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METHODS IN ARCHAEOLOGY**

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## The ACCORD project: Archaeological Community Co-Production of Research Resources

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### Abstract

*This paper introduces the AHRC funded ACCORD project, a partnership between the Digital Design Studio at the Glasgow School of Art, Archaeology Scotland, the University of Manchester and the RCAHMS. The ACCORD project examines the opportunities and implications of digital visualisation technologies for community engagement and research through the co-creation of 3D models of historic monuments and places. Despite their increasing accessibility, techniques such as laser scanning, 3D modelling and 3D printing have remained firmly in the domain of heritage specialists. Expert forms of knowledge and/or professional priorities frame the use of digital visualisation technologies and forms of community-based social value are rarely addressed. Consequently, the resulting digital objects fail to engage communities as a means of researching and representing their heritage. The first part of this paper presents how the ACCORD project seeks to address this gap through the co-design and co-production of an integrated research asset that encompasses social value and engages communities with transformative digital technologies. The second half of this paper (section 4) presents a case study of an ACCORD project based in Argyll which highlights the nature of community relations with expert groups, issues of archaeological authority and the transformative power of co-production using digital recording techniques.*

**Keywords:** Community Co-production, 3D, Visualisation, RTI, Authenticity, Social Value

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### 1. Introduction

There have now been nearly three decades of research and development of digital visualisation technologies in archaeology and heritage. Approaches that utilise photogrammetry, laser scanning, 3D modelling, and real time virtual reality have become standard practice in the academic archaeological sphere, commercial archaeological ventures and cultural heritage management. However, there is little community engagement with digital visualisation technologies, despite interest in the technologies themselves (Banks, 2011). Expert forms of knowledge and/or professional priorities, rather than community ones, invariably inform digital visualisations. Furthermore, digital visualisations commissioned in these traditional sectors rarely integrate forms of community-based social value relating to the historic environment into the recording exercise. Consequently, the resulting digital objects often fail to engage communities as a means of researching and representing their heritage. The low levels of community use and re-use, let alone co-production, of these resources also highlights concerns relating to perceptions of authenticity and value. Recent work by Latour and Low (2011) suggests that replicas and reproductions of original historic objects can indeed acquire authenticity, but that this is dependent on the nature of their production, as well as the quality of the resulting

outputs. Other research suggests that relationships between people, places and things are important in the experience of authenticity in relation to historic monuments, buildings and objects (e.g. Jones, 2009; Macdonald, 1997). It is not surprising then, that 3D models produced by ‘experts’ can seem disconnected, clinical, and irrelevant to the broader communities of interest that accrue around heritage places.

Community engagement has been increasingly prominent in archaeology and heritage over the last two decades (Newman and McLean, 1998; Smith and Waterton, 2009). Community archaeology projects are widespread, usually defined by community participation in the design, management, implementation and/or dissemination of archaeological field research (see Marshall, 2008; Moser *et al.*, 2002). Furthermore, in heritage management, social value has become an important aspect of international conservation charters and national policies. Defined as a collective attachment to place that embodies meanings and values important to communities (Johnston, 1994:10), social value is something that heritage organisations attempt to integrate into the conservation, curation and management of heritage assets. Sometimes this involves the active participation of community groups.

As 3D digital visualisation technologies are increasingly employed in research and representation in the heritage

sector, it is also important that forms of social value and community engagement are incorporated into the production of digital models. Issues around access to equipment, cost of recording and lack of technical expertise are no longer significant barriers to community participation. The on-going fall in hardware and software costs and the simplification of hitherto highly complex recording processes have brought at least some techniques easily within the reach of community groups. The development of freeware with associated support communities and online forums further enhances accessibility. The time is therefore ripe for the development of new approaches that bring academic researchers, heritage organisations and community partners together to explore the multiple opportunities created by the co-design and co-production of 3D digital visualisations of historic monuments and places. In particular, it will be important to investigate how co-design and co-production impact on the forms of social value and authenticity attributed to the resulting 3D models. What kinds of values are produced through co-design and co-production? Do the resulting models acquire different forms of authenticity and significance than those that are produced entirely within professional/academic domains? What is the potential of such models for community re-use and research?

## 2. The ACCORD Project: aims and objectives

The ACCORD project, funded by the UK Arts and Humanities Research Council's Connected Communities and Digital Transformations programmes, is a partnership between the Digital Design Studio at the Glasgow School of Art, Archaeology Scotland, the University of Manchester and the RCAHMS. At the time of writing we are mid-way through the project, which started in late 2013 and will complete in spring 2015.

