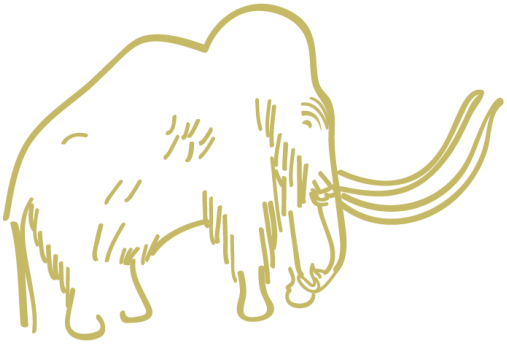

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III-1 (T). New advances in theoretical archaeology

Agency revisited: human action under an ethical spotlight.

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It is strange that one of the most popular concepts in archaeology, agency, remains one of the most understudied, especially in historical terms. In current scholarship, agency is based largely on the work of scholars like Anthony Giddens and Bruno Latour. Following these thinkers, agency is understood as a universal feature of humanity, granting free will and intentionality to humans (Giddens). Agency is also conceived in some circles, as an ontological aspect of the world distributed among humans and non-human objects (Latour). In both these conceptions of agency, the historical link between agency and ethics is overlooked, even though agency, and its associated concepts, can be traced to Aristotle's practical ethics, scholastic philosophy's notion of teleology, and Kant's and Hegel's work on normativism, laws, and ethics. This paper aims at making four interrelated points: 1) agency became an important concept from the enlightenment onwards when it became clear that human action could not be explained under religious concepts; 2) the ideals of western Liberalism and the French Revolution were essential towards establishing the human as a free agent and as a political, ethical, and economic subject; 3) agency is an ethical concept through and through and cannot be understood except in ethical terms. As argued by Hegelian scholars, the freedom of action understood in agency theory requires that the agent recognize the action as his or her own. Owning an action means that one has chosen the responsibility that comes with action; 4) finally, if agency is ultimately ethical in conception, this means that the study of agency in archaeology should be the study of past societies as ethical systems, that is to say, a study of social norms and institutions and how these can provide freedom of action.

Keywords: Agency, freedom, ethics, responsibility, normativism

*Speaker

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The archaeology of processes

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Since the nineties, Archaeology is mostly influenced by postmodern approaches, despite the fact that most of the new methodological advances since the beginning of the sixties are issued from exact sciences (physics, chemistry, mathematics, genetics and computer science) and earth sciences (geoarchaeology, archaeobotany, palaeoclimatology). Quite thirty years after, a postmodern archaeology is resulting only in the deconstruction of archaeology, rightly or wrongly, and the emergence of an activist archaeology. A new cognitive framework is then expected by scientific archaeologists.
The archaeology of processes, or Neoprocessual archaeology, is a theoretical approach focusing on the role of processes in major fields of archaeology like :

- business process of archaeology

- taphonomic processes of archaeological sites, taphonomic processes in archaeozoological and archaeobotanic studies,

- socio-cultural processes : manufacturing process, building design process, food resource management process, economic process, cultural change process, adaptation to climatic change process, governance process, societal attitude process, sacralization process, etc.
The approach by the processes allows replacing the XIX century typological approach of Montelius and "New Archaeology" approaches by an approach directly associated with systemic analysis, business process management (BPM), modeling by Petri network graphs, multidimensional data analysis and multi-agent systems.

Keywords: theoretical archaeology, process, systemic analysis

*Speaker

Epistemology and the posthuman turn: a critique of the function attributed to 'theory' in the latest archaeological models

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In their latest article, ora Petursdottir and Bjørnar Olsen (2017) write: 'Like drift matter on an Arctic shore, theories are adrift. They are not natives of any particular territory, but nomads in a mixed world'. They then continue to compare the theories' adrift-ness with that of wood lying on a beach shore, which in turn prompts a meditation on 'hybrid assemblages' and ultimately a posthuman condition. While this text makes an enjoyable poetic reading, it is rather representative for a number of works which raise important epistemological concerns-works that have been labelled under the banner of 'the new ontological turn'. These strands of thought have permeated archaeology via the works of Gilles Deleuze, Bruno Latour, Donna Harway, Viveiros de Castro or Manuel DeLanda. However, from a philosophy and history of science perspective the above assertions are highly problematic. Caught between ontological axioms and 'practice focused' approach, many of the new materialist/posthuman attempts end up as being mere poetic reflections, but with very little to add in terms of understanding what have made past assemblages be as they are. It is my goal in this paper to discuss what I see as the main problems for how archaeology frames its relation to the past in light of such works: (1) they raise important epistemological concerns, as they are advancing a world-view which has no criterion for validation or evaluation of the advanced hypothesis; (2) these accounts fail at what philosophers of science would call the generative properties of a hypothesis (they seem to fail at opening up an inquiry to the elaboration of further hypothesis; instead, the focus seems to be on elaborate descriptions); (3) they seem to be using traditional archaeological concepts-agency, theory, context,- with a different, often times unhelpful or ambiguous, meaning. Ultimately, the implication is that while militating for a more inclusive ontological perspective, in reality they fall short exactly in providing a room for acknowledging the alterity of the past. Therefore, I take their case as a starting point for a critique of the function attributed to 'theory' in the latest strands of thought in archaeology.

