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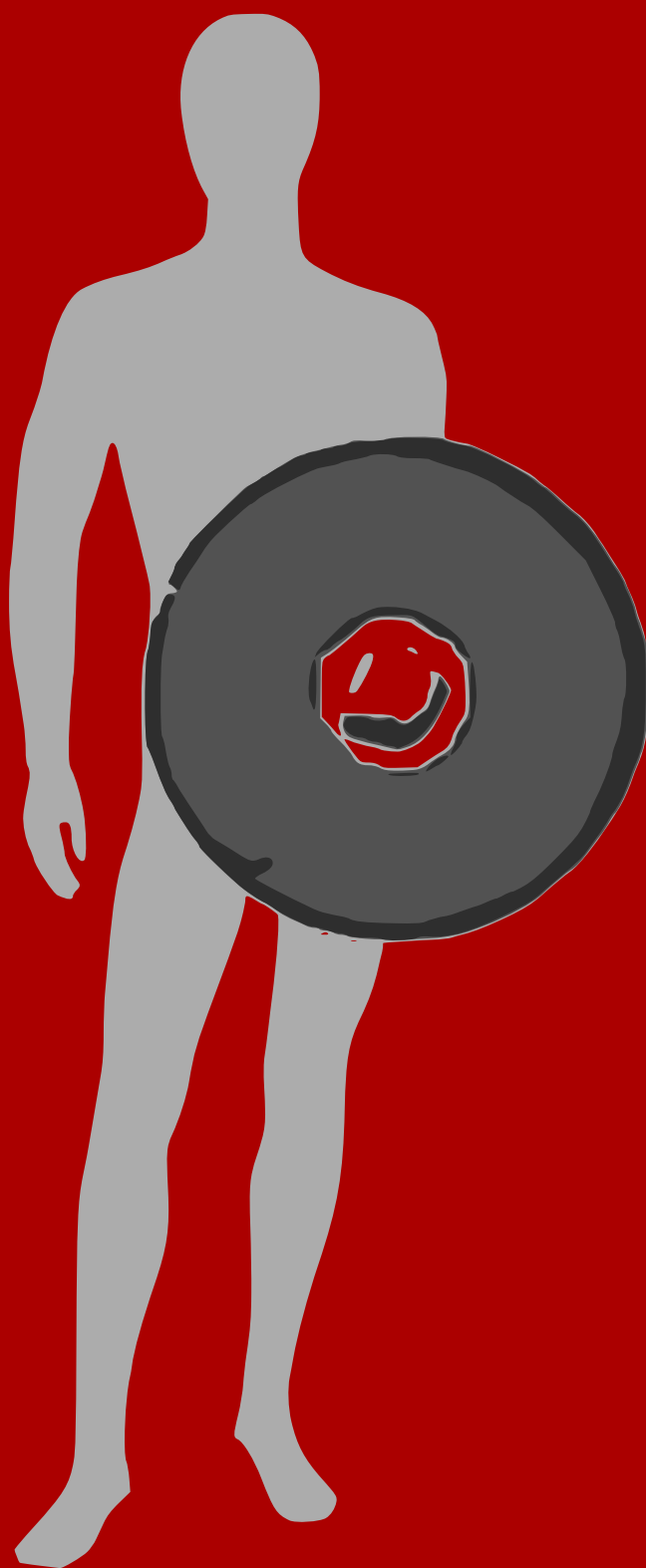
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Geophysical Survey at Rathcroghan 2010–2012

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Abstract

Following an extensive programme of geophysical survey at Rathcroghan published in 2009, five hitherto unexplored areas were surveyed using magnetic gradiometry in 2010–12. In an area south of Oweynagat a faint circular anomaly 20m in diameter and an equally faint arc some 8m across are of possible archaeological significance. Survey between the linear earthworks known as the Mucklaghs did not reveal any definite archaeological features but examination of Cashelmanannan demonstrates this is a complex multiperiod site. East of Rathcroghan Mound and its surrounding 360m enclosure, the geophysical evidence suggests that the avenue approaching the great mound does not extend beyond the enclosure limits. An area on the northwest was also investigated but apart from a semi-circular anomaly proved to be featureless. The latter, a possible ring-ditch, does indicate the possibility of significant features adjacent to and outside the enclosure.

A summary account of the monuments at the royal site of Rathcroghan, Co. Roscommon, was published in the pages of *Emania* over twenty-five years ago (Waddell 1988) and much work has been accomplished there since then. This has been comprehensively dealt with in a monograph published a number of years ago in which the results of a major programme of topographical and geophysical survey were described in detail (Waddell *et al.* 2009). A new programme of geophysical investigation was commenced in 2010 as a part of the ‘Connacht Project’ in the National University of Ireland (NUI) Galway. This project is multidisciplinary in nature, building on a substantial body of archaeological research at Rathcroghan since the 1980s, as well as ongoing study of the early history and literature of the region. Under the direction of Máirín Ní Dhonnchadha (Professor of Old and Middle Irish, NUI Galway), its aim is the investigation of aspects of the early Irish literary evidence relating to the ancient province of Connacht. This rich body of material includes extensive tales such as *Acallam na Senórach*, ‘Tales of the Elders of Ireland’ (dealing with the exploits of the legendary Fionn mac Cumhaill and others) and the *Táin Bó Cúailnge*, the ‘Cattle Raid of Cooley’ (that great epic of the Ulster Cycle) as well as Patrician texts and Bardic poetry. Rathcroghan, of course, is a place where myth, history and archaeology converge. The geophysical component of the project was designed to broaden the investigation of the archaeological complex by targeting areas where the occurrence of upstanding monuments and the results of previous work suggested the potential presence of significant, sub-surface archaeological remains.

The great monument Rathcroghan Mound, a large broad flat-topped circular mound, is the focal point of a complex comprising over sixty monuments including enclosures, burial mounds, pillar stones and other earthworks (Fig. 1). Geophysical survey has previously revealed a very large circular enclosure 360m in diameter formed by a substantial ditch surrounding the central mound and monuments within this enclosure visible in the geophysical imagery include a pair of ring bar-

rows to the east, a northern enclosure with an eastern avenue, and another avenue forming a formal eastern approach to the large mound. Miosgan Meva (Medb’s heap) is a prostrate pillar stone lying north-northeast of Rathcroghan Mound. A squat natural boulder called Milleen Meva (Medb’s lump) is situated to the north-northwest and is just one indication that natural features were also reference points in the ritual topography of the complex. A series of huge earthen embankments called the Mucklaghs lie to the south-west. They are two very large linear earthworks each formed by a slightly curving set of parallel banks running down slope from north-east to south-west into the broad valley that forms the southern limit of the Rathcroghan complex. Other monuments in this general area include Oweynagat, the famed ‘Cave of Cruachain’ or ‘Cave of the Cats’, a souterrain attached to a natural cave, rich in mythological associations, and Cashelmanannan, a degraded multivallate enclosure.