The primary aim of ACCORD is to examine the opportunities and implications of digital visualisation technologies for community engagement and research through the co-design and co-production of 3D models of historic monuments and places. The project actively engages existing community groups in the process of designing and producing 3D records and models of heritage places, many of which they have ongoing relationships with. A range of recording and modelling techniques is being made available for selection during the co-design process with each community heritage group. These include: consumer level photogrammetry; Reflectance Transformation Imaging (RTI); and 'white light scanning'. Depending on the outcomes of the co-design process, time of flight laser scanning has also been deployed for a sub-set of groups. 3D printing technology has also been used in select cases to create physical models from the captured data. The datasets resulting from the project will contain full contextual and technical metadata generated in collaboration with the community groups involved.

The ACCORD Project also aims to reflect on the nature of the relationships between community groups, digital heritage professionals, and the outputs they have created,

particularly in comparison to similar outputs produced in more traditional professional domains. The participation of interested communities in the design process will allow contemporary social values associated with heritage places to be explored and embedded in the resulting digital records and 3D objects, as well as the associated contextual metadata. Groups are encouraged to integrate existing research and community-generated material relating to their chosen heritage place(s) such as survey work, independent research, oral histories, folklore, and/or photographs. Throughout each ACCORD sub-project, the team also conduct qualitative reviews of the transformative aspects of the process, investigating changes in attitude to 3D recording technologies during the life of each project, as well as the forms of significance, authenticity, and value acquired by the resulting 3D objects.

Finally, the ACCORD Project aims to broaden capacity for the creation and reuse of digital visualisation technologies in community heritage activities and research and to increase awareness of the potential of 3D technologies for community heritage practice. This will be facilitated through the production of an open-access dataset. In addition to direct in-person collaborative work with the ACCORD groups, social media including the ACCORD blog, Twitter account and Facebook page, plays an important role by increasing access to the work. Beyond this we hope to create a community of communities by facilitating interaction between the ACCORD community groups that will extend beyond the lifetime of the project. The long-term legacy of the project is a research asset prepared for permanent archive by the community groups with the support of the ACCORD project team. This will be available via the UK's Archaeology Data Service (ADS) in a 'special programme' format i.e. an integrated archive specifically designed to be capable of regular update during the life time of the project. An interactive website facilitating promotion, communication, comment and social media integration exists separately. The technical team is actively guiding the co-production of technical metadata to ensure that each data asset has a well-formed OAI Submission Information Package (ISO 14721:2012, version 2, published 2012-08-21) enabling rapid archival ingest and dissemination of the datasets. These OAI Archival Information Packages will also be deposited with the RCAHMS.

## 3. Project methodology

### 3.1. Group selection

Since ACCORD only runs for 15-months, groups who already have well-established working relationships with partners on the ACCORD team were approached in the first instance. Ultimately we will work with 10-12 community groups, each of which will form a sub-project within the overall ACCORD Project. A number of community groups have been drawn from Archaeology Scotland's highly successful Adopt-a-Monument Scheme (out of 55 groups) and one from Glasgow Life's community scheme. In the first instance, a process of facilitated self-selection was used to

identify a cohort of groups with an interest in 3D recording, printing or digital visualisation for artistic reconstruction and heritage representation. Within this process of self-selection, the ACCORD project team also endeavoured to include a variety of different kinds of community groups and a wide geographical distribution across different regions of Scotland and between urban and rural environments. While a range of different historic monuments, buildings and objects is desirable, it is not an a priori consideration since the collaborative process at the heart of ACCORD means that the subject matter is prescribed by community interests and attachments. The community groups fall into a number of broad, sometimes overlapping, categories ranging from long established archaeological/heritage societies to local interest groups, action groups and loosely formed communities of interest/practice.

### **3.2. Timetable**

Each ACCORD sub-project is scheduled to take place over a 2-3-day period. The process is split into a number of phases. Phase 1 consists of focus group designed to explore baseline data on the nature of the group and the heritage places they engage with. Phase 2 is the co-design phase where the community groups and ACCORD project team together select targets and technologies. Phase 3 marks the start of co-production with field recording. Phase 4 focuses on data processing and initial model/RTI production. This is followed by the final Phase of engagement, which involves a further focus group reflecting on the process, issues of significance, authenticity and value, and the impact of the technologies.

