fourth-degree relatives at Parknabinnia. Powell (2005, 20) previously suggested that portal tombs were not concerned with lineage relations; so the absence of close genetic relations from Poulnabrone across over 20 generations of 'burial' activity seems directly informative about how kinship was practised and portrayed differently by users of that tomb. Contemporary, but potentially different kinds of social relations are represented by 'Linkardstown-type' tombs (see above). Few burials from these have been sequenced, but they do not form part of the passage-tomb genetic cluster. However, the distinctive kinwork associated with 'Linkardstown-type' tombs requires deeper consideration than is possible here.

Only during the later fourth millennium BC do new social practices associated with 'developed' passage tombs emerge, that enabled wider-scale social connections than any other tomb-type. Strontium isotope analysis of human remains from both the Carrowkeel passage-tomb complex and the passage-tomb-related monument at Ballynahatty indicates that a relatively diverse population were brought together in each monument, including some non-local individuals from outside these respective regions (Kador *et al.* 2018; Snoeck *et al.* 2016, cf. Snoeck *et al.* 2020). Indeed, 'developed' passage tombs show strong links beyond Ireland to western Britain, especially Orkney (Cooney & Carlin 2020b), but also Brittany and Iberia (Eogan 1990; O'Sullivan 2006; Shee Twohig 1981). Arguably, the genetic clustering caused by shared haplotypes among some individuals deposited at passage tombs relates to the emergence of more expansive forms of kinship whereby people (some of whom were distantly biologically related) interacted with each other at a greater frequency, intensity and geographical scale than before. We argue that these practices can be understood as 'kinwork', aimed at creating new, socially salient networks of relatedness that included, but also transcended, biological kin. Thus, such networks are only revealed by combining both genetic and archaeological evidence, e.g. the multiple characteristics of developed passage tombs.

Unlike other tombs, these later monuments were larger and situated in elevated, visible locations (Cooney 2000, 138; Powell 2014). Their entrances were generally aligned on each other, as well as landmarks and solstitial or other astronomical events, while smaller or lower tombs were located in such a way that intervisibility was maintained to larger focal tombs, often between passage-tomb complexes and over considerable distances (Prendergast 2016; Prendergast & Ray 2017). The occurrence of these passage tombs in often dense, extended clusters further stresses this social interconnectedness (Cooney 1990; 2000, 152–64; Eogan & Cleary 2017). Their siting also increasingly situated them at a remove from the everyday, which necessitated

**Figure 5.** Mapping the varied scale of Brú na Bóinne's interconnections with people, places, plants and things *c.* 3300–2700 BC. Shaded areas indicate zones where developed passage tombs occur. (Data sources: Copper *et al.* 2024; Corcoran & Sevastopulo 2017; Davis et *al.* 2017; Eogan & Shee Twohig 2022; Longworth & Cleal 1999; Marshall 1976/77; Meighan *et al.* 2011; O'Kelly 1982; Prendergast 2021; Robin 2008; Roe 1968; Ruggles 1999.)

seasonal journeys to participate in their construction and use (Cooney 2000, 141, 145; Hensey 2015, 32–3).

All this is exemplified by the remarkable passage-tomb concentration at *Brú na Bóinne*, comprising at least 40 monuments, including three very large examples at Dowth, Knowth and Newgrange. Their stone fabric combines both local and non-local materials obtained from a diverse set of places, some more than 40 km away (e.g. Corcoran & Sevastopulo 2017; Mitchell 1992; Phillips *et al.* 2002) (Fig. 5). Although these megaliths were cumulatively constructed over a few centuries, their quantities of quarried and transported stone or stripped turves and complex architecture required large numbers of people and extensive cooperation, with groups likely gathering for episodes of quarrying at significant sources, before journeying to the sites of construction (Carlin 2017; Cooney 2000, 135–8; Eogan & Cleary 2017, 765; Hensey 2015, 112–15). The intensity of these gatherings and the scale of interactions are also indicated by concentrations of contemporaneous lithics around the monuments, many of which were also made from non-local stones imported into the area from various locations (Brady 2007; 2018). These repeated communal acts of labour created and reinforced social cohesion. In other words, in constructing monuments collectively, people were also constructing kin relations. Such processes should not be assumed as being driven by elites, not least because unambiguous evidence is lacking and power relations were highly fluid and context-specific (Carlin & Cooney 2020b; Smyth *et al.* in press a).

The architecture of developed passage tombs greatly facilitated ongoing exchanges and interactions that made and remade a tangled web of kin connections between the living and dead, but also among the dead themselves (Fig. 5). Unlike other megaliths, art motifs and specially selected stones highlight important locations for such activities outside and inside the tomb, including the large central chambers (Eogan & Shee Twohig 2022; Powell 1994; Robin 2010). Their accessibility enabled the ongoing deposition of, and interaction with, remains of people of various ages and sexes, as well as those which had been in circulation, alongside animal remains, ceramics, pins, balls, pendants and maceheads, in a burnt or unburnt and/or fragmentary condition from *c.* 3300–2600 cal. BC (Cooney 2017; Eogan 1986). The orthostats and kerbstones were successively reworked and/or redecorated; and some also circulated, being removed from older monuments and incorporated into the fabric of new ones (Eogan 1998; Hensey 2015, 120–28; Jones & Díaz-Guardamino 2019). The exteriors of 'developed' passage tombs, with their straightened front façades and recessed entrances, seem designed to enable shared spaces for larger groups to participate in ceremonial activities. This is supported by the artwork on the kerbstones, external stone structures and the deposits of pottery, stone and flint tools outside these tombs, particularly near the entrances (Carlin 2017; Cooney 2000; Jones 2012, 56–7; O'Kelly 1973, 379).

