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In search of the lost ‘cromlech’ of Knowth: Geophysical investigations in Area 10 of the Knowth Passage Tomb cemetery, Brú na Bóinne World Heritage Site, Co. Meath.

JOE FENWICK

Introduction

The passage tomb cemetery of Knowth (Fig. 1) is part of the UNESCO Brú na Bóinne World Heritage Site, Co. Meath. It forms an integral and important component of what was once a great prehistoric numinous precinct embraced by a winding loop of the River Boyne between the townlands of Oldbridge, to the east, and Crewbane, to the west.1 The archaeological remains at Knowth were first investigated by R.A.S Macalister in 1941, during which several kerbstones were unearthed, but a more ambitious
programme of excavation commenced some twenty-one years later, in 1962, under the direction of George Eogan. This was to continue over the course of some fifty years and the unfolding results were comprehensively published as work progressed. More recently, a series of broader-ranging, collaborative initiatives have continued the momentum of this research to the present day.³

Attention has now turned to those largely unexplored areas beyond the confines of the excavated fenced area in order to examine in greater detail the nature, extent and limits of archaeological activities peripheral to Knowth’s core zone.³ Knowth Area 11, to its southeast, for instance, was subject to an extensive suite of geophysical surveys in 2011. This work was initiated by the Brugh na Bóinne Research Project⁴ in collaboration with George Eogan and was successful in identifying a number of significant low-relief and previously unknown sub-surface archaeological features and

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**Figure 1:** An aerial view of Knowth looking south-westwards, with the passage tomb cemetery contained within the fenced trapezoidal compound (centre right), the triangular field comprising Knowth Area 11 to its southeast (centre left) and Knowth Area 10 occupying a rhombic plot of land to the northeast (the tree-lined area containing farm house and outbuildings in the centre foreground).
monuments\(^5\) (Fig. 1). These included a large rectangular platform enclosure, measuring 65m in extent north/south and possibly related to activities associated with the medieval Cistercian grange at Knowth (SMR no: ME019-104), a substantial unclassified double-ditched elliptical enclosure of indeterminate date measuring \(c.63\)m north/south by \(c.70\)m east/west (SMR no: ME019-105), and the site of a possible kiln or series of kilns (SMR No: ME019-106).\(^6\)

More recently the Brugh na Bóinne Research Project, in association with George Eogan and the Office of Public Works (OPW), has completed a programme of archaeological and geophysical field survey at Knowth Area 10 and the results of these investigations form the subject-matter of this paper.

Knowth Area 10 is situated on the north-eastern periphery of the Knowth passage tomb cemetery. It is broadly rhombic in outline, defined along its south-western and south-south-eastern sides by the public road and along

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**Figure 2:** Knowth Area 10, outlined in a thick black line, is situated to the east of the passage tomb cemetery. Knowth House and related farm outbuildings are in-filled in grey. Topographical contours are displayed at 0.2m intervals (topographical survey map courtesy of Murphy Surveys Ltd, Kilcullen, Co. Kildare, and reproduced by kind permission of the OPW/National Monuments Service).
its north-north-western and north-eastern sides by field boundaries (Figs 1 & 2). It comprises Knowth House, its various farm-outbuildings and courtyards, in addition to extensive lawns to the east, northeast and south of these buildings.

An overview of the general topography and features of Knowth Area 10
The state-owned lands at Knowth were subject to detailed topographical survey in 2008. This provided an outline plan of the principal surface features, both ancient and modern (including passage tombs, buildings, roads, paths, boundaries, trees, etc.), against a backdrop of contours at 0.2m intervals. Knowth House clearly occupies the summit of a low eminence situated in the south-western quadrant of Area 10 (Fig. 2). From here the ground slopes downhill at a gentle gradient towards the east, south and southwest. There is a more pronounced terraced drop at a retaining wall marking the junction between the garden and upper courtyard to the northwest. The ‘upper lawn’ (Figs 2 & 3) extends eastwards from the front of the house.

Figure 3: A view looking westwards across the upper lawn towards Knowth House with the great mound (Knowth Site 1) in the background.
of the house to the tree-studded field boundary marking the north-eastern limits of Area 10. The ground at this boundary descends abruptly, by up to 1.5m in places, to the field below along an occasionally dry-stone-revetted escarpment (Fig. 4).