Following initial small-scale surveys in 2010 near Oweynagat and at the Mucklaghs and Cashelmanannan, the work was extended in 2012 with the support of Heritage Council funding to include further investigations at Cashelmanannan and on the state-owned lands surrounding Rathcroghan Mound. In addition to advancing our understanding of the composition and character of the archaeological complex, one of the main objectives of the current project was to raise awareness of the value of the archaeological research being undertaken at Rathcroghan and the types of scientific techniques employed by archaeologists in the investigation of such landscapes. To this end, the project presented an opportunity to provide field training in geophysical survey to interested volunteers, including several postgraduate students in the School of Geography and Archaeology and the Moore Institute, NUI Galway. A public ‘open-day’ event was also organised on site during Heritage Week 2012, which involved a presentation and guided tour, as well as a practical demonstration in how the geophysical instruments work and an opportunity to try out the survey equipment firsthand.

The geophysical investigations comprised reconnaissance and high-resolution gradiometer surveys.¹ This technique is well suited to the limestone geology of the region and its value in mapping both known and previously unrecorded archae-

¹ The surveys were carried out under license from the National Monuments Service, Department of Arts, Heritage and the Gaeltacht, and the National Museum of Ireland (Consent No. 10R47ext.).

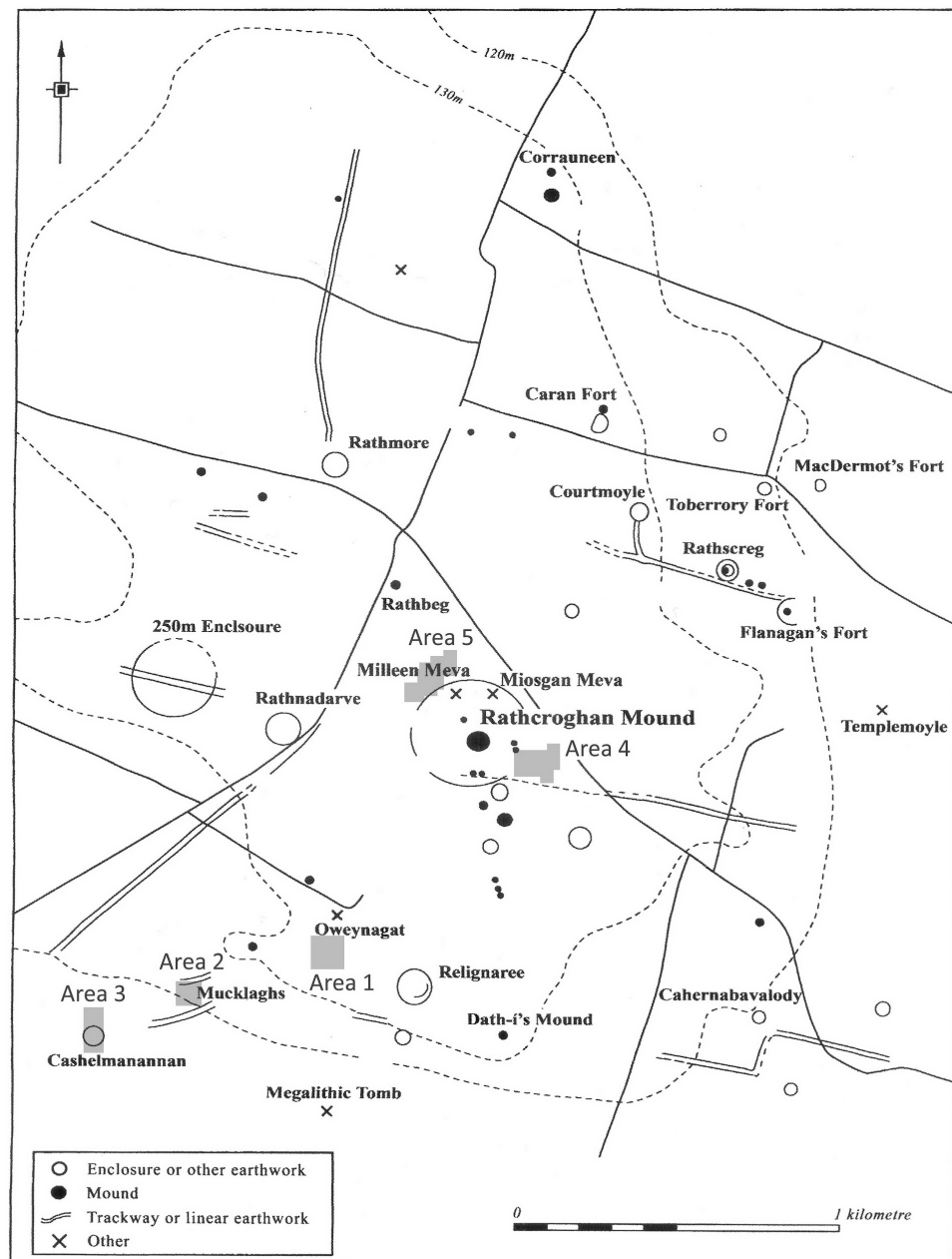


Fig. 1: Monuments in the Rathcroghan complex with survey areas 1–5 indicated.

ological features was highlighted by earlier surveys, which resulted in some remarkable discoveries, including the 360m-diameter ditched enclosure surrounding Rathcroghan Mound.