The genetic clustering shown by individuals from passage tombs is likely to have emerged from such kinwork, rather than a purely hereditary network. Over the centuries of passage-tomb-related social and religious practices, people may have preferentially chosen their reproductive partners from within this extended community of passage-tomb users, some of whom were genetically distantly related. Thus, when they reproduced with each other, haplotypes became shared, but also more widely dispersed across space and time. This resulted in the tangled web of distant genetic relations between individuals in the Carrowmore and Carrowkeel passage tomb cemeteries, Co. Sligo, as well as Newgrange, Co. Meath and the passage tomb-related monument at Millin Bay, Co. Down. Given the continuity of shared ritual practices over several generations within an insular environment, it should not be surprising that distant biological relatedness could endure over centuries. What remains unclear, given the extent of sampling so far, is how genetically distinctive the individuals deposited in passage tombs were compared to other members of the population from 3600 cal. BC onwards.

This developed passage-tomb network may have its origins in the northwest of Ireland after 3600 BC, where there were uniquely strong links in the architecture and siting of smaller, earlier passage tombs, such as those at Carrowmore, and nearby contemporary court tombs (see Cooney 2000, 112–16; 2023, 149; de Valéra 1965; Herity 1974, 274; Powell 2005, 22). Indeed, it is only in the west, particularly the northwest, that we see depositional activity at court tombs continuing into the late fourth and early third millennium BC (e.g. Schulting *et al.* 2012; Smyth *et al.* forthcoming). This seems to be reflected in the very close genetic relationships between car004 (from a passage tomb) and prs007 (from a court tomb), both individuals alive between 3640 and 3360 cal. BC, and likely contemporaries. The more distant genetic relatedness between car004 and others (dating from 3600–2500 BC) at the passage-tomb tradition sites of Carrowkeel, Newgrange and Millin Bay indicate considerable interaction between the northwest and eastern parts of the island over a sustained duration (Fig. 5). These places were interconnected via important communication routes along river networks and the sea (Moore 2016, 54–8). Emerging programmes of strontium isotope analyses on human and faunal remains are expected to clarify such longer-range mobility during this timeframe (Smyth forthcoming).

## Conclusion

Overall, the selection of bones for deposition within passage tombs in Neolithic Ireland does not seem strongly influenced by biological relatedness. Many other facets of identity, kinship, ability, role, cosmology and value influenced these decisions. The mapping of distantly related individuals interred within passage tombs far apart in time and place shows the shift towards more closely connected cultural and religious networks. These likely comprised dispersed groups who were increasingly mobile across a wide swathe of Ireland in the later half of the Neolithic. The evidence certainly does not support the existence of hereditary power (a 'dynasty') in these populations (see Smyth *et al.* in press a). We posit that this shared ancestry can be explained as resulting from preferential choice of partners within a dispersed community who shared cosmological beliefs and practices and enforced their social relationships through collective activities, including the construction of large, monumental sites and the funerary rites that played out at these. Over generations, the choice to reproduce with people whose values and practices aligned with one's own resulted in a somewhat closer genetic relationship within this group than between members of this group and the wider Irish Neolithic population.

More work is vital to achieve a fuller understanding of the social changes occurring in Ireland after 3600 cal. BC. We require more aDNA samples from a greater number of contemporary contexts, as well as denser sampling of key passage-tomb sites which allow analysis of biological relatedness (i.e. with more than four individuals). These results need to be fully contextualized with information from material culture, architecture, the settlement record and the human body, taking into account the theoretical frameworks underpinning the discipline of archaeology today. Such integration of genetic and archaeological evidence and expertise is required to achieve the full benefits of both fields (Frieman & Hofmann 2019; Greaney 2023; Richardson & Booth 2017). Further considerations of kinship, including the role of lineages and clans, and changing understandings of descent in the Neolithic (as outlined in Fowler 2022, 68–9), are also crucial. In particular, more attention needs to be given to the rich archaeological evidence for kinship practices in their widest sense: the ways in which people, places, plants, animals and things mutually constituted each other through their exchanges and relationships.

As scholars across the human sciences have repeatedly made clear, biologically determinist narratives (conflating biological realities with social identities) reinforce ethnocentric and historically contingent categories of self and other in ways that are not just incomplete but actively harmful (Abel & Frieman 2023). Ancient genetics offers a new suite of data about past people and their worlds, but it is just one source among many that must be tested, twined together and teased apart to make sense of the complex human practices that ultimately created the archaeological record. The past must be allowed its difference.

**Acknowledgements.** We thank Gabriel Cooney for commenting on an earlier draft and the helpful input of two anonymous reviewers. JS's contribution was supported by Irish Research Council Consolidator Laureate Award IRCLA/2017/206 'Passage Tomb People'; CJF's contribution is supported by Australian Research Council Future Fellowship FT220100024 'Kin and Connection: ancient DNA between the science and the social'.

## References

Abel, S. & C.J. Frieman, 2023. On gene-ealogy: identity, descent, and affiliation in the era of home DNA testing. *Anthropological Science* 131(1), 15–25.

Allentoft, M.E., M. Sikora, A. Refoyo-Martínez, *et al*., 2024. Population genomics of post-glacial western Eurasia. *Nature* 625, 301–11.

Ariano, B. & D.G. Bradley, 2023. Ancient genomics methodology and genetic insularity in Neolithic Europe, in *Ancient DNA and the European Neolithic: Relations and descent*, eds A. Whittle, J. Pollard & S. Greaney. (Neolithic Studies Group Seminar Paper 19.) Oxford: Oxbow, 41–50.

Ariano, B., V. Mattiangeli, E.M. Breslin, *et al*., 2022. Ancient Maltese genomes and the genetic geography of Neolithic Europe. *Current Biology* 32, 2668–80.

Barrett, J., 1988. The living, the dead and the ancestors: Neolithic and early Bronze Age mortuary practices, in *The Archaeology of Context in the Neolithic and Bronze Age*, eds J. Barrett & I. Kinnes. Sheffield: Department of Prehistory and Archaeology, 30–41.

Bayliss, A. & M. O'Sullivan, 2013. Interpreting chronologies for the Mound of the Hostages, Tara, and its contemporary context in Neolithic and Bronze Age Ireland, in *Tara – From the Past to the Future*, eds M. O'Sullivan, C. Scarre & M. Doyle. Dublin: Wordwell, 26–104.