The ground also descends northwards from a razed field boundary, which originally ran southwest/northeast across the centre of Area 10 and whose former presence is marked by an alignment of several mature trees (Fig. 5). These trees effectively mark the junction between the upper and lower lawns, which occupy the south-eastern and northern parts of Area 10 respectively (Fig. 2). Additional mature trees occupy the south-south-eastern roadside perimeter of Area 10 and also the ground to the immediate south of Knowth House (Figs 3 & 6). It is worth noting too, that a lone apple tree stands in the south-eastern quadrant of the upper lawn and a damson tree lies in a more sheltered part of the garden to the southwest of Knowth House. A low-relief earthen bank can also be observed running parallel and approximately 12 metres to the north of the public road marking the south-south-eastern limits of Area 10.
A number of the farm-outbuildings situated to the northwest of Knowth House have been repaired and refurbished by the OPW in recent years and now incorporate new toilet facilities, a canteen and an exhibition hall. In addition, a waste water treatment facility and percolation area has been installed across the northern part of Area 10 (the lower lawn). The upper and lower courtyard areas, to the northwest of Knowth House, have also been extensively renovated; introducing new cobbled, gravelled and grass-covered surfaces incorporating drainage channels (Fig. 7). Some archaeological excavation and monitoring was conducted in Area 10 in advance of these site works. The areas investigated proved to be largely devoid of archaeological features having been considerably disturbed and truncated during the construction of post-medieval and more recent farm buildings and their adjoining courtyards. The lower lawn area, however, revealed some underlying field boundary ditches and cultivation furrows, again likely to be of post-medieval date. Two additional parallel curving ditches, of indeterminate date, were also identified in the northern part of Area 10.

Figure 5: A view looking southwards across the lower lawn towards Knowth House.
Figure 6: A view looking northwards across the public road towards the southern, rounded corner of Knowth Area 10 and the modern gravelled driveway leading to the front of Knowth House.

Figure 7: A view looking north-westwards of the renovated upper and lower courtyard area and surrounding farm outbuildings.
Knowth House, with the exception of its roof, had not yet been restored at the time of writing and remains in a poor state of repair (Figs 1–3, 5–6). The upper lawn area, to the south and east of the house, was not subject to recent site works, although some additional soils were introduced and grass reseeded over certain parts of the garden in 2015, in order to level the lawn surface to facilitate lawn-mower access. New railings and entrance gates have also replaced earlier ones along the south-south-eastern side of Area 10 and along the curving roadside wall to the south of Knowth House (Fig. 6).

In addition to the interventions of more recent times, this part of Knowth has also undergone a number of transformations over the course of the last few centuries, as witnessed in the details of various historical maps and estate plans. The presence of upwards of eighteen individual post-medieval houses (or buildings), some of which were depicted on Bernard Scalé’s ‘Caldwell Estate Map’ of c. 1766, with others identified during the course of Eogan’s archaeological excavation, have been recorded in the general vicinity of the great mound. The majority of these are roughly aligned to the public roadway lying to the northeast of the mound but none appear to coincide with the location of Knowth House. No details of the garden or lawn areas, to the east and south of Knowth house, were recorded on the Caldwell map. By contrast, the Ordnance Survey of Ireland’s first edition 6-inch County Series map-sheet no. 19 for Co. Meath (published in 1837) documents a number of interesting features in Area 10, some of which are no longer extant (Fig. 8). While the roadside structures that appear in the Caldwell Estate Map are again depicted in the first edition map-sheet, a number of additional building are also recorded, including a rectangle representing a building at the point where Knowth House presently stands.

Of particular interest in regard to the geophysical survey detailed below, however, is the depiction of an approach driveway, marked with a dashed line, which forks at an angle from the public road at the north-eastern corner of Area 10. It appears to run north-east/south-west, parallel and north of the public road towards a group of buildings nestled in the southern elbow of Area 10, to the south of Knowth House. It is evident that the low-relief bank that runs parallel to the public roadway is a survival
of this earlier, original driveway. Additional dashed lines depicted on the first edition 6-inch map-sheet would appear to indicate that the garden and lawn areas were once sub-divided into three rectangular plots separated by a series of paths set orthogonally to the approach driveway and the field boundary defining the north-eastern side of Area 10. The first edition map-sheet might further suggest that there was an open, perhaps metalled, yard to the south of the Knowth House, whose surface extended around the eastern (the front) and northern sides of the house too. This map also appears to indicate a rectangular lawn situated to the east of the house. In addition, a series of regularly dispersed tree symbols, perhaps representing an orchard, are indicated across two larger rectangular plots flanking the eastern margin of Area 10.

