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New digital map reveals stunning hidden archaeology of Stonehenge

A host of previously unknown archaeological monuments have been discovered around Stonehenge as part of an unprecedented digital mapping project that will transform our knowledge of this iconic landscape – including remarkable new findings on the world's largest 'super henge', Durrington Walls.

The Stonehenge Hidden Landscapes Project, led by the University of Birmingham in conjunction with the Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology, is the largest project of its kind.

Remote sensing techniques and geophysical surveys have discovered hundreds of new features which now form part of the most detailed archaeological digital map of the Stonehenge landscape ever produced. The startling results of the survey, unveiled in full at the British Science Festival, include 17 previously unknown ritual monuments dating to the period when Stonehenge achieved its iconic shape. Dozens of burial mounds have been mapped in minute detail, including a long barrow (a burial mound dating to before Stonehenge) which revealed a massive timber building, probably used for the ritual inhumation of the dead following a complicated sequence of exposure and excarnation (defleshing), and which was finally covered by an earthen mound.

The project has also revealed exciting new – and completely unexpected – information on previously known monuments. Among the most significant relate to the Durrington Walls 'super henge', situated a short distance from Stonehenge. This immense ritual monument, probably the largest of its type in the world, has a circumference of more than 1.5 kilometers (0.93 miles).

A new survey reveals that this had an early phase when the monument was flanked with a row of massive posts or stones, perhaps up to three metres high and up to 60 in number – some of which may still survive beneath the massive banks surrounding the monument. Only revealed by the cutting-edge technology used in the project, the survey has added yet another dimension to this vast and enigmatic structure.

Work also revealed novel types of monument including massive prehistoric pits, some of which appear to form astronomic alignments, plus new information on hundreds of burial mounds, Bronze Age, Iron Age and Roman settlements and fields at a level of detail never previously seen. Taken together, these results – which will be featured in a major new BBC Two series titled *Operation Stonehenge: What Lies Beneath* – show that new technology is reshaping how archaeologists understand the landscape of Stonehenge and its development over a period of more than 11,000 years.

In the year marking the centenary of the First World War, the new Stonehenge map even impacts on our knowledge of that momentous event. Surveys have produced detailed maps of the practice trenches dug around Stonehenge to prepare troops for battle on the western front, as well as maps of RAF/RFC Stonehenge – one of Britain's first military airbases used by the Royal Flying Corps between 1917 and 1920.

British project leader Professor Vincent Gaffney, Chair in Landscape Archaeology and Geomatics at the University of Birmingham, said: 'The Stonehenge Hidden Landscapes Project is unique at a global level. Not only has it revolutionised how archaeologists use new technologies to interpret the past, it has transformed how we understand Stonehenge and its landscape.'

'Despite Stonehenge being the most iconic of all prehistoric monuments and occupying one of the richest archaeological landscapes in the world, much of this landscape in effect remains *terra incognita*.

'This project has revealed that the area around Stonehenge is teeming with previously unseen archaeology and that the application of new technology can transform how archaeologists and the wider public understand one of the best-studied landscapes on Earth.'

'New monuments have been revealed, as well as new types of monument that have previously never been seen by archaeologists. All of this information has been placed within a single digital map, which will guide how Stonehenge and its landscape are studied in the future.'

'Stonehenge may never be the same again.'

Professor Wolfgang Neubauer, Director of the Ludwig Boltzmann Institute, said: 'Developing non-invasive methods to document our cultural heritage is one of the greatest challenges of our time and can only be accomplished by adapting the latest technology such as ground-penetrating radar arrays and high-resolution magnetometers. The developments of the Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology (LBI ArchPro) offer Europe the opportunity to carry out fundamental archaeological research at a scale and precision never previously attempted.'

'No landscape deserves to benefit from a study at this level of detail more than Stonehenge. The terabytes of digital survey data collected, processed and visualised by LBI ArchPro provide the base for the precise mapping of the monuments and archaeological features buried in the subsurface or still visible in the landscape surrounding Stonehenge. After centuries of research, the analysis of all mapped features makes it possible, for the first time, to reconstruct the development of Stonehenge and its landscape through time.'

The Stonehenge Hidden Landscapes Project is a collaboration between the University of Birmingham; Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology, Vienna and its international partners; University of Bradford; University of St Andrews; and the 'ORBit' Research Group of the Department of Soil Management at the University of Ghent, Belgium.

The project operates under the auspices of the National Trust and English Heritage.

Dr Nick Snashall, National Trust Archaeologist for the Avebury and Stonehenge World Heritage Site, said: 'Using 21st-century techniques, the Stonehenge Hidden Landscapes team have transformed our knowledge of this ancient, precious and very special landscape. Their work has revealed a clutch of previously unsuspected sites and monuments showing how much of the story of this world-famous archaeological treasure house remains to be told.'