Beckett, J.F., 2011. Interactions with the dead: a taphonomic analysis of burial practices in three megalithic tombs in County Clare, Ireland. *European Journal of Archaeology* 14(3), 394–418.

Beckett, J. & J. Robb, 2006. Neolithic burial taphonomy, ritual, and interpretation in Britain and Ireland: a review, in *Social Archaeology of Funerary Remains*, eds R. Gowland & C. Knüsel. Oxford: Oxbow, 57–80.

Bentley, R.A., P. Bickle, L. Fibiger, *et al*., 2012. Community differentiation and kinship among Europe's first farmers. *Proceedings of the National Academy of Sciences USA* 109(24), 9326–30.

Bergh, S. & R. Hensey, 2013. Unpicking the chronology of Carrowmore. *Oxford Journal of Archaeology* 32(4), 343–66.

Betham, W., 1838/40. On the ancient tomb recently discovered in the tumulus in the Phoenix Park. *Proceedings of the Royal Irish Academy* 1, 196–200.

Blakey, M.L., 2020. On the biodeterministic imagination. *Archaeological Dialogues* 27(1), 1–16.

Booth, T.J., 2019. A stranger in a strange land: a perspective on archaeological responses to the palaeogenetic revolution from an archaeologist working amongst palaeogeneticists. *World Archaeology* 51(4), 586–601.

Booth, T.J., J. Brück, S. Brace & I. Barnes, 2021. Tales from the supplementary information: ancestry change in Chalcolithic–Early Bronze Age Britain was gradual with varied kinship organization. *Cambridge Archaeological Journal* 31(3), 379–400.

Borlase, W.C., 1897. *The Dolmens of Ireland*. London: Chapman & Hall.

Brace, S. & T.J. Booth, 2023. The genetics of the inhabitants of Neolithic Britain: a review, in *Ancient DNA and the European Neolithic: Relations and descent*, eds. A. Whittle, J. Pollard & S. Greaney. (Neolithic Studies Group Seminar Paper 19.) Oxford: Oxbow, 123–46.

Brace, S., Y. Diekmann, T.J. Booth, *et al*., 2019. Ancient genomes indicate population replacement in early Neolithic Britain. *Nature Ecology and Evolution* 3(5), 765–71.

Bradbury, J. & C. Scarre (eds), 2017. *Engaging with the Dead: Exploring changing human beliefs about death, mortality and the human body*. Oxford: Oxbow.

Bradley, R., 2007. *The Prehistory of Britain and Ireland*. Cambridge: Cambridge University Press.

Brady, C., 2007. The lithic landscape of the Newgrange environs: an introduction, in *From Stonehenge to the Baltic: Living with cultural diversity in the third millennium BC*, eds. M. Larsson & M. Parker Pearson. (BAR International series 1692). Oxford: Archaeopress, 213–20.

Brady, C., 2018. Lithic raw material acquisition in Brú na Bóinne and the implications for regionality. *Journal of the County Louth Archaeological and Historical Society* 29(2), 153–73.

Brindley, A.L. & J.N. Lanting, 1989/90. Radiocarbon dates for Neolithic single burials. *Journal of Irish Archaeology* 5, 1–7.

Bronk Ramsey, C., 2017. Methods for summarizing radiocarbon datasets. *Radiocarbon* 59, 1809–33.

Brown, K.A., 2014. Women on the move. The DNA evidence for female mobility and exogamy in prehistory, in *Past Mobilities*, ed. J. Leary. Farnham: Ashhgate, 155–74.

Brück, J., 2009. Women, death and social change in the British Bronze Age. *Norwegian Archaeological Review* 42(1), 1–23.

Brück, J., 2021. Ancient DNA, kinship and relational identities in Bronze Age Britain. *Antiquity* 95, 1–10.

Brück, J. & C.J. Frieman, 2021. Making kin: the archaeology and genetics of human relationships. *TATuP – Journal for Technology Assessment in Theory and Practice* 30(2), 47–52.

Brunel, S., E.A. Bennett, L. Cardin, *et al*., 2020. Ancient genomes from present-day France unveil 7,000 years of its demographic history. *Proceedings of the National Academy of Sciences USA* 117(23), 12791–8.

Buckley, L., C. Power, R. O'Sullivan & H. Thakore, 2017. Chapter 3: The human remains, in *The Passage Tomb Archaeology of the Great Mound at Knowth*, eds G. Eogan & K. Cleary. Dublin: Royal Irish Academy, 277–329.

Carlin, N., 2017. Getting into the groove: exploring the relationship between Grooved Ware and developed passage tombs in Ireland *c*. 3000–2700 cal. BC. *Proceedings of the Prehistoric Society* 83, 155–88.

Carlin, N. & G. Cooney, 2020a. Early prehistoric societies in Ireland: the contribution of DNA. *Archaeology Ireland* 34(3), 19–23.

Carlin, N. & G. Cooney, 2020b. On the sea roads: the ebb and flow of links with a wider world, in *The Ness of Brodgar: As it stands*, eds N. Card, M. Edmonds & A. Mitchell. Kirkwall: Kirkwall Press, 320–33.

Carsten, J., 2004. *After Kinship*. Cambridge: Cambridge University Press.

Case, H., 1969. Settlement patterns in the North Irish Neolithic. *Ulster Journal of Archaeology* 32, 3–7.

Cassidy, L.M., 2020. Ancient DNA in Ireland: isolation, immigration and elite incest. *British Archaeology* September-October, 32–41.

Cassidy, L.M., 2023. Islands apart? Genomic perspectives on the Mesolithic–Neolithic transition in Ireland, in *Ancient DNA and the European Neolithic: Relations and descent*, eds A. Whittle, J. Pollard & S. Greaney. (Neolithic Studies Group Seminar Paper 19.) Oxford: Oxbow, 148–67.

Cassidy, L.M., R. Martiniano, E.M. Murphy, M.D. Teasdale, J. Mallory, B. Hartwell & D.G. Bradley, 2016. Neolithic and Bronze Age migration to Ireland and the establishment of the insular Atlantic genome. *Proceedings of the National Academy of Sciences USA* 113(2), 368–73.