The Ordnance Survey Name Books (1836) mention the presence of a ‘cromlech’, a possible passage tomb, consisting of two large, upright and ivy-clad boulders forming an ‘L-shaped’ configuration in plan, which at that time stood to the front (east) of Knowth House.\(^{11}\) No visible traces of these stones remain and it is likely that these were removed or buried during refurbishment works to the house and grounds which took place around the year 1870.\(^{12}\) The detailed archaeological and geophysical survey described below was undertaken to determine if subsurface traces of this
former monument could be detected, or if other sub-surface features of potential archaeological significance might be identified in Knowth Area 10.

**Survey control and geophysical grid.**

Irish National Grid survey control was established at Knowth Area 10 using a Trimble R8 differential GPS and served as the basis for setting-out the geophysical survey grid of 20m x 20m squares with the aid of a total station. The geophysical survey grid was superimposed over the open ground comprising the garden and lawn areas of Area 10, situated to the east and south of Knowth House.

**Geophysical techniques, methodology and survey parameters.**

In order to facilitate a broader archaeological interpretation, three geophysical survey techniques, magnetic susceptibility, fluxgate gradiometry and electrical resistance, were deployed over the accessible parts of Knowth Area 10 in the summer of 2016. It was decided from the outset to implement a more intense survey of this area than that which had been applied previously to Knowth Area 11 as some of the potential sub-surface archaeological features, such as individual stone slabs or boulders, were likely to present relatively small targets. Furthermore, it was envisaged that a more intensive geophysical survey might also help to enhance the definition and configuration of surviving sub-surface archaeological features, particularly in the knowledge that this piece of ground had been subject to significant disturbance in more recent centuries, right up to the present day. The three survey techniques, which detect and measure different physical properties of the underlying soil, were applied at differing survey resolutions in order to optimise the level of detail obtained within the constraints of time and resources available.

**The magnetic susceptibility survey**

Volume specific magnetic susceptibility readings of surface soils were taken with a Bartington MS2 instrument employing an MS2D field-loop in zig-zag mode at 1m intervals along parallel north/south transects set 1m apart.
A total of 3,927 individual readings of magnetic susceptibility were recorded over two full and ten partial 20m x 20m survey panels, which covered an irregular area of ground measuring 80m north/south by 80m east/west in maximum extent. The principal magnetic susceptibility anomalies have been numbered with the prefix ‘S’ in Fig. 9 to aid cross-referencing with the text.

Prior to commencing the magnetic surveys some quantities of modern ferrous litter, including rusting nails and wire, which were visible on the gravelled surfaces around Knowth House, were removed from the site. No doubt, additional iron items remained unobserved or hidden in the surface soils, which are readily apparent in the noisy results of both the magnetic susceptibility and magnetometer surveys (discussed below). It was necessary therefore, to clip the magnetic susceptibility dataset so as to exclude values above 100 SI units x 10E-5, which are likely to represent this predominantly modern scatter of ferrous material, in an attempt to reveal the more subtle range of data values across the surveyed area. The apparent ‘holes’ in the magnetic susceptibility image represent those excluded, localised anomalies, which lie above this threshold. No additional filters have been applied to the image presented in Fig. 9.

The clipped dataset displays a zone of significantly enhanced susceptibility values (S1), interspersed with some very high localised anomalies (S2), concentrating largely in the south-western corner of Area 10, to the west of the gravelled-driveway at the point where the public road rounds sharply. These enhanced values might reflect underlying ferrous material and/or quantities of fired material such as clay brick. A number of other more discrete high susceptibility anomalies (S3) occur along the incline aligned west-southwest/east-northeast, marking the junction between the upper and lower lawns. These appear against a diffuse, mottled background of generally enhanced susceptibility values (S4) which extend...
northwards over the disturbed ground occupied by the percolation area (S5).

It is perhaps no coincidence that the most elevated readings (S1) occur in the vicinity of Knowth House and the roadside structures which formerly lay to its southwest; a reflection of this area’s exposure to an extended period of human habitation and all its associated activities. A proportion of this elevated response, however, might be attributed to the thin veneer of recently introduced soils which were applied to smooth over surface irregularities of the original garden. Similarly, the mottled zone of enhanced values (S5) over the percolation area is also likely to be a result of general disturbance to this area and the introduction of additional soil as backfill.