Guided by the results of this work, the recent investigations focused on five separate areas (Areas 1–5) within the complex, in the townlands of Glenballythomas and Toberrory (Fig. 1). These lie adjacent to areas previously investigated and encompass lands of approximately 4.9 hectares in total. The geophysical surveys grids were set out with a total station using a previously established network of control stations and are aligned to 20m multiples of the National Grid. The magnetic surveys were conducted using Bartington Grad 601–1 (single sensor) and Grad 601–2 (dual sensor) fluxgate gradiometers. Data were collected in unidirectional fashion, moving from south to north along parallel traverses. A 0.25m sample and 1m

traverse interval was employed in Areas 1 and 2, while a denser sampling strategy (0.25m by 0.5m) was adopted in Areas 3–5 where archaeological features were known to be present in order to optimise the clarity of the dataset and aid interpretation. The raw survey data have undergone minimal processing in preparation for final image production. Adjustments were made to correct instrument drift and occasional stripe errors, and adjacent grid squares have been edge-matched. The data range has also been clipped to reduce the effect of spurious, high-intensity magnetic anomalies (mainly caused by modern ferrous litter) and to highlight weaker anomalies of potential archaeological interest. Finally, the data presented in Figs 7, 9 and 11 has been interpolated (from 0.5 to 0.25m traverse spacing) to visually enhance or 'smooth' the results for display purposes.

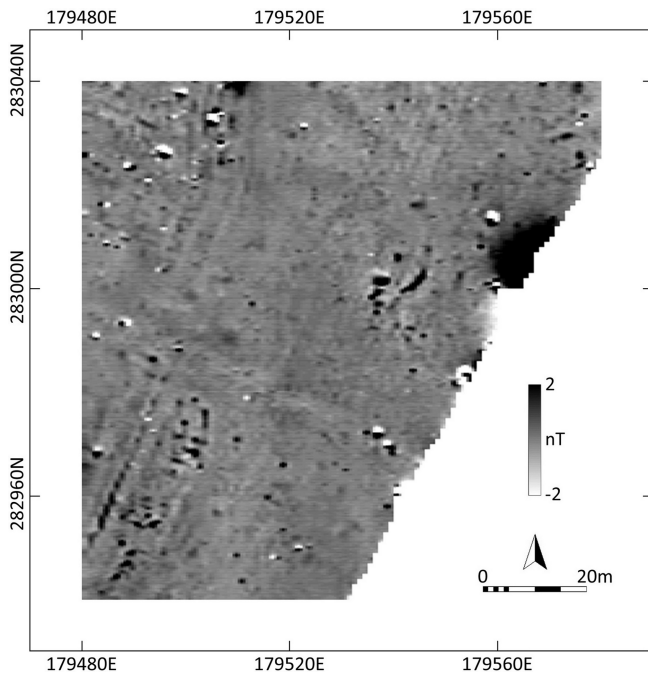


Fig. 2: Area 1 south of Oweynagat: greyscale image of gradiometer data.

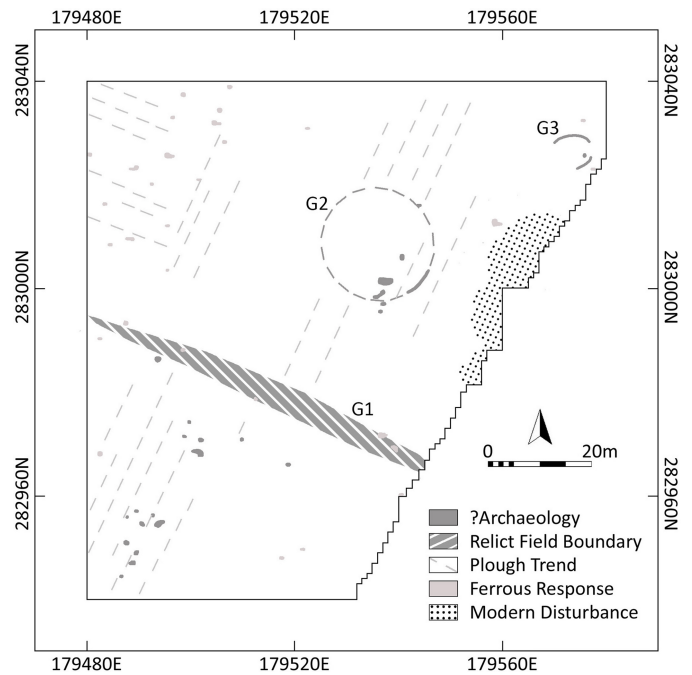


Fig. 3: Area 1: summary interpretation diagram.

Area 1

The area immediately surrounding the cave and souterrain complex at Oweynagat, also the location of a now-destroyed circular earthwork, was subjected to a programme of detailed topographical and geophysical survey in the past (Waddell *et al.* 2009, 79–89). Lands 70m to the south were now targeted for survey (Area 1) and represent the first archaeological investigation in the wider locality. The gradiometer survey was focused on a low rise near the centre of a large rectangular field of pasture, and covered a wedge-shaped area of approximately 0.8 ha, with maximum dimensions of 100m north–south by 100m east–west. While several features of potential archaeological interest were identified, the majority of anomalies mapped by the survey can be ascribed a relatively modern origin (Figs 2 and 3). Among the latter is a series of linear anomalies associated with past agricultural land use, the most prominent of which exhibits a broad, negative magnetic response (G1) and corresponds with a derelict field bank that traverses the centre of the field from northwest to south-east. This field boundary is first marked on the second-edition Ordnance Survey map, suggesting it was erected sometime between c. 1840 and 1900. Two relict cultivation patterns run parallel and at right angles to the field boundary (G1) respectively, and also align with the modern field layout, indicating a relatively modern date. Some of the small ‘pit-type’ anomalies evident in the data may likewise relate to agricultural activity, though a natural (pedological) or even archaeological origin for these anomalies is also possible. A scatter of small ferrous responses also occurs across the survey area, particularly in the northwest quadrant where the ground was extensively poached by cattle and littered with farm debris (silage bags, twine, etc.). Responses of this sort are typically caused by modern iron litter in the topsoil, and

are therefore deemed to be of little archaeological significance. Likewise, magnetic disturbance along the eastern edge of the survey area is associated with a concentration of modern ferrous debris in the area of the adjacent field boundary.

Of greater potential interest, however, are two faint arcuate anomalies located in the northern half of the survey area. The larger of the two appears as an ill-defined band of slightly enhanced magnetic values (G2), some 20m in diameter, the circuit of which is for the most part just discernible above the survey background levels. This feature, which is similar in size to the former circular earthwork to the north at Oweynagat, may represent the remains of a small enclosure with several discrete positive anomalies, possibly pits, in its interior. The second arcuate anomaly (G3), measuring c. 8m in diameter, is equally ill-defined but could denote the partial outline of a small circular structure or ring-ditch. Despite the faint magnetic expression of these latter features, which may well have been disturbed by later cultivation, they clearly hint at the presence of additional, sub-surface archaeological features in the area between Oweynagat and the Mucklaghs.