Cassidy, L.M., R. Ó Maoldúin, T. Kador, *et al*., 2020. A dynastic elite in monumental Neolithic society. *Nature* 582, 384–8.

Cleary, R.M., 1995. Later Bronze Age houses and prehistoric burials from Lough Gur, Co. Limerick. *Proceedings of the Royal Irish Academy* 95C, 1–92.

Cleary, R.M., 2018. *The Archaeology of Lough Gur*. Dublin: Wordwell.

Collins, A.E.P. & D.M. Waterman, 1955. *Millin Bay, a Late Neolithic Cairn in Co. Down*. (Archaeological Research Publication (N. Ireland) 4.) Belfast: HMSO.

Cooney, G., 1990. The place of megalithic tomb cemeteries in Ireland. *Antiquity* 64, 741–53.

Cooney, G., 2000. *Landscapes of Neolithic Ireland*. London: Routledge.

Cooney, G., 2016. Pathways to ancestral worlds: mortuary practice in the Irish Neolithic, in *The Neolithic of Mainland Scotland*, eds K. Brophy, G. MacGregor & I. Ralston. Edinburgh: Edinburgh University Press, 74–94.

Cooney, G., 2017. Chapter V: the Knowth mortuary practices in context, in *Excavations at Knowth 6: The passage tomb archaeology of the Great Mound at Knowth*, eds G. Eogan & K. Cleary. Dublin: Royal Irish Academy, 387–410.

Cooney, G., 2023. *Death in Irish Prehistory*. Dublin: Royal Irish Academy.

Cooney, G. & N. Carlin, 2020. Early prehistoric societies in Ireland: the contribution of DNA. *Archaeology Ireland* 34(3), 19–23.

Cooney, G., A. Bayliss, F. Healy, *et al*., 2011. Ireland, in *Gathering Time: Dating the early Neolithic enclosures of southern Britain and Ireland. Volume 2*, eds A. Whittle, F. Healy & A. Bayliss. Oxford: Oxbow, 562–669.

Copper, M., A. Whittle & A. Sheridan (eds), 2024. *Revisiting Grooved Ware: Understanding ceramic trajectories in Britain and Ireland, 3200–2400 cal BC*. Oxford: Oxbow.

Corcoran, M. & G. Sevastopulo, 2017. Provenance of the stone used in the construction and decoration of Tomb 1, in *Excavations at Knowth 6. The passage tomb archaeology of the Great Mound at Knowth*, eds G. Eogan & K. Cleary. Dublin: Royal Irish Academy, 505–68.

Crellin, R.J. & O.J.T. Harris, 2020. Beyond binaries. Interrogating ancient DNA. *Archaeological Dialogues* 27(1), 37–56.

Cummings, V. & C. Fowler, 2023. Materialising descent: lineage formation and transformation in Early Neolithic southern Britain. *Proceedings of the Prehistoric Society* 89, 1–21.

Cummings, V., D. Hofmann, M. Bjørnevad-Ahlqvist & R. Iversen, 2022. Muddying the waters: reconsidering migration in the Neolithic of Britain, Ireland and Denmark. *Danish Journal of Archaeology* 11, 1–25.

Cummings, V. & C. Richards, 2021. *Monuments in the Making: Raising the great dolmens in Early Neolithic northern Europe*. Oxford: Windgather Press.

Darvill, T.C., 1979. Court cairns, passage graves and social change in Ireland. *Man* 14(2), 311–27.

Davidsson, M. 1997. *Bones Will Yield Much More Than Little. An archaeoosteological analysis of the unburnt human bone material from Tomb 1 at Primrose Grange, County Sligo, Ireland*. Stockholm: Stockholm University Archaeoosteological Research Laboratory.

de Valéra, R., 1965. Transeptal court tombs. *Journal of the Royal Society of Antiquaries of Ireland* 95(1/2) (Papers in Honour of Liam Price), 5-37.

de Valéra, R. & S. Ó Nualláin, 1961. *Survey of the Megalithic Tombs of Ireland. Volume 1, County Clare*. Dublin: Stationery Office.

di Leonardo, M., 1987. The female world of cards and holidays: women, families, and the work of kinship. *Signs* 12(3), 440–53.

Dowd, M., 2015. *The Archaeology of Caves in Ireland*. Oxford: Oxbow.

Dowd, M., L.G. Lynch, L. Cassidy, *et al*., 2020. Neolithic engagements with the dead: mortuary processing on Bengorm Mountain in the northwest of Ireland. *Oxford Journal of Archaeology* 39(4), 368–94.

Eisenman, S., E. Bánffy, P. van Dommelen, *et al*., 2018. Reconciling material cultures in archaeology with genetic data: the nomenclature of clusters emerging from archaeogenomic analysis. *Scientific Reports* 8(1), 13003.

Elliot, E., T. Saupe, J.E. Thompson, J.E. Robb & C.L. Scheib, 2022. Sex bias in Neolithic megalithic burials. *American Journal of Biological Anthropology* 180(1), 196–206.

Ensor, B.E., 2021. *The Not Very Patrilocal European Neolithic*. Oxford: Archaeopress.

Ensor, B.E., J.D. Irish & W.F. Keegan, 2017. The bioarchaeology of kinship: proposed revisions to assumptions guiding interpretation. *Current Anthropology* 58(6), 739–61.

Eogan, G., 1986. *Knowth and the Passage Tombs of Ireland*. London: Thames & Hudson.

Eogan, G., 1990. Irish megalithic tombs and Iberian comparisons and contrasts, in *Probleme der Megalithgräberforschung: Vorträge zum 100. Geburtstag von Vera Leisner*, eds H. Schubart, W. Dehn & P. Kalb. (Madrider Forschungen 16.) Berlin: De Gruyter, 113–38.

Eogan, G., 1998. Knowth before Knowth. *Antiquity* 72, 162–72.

Eogan, G. & K. Cleary (eds), 2017. *Excavations at Knowth 6: The passage tomb archaeology of the Great Mound at Knowth*. Dublin: Royal Irish Academy.