### **3.3. Co-design and co-production**

Collaboration in the design and production of digital 3D records and models sits at the heart of the ACCORD project. In the first instance, the historic monuments, buildings and objects selected for recording are based on the specific interests and attachments of the community groups concerned. These are ascertained through the initial focus group. Co-design must also take into account timescales and technologies. The recording and modelling must be feasible within the timetable described above, and amendable to the technologies available. Consumer level photogrammetry and Reflectance Transformation Imaging (RTI) are favoured because they are more accessible and enable full community participation. Depending on the outcomes of the co-design process, time of flight laser scanning is sometimes also deployed. 3D printing technology is also used in select cases to create physical models from the captured data. Technical staff from Glasgow School of Art's Digital Design Studio facilitate community recording and modelling, but the ACCORD Project does not undertake formal training. In the case of laser scanning DDS technical staff usually lead the recording and modelling process, but they do so according to the collaborative design and they encourage as much community participation as possible. In the interests of co-production, we aim to always include photogrammetry and/or RTI work alongside laser scanning.

### **3.4. Social Value Capture**

During the co-design process, two semi-structured focus group sessions are held, one at the beginning of our work with each community group and one at the end. The first focus group explores the nature of the group and the historic monuments, buildings and/or objects they are interested in. There is a discussion of the group's make-up and history. There is also an in-depth exploration of the meanings and values associated with specific monuments, buildings and/or objects. Feelings of attachment and ownership are examined. The second focus group deals with the group's experience with 3D visualisation, including the recording and modelling process. It also explores the group's response to the models themselves and the forms of ownership and authenticity associated with them, if any. Finally, the ways in which participation in 3D visualisation has impacted on the interests and attachments of the group is considered.

In the intervening period between the focus groups, ACCORD project members actively participate in co-design and co-production. During this they observe and record community participants' responses, particularly changing attitudes to 3D technologies and the heritage places being recorded/modelled. A copy of social-media interactions, email and written communication is also being kept (including the project's own blog, facebook and twitter accounts). The extent of this social media will vary between groups and individuals, and is affected by practicalities (such as access and familiarity with the use of the internet in this way).

### **3.5. Ethics and intellectual property**

Due attention has been given to issues of inclusion and power relationships, both within and between community groups, as well as between community groups and project investigators/partners. The project builds on the relationships developed by its partners who are experts in the community engagement field. Throughout the community engagement process, careful attention has been given to the ethical dimensions of this research, particularly issues of informed consent. Potential tensions surrounding open-data and community feelings of ownership and intellectual property are also the subject of overt discussion. We draw heavily on the Ethical Guidelines created through the AHRC Connected Communities Programme (CSCJA, NCCPE 2012) (<http://connected-communities.org/>). The seven ethical principles of mutual respect, equality and inclusion, democratic participation, active learning, making a difference, collective action, and personal integrity underpin all aspects of our engagement. More specific legal issues relating to ownership of the resulting assets (intellectual property and copyright) are openly negotiated with the community groups. Groups are strongly encouraged to adopt as open a regime as possible (i.e. Creative Commons CC0) for the ACCORD outputs that they have co-created. Attribution and non-commercial re-use of data can be guaranteed by the CC-NC-BY license where appropriate.

#### 4. Case Study: Colintraive and Glendaruel Development Trust Archaeology and History Group

At the time of writing three sub-projects have been undertaken, each with a particular character and set of issues that help to highlight the nature of community relations with expert groups, archaeological authority and digital recording techniques. The case study below focuses on work at Colintraive and Glendaruel in the west of Scotland. The other two completed projects took place at Dumbarton Rock on the river Clyde working with rock climbers specifically interested in the sporting heritage of the site (as opposed to the renowned castle atop the rock), and with the Friends of Glasgow Necropolis in the centre of Glasgow city who have specific conservation and recording objectives which were ideally suited for the application of RTI.

Colintraive and Glendaruel is situated in Argyll, in the Parish of Kilmoden, on the West coast of Scotland. The ACCORD team worked with the Colintraive Glendaruel Development Trust (CGDT) Archaeology and History Group on 6th April and 21st – 22nd June 2014. The CGDT Archaeology and History Group is a recently formed sub-committee of the CGDT (<http://cgdt.org/about/>). The CGDT is governed by a Board of Directors, elected from and by the community. It currently has c.40 official members; membership is open to all those who are permanently resident in Colintraive and Glendaruel and on the electoral roll. The Trust is established as a Company Limited by Guarantee (SC350010) and is registered as a Charity (SC040002). The CGDT Archaeology and History Group was founded following an Archaeology Scotland Adopt-a-Monument workshop held on the 23rd and 24th of November 2013. The group is currently made up of around 12 passionate and driven members of the local community, who see their work in the spirit of the CGDT as ‘Making Colintraive and Glendaruel a better place to live and work’.