Area 2

Survey Area 2 (Fig. 1) is located between the impressive pair of linear earthworks known as the Mucklaghs situated on gently sloping ground roughly midway between Oweynagat and Cashelmanannan (Waddell *et al.* 2009, 89–103). The shorter but more substantial Northern Mucklagh consists of two large, closely spaced earthen banks, c. 100m in length standing up to 2.5m and 3m above the surrounding ground level respectively. The Southern Mucklagh, situated some 90m south of its neighbour, comprises a more complex arrangement of three

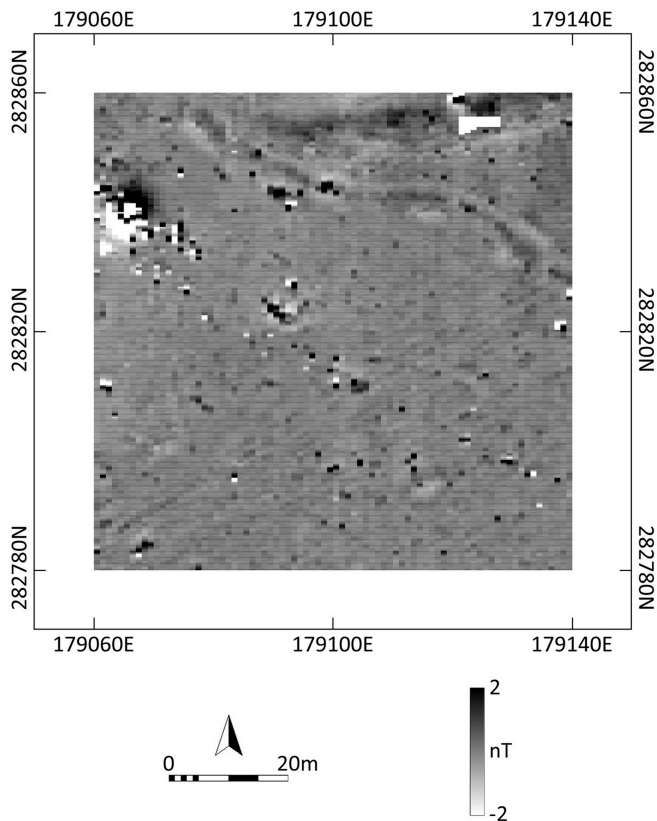


Fig. 4: Area 2 at the Mucklaghs: greyscale image of gradiometer data.

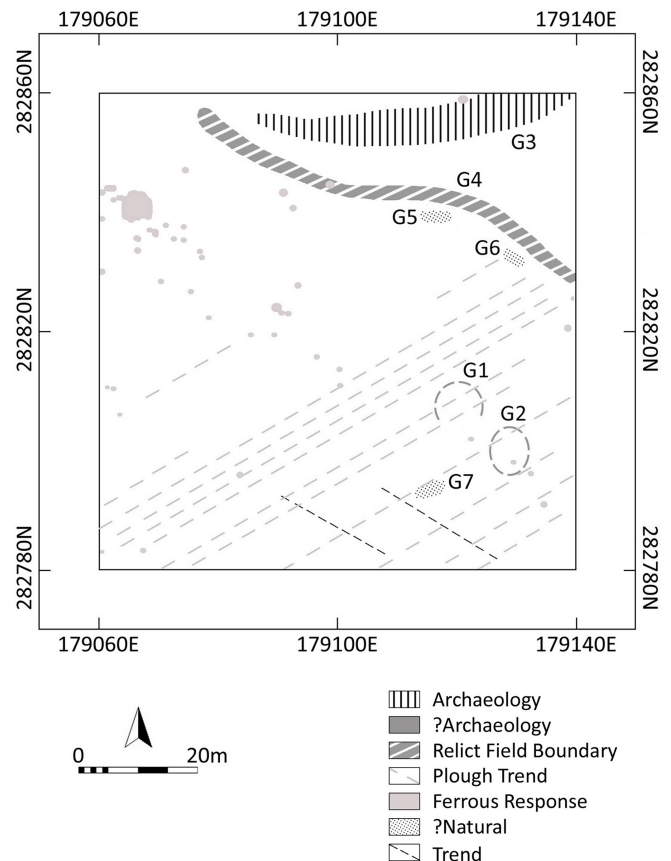


Fig. 5: Area 2: summary interpretation diagram.

earthen banks (c. 280m in total length) that extend in a general northeast–southwest direction and are interrupted at intervals by a series of gaps, some of which may be original features. Although among the more enigmatic monuments within the Rathcroghan complex, a ceremonial role for these earthworks—which invite comparison with potentially related sites at Tara (Tech Mídharta) and Teltown (the Knockans), Co. Meath – seems likely (*ibid.*, 101–103). The results of detailed topographical survey across the area in the 1990s suggest that many of the low-relief linear features that adjoin the earthworks, including a slightly sinuous bank and ditch that joins the northern and southern portions of the monument, are likely to be later field boundaries, but could nonetheless be of some antiquity. Somewhat more enigmatic are the numerous small linear and sub-rectangular depressions recorded in the vicinity of the Mucklaghs and elsewhere in the Rathcroghan complex, which are most likely geological in origin (Fenwick and Parkes 1997; Waddell *et al.* 2009, 86–89, 93). Previous small-scale geophysical investigations across two sections of the Mucklaghs have also yielded intriguing results. Of particular interest was the discovery through gradiometer survey of what may be the foundation trench of a rectangular timber building that partly underlies the middle bank of the Southern Mucklagh (*ibid.*, 95–101). A number of discrete positive anomalies identified in its interior and immediate surrounds may denote associated features such as post-pits, storage pits, etc. In view of its morphology and proximity to a ruined megalithic tomb (c. 500m to the south-east), this feature has been interpreted as representing the footprint of a possible rectangu-

lar Neolithic house measuring approximately 7m northwest–southeast by at least 10m southwest–northeast.