Eogan, G. & E. Shee Twohig (eds), 2022. *Excavations at Knowth 7. The megalithic art of the passage tombs at Knowth, County Meath*. Dublin: Royal Irish Academy.

Fernandez, E., A. Pérez-Pérez, C. Gamba, *et al*., 2014. Ancient DNA Analysis of 8000 B.C. Near Eastern farmers supports an Early Neolithic pioneer maritime colonization of mainland Europe through Cyprus and the Aegean Islands. *PLOS Genetics* 10(6), e1004401.

Fleming, A., 1972. Vision and design; approaches to ceremonial monument typology. *Man* 7, 57–72.

Fowler, C., 2010. Pattern and diversity in the Early Neolithic mortuary practices of Britain and Ireland. Contextualising the transformation of the dead. *Documenta Praehistorica* 37, 1–18.

Fowler, C., 2022. Social arrangements: kinship, descent and affinity in the mortuary architecture of Early Neolithic Britain and Ireland. *Archaeological Dialogues* 29, 67–88.

Fowler, C., I. Olalde, V. Cummings, *et al*., 2022. A high-resolution picture of kinship practices in an Early Neolithic tomb. *Nature* 601, 584–7.

Frieman, C.J., 2023. *Archaeology as History: Telling stories from a fragmented past*. Cambridge: Cambridge University Press.

Frieman, C.J. & D. Hofmann, 2019. Present pasts in the archaeology of genetics, identity, and migration in Europe: a critical essay. *World Archaeology* 51(4), 528–45.

Frieman, C.J., A. Teather & C. Morgan, 2019. Bodies in motion: narratives and counter narratives of gendered mobility in European later prehistory. *Norwegian Archaeological Review* 52(2), 148–69.

Furholt, M., 2018. Massive migrations? The impact of recent aDNA studies on our view of third millennium Europe. *European Journal of Archaeology* 21(2), 159–91.

Furholt, M., 2019. Re-integrating archaeology: a contribution to aDNA studies and the migration discourse on the 3rd millennium BC in Europe. *Proceedings of the Prehistoric Society* 85, 115–29.

Furholt, M., 2020. Biodeterminism and pseudo-objectivity as obstacles for the emerging field of archaeogenetics. *Archaeological Dialogues* 27(1), 23–5.

Geber, J., R. Hensey, P. Meehan, S. Moore & T. Kador, 2017. Facilitating transitions: postmortem processing of the dead at the Carrowkeel passage tomb complex, Ireland (3500–3000 cal. B.C.). *Bioarchaeology International* 1(1–2), 35–51.

Greaney, S., 2023. Looking back, looking forward — humanity beyond biology, in *Ancient DNA and the European Neolithic: Relations and descent*, eds A. Whittle, J. Pollard & S. Greaney. (Neolithic Studies Group Seminar Paper 19.) Oxford: Oxbow, 183–94.

Grogan, E. & G. Eogan, 1987. Lough Gur excavations by Seán P. Ó Ríordáin: five enclosed habitation sites of the Neolithic and Beaker period on the Knockadoon Peninsula. *Proceedings of the Royal Irish Academy* 87C, 299–506.

Haak, W., I. Lazaridis, N. Patterson, *et al*., 2015. Massive migration from the steppe was a source for Indo-European languages in Europe. *Nature* 522(7555), 207–11.

Hartnett, P.J., 1957. Excavation of a passage grave at Fourknocks, County Meath. *Proceedings of the Royal Irish Academy* 58, 197–277.

Hartwell, B., S. Gormley, C. Brogan & C. Malone (eds), 2023. *Ballynahatty: Excavations in a Neolithic monumental landscape*. Oxford: Oxbow.

Hakenbeck, S.E., 2019. Genetics, archaeology and the far right: an unholy Trinity. *World Archaeology* 51(4), 517–27.

Hensey, R., 2015. *First Light: The origins of Newgrange*. Oxford: Oxbow.

Herity, M., 1974. *Irish Passage Graves: Neolithic tomb-builders in Ireland and Britain 2500 BC*. Dublin: Irish University Press.

Herity, M. & G. Eogan, 1977. *Ireland in Prehistory*. London: Routledge & Kegan Paul.

Hofmanova, Z., S. Kreutzer, G. Hellenthal, *et al*., 2016. Early farmers from across Europe directly descended from Neolithic Aegeans. *Proceedings of the National Academy of Sciences USA* 113(25), 68886–91.

Johnston, R., 2020. *Bronze Age Worlds: A social prehistory of Britain and Ireland*. London: Routledge.

Jones, A.M., 2012. *Prehistoric Materialities. Becoming material in prehistoric Britain and Ireland*. Oxford: Oxford University Press.

Jones, A.M. & M. Díaz-Guardamino, 2019. *Making a Mark: Image and process in Neolithic Britain and Ireland*. Oxford: Oxbow.

Jones, C., 2007. *Temples of Stone: Exploring the megalithic tombs of Ireland*. Cork: Collins Press.

Jones, C., 2019. The north Munster atypical court tombs of western Ireland: social dynamics, regional trajectories and responses to distant events over the course of the Neolithic, in *Megaliths – Societies – Landscapes. Early monumentality and social differentiation in Neolithic Europe*, eds J. Müller, M. Hinz & M. Wunderlich. Bonn: Habelt Verlag, 983–1004.

Jones, E.D. & E. Bösl, 2021. Ancient human DNA: A history of hype (then and now). *Journal of Social Archaeology* 21(2), 236–55.

Kador, T., L. Cassidy, J. Geber, R. Hensey, P. Meehan & S. Moore, 2018. Rites of passage: mortuary practice, population dynamics, and chronology at the Carrowkeel Passage Tomb Complex, Co. Sligo, Ireland. *Proceedings of the Prehistoric Society* 84, 225–55.

Knipper, C., A. Mittnik, K. Massy, *et al*., 2017. Female exogamy and gene pool diversification at the transition from the Final Neolithic to the Early Bronze Age in central Europe. *Proceedings of the National Academy of Sciences USA* 114(38), 10083–8.