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Keywords: postumanism, archaeology, theory, epistemology, philosophy

*Speaker

Post-Pleistocene Adaptations in North-Central India as a Case Study to Evaluate Binford's Predictive Model based on Ethnographic Analogy

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Mobility, a near-universal phenomenon from prehistoric times, was affected by palaeoclimatic changes since the Pleistocene-Holocene interface. Based on contemporary cross-cultural data compiled in Murdock's Ethnographic Atlas, Lewis Binford proposed a predictive model on prehistoric hunter-gatherer adaptation explaining settlement pattern as a latitude-dependent phenomenon. Accordingly, there is greater likelihood that foragers of temperate and still colder conditions (effective temperature, ET < 15oC) would follow a 'logistic' mobility pattern as annual resource distribution is clumped one. In contrast, those in warmer regions of Asia and Africa, for example, where resource distribution is year round in different pockets shall follow residential mobility pattern, which is consistent with the consensus agreed upon in Man the Hunter symposium (1968).

By way of testing the above hypothesis, the problem of prehistoric adaptations in sub-tropical north-central India (ET > 15 oC) was re-evaluated as a case study. The area of study consists of topographically heterogeneous regions of the central Ganga plains and its southern region of the Vindhyan plateau and hills. On the basis of excavations at early Holocene Mesolithic site of Sarai-Nahar Rai in the Ganga valley, characterized by regular onsite, human burial practices, a region devoid of natural rocks, G. R. Sharma had proposed a 'seasonal migration' hypothesis of people between stone-rich Vindhyas and the Ganga valley, especially during summer months when resources were scarce in the former region to support rising populations. This was consistent with Binford's above prediction. However, later excavations at sites like Mahadaha and Damdama with thicker occupational deposits somehow opened way for a different explanation. The common features of the three excavated sites include onsite burial practice, the existence of bone/antler tools and objects, and near-exhausted lithic cores of Vindhyan origin. The study of faunal remains from these sites – ageing of teeth of two species of deer (Axis porcinus and Cervus duvauceli duvauceli) suggests a near-year round occupation at Mahadaha and Damdama, which is further corroborated by the regular occurrence of remains of bandicoot rat. Finally, the grave orientation pattern confirms the year-round occupation pattern. The study also suggests the existence of inter-group complementarity reflected by the flow of stone raw materials from the Vindhyas in exchange for Gangetic local products (bone tools, for example).

This study, thus, highlights the weaknesses of New Archaeological approaches on the use of ethnographical analogy in the reconstruction of the past.

*Speaker

Keywords: 'logistic' mobility, early Holocene Mesolithic, central Ganga plains, India

Revisiting Symbolic Archaeology in Search for a Theory of Connectedness

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Professional archaeology, in general, and theoretical archaeology, in particular, constitutes an academic gift of the West to world cultures. There has been enormous progress in archaeological theory in western circles over the past six decades. All of it was largely rooted in Western modernity with two striking points of focus – 'identity' and 'nationality' (i.e. bounded regionality) that have only added to cultural fragmentation leading to sufferings rather than connectedness. According to Frank Ankersmit, trauma and suffering constitute one of the forgotten sources of Western historical consciousness, later ignored in both historical and archaeological discourses. Can we not introduce debates in archaeological theory to such universal issues that connect all human beings? The phenomenological moment in the 1990s-2000s, re-evaluating themes of post-processual archaeology from 'within', has been a welcome departure towards re-introspection and incorporation of ideas from diverse cultures. Despite adopting Western modernism with doubtful success, Indian culture has had a strong prehistoric/Pagan foundation. The four-fold logical system in ancient Indian Classical civilization, wider in scope than what one finds in modernity, has the potential to improve upon 'symbolic archaeology' that is prone to some interrogations from 'without'. An attempt is being made here to incorporate ideas, within the wider framework of phenomenology, on routine human experiences from prehistoric past – periodicity of movement (outgoing-homecoming; action-rest) – which got reflected in a simple sign of crossroad (+) in prehistoric paintings world over. It will be argued with illustrations how this powerful sign with four arms (having spatio-temporal dimensions) meeting at a dimensionless point of intersection was the foundational idea or 'archetype' behind the architectural shrines of Buddhism, Jainism and different sects of Hinduism in ancient India and other parts of Asia, thus showing the common phenomenological roots of apparently diverse sets of belief systems; in short connectedness. The 'dynamic' crossroad symbol is also related to the problem of human suffering in the world and ways to overcoming it; it also symbolizes existential philosophy. Thus, any 'theory for future' has to focus on cultural connection between West and East; North and South – to ensure a brighter future of mankind. It will be argued in the end, in the light of David Bohm's interpretation of the famous EPR experiment in modern physics, that 'connection' is inbuilt in nature; it is certain cultural forces that deny it for socio-political purposes. Archaeology cannot be part of that disruptive force.