The zones of elevated magnetic susceptibility values identified above, however, are in stark contrast to relatively subdued values (S6) evident across the upper lawn to the east of the house. It is largely within this area that the magnetometer and electrical resistance surveys have identified features of archaeological potential.

The magnetometer survey

The magnetometer survey was conducted using a Bartington Grad 601 single sensor fluxgate gradiometer. In this instance readings were taken at 0.25m intervals in parallel mode, south to north, along traverse lines set apart. A total of 26,744 individual readings of magnetic gradient were recorded over two full and eight partial 20m x 20m panels. This survey covered an irregular, roughly trapezoidal area measuring 80m north/south by 60m east/west in maximum extent. The principal features identified in the magnetometer survey have been numbered with the prefix ‘G’ in Fig. 10.

Again, the presence of a significant scattering of underlying ferrous litter, particularly to the southeast of Knowth House (G1), presented a strong magnetic response which all-but overwhelmed the lesser magnetic variations across the site. It was necessary therefore to de-spike and clip the

Figure 10: The Fluxgate Gradiometry survey of Knowth Area 10. The principal anomalies have been numbered with the prefix ‘G’ to aid cross-referencing with the text (topographical base-map layers courtesy of Murphy Surveys Ltd, Kilcullen, Co. Kildare, and reproduced by kind permission of the OPW/National Monuments Service).
raw dataset so as to isolate the statistical bulk (and relatively narrow range) of magnetic gradient values to between +8nT and -8nT so as to reveal some of the more subtle anomalies of potential archaeological significance. The apparent ‘holes’ in the resulting magnetic gradiometer image represent those values above and below these thresholds, the majority of which, like the magnetic susceptibility image, represent point-source, ferrous-related, dipolar anomalies or quantities of concentrated fired material (G1). With the exception of applying a ‘zero mean traverse’ across the dataset, no additional processing steps or filters have been applied to it and so the resulting image presented in figure 10 is largely representative of the clipped raw dataset.

In addition to the considerable magnetic response to the south-southeast (G2) and to the immediate east of Knowth House (G3), the percolation area (G4) and the inclined ground marking the junction between the upper and lower lawns (G5) also display particularly noisy magnetic responses. This, no doubt, reflects the underlying ground disturbance and magnetically enhanced residues of this area.

In contrast, and in accordance with the results of the magnetic susceptibility survey detailed above, the upper lawn to the east of Knowth House presents a more subdued magnetic response (G6). Within this area, a number of features of potential archaeological significance can be observed. A rather indistinct series of irregular broad bands of alternating higher and lower positive magnetic gradient (G7) aligned southwest/northeast across the upper lawn might be indicative of an underlying episode of cultivation preserved beneath the lawn surface. Almost parallel to these broad alternating bands is a faint, narrow lineament of positive magnetic gradient (G8) that appears to traverse the width of the upper lawn southwest/northeast. Curiously, this feature is not evident in the electrical resistance survey (discussed below) and so is unlikely to correspond to a buried wall-footing, French-drain, or equivalent sub-surface, stone-built feature. It is more likely therefore, to represent a narrow backfilled cutting, such as a pipe trench or unlined drainage channel. In addition to a few dispersed dipolar anomalies (generally stray pieces of surface iron), there are also a number
of other localised, roughly circular zones of positive magnetic gradient, ranging between two and four metres in diameter (G9). These possibly represent sediment-filled pits or other backfilled artificial features, although a natural explanation for such hollows cannot be entirely dismissed, such as a sediment-filled root-ball of a wind-felled tree, for instance. The low relief bank running parallel with the public road in the south-eastern quadrant of Area 10, a survival of the original driveway leading to Knowth House, also exhibits a linear positive magnetic gradient (G10).

**The electrical resistance survey**

The electrical resistance survey employed a Geoscan RM85 instrument configured as a twin-probe array with an electrode a-spacing of 0.5m.\(^{18}\) Readings were taken at 0.5m intervals in zig-zag mode along a series of parallel, north/south transects set 0.5m apart. The survey was conducted over 2 complete and 10 partial 20m x 20m survey panels and was confined to an irregular area to the east and south of Knowth House, which measured 80m north/south by 80m east/west in maximum extent. The completed survey consists of 15,382 individual readings of electrical resistance. A bias was applied to some survey panels in order to equalise the resistance readings between individual panels and so produce a relatively seamless, composite image. The dataset presented in Fig. 11, however, has not been subject to filtering or other image enhancement procedures. Notable features identified in the electrical resistance image have been numbered with the prefix ‘R’ to assist cross-referencing with the text.