Kuijt, I. & C.P. Quinn, 2013. Biography of the Neolithic body: tracing pathways to cist II, Mound of the Hostages, Tara, in *Tara: From the Past to the Future*, ed. M. O'Sullivan. Dublin: Wordwell, 130–43.

Li, H. & R. Durbin, 2011. Inference of human population history from individual whole-genome sequences. *Nature* 475, 493–6.

Lipatov, M., K. Sanjeev, R. Patro & K.R. Veeramah, 2015. Maximum likelihood estimation of biological relatedness from low coverage sequencing data. BioRxiv. https://doi.org/10.1101/023374

Longworth, I. & R. Cleal, 1999. Grooved Ware gazetteer, in *Grooved Ware in Britain and Ireland*, eds R.M.J. Cleal & A. MacSween. (Neolithic Studies Group Seminar Paper 3.) Oxford: Oxbow, 177–206.

Lynch, A., 2014. *Poulnabrone: An Early Neolithic portal tomb in Ireland*. Dublin: Stationery Office.

MacAdam, J., 1855. Discovery of an ancient sepulchral chamber. *Ulster Journal of Archaeology* 3, 358–65.

Marshall, D.N., 1976/77. Carved stone balls. *Proceedings of the Society of Antiquaries of Scotland* 108, 40–72.

McFadyen, L., 2006. Building technologies, quick architecture and early Neolithic long barrow sites in southern Britain. *Archaeological Review from Cambridge* 21(1), 117–34.

McGuinness, D., 2010. Druids' altars, Carrowmore and the birth of Irish archaeology. *Journal of Irish Archaeology* 19, 29–49.

Meighan, I., P. Turkington & M. Cooper, 2011. Detective work on the ancient stones of Newgrange. *Earth Science Ireland* 9, 8–9.

Mitchell, F., 1992. Notes on some non-local cobbles at the entrances to the passage-graves at Newgrange and Knowth, Co. Meath. *Journal of the Royal Society of Antiquaries of Ireland* 122, 128-45.

Mittnik, A., K. Massy, C. Knipper, *et al*. 2019. Kinship-based social inequality in Bronze Age Europe. *Science* 366(6466), 731–4.

Mittnik, A., K. Massy, C. Knipper, R. Friedrich, J. Krause & P.W. Stockhammer, 2023. Kinship, status and mobility in the Bronze Age Lech Valley, in *Kinship, Sex, and Biological Relatedness: The contribution of archaeogenetics to the understanding of social and biological relations: 15. Mitteldeutscher Archäologentag vom 6. bis 8. Oktober 2022 in Halle (Saale)*, eds H. Meller, J. Krause, W. Haak & R. Risch. Halle (Saale): Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt/Landesmuseum für Vorgeschichte, 195–217.

Moore, S. 2016. Movement and thresholds: architecture and landscape at the Carrowkeel-Keshcorran passage tomb complex, Co. Sligo, Ireland, in *Moving on in Neolithic Studies*, eds J. Leary & T. Kador. (Seminar Papers 14.) Oxford: Neolithic Studies Group, 45–66.

Murphy, E., 2003. Funerary processing of the dead in prehistoric Ireland. *Archaeology Ireland* 17(2), 13–15.

Ó Ríordáin, S.P., 1954. Lough Gur excavations: Neolithic and Bronze Age houses on Knockadoon. *Proceedings of the Royal Irish Academy* 56C, 297–459.

O'Donnabháin, B. & M. Tesorieri, 2014. Bioarchaeology, in *Poulnabrone: An Early Neolithic portal tomb in Ireland*, ed. A. Lynch. Dublin: Stationery Office, 61–86.

O'Kelly, C., 1973. Passage-grave art in the Boyne Valley. *Proceedings of the Prehistoric Society* 39, 354–82.

O'Kelly, M.J. 1982. *Newgrange: Archaeology, art and legend*. London: Thames & Hudson.

O'Sullivan, M., 2005. *Duma na nGiall – the Mound of the Hostages, Tara*. Dublin: Wordwell.

O'Sullivan, M., 2006. The Boyne and beyond: a review of megalithic art in Ireland, in *Origine et développement du mégalithisme de l'ouest de l'Europe. Actes du colloque international, 26–30 octobre 2002, Bougon (France)*, eds R. Joussaume, L. Laporte & C. Scarre. Niort: Conseil Général des Deux-Sèvres, 649–86.

Olalde, I., S. Brace, M.E. Allentoft, *et al*., 2018. The Beaker phenomenon and the genomic transformation of northwest Europe. *Nature* 555(7695), 190–96.

Olalde, I., S. Mallick, N. Patterson, *et al*., 2019. The genomic history of the Iberian Peninsula over the past 8000 years. *Science* 363(6432), 1230–34.

Papac, L., M. Ernée, M. Dobeš, *et al.*, 2021. Dynamic changes in genomic and social structures in third millennium BCE central Europe. *Science Advances* 7(35), eabi6941.

Parker Pearson, M., 1999. *The Archaeology of Death and Burial*. Stroud: Sutton.

Patterson, N., M. Isakov, T.J. Booth, *et al.*, 2022. Large-scale migration into Britain during the Middle to Late Bronze Age. *Nature* 601(7894), 588–94.

Petrie, G., 1833. New Grange. *Dublin Penny Journal* 1(39), 305–6.

Phillips, A., M. Corcoran & G. Eogan, 2002. Identification of the Source Area for Megaliths Used in the Construction of the Neolithic Passage Graves of the Boyne Valley, Co. Meath. Unpublished report for the Heritage Council, Department of Geology, Trinity College Dublin.

Powell, A.B., 1994. Newgrange – science or symbolism? *Proceedings of the Prehistoric Society* 60, 85–96.

Powell, A.B., 2005. The language of lineage: reading Irish court tomb design. *European Journal of Archaeology* 8(1), 9–28.

Powell, A.B., 2014. Corporate identity and clan affiliation: an explanation of form in Irish megalithic tomb construction, in *Fonctions, utilisations et représentations de l'espace dans les sépultures monumentales du Néolithique européen*, eds G. Robin, A. D'Anna, A. Schmitt & M. Bailly. Aix-en-Provence: Presses Universitaires de Provence, 81–95.