Keywords: Symbolic archaeology, cross, roads, archetype, connectedness

*Speaker

Property and wealth inequality as cultural niche construction: a review

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In an earlier paper I took an evolutionary ecology perspective on understanding the power and wealth inequalities in human societies assuming that wealth and power are not ends in themselves but proximate goals that contribute to the ultimate Darwinian goal of achieving reproductive success. The most successful means of achieving it in specific times and places depend on local conditions and these have changed in the course of human history, to such an extent that strategies focused on the maintenance and increase of wealth can be more successful in reproductive terms than strategies directed at maximizing reproductive success in the short term. I suggested that this shift can be seen as a process of evolutionary niche construction related to the increasing importance of fixed and defensible resources in many societies after the end of the last Ice Age. The paper will review these ideas in the light of archaeological and anthropological work that has taken place since it was published.

Keywords: evolutionary ecology, reproductive success, inequality, niche construction

*Speaker

III-1 (CA). Big Data, databases and archaeology

Cagny-l'Épinette (Somme valley, France), thirty years of mixed data: potential and limits.

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Belonging to the third alluvial terrace of the Somme Valley, Cagny-l'Épinette has provided numerous archaeological layers in each the alluvial deposits and the loess cover. These levels include well preserved acheulean assemblages - lithic industries and faunal remains - embedded in the alluvium (MIS 10 and MIS 9) and Middle Palaeolithic industries in the cover (MIS 8 to MIS 5e).

From 1980, year of the first test trenches, to the last planned campaign in 2010, this site has been excavated for thirty years during a period at which the archaeology was subject to the emergence of the computerization concerning the data recording and management. Due to this evolution, an adaptation of the process regarding the data acquisition was conducted at Cagny-l'Épinette in the early nineties with the introduction on the field of a Leica Electronic Theodolite. Such an adjustment in the protocol has thus yielded a large amount of archaeological data, manual and computerized (field drawings and books, film and digital photography, Leica recordings), enriched by the databases of the lithicians and archaeozoologists.

In order to undertake the study of the acheulean levels, the data gathering started in 2013 and was completed as part of a Ph.D. topic initiated in 2016 about the spatial identification of the activities during the Lower Palaeolithic. For that purpose, a methodology involving computer tools in a combined manner - in particular ArcGIS (Geographic Information System software) and eCognition (image analysis software) - has been applied so as to gather, homogenize and link the spatial information with the qualitative data.

Through the instance of the site of Cagny-l'Épinette, this presentation intents to propose a reflection about the methodological possibilities of management and exploiting of such diversified

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data obtained through different protocols. It intents to highlight the potential and the limits of the unified archives for the very purpose of studying archaeological layers in palaeoethnological terms.

Keywords: Data management, data exploiting, Image Analysis, Geographic Information System, Cagny, l'Épinette, Lower Palaeolithic

Big Data et archéologie : l'enjeu du futur

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Longtemps, l'archéologie a été une science de l'objet avant de devenir après les années 1960, une science de l'information des sociétés du passé. Cette information était dans les bibliothèques, qui conservaient précieusement les monographies de sites archéologiques et les corpus d'objets. Puis l'informatique arriva, et cette information se retrouva d'abord dans des fichiers, dont la documentation se retrouva en ligne. La correspondance scientifique se transmua en messagerie et le tiré à part en fichier pdf. Puis la numérisation s'accéléra, qui engendra pour l'archéologie les mesures physico-chimiques, la prospection géophysique, la cartographie, le système d'Information Géographique, la photographie numérique, la numérisation des photographies argentiques, le film numérique, et enfin le 3D avec la réalité virtuelle et la photogrammétrie numérique. Devant cette marée de données, il faut stocker, organiser, indexer, retrouver et surtout conserver, en tenant compte des technologies qui se renouvellent à un rythme rapide et des normes qui facilitent la compatibilité. L'enjeu est de taille car la fonction d'archivage est la dernière pierre du système d'information archéologique, dont elle dépend car il produit les données dont elle aura la charge.

Keywords: big data, archéologie

*Speaker

How Big is Big Data: An Archaeological Computing Perspective

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The paper illustrates the advent of Big Data in archaeology from a historical point of view. The shift in scale of data volume in archaeology and the consequent use of new methods and techniques are not a new phenomenon. The history of archaeological computing is scattered by periods of information growth, which in general coincide with important stages for both the dissemination of historic and scientific culture and the advent of new technologies. Three main periods can be identified:
The 1960s – In the early 1960s, at Ispra (VA, Italy) EURATOM Laboratories, the Centre Européen de Traitement de l'Information Scientifique (CETIS) soon became an attraction pole for scholars interested in the automatic processing of scientific documentation. In this stimulating interdisciplinary milieu, where engineers and mathematicians worked together with social and humanities scholars, the foundations for computer applications and for the development of Information Retrieval Systems in archaeology were laid.

The 1990s – In the mid-1990s the advent of the Internet, with its new communication philosophy, dramatically changed data dissemination paradigms and archaeology was faced with the new challenge of the "Information Age". The increasing availability of digital research data elaborated during long-lasting excavations or collected in large databases, their integration within a GIS platform and their representation thanks to 3D modelling techniques provided archaeologists with new insights.