A number of interesting features of potential archaeological significance can be observed in the electrical resistance image but before discussing these, it will firstly be necessary to identify several spurious anomalies which represent modern features or recent episodes of surface disturbance so as to dismiss these from the overall discussion and interpretation. A sizable circular feature of low electrical resistance (R1) that occupies the northern sector of the upper lawn, for instance, marks the location of a pit that has recently been backfilled with introduced soil. Similarly, the faint curving parallel lines of low electrical resistance (R2) that extend
southwest/northeast across the centre of the upper lawn can be attributed
to dumper-truck wheel ruts, the result of recent site works, but which were
subsequently smoothed-out and reseeded with grass. There is the possibility
too, that the distinct linear feature of high electrical resistance (R3), aligned
east-northeast/west-southwest situated to the south of Knowth House (if
not a wall-footing, stone-lined drain, pipe trench or service channel) might
mark the line of a recently laid electrical cable.¹⁹

One particularly curious feature is the presence of a narrow penannular
lineament of low electrical resistance (R4) that occurs in the north-eastern
corner of the upper lawn. At first glance it might appear to represent a narrow
backfilled gully or channel, but upon further site investigation it was found
to coincide with a conspicuous mushroom-ring (Fig. 12). It would appear,
therefore, that the root-like fungal mycelium is acting in some way as a
conduit for the electrical current, perhaps on account of the greater moisture
retained by its fibrous hyphae in contrast to that of its surroundings. Despite the intriguing electrical resistance response, this feature seems to be entirely natural in origin and is of no archaeological consequence.

A small earthen mound situated beneath a mature chestnut tree at the northern edge of the incline marking the junction between the upper and lower lawns is a recent addition to the garden and was therefore omitted from the survey. This earthen mound was intentionally heaped over a number of lichen-covered boulders as part of a trial investigation to see if this might prove to be an effective way of removing this damaging fungal/algal bloom from the surfaces of kerbstones and other exposed structural stones of the Knowth archaeological complex.20 The curious zone of high-resistance (R5), extending north/south and adjoining to the south and east of this earthen mound, however, is clearly independent of this feature and its underlying boulders. It seems that this might reflect a localised underlying zone of buried rubble or stony material, the nature of which remains unknown. It is interesting to note too that there are some irregular patches of high electrical resistance (R6) coinciding with the mature trees along the former field-boundary between the upper and lower lawns. This might be due in part to a moisture deficit in the soils local to the tree root systems but might also indicate a loose spread of underlying stony material associated with the remnants of the levelled field boundary.

Of more convincing archaeological significance, however, are the series of faint narrow lineaments of high electrical resistance (R7) against a backdrop of generally high values (R8) situated to the south of Knowth House. This might be an indication of a surviving wall-footing or building foundation and a metalled surface respectively, possibly features associated with the roadside buildings depicted on the first edition Ordnance Survey 6-inch map-sheet (Fig. 8). Similarly, the earthen banks framing the original entrance driveway to Knowth House, depicted on the same first edition map-sheet and surviving as a low-relief topographical feature, also display a distinctive electrical resistance response (R9).

A number of other electrically resistive features of potential archaeological significance occur in the upper lawn. There are traces of an arcuate feature
of high electrical resistance (R10) extending into the lawn to the immediate northeast of Knowth House. In addition, a closely-set pair of small yet well-defined anomalies of high resistance (R11) can be observed some 15m to the east (to the front) of Knowth House, with a third smaller anomaly (R12) a little further to the southeast. These are likely to represent discrete, compact, or stony material lying just beneath the ground surface, very possibly buried boulders. The seeming coincidence of the location of the two well-defined high-resistance anomalies (R11) with the location of the ivy-clad ‘cromlech’ as described in the nineteenth century ‘Name Books’