Prendergast, F., 2016. Interpreting megalithic tomb orientation and siting within broader cultural contexts. *Journal of Physics: Conference Series* 685, 1–18.

Prendergast, F., 2021. The alignment of passage tombs in Ireland – horizons, skyscape, and domains of power, in *Zeit ist Macht. Wer macht Zeit?/Time is power. Who makes time?*, eds H. Meller, A Reichenberger & R. Risch. Halle (Saale): Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt/Landesmuseum für Vorgeschichte, 107–23.

Prendergast, F. & T. Ray, 2017. Alignment of the western and eastern passage tombs, in *Excavations at Knowth 6: The passage tomb archaeology of the Great Mound at Knowth*, eds G. Eogan & K. Cleary. Dublin: Royal Irish Academy, 263–76.

Quinn, C.P., 2015. Returning and reuse: diachronic perspectives on multi-component cemeteries and mortuary politics at Middle Neolithic and Early Bronze Age Tara, Ireland. *Journal of Anthropological Archaeology* 37, 1–18.

Reimer, P.J., W.E.N. Austin, E. Bard, *et al.*, 2020. The IntCal20 Northern Hemispheric radiocarbon calibration curve (0–55 kcal BP). *Radiocarbon* 62(4), 725–57.

Richardson, L. & T. Booth, 2017. Response to 'Brexit, Archaeology and Heritage: Reflections and Agendas'. *Papers from the Institute of Archaeology* 27(1), Art. 2.

Ringbauer, H., J. Novembre & M. Steinrücken, 2021. Parental relatedness through time revealed by runs of homozygosity in ancient DNA. *Nature Communications* 12(1), 5425.

Rivollat, M., C. Jeong, S. Schiffels, *et al.* 2020. Ancient genome-wide DNA from France highlights the complexity of interactions between Mesolithic hunter-gatherers and Neolithic farmers. *ScienceAdvances* 6(22), eaaz5344.

Rivollat, M., A.B. Rohrlach, H. Ringbauer, *et al.*, 2023. Extensive pedigrees reveal the social organization of a Neolithic community. *Nature* 620(7974), 600–606.

Rivollat, M., A. Thomas, E. Ghesquière, *et al.*, 2022. Ancient DNA gives new insights into a Norman Neolithic monumental cemetery dedicated to male elites. *Proceedings of the National Academy of Sciences USA* 119(18), e2120786119.

Robb, J., 2016. What can we really say about skeletal part representation, MNI and funerary ritual? A simulation approach. *Journal of Archaeological Science: Reports* 10, 684–92.

Robin, G., 2008. Neolithic Passage Tomb Art around the Irish Sea: Iconography and Spatial Organisation. Unpublished PhD thesis, Université de Nantes.

Robin, G., 2010. Spatial structures and symbolic systems in Irish and British passage tombs: the organisation of the architectural elements, parietal carved signs and funerary deposits. *Cambridge Archaeological Journal* 20(3), 373–418.

Roe, F., 1968. Stone mace-heads and the latest neolithic cultures of the British Isles, in *Studies in Ancient Europe: Essays presented to Stuart Piggott*, eds J.M. Coles & D.D.A. Simpson, 145–72. Leicester: Leicester University Press.

Ruggles, C., 1999. *Astronomy in Prehistoric Britain and Ireland*. London/New York: Yale University Press.

Sánchez-Quinto, F., H. Malmstrøm, M. Fraser, *et al.*, 2019. Megalithic tombs in western and northern Neolithic Europe were linked to a kindred society. *Proceedings of the National Academy of Sciences USA* 116(19), 9469–74.

Schneider, D., 1984. *Critique of the Study of Kinship*. Ann Arbor (MI): University of Michigan Press.

Schulting, R.J., 2014a. Dating the construction of Newgrange, in Newgrange revisited: new insights from excavations at the back of the mound in 1984–8, by A. Lynch. *Journal of Irish Archaeology* 23, 46–50.

Schulting, R.J. 2014b. The dating of Poulnabrone, Co. Clare, in *Poulnabrone: An Early Neolithic portal tomb in Ireland*, ed. A. Lynch. Dublin: Stationery Office, 93–113.

Schulting, R.J., C. Bronk Ramsey, P. Reimer, G. Eogan, K. Cleary, G. Cooney & A. Sheridan, 2017a. Dating Neolithic human remains at Knowth, in *Excavations at Knowth 6: The Neolithic Archaeology of the Large Passage Tomb at Knowth, Co Meath*, eds. G. Eogan & K. Cleary. Dublin: Royal Irish Academy, 331–79.

Schulting, R.J., M. McClatchie, A. Sheridan, R. McLaughlin, P. Barratt & N.J. Whitehouse, 2017b. Radiocarbon dating of a multi-phase passage tomb on Baltinglass Hill, Co. Wicklow, Ireland. *Proceedings of the Prehistoric Society* 83, 305–23.

Schulting, R.J., E. Murphy, C. Jones & G. Warren, 2012. New dates from the north and a proposed chronology for Irish court tombs. *Proceedings of the Royal Irish Academy* 112C, 1–60.

Seguin-Orlando, A., R. Donat, C. Der Sarkissian, *et al.*, 2021. Heterogeneous hunter-gatherer and steppe-related ancestries in Late Neolithic and Bell Beaker genomes from present-day France. *Current Biology* 31(5), 1072–83.

Seersholm, F.V., K.G. Sjögren, J. Koelman, *et al.* 2024. Repeated plague infections across six generations of Neolithic Farmers. *Nature* 632, 114–21.

Shee Twohig, E., 1981. *The Megalithic Art of Western Europe*. Oxford: Oxford University Press.

Sheridan, A.L., 1986. Megaliths and megalomania: an account, and interpretation, of the development of passage tombs in Ireland. *Journal of Irish Archaeology* 3, 17–30.