From 2010 onwards – The first decades of the new Millennium are characterised by the open access movement and the explosion of available data, which together led to the spreading of the Big Data concept, generating some questions about how it can be related to and instrumental in archaeology.
Several archaeological case studies will be illustrated and, through the analysis of some specific methods and systems and of extensive bibliographic references, the paper will end with an attempt to propose a definition of Big Data and large datasets, their nature and dimension from an archaeological perspective. An appraisal of the role of Big Data as a resource and an analytical tool affecting our knowledge and interpretation of complex cultural and historical phenomena will also be discussed.

Keywords: Archaeology, Archaeological Computing, Big Data

*Speaker

Analyzing large collections of Neolithic pottery from the Sozh River basin (Eastern Belarus)

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Active excavations of the Neolithic sites in the Sozh River basin were conducted by A. Kalechyts in the 1970s and 1980s. Following the tradition prevalent at that time, the researcher focused primarily on the accumulation of archeological sources, while the analysis and interpretation of the material were given less attention. After a significant part of the region became unavailable for fieldwork in connection with the accident at the Chernobyl nuclear power plant in 1986, the interest in collected materials was lost.

The study with these collections is complicated by several factors. Voluminosity – more than 20 thousands potsherds from five main sites – is among them. The further issues are that they came from non-stratified sites and were obtained with the old method.

Another problem the author faced is which category should act as a unit of counting – a potsherd or a vessel. Fragmentation of pottery complicates the reconstruction of complete shapes of vessels. The advantage of the material is that each vessel had its own specific features. There was no mass production of earthenware in the territory of Belarus during the Neolithic. With a close look at the collections, it was easy to identify potsherds belonging to a separate vessel. The analysis made it evident that it was the vessel, not the potsherd, should be the basic unit when analyzing such kind of collections.

Each vessel should be considered as a separate phenomenon with its own characteristic features. On the other hand, the Neolithic vessel is a complex system of features, for the documentation and further analysis of which computer methods should be used.

The statistical methods (cluster analysis, correspondence analysis etc.) were employed for determination the hidden links between the variables included in the analysis. These methods have been employed for the first time for such large pottery collections in Belarus.

The study resulted in distinguishing of the really existing types of pottery which reflect the cultural situation in the region. The revised periodization of the Neolithic of the Eastern Belarus was developed on the basis of the new typology.

Keywords: Pottery, the Neolithic, databases, Belarus

*Speaker

SignBase: Creating a database for abstract motives in the Upper Palaeolithic

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In Palaeolithic art, abstract motives - often referred to as "signs" - are extremely abundant. They appear in parietal as well as mobile art. Many researchers proposed interpretations for the abstract motives in parietal art (e.g. Breuil 1952; Clottes and Lewis-Williams 1998; Leroi-Gourhan 1965; Sauvet and Wlodarczyk 1995; von Petzinger 2016), but there are fewer studies on mobile objects (e.g. Hahn 1986; Marshack 1991), although the "signs" often constitute the majority of the assemblages of motives (see Vialou 1986).
SignBase is a project at the University of T´ubingen, harnessing the wealth of abstract motives on mobile art of the Swabian Jura in particular (Dutkiewicz 2017; Dutkiewicz and Conard 2017; Dutkiewicz, et al. 2017), but also extending to the European Upper Palaeolithic in general. Currently, more than 500 objects (mainly Aurignacien, Gravettien), carrying several thousand abstract motives, are registered in SignBase. Our aim is to create an openly available interface, as well as developing classification algorithms that will allow us to study the "signs" geographically and chronologically. Furthermore, while any inference about their meaning is inevitably speculative, information-theoretic analyses can shed light on the evolution of their information encoding potential, and compare it to later graphical behaviour such as early written language.

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Keywords: Abstract motives, Palaeolithic, Mobile art, Information, theoretic analyses

ABCData, an online palynological and anthracological database: for a new approach to the vegetation history

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Palaeoenvironmental records, which represent a rich amount of information, set complex problems of data management. Thus, they need to be stored within an appropriate device, such as an online RDBMS. Indeed, several European bioarcheological database projects already exist but they don't concern anthracological and palynological records. For these reasons, we decided to gather the palynological and anthracological results of the investigatory works carried out among the UMR 6566 CreAAH of Rennes. Afterwards, we built an online relational database whose aims were to allow palaeoenvironmentalists to record, read and exploit this information. The database, called ABCData (for Archeology, Biodiversity, Chronology Data), was created using the FuelPhP framework, which respects the *Hierarchical Model View Controller* architecture, and allowed us to generate the numerous files associated to the CRUD (*Create, Read, Update, Delete*) functions of the different tables. The tables are stored in a PostgreSQL database and were created through the administration PhpgAdmin interface. The user interface, (abcdata.univ-rennes1.fr), required the use of several programming languages, as well as two free libraries, PhpExcel and D3.js. The first one allows the user to import and export spreadsheets, and the second one to generate graphic representations of the archeobotanical results.

A prior attention was brought to ensure possibilities of interdisciplinary and interoperability with other palaeonvironmental remains and databases, and more specifically to foresee the problems associated to the dating and chrono-attribution of the samples, and to the taxonomic references.

The php database also permitted the construction of a palynological query interface, in association with a SVG (Scalable Vector Graphic) generator. These tools provide an interesting way of analyzing the sample data, crossing the different records and studying the impact of numerous parameters such as the topographic implantation or the sediment characteristics throughout the Holocene period.