Figure 13: An undecorated Lower Palaeozoic greywacke slab which was unearthed in the upper courtyard close to the hand water-pump, northwest of Knowth House, during recent renovation works.
mentioned above, is compelling. Perhaps then, the large slabs comprising this megalith were not removed from site but simply toppled and buried in a pit beneath the lawn. Indeed, not far away, a sizable slab of Lower Palaeozoic greywacke was found in the vicinity of the hand water-pump during the resurfacing of upper courtyard to the northwest of Knowth House (Figs 7 & 13). The presence of greywacke, in this instance, is particularly significant as this type of stone is not native to Brú na Bóinne but was imported into the area in quantity as large slabs during the Neolithic period for the purposes of passage tomb construction. It is also interesting to note that two rounded boulders of different rock type, which may once have served as passage tomb kerbstones, have also been recorded by the gateway to the shuttle-bus set-down area, just a few metres to the northeast of the public road (Fig. 14). A number of other similarly sized boulders lie along the line of the stepped field boundary marking the north-eastern limits of Area 10 (Fig. 15).

Also of note is the distinctive zone of high resistance (R13) surrounded by a penumbra of lesser high resistance values (R14) that occupy the north-eastern half of the upper lawn. This again is suggestive of a spread of hard, well-drained stony material. Both the central zone and its penumbra are curiously circular in outline, averaging approximately 7m and 30m in diameter respectively, although the north-eastern quadrant of the larger (R14) is transected by the field boundary. As previously mentioned, the line of this field boundary marks a significant step in the topography and it is interesting to note too that a quantity of stone is exposed or built-up to form a rudimentary revetment to the escarpment at this point, with one or two larger stones protruding towards the south-eastern end of the boundary (Fig. 15). A natural explanation for this high resistance zone cannot be entirely dismissed but, given its archaeological context, an alternative explanation must also be considered. It has been demonstrated elsewhere that the structural materials that constitute passage tombs generally exhibit a higher resistance response to that of surrounding background soils. It is a possibility, therefore, that this vaguely circular zone of high resistance values might very well represent the sub-surface remains of another ‘satellite’ passage tomb.
Figure 14: Two large boulders, that might originally have served as kerbstones to a smaller passage tomb (or tombs), which today lie at the boundary marking north-western corner of Knowth Area 10, at the entrance to the shuttle-bus set-down area.

Figure 15: A large bolder, that may originally have served as a kerbstone to a smaller passage tomb, which today lies along the field boundary close to the northern corner of Knowth Area 10.

Figure 16: A large boulder that might originally have formed part of a megalithic tomb, which today can be found along the field boundary towards the eastern corner of Knowth Area 10.
Discussion and conclusion

In addition to the building of the farmhouse, its related farm buildings and cobbled courtyards, it is clear from both the geophysical and excavated evidence that there has been considerable disturbance to significant parts of Knowth Area 10 throughout the course of the post-medieval period and through to modern times. The significant magnetic response from soils to the south (S1-2, G2) and east (G3) of Knowth House is very much a reflection of the activities associated with a working farm over the course of recent centuries and perhaps long before this too. In addition to Knowth House and its related farm buildings and courtyards, historical maps depict a number of other roadside buildings and structures that are no longer extant. This appears to be confirmed in the electrical resistance survey where the possible sub-surface remains of wall foundations (R7) and associated metalled surfaces (R8) have been identified to the south of the house. The first edition Ordnance Survey 6-inch map-sheet also depicts an earlier driveway approaching Knowth House from the east, which ran parallel to the public road. This can still be traced as a low-relief topographical feature along the south-eastern margins of upper lawn and also registers in both the magnetometer (G10) and electrical resistance (R9) surveys. It is evident in the first edition map-sheet too, that the upper lawn, extending eastwards from the front of the house, was formerly subdivided by a series of paths into a number of rectangular plots containing a possible orchard. No evidence for these features has been identified in the geophysical survey, though a suggestion of relict cultivation (G7) and a number of pit-like features (G9) were noted in the magnetometer survey.

The ‘cromlech’ consisting of two large boulders that once stood to the front of Knowth House, although recorded in the Ordnance Survey ‘Name Books’ of 1836, is not depicted on the Ordnance Survey first edition map sheet of 1837. Its precise location, therefore, remains unknown but the presence of the two sub-surface boulder-sized features of high electrical resistance (R11) situated little more than 15m to the east of the house might seem more than coincidental. Similarly the curious circularity of the zone of high resistance values (R13), surrounded in turn by a penumbra of lesser
high resistance values (R14), that occupy the north-eastern sector of the upper lawn is a puzzling feature. This is likely to represent an underlying volume of hard stony material and given the proximity to the great passage tomb of Knowth and the concentration of smaller surrounding tombs, one cannot dismiss the possibility that this too might represent the footprint of yet another outlying passage tomb.