The present survey area was positioned 20m to the north of the earlier investigations over the Southern Mucklagh and comprised an 80 x 80m grid extending as far as the southern bank of the Northern Mucklagh. The lands here lie between the 125m and 113m contours and slope gently southwards. Despite investigating a substantial portion of the area between the linear earthworks, the gradiometer survey did not reveal any definitive new archaeological features in this area (Figs 4 and 5). Two arcuate positive magnetic trends (G1, G2) recorded in the south-east quadrant of the survey area are of potential archaeological interest; however, neither is sufficiently well defined to allow for confident identification or interpretation. The southern bank of the Northern Mucklagh registered in the survey as a broad, slightly arcuate band of enhanced magnetic gradient (G3), flanked on the south by a slender negative magnetic lineation which corresponds with the break of slope from which the bank descends quite steeply; dummy (null) values were recorded in one place along the length of the bank where erosion has created a near vertical incline, impeding survey. The derelict field boundary running between the Northern and Southern Mucklaghs is similarly well defined, appearing as a sinuous positive/negative magnetic band (G4) that skirts, and has possibly truncated, the earthwork on the west.

Several localised zones of negative magnetic gradient recorded just to the south of the field boundary (G5, G6) and in the southern part of the survey area (G7) correspond with sub-rectangular depressions mapped by topographical survey,



Fig. 6: Aerial view of Cashelmanannan from the west (Area 3).

and are deemed to be of natural (geological) origin. In addition to the field boundary, most of the remaining anomalies mapped by the survey can be linked to agricultural and other activities over recent centuries. Cultivation is indicated by a pattern of faint positive trends that extend in a north-east to southwest direction across the southern part of the survey area, the close spacing of which is suggestive of modern ploughing. The significance of two positive linear trends that run at right angles to the cultivation pattern is less clear, though these may likewise have an agricultural origin. A wide scatter of ferrous responses was also recorded, including a significant concentration of near-surface ferrous debris close to the northwestern limit of the survey area. Some of these anomalies appear to form a northwest-southeast alignment and may mark the line of an old field fence associated with a possible gatepost in the northern bank of the Southern Mucklagh (Waddell *et al.* 2009, 94).

Area 3

The multivallate enclosure known as Cashelmanannan, in the south-west sector of the Rathcroghan complex, was the focus of two separate phases of survey, in 2010 and 2012. One of several monuments with mythical associations at Rathcroghan, Cashelmanannan is an oval enclosure defined by three low, closely spaced banks of earth and stone and has maximum overall dimensions of approximately 57m north-south by 63m east-west (Waddell *et al.* 2009, 221, 238). The banks are quite denuded (maximum height 0.5m) and breached in places, and the location of the original entrance is unknown (Fig. 6).

Although unexcavated, the size and morphology of the enclosure might suggest it to have been a high-status site of the first millennium AD, with a superficial resemblance to the larger multivallate Rath of the Synods at Tara. Adjoining the oval enclosure on the north and east respectively are two rectangular enclosures or annexes, each defined by a single bank. Ancil-

lary enclosures of this type are often described as small fields or cattle enclosures in the archaeological literature and the general lack of domestic structures in the interiors of excavated examples, such as at Dowdstown 2, Co. Meath (Cagney and O'Hara 2009), seems to support an agricultural interpretation for at least some of these earthworks.

The initial survey at Cashelmanannan focused on the multivallate enclosure and was conducted over a rectangular grid with maximum dimensions of 80m north-south by 60m east-west. As can be seen from the resulting survey images (Figs 7 and 8), the banks of the enclosure (G1, G2 and G3) exhibit only a weakly enhanced magnetic response, which is most clearly discernible on the north and east. However, survey across the inner enclosure revealed a dense concentration of magnetic anomalies possibly indicative of settlement activity. These include the footprint of what may be a circular building (G4), as well as an array of pit-type features (e.g. G5) and areas of potential burning (e.g. G6), particularly along the circuit of the inner bank, which may relate to domestic and/or industrial activities. Several other features recorded by the survey overlap with the boundary of the enclosure and clearly point to multi-period activity at the site. The most intriguing is a slender, semi-circular band of enhanced magnetic gradient (G7), possibly representing the slot-trench of a circular enclosure some 28m in east-west diameter, which appears to partly underlie the denuded and magnetically 'transparent' middle and outer banks of Cashelmanannan on the south. A sinuous, weak magnetic linear feature (G8) just to its east corresponds with a derelict field bank that runs in a southeasterly direction from the multivallate enclosure.

In 2012 the investigations were extended to include the larger northern annex (maximum dimensions approximately 42m north-south by 36m east-west) in the hope of gaining some insights into its role and potential relationship with the oval enclosure. The survey here was conducted over a 60 x 60m grid, adjacent to that surveyed in 2010, bringing the total area investigated by fluxgate gradiometry at Cashelmanannan to approximately 0.8 ha. Although the survey revealed a range of features of potential archaeological interest (discussed below), the level of magnetic variation recorded across the interior of the annexe as a whole was significantly lower than that evidenced within the multivallate enclosure. Despite being well defined topographically, moreover, the boundary of the annexe (like the middle and outer banks of Cashelmanannan) is generally very faint, and in places virtually invisible, in the geophysical imagery (G9). This is particularly true of its northern and, to a lesser extent, its western sides where there is little discernible magnetic contrast between the bank and the surrounding soils. The eastern bank, by comparison, exhibits an increased magnetic response and contains a number of regularly-spaced, pit-type anomalies along its length. Two clusters of discrete, pit-type anomalies, varying from 1–2m in diameter, also occur just to the south-west and south-east of the eastern bank respectively (G10 and G11). While the significance of these latter features is uncertain, their strength (20–30 nT) suggests the presence of burnt or fired material which – together with their circular or figure-of-eight shape – raises a variety of possible archaeological interpretations; they could, for instance, represent hearths, cereal-drying kilns or small ovens (e.g. roasting pits), among other things. Some

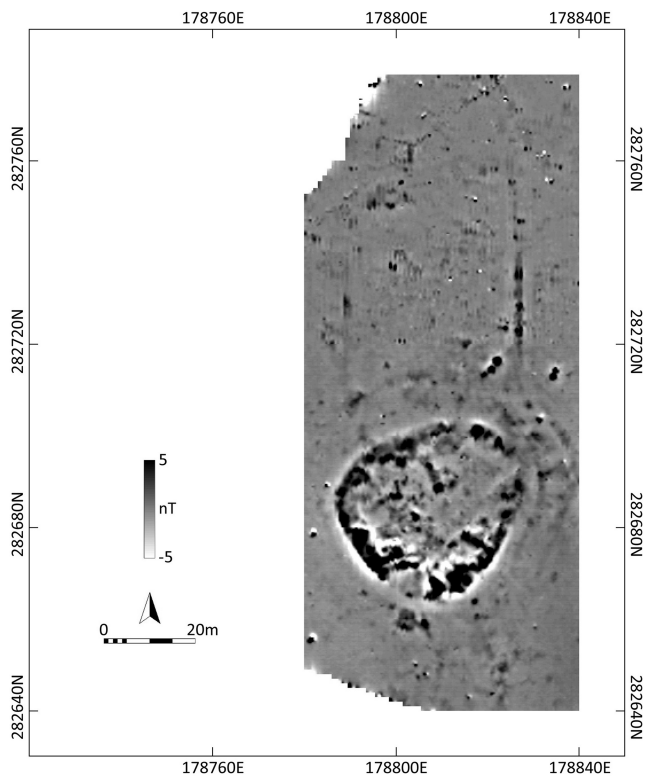


Fig. 7: Area 3: greyscale image of gradiometer data.