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We conducted a series of analyses based on the palynological content of 55 sedimentary cores and 44 anthracological studies from the Paris Basin, in order to compare ABCData's performances to the synthetic history of the basin vegetation set on the empiric merging of the same data. This study revealed a great accordance between the two methods, and highlighted some bias and the necessity of permanently watching over of the statistic distribution of the samples.

Keywords: Database, Programming, Palaeoenvironment, Interdisciplinary, Visualization, bioarcheology

Isotopic Brexit: A split between the United Kingdom and the continental Europe as to isotopic studies in classical antiquity spotted by IsoArcH

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Recently, the number of isotopic studies conducted in archaeology have increased significantly. Since 2010, no fewer than 300 articles have been released in esteemed peer-reviewed journals, for a total of about 30,000 published isotope values. This is clear evidence for the dynamism of the field of study which can present challenges with regard to staying updated about the new publications relevant for one's own research. Additionally, all time periods are not subject to the same research interest and there is a difference in treatment of prehistoric versus historical periods. The historical periods, and especially the classical era, are less isotopically investigated. This fact is, nevertheless, not new, but exemplifies to the contrary, over a short period, what occurred in the last 40 years.
Here, we propose to make an assessment of the current state of isotopic research in Classics. More particularly, we are taking inventory of isotopic studies focusing on human and animal diet and mobility patterns, crop and animal management practices, and paleoenvironment changes from the Iron age to the late Antiquity across Europe. To realise this drilldown report, we are using IsoArcH (www.isoarch.eu), a new open-access web-based database that my colleagues and I developed to gather isotopic data and associated archaeological information of more than 6,000 bioarchaeological samples from the Graeco-Roman world *sensu lato*.
The results highlight the existence of a gap between the United Kingdom and the continental Europe with regard to the number of analysed samples and published isotopic data. The latter is clearly understudied compared to the British territories, spotlighting the current research questions on which the scientific community is principally focused, but also underlining the necessity to carry out more isotopic investigations in some European parts, such as France.

Keywords: Big data initiative, Open, access, Collaborative, and Georeferenced Database, Stable Isotope Analysis, Iron age, Classical Antiquity, Diet, Mobility

*Speaker

3D models and GIS on Salvage Excavations in Serbia: Implementation and Benefits

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During excavations archaeologist collect large amounts of data. Neatly classified and organized archaeological documentation enables more efficient and elaborate publications of the data. This process has proven to be time-consuming if done in a classical manner. However, there is a growing need to cut excavations shorter, due either to the pressure imposed by the building contractors during salvage excavations, or to the lack of funding provided by the government for systematic excavations. Thus, a need is created for new methods of documenting archaeological excavations, which will be both time efficient and provide all the necessary information about the excavated material. This challenge can be solved only by using the new tools and technologies. The Provincial Institute for Protection of Cultural Monuments (Serbia) conducts a series of salvage excavations every year due to the installation of a gas pipeline, construction of railways, construction of highways, and other construction projects. Faced by the problems outlined above, we developed a new system for documenting of excavated archaeological materials and architecture, based on GIS, 3D scanning and 3D modeling technology. 3D scanning and photogrammetry, represent at this moment the most progressive techniques in archaeological documentation. Combining the results of 3D models obtained with 3D scanning, and photogrammetry with the results of GIS analyzes in the process of archaeological documentation is not a new idea. However, it is rarely done on a larger scale Serbia, especially in salvage excavations and is generally reserved for presenting the finds, not for documentation. Even though the complete potential of its application in the documentation has yet to be understood.

Keywords: 3D scanning, photogrammetry, 3D modeling, GIS, salvage excavations, archaeological documentation

*Speaker

Recent efforts for setting up a database for Carpathian obsidians

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Archaeometry-centred databases on special raw materials or raw material type groups have already been reported on (e.g., marble, ceramics etc.). Currently we are centred on obsidian: the idea is topical as we are having the International Obsidian Conference in Hungary soon (http://ioc-2019.ace.hu/). Preparatory work for the database has been accomplished in the framework of the OTKA project National Scientific Fund (OTKA) K-100385 Provenance study of lithic raw materials of stone tools found in the Carpathian Basin". The current version of the database contains historical research reported by scholars of the XIXth century; by the time of the Congress we plan to include all published and available archaeometry reference data on Carpathian obsidians.

Keywords: obsidian, database, Central Europe, Hungary

*Speaker

Histoire et devenir d'un logiciel pérenne et performant d'enregistrement et d'exploitation des données archéologiques : l'évolution de Syslat en SIA

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Actuellement, notre laboratoire s'investit fortement dans la pérennisation et le développement du logiciel Syslat, créé par Michel Py (CNRS) et l'équipe de Lattes dans les années 80. Conçu comme un outil informatique de gestion et d'exploitation des données de fouilles, ce logiciel est en train d'évoluer vers un véritable Système d'Information Archéologique (SIA), destiné à être adaptable à tous types de sites, de vestiges et à toutes périodes. Les différentes évolutions du programme, depuis Syslat 3.1 jusqu'à Syslat-Terminal, ont permis de relever l'un des principaux défis posé par le développement de l'archéologie à partir des années 80 : celui de la gestion et de la normalisation de l'enregistrement des données de fouilles, devenues exponentielles, dans toute leur diversité et leur complexité, grâce à l'usage des nouveaux outils informatiques. Basé dès le départ sur l'association d'un outil très performant d'analyse et de plusieurs bases de données, l'évolution de Syslat en SIA permettra d'intégrer les dernières avancées en matière de procédures d'enregistrement et d'exploitation des données de fouille, tout en poursuivant l'effort de normalisation et de création de référentiels liés aux différents dictionnaires et bibliothèques attenants au logiciel.
Actuellement, la suite *Syslat Pro* est un Système d'Information Archéologique (SIA) qui propose une suite d'outils complets et gratuits pour la gestion des données d'une fouille archéologique :