Skourtanioti, E., H. Ringbauer, G.A. Gnecchi Roscone, *et al.*, 2023. Ancient DNA reveals admixture history and endogamy in the prehistoric Aegean. *Nature Ecology & Evolution* 7, 290–303.

Smyth, J., 2012. Breaking ground: an overview of pits and pit-digging in Neolithic Ireland, in *Regional Perspectives on Neolithic Pit Deposition: Beyond the mundane*, eds H. Anderson-Whymark & J. Thomas. Oxford: Oxbow, 13–29.

Smyth, J., 2014. *Settlement in the Irish Neolithic*. (Prehistoric Society Research Paper 6.) Oxford: Oxbow.

Smyth, J., 2020. House of the living, house of the dead. An open and shut case from Ballyglass, Co. Mayo?, in *Houses of the Dead?*, eds A. Barclay, D. Field & J. Leary. Oxford: Oxbow, 145–57.

Smyth, J., forthcoming. Para-megalithism: alternative routes to understanding big stones, in *Megalithic Societies: Old questions, new narratives*, eds G.M. Higginbottom, J. Verdonkschot, C. Scarre, A.C. González-García & F. Criado-Boado. Oxford: Archaeopress.

Smyth, J., N. Carlin, G. Cooney, *et al.*, forthcoming. *The Neolithic House and Tomb, Ballyglass, Co. Mayo, Ireland: Excavations by Seán Ó Nualláin 1969–1971*. Leiden: Sidestone Press.

Smyth, J., N. Carlin, D. Hofmann, *et al.*, in press a. The 'king' of Newgrange? A critical analysis of a Neolithic petrous fragment from the passage tomb chamber. *Antiquity*.

Smyth, J., J. Geber, N. Carlin, *et al.*, in press b. Notes from the archives: re-analysis of skeletal assemblages from three later 4th millennium BC Irish passage tombs, in *The Early Neolithic of Northern Europe: New approaches to migration, movement and social connection*, eds V. Cummings, D. Hofmann, R. Iversen & M. Bjørnevad-Ahlqvist. Leiden: Sidestone Press, 147-57.

Snoeck, C., C. Jones, J. Pouncett, *et al.* 2020. Isotopic evidence for changing mobility and landscape use patterns between the Neolithic and Early Bronze Age in western Ireland. *Journal of Archaeological Science: Reports* 30, 102214.

Snoeck, C., J. Pouncett, G. Ramsey, *et al.*, 2016. Mobility during the Neolithic and Bronze Age in Northern Ireland explored using strontium isotope analysis of cremated human bone. *American Journal of Physical Anthropology* 160(3), 397–413.

Stone, L. & D. King, 2019. *Kinship and Gender. An introduction* (6th edn). London: Routledge.

Thomas, J., 2022. Neolithization and population replacement in Britain: an alternative view. *Cambridge Archaeological Journal* 32(3), 26–31.

Waddell, J., 2005. *Foundation Myths: The beginnings of Irish archaeology.* Bray: Wordwell.

Whitehouse, N.J., R.J. Schulting, M. McClatchie, *et al.*, 2014. Neolithic agriculture on the European western frontier: the boom and bust of early farming in Ireland. *Journal of Archaeological Science* 51, 181–205.

Whittle, A., F. Healy & A. Bayliss (eds), 2011. *Gathering Time: Dating the Early Neolithic enclosures of southern Britain and Ireland*. Oxford: Oxbow.

Wood-Martin, W.G., 1888. *The Rude Stone Monuments of Ireland (Co. Sligo and the Island of Achill).* Dublin/London: Hodges, Figgis & Co./ Williams & Norgate.

**Neil Carlin** is a Lecturer in the School of Archaeology at University College Dublin. His research concentrates on relationships between people, places, plants, animals and things in Ireland and Britain and their wider European contexts during the second, third and fourth millennia BC.

**Jessica Smyth** is an Associate Professor in the School of Archaeology at University College Dublin. She has a long-standing interest in daily life and farming in prehistory, and was recently the Principal Investigator on 'Passage Tomb People' (IRC Laureate Consolidator Grant 2018–2022), investigating the social drivers of passage-tomb construction in the fourth and third millennia BC.

**Catherine J. Frieman** is an Associate Professor in European Archaeology in the School of Archaeology and Anthropology, ANU, Australia. Her research concerns the relationships between people, technology and material culture including prehistoric mobility, innovation and ancient genetics. Her current publications explore cross-disciplinary approaches such as the impact of genetic data on archaeological narratives and models, as well as the methodological and ethical implications of this research.

**Daniela Hofmann** is Professor of Stone Age Archaeology at the University of Bergen, Norway. Her research focuses on integrating archaeology and the natural sciences to address migration, kinship, ritual, social inequality and resistance to it, as well as social contacts and change.

**Penny Bickle** is Professor of Funerary Archaeology at the University of York, UK. She researches the Neolithic period in Europe, with a particular interest in bioarchaeological methods, such as radiocarbon dating, strontium isotopes and aDNA, and their application to resolving issues of identity, kinship, gender and inequalities.

**Kerri Cleary** is a Research Manager with Archaeological Consultancy Services Unit Ltd based in Drogheda, Co. Louth, Ireland, and an Adjunct Research Fellow with the UCD School of Archaeology. Her research focuses on Neolithic and Bronze Age Ireland, particularly mortuary and settlement archaeology. She was coordinator for the excavations at Knowth publication project (2007–2017), an expert advisor for the 2019 refurbishment of the Brú na Bóinne Visitor Centre and a contributor to the Knowth guidebook (Royal Irish Academy, 2024).

**Susan Greaney** is a Lecturer in Archaeology at the University of Exeter, UK. Her research focuses on Neolithic and early Bronze Age Britain and Ireland, particularly focusing on monumentality, society and relations of power, and using radiocarbon chronologies to construct detailed narratives of this period.

**Rachel Pope** is a Reader in European Prehistory at the University of Liverpool, UK. Her research focuses on the nature of Late Bronze Age-Early Iron Age societies in Europe. An active fieldworker, she specializes in settlement archaeology, gender archaeology and the development of archaeological method.

https://doi.org/10.1017/S0959774325000058