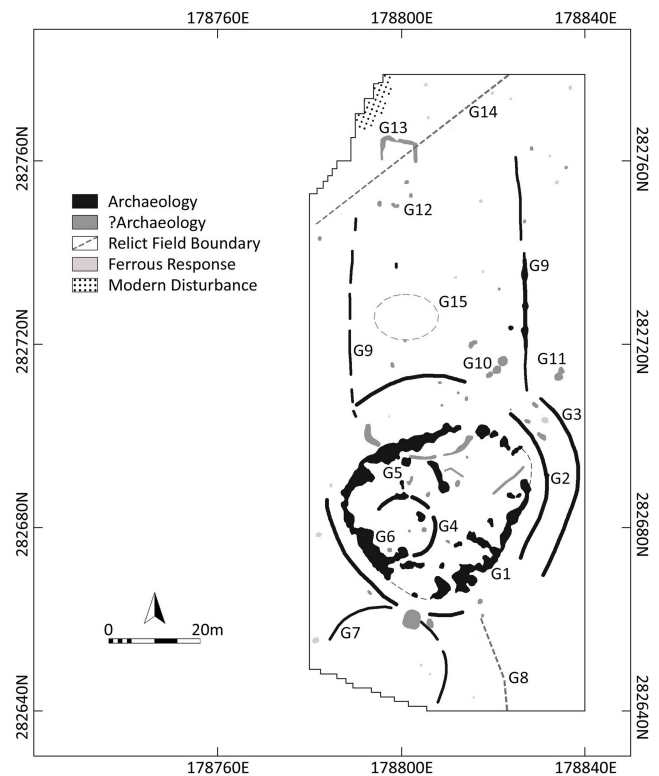


Fig. 8: Area 3: summary interpretation diagram.

of the smaller pit-type anomalies scattered across the survey area might also be anthropogenic in origin, while others, such as those located in the vicinity of an irregular (natural?) depression near the northern boundary of the annexe (e.g. G12), are more likely to reflect natural variations in the underlying geology or soil. In addition to some of the pits described above, a number of other features of potential interest were revealed by the survey both inside and to the north of the annexe. The most conspicuous lies just outside on the north and is defined by a rectilinear band of positive magnetic gradient, which may represent the foundation trench of a rectangular structure measuring approximately 8m east–west by 5m north–south (G13). It overlaps with an old, northeast–southwest-oriented field boundary (G14), which is marked on the second-edition Ordnance Survey map but no longer exhibits any surface expression. Potential traces of other features are also discernible in the survey data, particularly in the interior of the annexe. However, apart from a slender annular anomaly in the south-west quadrant of the annexe—which may be the remains of a building, or perhaps a ring-ditch, measuring about 14m in diameter (G15)—most of them are of insufficient clarity to allow for archaeological interpretation.

Taken together, the surveys at Cashelmanannan suggest this to be a relatively complex, multi-period site, with a longer history of activity than was previously recognised. As well as identifying the remains of a possible circular enclosure underlying the boundary of the multivallate enclosure on the south, the survey has also revealed evidence of potential settlement and industrial activities within the inner enclosure, as well as a range of pit-type features which may be associated with domestic and/or agricultural activities in the vicinity of the northern annexe. While the relationship between the multivallate

enclosure and the annexe can only be determined by excavation, the results of geophysical survey leave open the possibility that the two earthworks are broadly contemporary and that the annexe may have served an agricultural function.

Area 4

In addition to the survey at Cashelmanannan, two areas were also targeted for investigation in 2012 on the state-owned lands to the east of the large enclosure surrounding Rathcroghan Mound (Area 4). Both of these represent extensions to the large-scale gradiometer survey conducted around the great mound in the 1990s (Waddell *et al.* 2009, 142–156). These earlier investigations resulted in the discovery of a host of significant sub-surface archaeological features, among them that 360m-diameter ditched enclosure and a funnel-shaped avenue leading to Rathcroghan Mound from the east. The purpose of this survey in Area 4 was to investigate, for the first time, the lands extending eastwards from the 360m enclosure and to undertake a more detailed examination of the entrance area of the eastern avenue, where the enclosure ditch is not so well defined and interpretation is further complicated by the convergence here of a significant number of archaeological and later agricultural features. The survey covered a roughly rectangular area of 1.24 ha, with maximum dimensions of 120m north–south by 140m east–west.

The latest survey – conducted at twice the resolution of the previous gradiometer survey – recorded in even greater detail the dense array of features around the junction of the entrance avenue and the ditch of the enclosure, and has also revealed a number of previously unrecorded features of archaeological

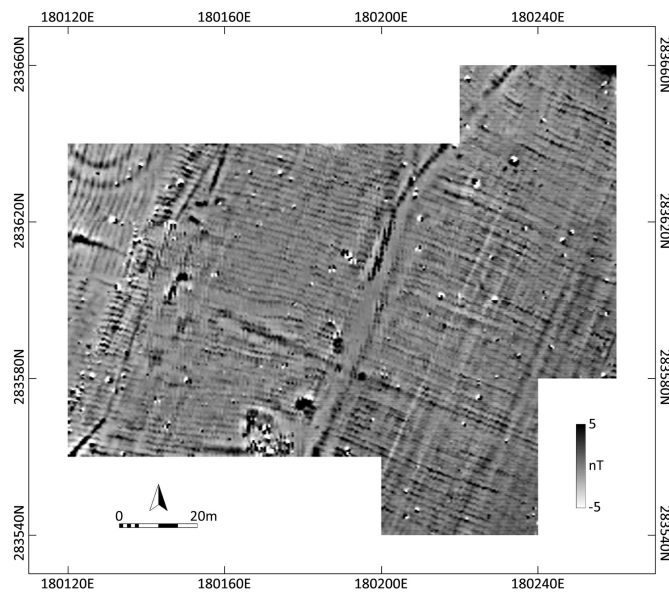


Fig. 9: Area 4 east of the 360m enclosure around Rathcroghan Mound: greyscale image of gradiometer data. The double ditches of a ring barrow within the enclosure are visible on the top left.