> *Syslat-Terminal*, logiciel multiplateforme de bureau, permet de gérer l'ensemble des données issues d'une fouille archéologique ; *iSyslatPro*, logiciel plus léger et adapté aux appareils mobiles, facilite l'enregistrement et la consultation des données sur le terrain.

Elle s'appuie sur une structuration originale des données et utilise pour ce faire le système de gestion de bases de données MySQL et un serveur de fichiers (S)FTP pour la gestion de la

*Speaker

documentation numérique. La suite *Syslat Pro* offre un hébergement gratuit des données sur un serveur central externe actuellement géré par la Très Grande Infrastructure de Recherche (TGIR) Huma-Num. Il est aussi possible de l'installer sur un serveur indépendant et elle reste utilisable en version monoposte.
La plupart des champs de saisie sont alimentés par des bibliothèques de vocabulaires contrôlés dont le contenu peut être adapté aux spécificités des sites archéologiques étudiés. Ces outils sont interconnectés avec une série de dictionnaires de références externes : Dicocer (mobilier céramique), Dicobj (objets) et Dicomon (monnaies), Dicos (faune) facilitant le travail d'analyse et d'identification des spécialistes. D'autres dictionnaires de références sont actuellement en cours de réalisation : Dicoverre (vaisselle en verre), Dicocerpo (graines), ainsi que de nouveaux modules (Archéologie funéraire).

Keywords: SIA, syslat, informatique, fouilles, exploitation des données, normalisation, dictionnaire, tablettes, Huma, Num

Evaluation of the duration of the anthropic occupations and of the degree of mobility of human Middle Pleistocene populationsat the Caune de l'Arago (Tautavel, France). First results of an innovative multidisciplinary method using artificial intelligence and machine learning.

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After 53 years of excavations, a large amount of raw data has been acquired and many archaeometric databases have been developed through the study of the Caune de l'Arago site.While a monographic work of synthesis is completed (Lumley et al, 2015), archaeologists have enough perspective on their data to start the next step: digital full use of databases through an innovative and unique system (SCHOPPER ANR project) that is able to test research hypotheses on human behavior in the Paleolithic using artificial intelligence and machine learning, and later, through simulations in virtual environment.
Today, the research hypotheses in this area are often tested through reproducing gestures of prehistoric man, and the limits are quickly reached. To overcome these limitations, innovative solutions for Machine Learning and virtual reality immersion is currently being developed to manage a large amount of data and to offer new visualization means of scientific results and interaction with the environment, as a research tool.

The current tests focused on the evaluation of the duration of human occupations at Caune de l'Arago, specifically those between 560 000 years and 400 000 years, among which different types of settlement patterns have already been identified (Lumley et al, 2004). All archaeological and environmental criteria providing information on the issue of duration of occupation were collected, qualified and quantified by the multidisciplinary team of archaeologists and combinations, correlations, significant oppositions have been identified by the artificial intelligence (AI) device and then learned.The machine learning is able to buildmodelsbased on expert knowledge or currentdataset. Then, thosemodelscanbeusedeither to propose answer to new samples, to answertheoretical question.
Theoretical patterns corresponding to short or long term occupation systems or to a seasonal occupation system were created as references and used as learning data for AI. They were then confronted with emerging archaeological patterns in order to characterize them. The degree of

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mobility of the Caune de l'Arago occupants was also tested with this system is according to the same principle and based on a large number of multidisciplinary parameters indicative of and significant offor mobility. The innovative method and the first results will be presented on this paper.

Keywords: prehistory, Artificial Intelligence

III-2 (CA). 3D data in archaeology & clouds of dense points: new research objects

3D measurements and toolmark recognition, examples from archaeological remains of woodworking in the North American Arctic

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As 3D documentation is increasingly used for archaeological studies, the prospects of this new type of data have yet to be fully discovered. Along with an easier manipulation and visualization of archaeological fact–which can be artefacts, features, or layers of excavation–3D documentation offers new means of analysis and understanding for archaeological recording. While we are exploring these new techniques, new constraints also have to be understood and taken into consideration.
In this paper, we aim to expose and critique a method developed for the analysis and recognition of toolmarks on wooden remains from North American Arctic archaeological sites. We created a methodology based on photogrammetry recording and measurements taken directly on the 3D models. Our main goal was to characterize the woodworking from different features within the same site – and dated from different periods – and possibly differentiate them, based simply on toolmark measurements.

During the process, we realized that the modification of small parameters, could significantly change the data we obtained, while other changes showed almost no impact.