Some other more localised, amorphous spreads of high resistance material (e.g. R5 and R5) have also been identified in the vicinity of the former field boundary aligned southwest/northeast across the centre of Area 10 and present something of an interpretational challenge. These and the other potential archaeological features identified in the various geophysical surveys will require an additional, more invasive programme of targeted field investigation in order to test the nature of these underlying anomalies and the veracity of the interpretation presented above. There is little doubt, however, that Knowth has the potential to reveal yet more remarkable archaeological surprises.

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References


2. See, for example, the series of volumes concerning Knowth published by the Royal Irish Academy, the most recent of which is G. Eogan & K. Cleary, (archaeological editor), *The Passage Tomb archaeology of the great mound at Knowth: Excavations at Knowth 6* (Dublin, 2017).

3. The original extent of the state-owned lands at Knowth was confined to the fenced area around the great mound but this has expanded in more recent times to include Knowth Areas 10 (Knowth House and grounds) and Area 11, to the northeast and southeast of the fenced area respectively.

4. This research project, established in 2004, is an initiative by the Department of Archaeology, School of Geography and Archaeology, NUI Galway, and is exploring selected aspects of the broader *Brú na Bóinne* landscape through the exclusive use of non-invasive survey techniques. For an overview of the investigations and published papers to date see: https://www.nuigalway.ie/colleges-and-schools/arts-social-sciences-and-celtic-studies/geography-archaeology/disciplines/archaeology/research/ireland-atlantic-europe/thebrughnaboinneresearchproject/ [accessed 9 July 2018].


8. This topographical survey was conducted by Murphy Surveys Ltd. on behalf the Office of Public Works and the National Monuments Service, Department of Culture, Heritage and the Gaeltacht. Selected layers from this survey covering Knowth Area 10 has been reproduced for illustrative purposes in figure 1 and have also been used as the base-map for the various geophysical surveys.

9. Archaeological monitoring during the course of these site works and building renovations were conducted by Melanie McQuade, Archaeological Development
Services Ltd. in 2012 (Licence numbers: C248, E4327) and by Donald Murphy and Jon Stirland, Archaeological Consultancy Services Unit, between 2012 and 2014 (Licence Numbers: C248, E4412, R294; C248, E4412). For further details see: http://www.excavations.ie/report/2012/Meath/0023445/, also 0023039 and 0024353 [accessed: 6 February 2017].


15. The geophysical surveys were completed over the course of nine full working days; 16th and 17th May, 2nd and 3rd June, 16th to 18th June, 15th July, and 15th and 16th September 2016.

16. For technical details relating to magnetic susceptibility see, for example, J. A. Dearing, Environmental magnetic susceptibility: using the Bartington MS2 system (Kenilworth, 1999); P. J. Gibson & D. M. George, Environmental applications of geophysical surveying techniques (New York, 2003).

17. For technical details relating to magnetometry see, for example, A. Aspinall, C. F. Gaffney and A. Schmidt, Magnetometry for archaeologists (Lanham; 2008); C. Gaffney & J. Gater, Revealing the buried past; geophysics for archaeologists (Gloucestershire, 2003), pp 66–7; J. Oswin, A field guide to geophysics in archaeology (Chichester, 2009), pp 180–6.

18. For technical details relating to electrical resistance see, for example, A. Clark, Seeing beneath the soil: prospecting methods in archaeology (London, 1990), pp 27–63; Gaffney & Gater, Revealing the buried past, pp 66–67; Oswin, A field guide to geophysics for archaeologists, pp 180–6; A. Schmidt, Earth resistance for archaeologists (Lanham, 2013).

19. Mr Peter Boyle pers. comm., Office of Public Works (OPW), Knowth.


22. G. Eogan, Excavations at Knowth 1: Smaller passage tombs, Neolithic occupation and Beaker activity (Dublin, 1984), p. 2, Fig. 3, p. 24, p. 35; G. Stout, ‘6.4.1.2.1 History and background’ in Eogan, The archaeology of Knowth in the first and second millennia AD, pp 211–215.