

Archaeology Research Grant 2022

Joseph Fenwick

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1. Title: Mr

First name: Joe

Surname: Fenwick

2. Email:

3. Grant programme Archaeology Research Grant

4. Year awarded 2022

5. Title of project Crafting the Knowth macehead: an experimental exploration of a unique Neolithic artefact.

6. Summary of report
(Minimum allowed 100 words)

Through an exploration of several strands of experimental archaeological research, this project seeks to ‘reverse-engineer’ the specialist technology, methodology and innovative ingenuity that was required to craft the Knowth maesmor-type macehead, a singularly assured masterpiece of Neolithic craft and artistry. This research is being conducted in collaboration with Fred Curtis, internationally renowned crystal glass sculptor, designer and artist.

Using materials that would have been readily available to the Passage Tomb peoples of these islands during the latter half of the fourth millennium BC, it has been possible to recreate some of the processes that were likely to have been used in the crafting of this remarkable flint artefact. This achievement is all the more compelling given the unyielding hardness of this raw material. Despite the inherent challenges, it can be demonstrated with a significant degree of confidence how the aperture in a flint macehead could have been produced using a combination of hollow wooden drill-bit and a water-suspended abrasive medium. Moreover, this research has also rediscovered the means by which a stone object – a macehead or battle-axe – could be drilled from both sides so as to achieve a straight aperture that meets precisely in the middle.

In addition to drilling, it has also proved possible to cut a series of elongated concave facets in flint, of a type similar to those on the surface of the Knowth and other maesmor-type maceheads. This was achieved with the use of a fixed-horizontal-axis rotating wooden wheel with a water-suspended abrasive paste applied to its edge – a specialist technology of a type used in crystal glass cutting, but which is otherwise unknown in a prehistoric context.

Some limited exploration of stone polishing – in this instance flint - against an abrasive grit-imbedded wooden surface was also explored. This technique also proved to be effective. It might be the case, therefore, that a polissoir or grinding stone was not a necessary requirement in order to polish stone.

The preliminary results of the work to date have been very encouraging and additional experimental research is currently underway.

7. Please provide two appropriate images



Flint aperture and hollow wooden drill bit



Wooden grinding wheel applied to flint

8. Please outline the objectives of the project

This project seeks to explore, through practical experiment, some of the observations and hypothetical propositions outlined in:

Fenwick, J. 1995 The manufacture of the decorated macehead from Knowth, county Meath. *Journal of the Royal Society of Antiquaries of Ireland* 125, 51-60.

An important part of this project involves an understanding of the technology and methodology used to grind and engrave crystal glass. Collaborative expertise in this regard, is being provided by Fred Curtis, a glass crystal sculptor and former employee of Waterford Crystal. Advice on the properties and uses of native wood types has been provided by Ambrose O'Halloran, a professional wood turner, who also produced the wooden drill-bits and wheels used by the project. Geological expertise and insight has been provided by Dr Sadhbh Baxter, School of Earth and Ocean Sciences, University of Galway. With the permission of the National Museum of Ireland, Anthony Corns and Robert Shaw of the Discovery Programme undertook the laser-scanning and structure-from-motion (SfM) photogrammetric surveys of the macehead.

This project has explored a number of potential ancient stone-working techniques, most especially those related to the production of maesmor-type maceheads, which are unique among Neolithic maceheads on account of their distinctive morphology and surface decoration. Some of the techniques explored are entirely novel to the suite of recognised prehistoric technologies, but the programme of practical experiments conducted as part of this project would seem to indicate that these were available to a limited number of specialist or elite craft-workers on these islands during the Later Neolithic period. As the decorated Knowth macehead was produced from a flint nodule, experiments have been conducted exclusively to this particular stone type.

Three areas of this ancient technology, using materials that would have been readily available to Neolithic peoples, have been subject to experimental investigation. These are:

1. drilling an aperture in flint,
2. applying surface decoration to flint without the use of percussion or pressure-flaking.
3. surface polishing flint.

Significant and positive progress has been made in all three areas of this research to date.