Together we recorded and modelled 3 monuments located in the Kilmoden Parish: the Lephinkill Chambered Cairn; a cup and ring marked stone; and a World War One memorial to two men who fell at Gallipoli. For this sub-project photogrammetry, RTI and laser scanning were deployed. As will become clear, the value of the monuments discussed here is in part a product of their relation to the Stronafian Forest which the CGDT purchased in 2013 and the ability of these technologies to make the invisible visible.

The CGDT Archaeology and History Group describe themselves as ‘incomers’, holiday-homers, part-time inhabitants and ‘locals’ who have family ties going back generations. The group’s recent interest in the archaeology and history of the area is framed within the CGDT’s purchase of the Stronafian Forest and the sense of ownership and belonging it entails. The Group express a strong sense of continuity with the past. This motivates some to learn more about their landscape; indeed for some this is a duty or responsibility. For some, ‘getting the facts right’ about the dates and national significance of the archaeological remains is a very important issue. For

others it is more about ‘the story’ and a passion to get more ‘in touch’. The CGDT purchased Stronafian Forest (which covers 600 ha) as a social enterprise project in February 2013. This desire for development is motivated by a desire to enhance the area’s social, economic, and historic value, while it is also seen to represent the ambition and resilience of the ColGlen community. There is a strong sense of pride in this vibrant, exciting and special place. It is not just about legal ownership; working together as a community is seen as a key part of taking ownership of ‘our forest’.

Against this backdrop of ambition and resilience, there is also a sense that the ColGlen community is a ‘community at risk’. It is hoped that the Stronafian forest will form a social hub and focal point, for the dispersed inhabitants. Purchase of the Forest is associated with amenity, educational, and wellbeing benefits for the community. The community forest is also recognised as an economic asset for tourism, leisure and local businesses, offering the opportunity to create something that will ‘entice’ and ‘attract’ public interest, and encourage those who are passing through the area to stop and explore. Archaeology and history have a prominent place in this vision.

##### 4.1. The ACCORD-CGDT Archaeology and History Group project monuments

The first site of interest identified was Lephinkill Chambered Cairn (NGR NS 0027 8432). This chambered cairn is situated above the valley floor about 600m E of Clachan of Glendaruel in a clearing within a forestry plantation. Described as a ‘Clyde-type long cairn’, it appears as a vegetation covered irregular mound of stones. The chamber is at the north end and is entered through a concave facade, now blocked by stones. It has been disturbed and robbed for building material. The cairn is not scheduled but is historically significant in terms of understanding the distribution of Neolithic settlement and burial. It is included in the National Monument Record (Canmore ID 40540 <http://canmore.rcahms.gov.uk/en/site/40540/details/lephinkill/>), volume 6 of the RCAHMS Argyll Inventory and Henshall’s *Chambered Cairns of Scotland* (Henshall, 1972: 329-30). In terms of social value, current local interest in this cairn has recently accrued since the purchase of this forest and is framed by its location here. Despite the focus on its ruinous state in monuments records, it is seen as one of the most pristine monuments in the forest and is perceived to be aesthetically pleasing. The age of the cairn is also important, being seen as the oldest monument and the anchor for a narrative of human inhabitation of the area. Other factors which underpin the interest of the CGDT History and Archaeology Group in this monument are its visibility and accessibility, which make it a good focal point for a footpath positioned at a good viewpoint above the valley. Therefore, the group see it as an attraction and ‘hub’ from which a sense of connection to the past emerges, and from which people can further explore the landscape.

For the ACCORD recording exercise, the CGDT Archaeology and History Group expressed a strong desire



FIGURE 1: THE LEPHINKILL CAIRN DURING LASER SCANNING USING A LEICA C10 SCANNER.



FIGURE 2: LEFT – THE GROUP CAPTURING IMAGES FOR PHOTOGRAMMETRIC MODELLING. RIGHT – A SCREENSHOT OF THE COMPLETED MODEL.

to focus on the cairn for the reasons outlined above; as a visible, ancient and aesthetically pleasing monument that people were increasingly attached to. However, the monument was not conducive to photogrammetry, so over the weekend 21st and 22nd of June it was topographically recorded by low resolution laser scan.