Dr Heather Sebire of English Heritage, Curator of Stonehenge, said: 'This is such an exciting project. The surveys will help us form an understanding of possible new sites which have not been recorded before but which will need further investigation.'

Operation Stonehenge: What Lies Beneath is due to be broadcast on BBC Two at 8pm BST on Thursday 11 September. The documentary will also be broadcast in the US (Smithsonian Channel), Canada (CBC), Austria (ORF), Germany (ZDF) and France (France 5).

ENDS

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Images are available to download [here](#).

Video clips featuring interviews and general footage are available to download [here](#) and [here](#).

Notes to editors

The Stonehenge Hidden Landscapes Project (2010–14)

<http://lbi-archpro.org/cs/stonehenge/index.html>

The Stonehenge Hidden Landscapes Project has brought together experts in non-invasive geophysical prospection and remote sensing, and specialists in British prehistory and landscape archaeology in order to carry out one of the most sophisticated single archaeological projects in Europe. The outstanding geophysical survey and visualization capabilities of the team has been made possible only because of the unique expertise and combined resources of the project partners, the Digital Humanities Hub and Department of Classics, Ancient History and Archaeology at the University of Birmingham; the Ludwig Boltzmann Institute for Archaeological Prospection & Virtual Archaeology (LBI Arch Pro) in Vienna and its European partners; the Division of Archaeological, Geographical and Environmental Sciences at the University of Bradford; the Department of Earth Sciences at the University of St Andrews; and the Soil Spatial Inventory Techniques Research Group at the University of Ghent.

This project aimed to address gaps in our knowledge and understanding of the Stonehenge landscape by conducting a cutting-edge geophysical and remote sensing survey at an unprecedented scale and resolution. Beginning in July 2010, the fieldwork took about 120 days, spread over four years. Cutting-edge geophysical technologies, applied at an unprecedented spatial scale and resolution using multiple motorized magnetometers, ground-penetrating radar arrays, electromagnetic induction sensors, earth resistance surveys and terrestrial 3D laser scanners, have revealed the landscape of Stonehenge through the largest and most detailed archaeological prospection project.

The results of the survey project are used to create a highly detailed archaeological map of the 'invisible' landscape, providing the basis for a full interpretative synthesis of all existing remote sensing and geophysical data from the study area. For the first time, it will therefore be possible to create total digital models of the Stonehenge landscape at a true 'landscape scale' that will not only transcend the immediate surrounds of individual monuments within the study area but will also tie them together within a seamless map of sub-surface and surface archaeological features and structures.

The Stonehenge Hidden Landscapes Project is supported by the work of numerous young researchers and remote sensing and archaeological specialists. These include Klaus Löcker, Mario Wallner and Dr Geert Verhoeven (Austria), and Eamonn Baldwin, Henry Chapman, Paul Garwood and Dr Eugene Ch'ng (UK).

The Stonehenge Hidden Landscapes Project is a collaborative work carried out under the auspices of the National Trust and English Heritage.

About the British Science Festival

The British Science Festival is one of Europe's largest science festivals and regularly attracts over 350 of the UK's top scientists and speakers to discuss the latest developments in science with the public. Over 50,000 visitors attend the talks, discussions and workshops. Registration is free for journalists and gets you access to hundreds of free events. To register, please click [here](#). The Festival takes place at a different location each year and was last held in Birmingham in 2010. The 2014 Festival will take place from 6 - 11 September hosted by the University of Birmingham. For further information, visit www.britishsciencefestival.org @BritishSciFest #BSF14

About the British Science Association

The British Science Association (BSA) believes that science should be part of – rather than set apart from – society and culture, and is owned by the wider community. Our programmes encourage people of all ages and backgrounds to engage with science, become ambassadors for science, and ultimately to be empowered to challenge and influence British science - whether they work in science or not. Established in 1831, the BSA is a registered charity that organises major initiatives across the UK, including National Science & Engineering Week, the annual British Science Festival, regional and local events, the CREST Awards and other programmes for young people in schools and colleges. The BSA also organises specific activities for professional science communicators, including a specialist conference and training. For more information, please visit www.britishscienceassociation.org

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Department of Earth and Environmental Sciences
(<http://earthsci.st-andrews.ac.uk/>)
ORBit University of Ghent
(<http://www.ugent.be/bw/soilmanagement/nl/onderzoek/bodeminventarisatietechnieken-orbit>)
The National Trust (<http://www.nationaltrust.org.uk>)
English Heritage (<http://www.english-heritage.org.uk/>)

Biographies and quotes

Professor Vincent Gaffney

Professor Vincent Gaffney is Chair in Landscape Archaeology and Geomatics at the University of Birmingham. Vince has worked in many parts of the world, including Italy, Croatia and the United States. Past projects include the Wroxeter Hinterland Project, which carried out the first comprehensive geophysical survey of a major Roman town in Britain. He also led the team mapping the vast prehistoric landscapes that now lie beneath the southern North Sea. Recent research projects include the study of what may be the world's earliest time reckoner at Warren Field in Aberdeenshire. Professor Gaffney is also a member of the teams that scanned the mausoleum of Diocletian in Split and, with Princeton and Durham, are creating an agent-based model of the Byzantine army that marched to the battle of Manzikert in 1071.