While the first results were promising and helped us identify the use of specific tools and tool materials, we also faced problems resulting from the photogrammetry recording as well as understanding the 3D data itself. Step by step, we improved our protocol comparing new data to previous results.
We intend to show and explain the different choices we had to face while building our protocol. The results of our trial and error will no doubt prove useful to future archaeological studies at varying scales.

Keywords: Photogrammetry, Woodworking, 3D analysis, Toolmarks, Technology

*Speaker

La cartographie multi-scalaire d'un habitat sur un site accidenté : la Silla del Papa (Espagne)

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Le site archéologique de la Silla del Papa (Espagne) possède deux particularités qui rendent son étude topographique méthodologiquement complexe : les vestiges d'occupation se situent sur un site de hauteur combinant de forts dénivelés et une végétation persistante. De plus, les bâtiments de la fin de l'âge du fer sont ancrés à plusieurs niveaux dans les parois de barres rocheuses, ce qui rend inopérante une analyse architecturale traditionnelle à partir de planimétries en 2D. Dans le cadre du projet ANR Archeostraits, la cartographie du site en 3D à plusieurs échelles, de l'environnement du site au sondage, a été un axe privilégié. Nous ferons ici un focus méthodologique sur l'adaptation des outils d'acquisition 3D à cet environnement particulier.
Trois technologies d'acquisition 3D sont utilisées sur le terrain : le lidar embarqué sur un drone (ALS), le scanner 3D (TLS) et la photogrammétrie (drone/perche/sol). Ces technologies fournissent toutes des nuages de points denses. Cet objet numérique est le dénominateur commun permettant de combiner, croiser et compléter les modes d'acquisition. En effet chaque technologie possède une précision (positionnement réel du point en x,y,z) et une résolution de travail (taille pixellaire du raster en sortie) propres. Le niveau de détail rendu nécessaire par les problématiques de recherche varie du décimétrique jusqu'au millimétrique

Le lidar aéroporté est employé à l'échelle du site (40 ha) pour obtenir une cartographie générale. Le " sol " est renseigné par 14 millions de points, offrant une précision à 15 cm et une résolution en 2D à 25 cm. Ce squelette nettoyé de la végétation sera complété et amélioré par les deux autres sources de données millimétriques. Pour les espaces ouverts et les excavations, la photogrammétrie est retenue pour sa rapidité d'acquisition. En revanche l'étude des parois combine le scanner 3D et la photogrammétrie. Ces nuages de points serviront de support pour la réalisation des plans 2D, pour la production de coupes, et pour la réalisation de maillages destinés à la restitution.
Cette étude multi-scalaire avec une combinaison de technologies pose au final les questions du stockage et de l'archivage des milliards de points produits.

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Keywords: Archeostraits, 3D, Lidar, Scanner 3D, Photogrammétrie

Study of Lost Reality: Photogrammetric 3D-modelling of Ancient Art Instances in Ukraine

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3D data and 3D modelling offer an extremely informative way to store, collect and work with visual and metric information regardless of actual location of an object. Thus, a new prospective for studying of ancient items arises. It is proven by the latest finds on the Kamyana Mohyla 1 multilayer prehistoric site located in the Ukrainian steppes. Kamyana Mohyla is known as a location of numerous ancient rock art examples and considered special and possibly sacred place. That is the reason why search for the instances of prehistoric culture might be efficient there.
Finds from the field season of 2016 at Kamyana Mohyla 1 can presumably be interpreted as animal-like sculptural images. They are made of local sandstone, so it was very easy to shape and process them with prehistoric technologies. According to analysis, objects belong to the Mesolithic Kukrek Culture layer, which is dated to 8500-7400 calBC. Studying of the objects involves accurate and reliable measuring of their parameters, proportions and profiles on different cross-sections. To collect all available information about this finds, qualitative studying of their structure and texture is also needed. These features are available through the photogrammetric 3D-modelling including the model scaling and referencing.

Use of a model is the most productive and comfortable way to measure and describe the complicated shape of investigated objects. Furthermore, it reveals the original state that they had before the cleaning and analysis. From this point of view, photogrammetric modelling appears to be the way to store complete visual information about lately destroyed reality and the only way to make spatial visual reconstructions and assumptions concerning the ancient state of objects. This is extremely important considering that unique and unmatched objects might suffer damage during archeological study.
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Keywords: Photogrammetry, 3D modelling, Kukrek Culture, mesolithic, Kamyana Mohyla

Photogrammetry and cultural heritage at Cape Espenberg, coastal Alaska : A tool to record, analyze, preserve and "return" architectural remains

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In this paper, we present the use of photogrammetry during the Cape Espenberg Birnirk Project (CEBP) and discuss how photogrammetry recording contributes to field decision making, post-field analysis and long-term preservation of house architecture and building technology. One specificity of Thule and Birnirk semi-subterranean houses at Cape Espenberg and along the coast of northwestern Alaska is the frozen state of preservation of most wood and whalebone structural elements due to permafrost conditions. Wood preservation, however, is not excellent throughout the sediment and improves with depth of deposit. At the same time, house collapse and post-abandonment processes result in the complex accumulations of wood structural elements often described by early Alaskan archaeologists as "hopeless tangles of wood". Over the years, a fairly large number of well-preserved house frames have been excavated and dismantled by archaeologists, and apart from rare exceptions, what we are left with are a few photos and base maps, usually of the last level of excavation showing the best-preserved frame parts. To make matters worse, rising temperature in the Arctic, melting permafrost and enhanced coastal erosion is now threatening houses that were left unexcavated.