The second identified site was a Cup and Ring Marked Stone (NGR NR 9985 8408). This decorated boulder is situated in a recent deciduous plantation 100m SE of the road bridge (A886) over the Clachan Burn. The Canmore entry describes it as a sunk schist boulder. Its upper surface ‘bears ten cupmarks, one of which is surrounded by a single



FIGURE 3: LEFT -THE STONE BEING PREPARED FOR RTI RECORDING, RIGHT – A SCREEN SHOT OF THE RESULTING RTI.

ring and another by a keyhole-shaped ring' (Canmore ID 39960). This Neolithic rock art is described as both hard to find and difficult to discern except 'when wet and in low sun'. The boulder is not a Ancient Monument, but it is included the national monuments record, and Morris's *The prehistoric rock art of Argyll* (Morris 1977). Although maps in the Colintraiive Community Hall show this boulder located in the forest, to the group this monument was shrouded in mystery and none of the members present had visited it. Nevertheless its chronological and cultural connection to the cairn instigated a desire to locate it. When it was eventually found, it was, fortuitously, near to one of the 'desire lines' (proposed path route) leading up to cairn. With the ACCORD project team the group 3D modelled and recorded it using photogrammetry and RTI (RTIBuilder and PTMFitter).

Finally the group selected a WWI War Memorial ('The Gallipoli memorial') (NGR NS 028 750): This memorial, located on a rocky foreshore is dedicated to two brothers, R.F. McKirdy and P.M. McKirdy, who fell at the Battle of Gallipoli. It is not included in the National Monument Record but there is an entry in the Imperial War Museum online War Memorial Archive where it is described as an ornamental drinking fountain and unworked stone cairn. There are bronze lions on the fountainhead and the Badges of RNVR and Argyll and Sutherland Highlanders. The date of erection is unknown and it is noted that coastal erosion has affected the memorial. Only one member of the group, having only moved to Colintraiive in September from Australia, knew about the existence of 'the Gallipoli memorial'. On discussion, another member of the group remembered that they had a personal connection to the son of one of the individuals commemorated on the monument. The whole group felt it was important to record this monument in order to 'raise awareness' of this 'overlooked' site. It has also been since noted that next year is the 100 year anniversary of the deaths of the McKirdy brothers. The memorial was modelled using photogrammetry (Photoscan) by the Group in collaboration with the ACCORD team on the weekend of 21st and 22nd June.

#### 4.2. *The impact of 3D visualisation in Colintraiive and Glendaruel*

It was clear that the process of recording and modelling the monuments had an impact on how people perceive and engage with them. Only the chambered cairn was a strong focus of interest before the ACCORD weekend, but the opportunity to explore their local heritage in a new engaging way resulted in new relationships with the cup and ring marked boulder and the War Memorial. As one group member noted: 'It's the things that are on your doorstep which you don't explore.' In the case of 'the Gallipoli memorial', a member of the group who had just returned after 20 years living in Australia and New Zealand decided to find out more about the McKirdy brothers since 'Gallipoli, during World War One, is an event etched in the stone memorials and hearts of every ANZAC'. His personal account is now on the ACCORD Blog (<http://accordproject.wordpress.com/>). In the case of the rock art, the value of 3D recording lay in rendering the invisible visible. As one member of the group said, 'I couldn't see why it was important and exciting before... now I see why!'

The group were extremely enthusiastic about the potential for photogrammetry and RTI. The results were recognised as bringing the monuments to life in a visually stunning way. There was also excitement about using the 3D models in various ways: for communication, analysis (especially RTI), raising the profile of the forest, increasing access to the archaeology for educational and interpretation purposes, encouraging visitors to the sites, and enhancing the monuments which are already there, though importantly never replacing them. Members of the CGDT History and Archaeology Group felt they offered a low cost to failure; constraints of time and money were not an issue, while results did not necessarily need professional or specialist validation

#### 5. Conclusion and future work

The innovative nature of the project derives from its use of digital visualisation technologies to engage communities

in the co-creation of 3D models of historic monuments and places. There is a great deal of research demonstrating that community participation both enhances existing significance of the historic environment and in some cases generates new forms of significance (Smith and Waterton 2009; Moser et al 2002; Marshall 2009). The case study above shows clearly that a co-design and co-production process has a transformative affect on the relationship between the group, their heritage, and the digital outputs of the recording process. It is too early to say to what extent that transformation is long lasting or profound. However, these initial results suggest that the approach adopted by ACCORD has the potential to deal with the long-standing problems of lack of engagement with digital outputs. It may also counteract the wariness of some non-specialist groups to metaphorically take ownership of local heritage, which they perceive as the domain of experts, professionals and authoritative bodies. Through a collaborative process – addressing what is to be recorded, how it is recorded, who records it, and how it is modelled – a network of relationships (that is participatory, inclusive and local) is created around the outputs. There is also some evidence emerging that the creation of this network of relationships impacts on the perceived authenticity of the digital outcomes and therefore their relevance and re-use potential.