9. Please describe the methodology used in conducting the research

Prior to experimental research commencing, preliminary documentary research of Neolithic stone-working techniques and related experimental archaeological research was explored. Direct evidence of the technologies used to produce these artefacts is largely lacking but the indirect evidence of the artefacts provide some useful insights. The NMI, through its Duty officer, Sharon Weadick, kindly granted permission to examine, photograph and 3D scan the Knowth macehead as part of the project research. As part of this project, different methodologies and approaches have been applied to the three strands of experimental research - the drilling of an aperture, the application of surface decoration and the grinding/polishing of stone – as each presented its own challenges. The experimental process involved a significant amount of trial and error, success and failure. Throughout, copious notes and photographs have recorded the various experimental avenues (and cul-de-sacs) and a detailed record or ‘diary’ of the various strands of exploration has been compiled as work progresses. It was very much an iterative process, with each step built upon the lessons learned in previous experimental attempts.

1. Drilling an aperture:

Initial tentative experiments involved the use of an electric pillar-drill set to a low rotation speed using a hollow wooden drill-bit with a granular form of industrial corundum abrasive (and later, a crushed stone abrasive grit). Subsequent experiments involved the construction and use of a fixed vertical-axis bow-drill with a drill-bit of bone using a water-suspended crushed stone grit as an abrasive paste and also a fixed vertical-axis pump-action drill with hollow wooden drill-bit together with a crushed stone abrasive medium. An attempt to drill an aperture through a flint nodule from opposite sides is currently underway.

2. Applying Surface Decoration:

A series of three flint-cutting and grinding workshops were conducted in Fred Curtis’ studio using specialist glass-cutting and engraving machinery and tools. Initial explorative experiments used industrial-standard cutting wheels and saws, and industrial-grade abrasives and polishing pastes. Although considerably harder, flint exhibited remarkably similar properties to glass. This is perhaps unsurprising as both are silica-based materials. It was found, for instance, that flint could be cut, ground and polished in a similar fashion to crystal glass. During the course of experimentation, it also proved possible to reproduce many of the decorative surface facets of the Knowth macehead using a variety of industrial abrasive wheels. The lattice of lozenge-shaped ‘uprights’ notable on the Knowth and Maesmor maceheads, for example, are also a common feature of crystal glass working. Additional abrasive wheel experiments used wooden wheels, initially with an industrial abrasive grit, but subsequently with a crushed stone abrasive grit. These were found to work remarkably efficiently and were quite capable of cutting an elongated concave facet in flint after only several minutes of applied grinding.

3 Polishing:

Some experimental polishing of flint without the use of a stone polissoir were also attempted. In this instance, wooden and leather surfaces with a granular abrasive medium were used, with varying degrees of success and failure.

10. Please outline the findings of your research and/or milestones achieved

During the course of experimental work, a number of important observations were made, some of which were particularly informative. In addition, the ‘trial and error’ methodology employed in the practical

experimentation also proved to be very instructive, as each stage of investigation informed the next phase or presented new challenges to be addressed and overcome.

National Museum of Ireland - observations:

An examination of the Knowth macehead at the NMI revealed that its cylindrical aperture had been drilled from both sides to meet in the middle. This required some exacting tolerances of precision to achieve.

A detailed examination of facets and striations of the Knowth macehead, indicate that its decoration had been ground into the surface, with no evidence of chipped or flaking techniques observed. Moreover, the nature and form of the features composing the surface decoration are broadly consistent with the use of a cutting wheel. The technical skills required to achieve this are, according to Fred Curtis, little short of astonishing.

Practical Experimental Research – drilling, wheel cutting and polishing – some milestones:

A means of drilling an aperture in flint using materials readily available to Neolithic peoples was achieved (i.e. without the use of metals).

In order to drill an aperture with any degree of precision, the artefact would firstly have to be held securely on a purpose-made mount, which would allow the object to be removed and placed back in position from time-to-time during the drilling process.

A fixed-vertical-axis drill would have been required to drill the aperture in order to ensure the drill-bit did not drift during the drilling process.

A bow-drill was found to be unsuitable for this purpose, as lateral forces are exerted on the drill-shaft and bit, causing it to oscillate left-right with each stroke.

Some form of fixed-vertical-axis pump-drill, in which all forces to rotate the drill-bit are directed vertically, was found to be a necessary requirement in order to drill a perfectly cylindrical aperture.

The cutting and polishing properties of flint were found to be very similar to glass and so could be worked in a similar way to crystal glass cutting and engraving.