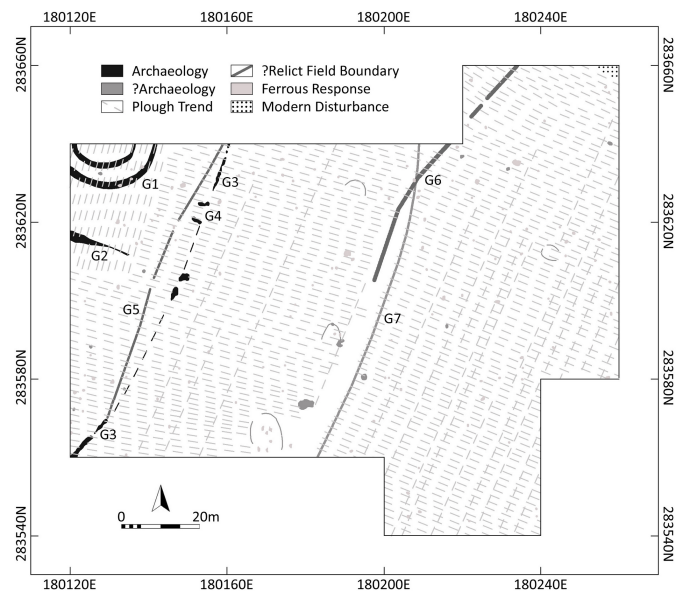


Fig. 10: Area 4: summary interpretation diagram.

significance to the east of the enclosure (Figs 9 and 10). Indeed, apart from the numerous ferrous responses recorded across the area (the majority of which are likely to represent modern iron objects buried in the topsoil) most of the features visible in the gradiometry image appear to underlie the imprint of a fossil cultivation pattern, and are therefore likely to be of some antiquity. The principal cultivation pattern is aligned west-northwest to east-southeast, however a contrasting pattern oriented at right angles to this is also evident across much of the image, including the north-west sector, which is dominated by the southern half of a large ring-barrow defined by two concentric ditches (G1). This barrow is centrally positioned within the avenue leading to Rathcroghan Mound, the southern arm of which (G2) is visible just to its south. As noted above, the ditch of the 360m enclosure (G3), which is estimated to be about 5m wide and is almost certainly rock-cut, exhibits a less distinct magnetic response in this area than elsewhere along its circuit, in some places forming only a very slight contrast with the surrounding soils. This is likely due to a combination of factors, including ground disturbance caused by later cultivation and, possibly, the construction of a field boundary (see G5, below) that partly overlaps with the line of the enclosure. Likewise, the southern arm of the avenue (G2), which registers as a positive magnetic lineation aligned west-northwest to east-southeast, seems to peter out some 15m east of the point at which it would intersect with the 360m enclosure, but may simply be obscured in this area by the overprint of similarly-aligned cultivation trends. Very significantly, however, no trace of any continuation of the avenue was recorded by the survey further to the east, which means that we can now be relatively confident that the avenue does indeed terminate at the 360m enclosure.

Detailed survey has also helped to clarify the nature of a number of other features in this area. It now seems likely, for example, that a distinct gap in the line of the 360m enclosure, flanked on either side by a short positive magnetic lineation

(G4), marks the position of a formal, funnel-shaped entrance set slightly south of the central axis of the avenue. A slightly curving linear anomaly of positive magnetic gradient (G5) extends in a north-northeast to south-southwest direction just to the west of G4 and appears to intersect with the line of the enclosure near the northern and southern limits of the survey area. This feature broadly corresponds with a relict field ditch which is first marked on the second-edition Ordnance Survey map, and may therefore be of agricultural origin. A similar but slightly broader linear anomaly (G6) was recorded some 50m to the east of G5 and may likewise represent an old field boundary; however, there is no cartographic evidence to indicate the former existence of such a feature in this area and, as such, the possibility of an archaeological origin cannot be ruled out.

Another relatively substantial but previously unrecorded feature partly overlaps with G6, and registers as a curvilinear band of enhanced magnetic gradient (G7), some 80m in length, which extends beyond the limits of the survey area. The occurrence of a 5–6m wide gap in the cultivation pattern along the western side of this feature suggests that it may be associated with an old trackway, though its curvilinear form and the fact that it is more or less concentric with the line of the 360m enclosure also raise the intriguing possibility that it forms part of yet another large enclosure. That said, no obvious trace of such an enclosure was identified by the survey undertaken as part of the present project to the north-west of the 360m enclosure (Area 5), nor by any of the other geophysical surveys conducted in the vicinity of Rathcroghan Mound to date. At present, therefore, the precise nature of this feature remains uncertain. As well as the features discussed above, a variety of smaller anomalies of archaeological potential were also identified by the survey to the east of the 360m enclosure. These include several well-defined pit-type anomalies, as well as a number of faint, arcuate and semi-circular anomalies of varying size, many of which are only discernible on close inspection of the data. Despite their weak magnetic expression however, it is

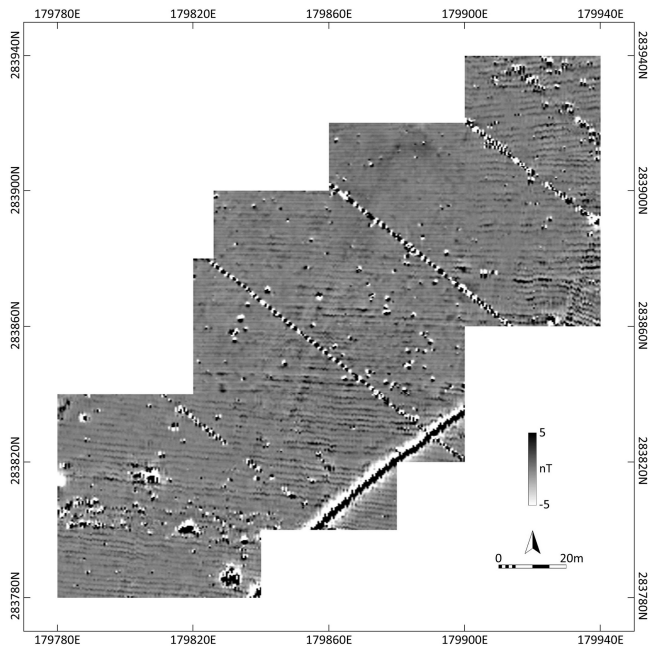


Fig. 11: Area 5 north-west of the 360m enclosure around Rathcroghan Mound: greyscale image of gradiometer data. The ditch of the enclosure is visible on the lower right.