'The Stonehenge Hidden Landscapes Project is unique at a global level. Not only has it revolutionised how archaeologists use new technologies to interpret the past, it has transformed how we understand Stonehenge and its landscape. Despite Stonehenge being the most iconic of all prehistoric monuments and occupying one of the richest archaeological landscapes in the world, much of this landscape in effect remains terra incognita. This project has revealed that the area around Stonehenge is teeming with previously unseen archaeology and that the application of new technology can transform how archaeologists and the wider public understand one of the best-studied landscapes on Earth. New monuments have been revealed, as well as new types of monument that have previously never been seen by archaeologists. All of this information has been placed within a single digital map, which will guide how Stonehenge and its landscape is studied in the future. Stonehenge may never be the same again.'

Professor Wolfgang Neubauer

Wolfgang Neubauer studied Prehistoric Archaeology, Mathematics, Archaeometry and Computer Science at the University of Vienna and the Vienna University of Technology. He specialises in archaeological prospecting, digital documentation and virtual reality

visualisation of archaeological heritage. Wolfgang has carried out archaeological research on sites all over the world for over 25 years, has coordinated many national and international research projects, and is currently Director of the Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology (LBI ArchPro). His recent research focused on the development of hardware and software for non-invasive, large-scale efficient geophysical exploration of archaeological landscapes at unprecedented resolutions. Besides the survey in Stonehenge, he is focusing on large-scale surveys of Viking Age sites and landscapes in Scandinavia. He is currently directing the detailed prospection of Roman Carnuntum (Austria) after the detection of the unique school of gladiators in 2011, the largest geophysical survey ever attempted to explore a Roman site.

'Developing non-invasive methods to document our cultural heritage is one of the greatest challenges of our time and can only be accomplished by adapting the latest technology such as ground-penetrating radar arrays and high-resolution magnetometers. The developments of the Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology (LBI ArchPro) offer Europe the opportunity to carry out fundamental archaeological research at a scale and precision never previously attempted. No landscape deserves to benefit from a study at this level of detail more than Stonehenge. The terabytes of digital survey data collected, processed and visualised by LBI ArchPro provide the base for the precise mapping of the monuments and archaeological features buried in the subsurface or still visible in the landscape surrounding Stonehenge. After centuries of research, the analysis of all mapped features makes it possible, for the first time, to reconstruct the development of Stonehenge and its landscape through time.'

Dr Christopher Gaffney

Chris Gaffney was appointed to the staff at Bradford in October 2007. His link with Bradford goes back to the 1980s, as he undertook both undergraduate and postgraduate degrees at this university. Having completed doctoral research (in Earth Resistance), Chris formed a commercial archaeological geophysical company with John Gater. Subsequently, GSB Prospection became the largest group working in Britain, and in the summer of 2007 Chris was awarded an Honorary Doctorate for popularising archaeological geophysics via Time Team and other media opportunities. His research interests include developing commercial avenues while reducing the environmental footprint of prospecting devices. His most recent project is DART, which investigates changes in physical properties that allow detection using remote sensing.

'The Stonehenge Hidden Landscape project is the pinnacle of a recent trend to apply new and rapid technologies to collect accurate non-invasive data for mapping the buried heritage. In many respects, the Stonehenge project goes far beyond any other project – both in the complexity of the data sets generated but also in the immense impact it will have on our understanding of Britain's greatest and best-known archaeological site. Archaeology studies the past, but, in the application of remote sensing at this scale, the Stonehenge Hidden Landscapes Project demonstrates how future researchers will investigate our archaeological heritage. Increasingly, the investigation and understanding of iconic sites across the globe will be enhanced by rapidly mapping the larger-scale environment that they have come to dominate.'

Dr Richard Bates

Richard Bates is an applied geophysicist working in the Department of Earth and Environmental Sciences, University of St Andrews. Richard began his career in industry using geophysical methods to solve exploration and environmental problems. However, on his return to academia he has concentrated on developing techniques for application in a range of applied fields including exploration of buried and drowned archaeological landscapes. Current projects include investigations of the World Heritage Sites of Orkney, the ancient human discoveries in Norfolk and lost landscapes of the North Sea.

'We can think of applied geophysics as the modern eyes and ears of science for discovering what is hidden beneath the Earth's surface. The absolute latest in geophysical developments are being applied and showcased at Stonehenge and we can see the results of this in the new discoveries. What is really exciting is that these tools give us the opportunity to link actual find sites intimately to the landscapes that they were built in and used within.'