The ACCORD project will continue to engage with a further 5-8 groups throughout the remaining project period, while we will additionally revisit a selection of communities in order to evaluate the legacy effects of the project. The use of digital technologies to enhance and generate forms of social significance is an important outcome, adding distinctive value to existing heritage assets and our understandings of them. Community groups will be able to draw on the resulting digital datasets for various strategic purposes, including public access and presentation, education, and tourism initiatives. The records and models resulting from the project will also provide important research resources. For instance community groups will be able to continue to integrate them into their research initiatives, such as survey work, interpretation, oral history projects or forms of artistic intervention. The integration of contemporary social value in the design and production of the 3D models and the associated contextual data means that the resulting assets also provide heritage managers with a new source of information about the local significance of heritage places. Finally for academic researchers interested in community heritage initiatives and the generation of social value, the project promises to provide an important exemplar for analysing how digital technologies mediate the complex relationships that people have with heritage places.

## References

BANKS, S. (2011). Connected Communities scoping study, <http://www.ahrc.ac.uk/Funding-Opportunities/Research-funding/Connected-Communities/Scoping-studies-and-reviews/Documents/Community-based%20Participatory%20Research.pdf>

CSCJA, NCCPE (2012). <http://connected-communities.org/>, accessed 29/07/2014.

HENSHALL, A. S. (1972). *The chambered tombs of Scotland*, vol.2 Edinburgh: Edinburgh University Press. pp. 329-30.

ISO (2012). Space data and information transfer systems Open archival information system (OAIS) Reference model, ISO 14721:2012, version 2, <https://www.iso.org/obp/ui/#iso:std:iso:14721:ed-2:v1:en>

JONES, S. (2009). Experiencing authenticity at heritage sites: some implications for heritage management and conservation. *Conservation and Management of Archaeological Sites*.12(2). pp. 133-147.

JOHNSTON, C. (1994). *What is Social Value? A discussion paper*. Canberra: Australian Government.

LATOUR, B. & LOWE, A. (2011). The migration of the aura, or how to explore the original through its facsimiles. In: Bartscherer T (ed.). *Switching Codes*, 275-98. Chicago: University of Chicago Press.

MARSHALL, Y. (2009). Community archaeology. In: B. Cunliffe, C. Gosden and R. Joyce (eds). *The Oxford Handbook of Archaeology*. Oxford: Oxford University Press, pp. 1078-1102

MACDONALD, S. (1997). A people's story: heritage, identity and authenticity, In: C Rojek and J Urry (eds). *Touring Cultures: transformations of travel and theory*. London: Routledge. pp. 155–175.

MORRIS, R. W. (1977). *The prehistoric rock art of Argyll*. Poole: Dolphin Press.

MOSER, S., GLAZIER, D., PHILLIPS, J. E., LAMYA NASSER EL NEMR, SALEH MOUSA, M. NASR AIESH, R. RICHARDSON, S., CONNER, A., and SEYMOUR, M. (2002). Transforming archaeology through practice: strategies for collaborative archaeology and the community archaeology project at Quseir, Egypt. *World Archaeology* 34. pp. 220–48.

NEWMAN, A. & McLEAN, F. (1998). Heritage builds communities: the application of heritage resources to the problems of social exclusion. *International Journal of Heritage Studies* 4(3). pp. 143-53.

RCAHMS (1988). *Argyll: an inventory of the monuments volume 6: Mid-Argyll and Cowal, prehistoric and early historic monuments*, Edinburgh: The Royal Commission on the Ancient and Historical Monuments of Scotland. Page(s): 48, no. 18 Plan, 48 (B).

SMITH, L. & E. WATERTON (2009). *Heritage, Communities and Archaeology*. London: Duckworth. The ACCORD blog, <http://accordproject.wordpress.com/>, accessed 30/07/2014.

The CGDT website, <http://cgdt.org/>, accessed 29/07/2014