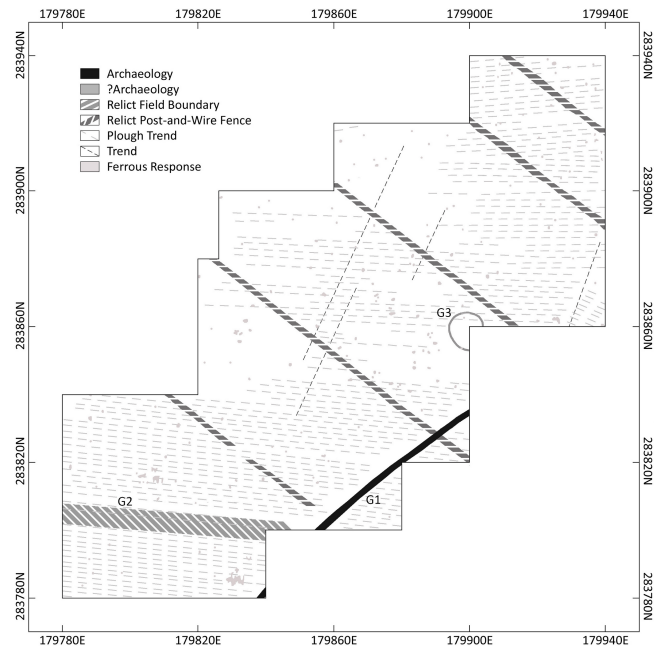


Fig. 12: Area 5: summary interpretation diagram.

quite possible that these anomalies represent the remains of relatively ephemeral, subsurface archaeological features that have been truncated and in some cases almost wholly erased by later cultivation.

Area 5

The final area targeted for investigation is located immediately to the north-west of the 360m enclosure, and encompassed lands totalling approximately 1.4 ha (Area 5). This area, which had never before been subject to geophysical survey, lies a short distance to the west of the natural boulder known as Milleen Meva and is overlooked to the north by Rathbeg, a prominent ring-barrow. In addition to its intrinsic archaeological potential, survey in this area also provided an opportunity to ascertain whether a curvilinear feature identified outside, and concentric with, the 360m enclosure in Area 4 (marked G7 on Fig. 10) may have formed part of a second large enclosure surrounding Rathcroghan Mound.

In contrast to Area 4, the 360m enclosure (G1) displays a very distinct signature in this area (Figs 11 and 12), registering as a broad band of negative-positive-negative magnetic gradient near the southern limit of the survey area. Significantly, however, no trace of any feature corresponding with the curvilinear anomaly (G7) identified in Area 4 was identified by the survey here, and further work is therefore required to elucidate the nature and significance of this particular anomaly. Indeed, apart from the 360m enclosure, few features of potential archaeological interest were recorded in this area, which is instead dominated by a range of anomalies of more recent origin. The most striking of these is a series of distinct lineations composed of alternating positive and negative responses, which cross the survey area at regular intervals from northwest to

southeast. These reflect the buried remains of post-and-wire fences which divided the lands around Rathcroghan Mound until relatively recently (Waddell *et al.* 2009, 144). A broad band of scattered ferrous responses (G2) that extends roughly east-west across the southern part of the surveyed area likewise marks the line of a former field boundary, in this case a low-profile bank first recorded on the second-edition Ordnance Survey map. The random scatter of other, similarly intense magnetic anomalies points to an abundance of modern ferrous litter in this area, although the possibility of an archaeological origin for some of these responses – particularly those located in the immediate vicinity of the 360m enclosure – cannot be dismissed. Of perhaps greater interest, however, are several faint, positive linear trends, aligned northeast-southwest, at the centre and east of the survey area, the most extensive of which was traced for a distance of about 80m. These appear to underlie the fossil cultivation pattern – which in this area adopts an east–west orientation (similar to the relict field boundary G2) – and could therefore represent earlier agricultural features. Lastly, the partial outline of what may be a small ring-ditch, evidenced as a faint semi-circular anomaly some 10m in diameter (G3), can also be discerned beneath the imprint of cultivation along the eastern edge of the survey area. The presence of a possible ring-ditch just outside the 360m enclosure is intriguing. There may be a parallel here in the funerary monuments, which have been shown by geophysical survey to adjoin the large-scale ceremonial enclosures at Tara (Fenwick and Newman 2002; Newman 2007).

Conclusion

The gradiometer surveys conducted at Rathcroghan in 2010 and 2012 have shed new light on some of the key monuments within the complex and have also revealed several previously unrecorded features of archaeological, and potential archaeological, significance. These vary from the well-defined footprint of a circular building and other features indicative of settlement and possible industrial activity at Cashelmanannan, to more ephemeral features that hint at the presence of ring-ditches and other sub-surface archaeological remains in the vicinity of the upstanding monuments. Disturbance by agricultural activity in recent centuries is likely to blame for the weak magnetic expression of many of the newly-identified features, as well as the poor definition of the 360m enclosure on the east, where it is intersected by a former field boundary. Despite this latter disturbance, however, the survey has succeeded in clarifying the location and configuration of the original entrance to the enclosure, as well as the relationship between the enclosure and the funnel-shaped avenue leading to Rathcroghan Mound. In addition to providing new insights into the role of the earthworks at Cashelmanannan, the longer history of this site has also been brought into sharper focus by the discovery of a circular enclosure underlying its multivallate boundary. This interesting feature attests to multi-phase, if not multi-period, activity at the site, mirroring a pattern also evidenced by previous geophysical surveys at other monuments within the complex, most notably Rathcroghan Mound and the Mucklaghs. Apart from a number of tentative features, nothing of obvious archaeological significance was identified during the present campaign of survey at the Mucklaghs and to the south of Oweynagat, though further survey in these areas may yet reveal additional features of interest.

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