Professor Marc Van Meirvenne of Ghent University, Belgium

'Thanks to the Stonehenge Hidden Landscapes Project we were able to apply a novel non-invasive soil sensor within the landscape surrounding the Stonehenge monument. This soil sensor is less common in archaeological prospection and therefore we were able to provide an added value to the measurements conducted by the archaeological teams of Birmingham and Vienna. This project represents a major step forward in the way archaeologists and soil scientists can collaborate to unravel the complex stories hidden in our soil.'

Dr Nick Snashall, National Trust Archaeologist for the Avebury and Stonehenge World Heritage Site

'Using 21st-century techniques, the Stonehenge Hidden Landscapes team have transformed our knowledge of this ancient, precious and very special landscape. Their work has revealed a clutch of previously unsuspected sites and monuments showing how much of the story of this world-famous archaeological treasure house remains to be told.'

Dr Heather Sebire of English Heritage, Curator of Stonehenge

'This is such an exciting project. As scientific archaeological techniques develop, it is possible to gain so much information about an archaeological site without excavation. The surveys will help us form an understanding of possible new sites which have not been recorded before but which will need further investigation. The results are eagerly awaited by everyone involved with Stonehenge, from academic researchers to site staff and the general public. We were very pleased that the sponsors of this project were interested in finding out more about the complex iconic site that is Stonehenge and its landscape.'

Institutions

University of Birmingham

The Digital Humanities Hub, with the Department for Classics, Ancient History and Archaeology at Birmingham, supports academic research and application development for heritage and the humanities. Using state-of-the-art technology in the Michael Chowen and Garfield Western Prototyping Hall, staff provide unparalleled opportunities for research, postgraduate and professional training in archaeology, the humanities and associated disciplines.

The Ludwig Boltzmann Institute for Archaeological Prospection and Virtual

Archaeology is a research institute of the Austrian Ludwig Boltzmann Gesellschaft and was founded in 2010. The institute carries out its research activities together with several international partner organisations and aims to create a network of archaeological scientists supporting interdisciplinary research programmes for the development of large-scale, efficient, non-invasive technologies for the discovery, documentation, visualisation and interpretation of Europe's archaeological heritage. The lead partners of the institute based in Vienna are the University of Vienna, the Vienna University of Technology, ZAMG (the Austrian Central Institute for Meteorology and Geodynamics), 7-reasons, ABT-Airborne Technologies, the Province of Lower Austria, RGZM-Roman-Germanic Central Museum Mainz, RAÄ-Swedish National Heritage Board, the University of Birmingham, Vfk-Vestfold Fylkeskommune and NIKU-Norwegian Institute for Cultural Heritage Research.

Division of Archaeological, Geographical and Environmental Sciences

The Division of Archaeological, Geographical and Environmental Sciences uniquely integrates Archaeological Sciences, Geography, Environmental Sciences, Biological Anthropology and Forensic Sciences in a single profoundly multidisciplinary department bridging the sciences and the humanities. In Archaeological Sciences, a unique mix of scientists, archaeological scientists and archaeologists focus on several areas: the analysis and interpretation of material culture; environmental archaeology; the analysis of contact and interaction between societies; and archaeological chemistry, biochemistry and geophysics.

Department of Earth Sciences at the University of St Andrews

The Department of Earth Sciences at the University of St Andrews carries out research addressing the profound questions about the co-evolution of Earth and life and with an emphasis on delivering societal and economic impact. It spans the study of recent environmental change to Earth System evolution in Deep Time, all underpinned by a suite of state-of-the-art analytical and field facilities.

Ghent University, Belgium

The research unit 'ORBit' of the Department of Soil Management at Ghent University, Belgium, specialises in techniques to inventory soil properties, including the identification of buried anthropogenic phenomena. Over the past 15 years it has acquired a strong specialisation in the use of mobile non-destructive soil sensors, especially with electromagnetic induction. This unit is a collaborative partner of LBI ArchPro and has conducted three surveys at Stonehenge over the past three years in collaboration with the University of Birmingham, covering in total about one square mile. This research is ongoing.

The National Trust cares for over 73,000 archaeological sites, making it the largest privately owned collection in England, Wales and Northern Ireland. The Trust's archaeologists are involved in projects across all areas of the organisation, including historic houses, gardens, parks, coast, woodland and countryside, from a huge range of periods – <http://www.nationaltrust.org.uk>.

Within the Stonehenge World Heritage Site, the National Trust manages 827 hectares (2,100 acres) of downland surrounding the famous stone circle. Walking across the grassland, visitors can discover other prehistoric monuments, including the Avenue and King Barrow Ridge with its Bronze Age burial mounds - <http://www.nationaltrust.org.uk/stonehenge-landscape/>