It was possible to reproduce the decorative surface facets and raised curvilinear ornamentation of the Knowth macehead on a nodule of flint using modern glass-cutting wheels.

The lattice of concave lozenges decorating the top and bottom of the Knowth macehead are relatively easy to produce using a cutting wheel.

These facets are known as ‘uprights’ in the crystal glass industry.

An elongated facet, similar to those applied to the Knowth macehead, can be produced using a wooden rotating wheel with an applied abrasive of crushed stone.

It was demonstrated that it is possible to polish flint on a block of wood using a water-suspended abrasive grit of crushed stone.

11. a) Please provide details of the dissemination of the outcomes from this project (inc. publications, presentations, outreach, media etc.) including details of any social media/web platforms used to publicise this project

The project has been underway since May 2022 (a little over 6 months) and although much has been achieved, the research continues. It is intended to publish and present the results of this research project as widely as possible to both an academic and general audience. At this juncture, however, publication may be premature, but it would be possible, indeed welcome, to have the opportunity to present the results to the RIA, if invited.

Crafting the Knowth Macehead project has been assigned its own webpage under the ‘Research’ pages of the Department of Archaeology, School of Geography, Archaeology & Irish Studies, University of Galway. See: <https://www.universityofgalway.ie/colleges-and-schools/arts-social-sciences-and-celtic-studies/geography-archaeology-irish-studies/disciplines/archaeology/research/ireland-atlantic-europe/craftingtheknowthmacehead/#d.en.366125> Additionally, Crafting

the Knowth Macehead project details can be found under the IRIS 'Institutional Research' pages for Joe Fenwick, University of Galway. See: <https://www.universityofgalway.ie/colleges-and-schools/arts-social-sciences-and-celtic-studies/geography-archaeology-irish-studies/disciplines/archaeology/our-team/> At present, a 52-page illustrated report has been prepared on the series of drilling, cutting wheel and polishing experiments conducted up to the beginning of November 2022. This will provide the primary material towards writing and publication in the future.

b) No. of Academic Papers/articles published: 0

c) No. of Lectures given/outreach events involved in: 0

d) Media Coverage (article in local newspaper, feature on University website etc.): 1

Please upload any relevant media coverage

<https://www.universityofgalway.ie/colleges-and-schools/arts-social-sciences-and-celtic-studies/geography-archaeology-irish-studies/disciplines/archaeology/research/ireland-atlantic-europe/craftingtheknowthmacehead/>

e) How will you continue to communicate the results of your project and what are your publication plans?

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15. How did the award enhance your professional development (e.g. in terms of specific opportunities, opportunities for enhancing skills, collaborations with others etc.)?

Experimental archaeology is a new departure for me, but I was able to draw on my previous work experience and hobbies – architectural technician, survey and technical drawing, architectural model making, butchery (not a hobby), woodworking, wood carving and stone sculpture - towards a feasible approach to the task and in the design and making of some equipment and tools used in the project. The project also presented an opportunity to meet and work alongside a number of experts from different fields, within and without the archaeological profession. This research project is unlikely to develop my career significantly or present promotional opportunities, but it has been a truly rewarding and engaging experience. I have forged new friendships and re-established old acquaintances. It has enhanced my personal, more so than my professional development. I would hope that I am a better all-round archaeologist as a result.

16. What plans (if any) do you have to further your proposal/project?

The project has achieved many of its aims over a relatively short period of time. We had originally scheduled one additional workshop related to wheel engraving but unfortunately Fred became ill in August and has been in hospital since. He is making strides towards recovery and hopes to reengage with the project just as soon as he is able. For this reason the allocated funds of €1,750 have not been fully spent.

We would hope to reapply for a small RIA Archaeology Grant in 2023 to complete some outstanding work and pursue some additional strands of research. I would like, for instance, to construct a bow-powered cutting wheel and test its effectiveness on a nodule of flint. This would be similar to a bow-drill but set on a horizontal axis. Fred is also keen to make a reproduction of the Knowth macehead in flint and/or crystal glass using modern wheel technology. The 3D renderings of the macehead in Sketchfab and the 3D-print of the artefact will serve as a particularly useful template from which to work. This phase of experimental research should give some indication of the size and shape of wheels that were required to produce the surface ornamentation on the Knowth macehead. This exercise might also provide some additional opportunities to publicise the results of the research to the wider public.