During two field-seasons at the Cape Espenberg Rising whale site (KTZ-304) in Northwestern Alaska, we implemented a 3-fold recording strategy that combines detailed traditional mapping, total station recording and photogrammetry coverage using a 3D field protocol developed by R. Méreuze who also provided training. Feedback from the first field season led to improving our photogrammetry implementation during the 2nd year, introducing changes that helped respond more closely to field and research questions.

One objective of this recording procedure is to obtain detailed information on individual wood and whalebone structural elements so as to better understand house architecture and technology including poorly known roofs while providing a long-lasting 3D image of a fragile feature that can then be revisited. Unlike stones which can be left in place after exposure, wood starts to dry and decompose so photogrammetry allows its precise documentation without excessively

*Speaker

increasing recording time during excavation. In addition, access in 2017 to renewable sources of energy (wind and solar) despite the remoteness of Cape Espenberg, increased computer time and led to the quick production of 3-D models that closely followed the excavation timeframe and more than once informed decision making at the excavation site. Finally, 3-D models contributed greatly to public outcome activities that took place at the nearby (> 150km) Shishmaref Inupiaq community

Keywords: 3D, photogrammetry, Cape Espenberg, recording procedures

Use of digital photogrammetry as a tool for recording and analysis of the megalithic tomb of Anta 1 de Vale da Laje, Tomar, Central Portugal.

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Within the scope of a pluriannual research project an archaeological excavation campaign was carried out in Anta 1 de Vale da Laje (VL1), Tomar, Central Portugal. This Neo-Chalcolithic monument has been subject of previous studies with new ones trying to build upon and acquire further chronological and palaeoenvironmental data. Other restauration and conservation works will be undertaken to improve the visitor experience at the monument. Within this framework, digital photogrammetry was applied as a technique of registration and production of technical archaeological documents to aid in the study and interpretation of the megalithic monument.
Aerial and terrestrial photographs were used for the photogrammetric processing. Aerial photographs were captured close to the ground (2m-20m agl.) using a DJI P3P drone equipped with a 12Mp digital still camera, and the terrestrial photographs were captured by a camera with a high-resolution sensor (28Mp). Photogrammetric processing was performed in Photoscan software (Agisoft LLC) for the production of 3D models as point clouds, mesh models and textured models, and for the production of 2D data such as high resolution orthophotography and digital surface models (DSM). Collected data was treated in a GIS environment for analysis and production of cartographic support.
The positional accuracy was attributed and validated based on more precise topographic control points, captured by a total station Leica TRC407, with an average error of less than 0.5cm. The use of this method allowed us to digitally model VL1 monument in a fast, economical, precise and complete way in 3D, obtaining a cloud of 8 234 766 coordinated points with a density of 21 662 points/m2. Based on the cloud points, a 3D mesh model was created, which is lighter, but represents in detail the studied surfaces where the textures on the basis of the photographs have been applied, giving it a much more realistic look in real colors. After orthorectification of the images it was possible to produce an orthophotographic mosaic with 1.7mm/pixel of spatial resolution and a DSM with altimetric data for each 6.7mm/pixel. With the application of this

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†Speaker

technique it was possible to obtain a larger, more accurate and realistic amount of microtopographic data than those traditionally produced. It was concluded that the completeness of the information improved the records, increased the capacity for visual and computational analysis and facilitated the dissemination of the archaeological heritage in a digital environment.

Keywords: 3D modeling, digital photogrammetry, archaeology, Anta 1 Vale da Laje

The Digital Era meets Taphonomy

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In recent years, the study of taphonomic traces on bone surfaces has become fundamental for the interpretation of prehistoric carcass exploitation by hominins and carnivores. Due to the difficulties in the correct identification of certain marks, different criteria have been suggested for their description and classification.
New non-invasive techniques have been recently applied for the morphological study of marks. The methods commonly used for such analyses rely on high-cost microscopy techniques with low portability, such as the 3D digital microscope (3D DM) or laser scanning confocal microscopy (LSCM); but, recently, new algorithmic developments in the field of computer vision and photogrammetry, have achieved very high precision and resolution, offering portable and low-cost alternatives.

Anthropogenic and carnivore marks have been reconstructed and analyzed using Micro-Photogrammetry (M-PT) and a methodology based on the use of a medium/low-cost improved structured light scanner (SLS-2) yielding comparable results to those obtained using high-cost methods. High-resolution 2D and 3D models have been analyzed to best capture the morphology of long (e.g. cut marks and tooth scores) and circular (e.g. tooth pits and percussion marks) traces providing new ways of distinguishing between marks that present overlapping characteristics and are sometimes difficult to identify. The reliability of these methods has been tested using experimental samples that include cut and percussion marks generated using different raw materials and different carnivore score and pits. Ultimately, the methodology has been applied on actual archaeological and paleontological samples providing more accurate answers to current taphonomic questions concerning the hunting-scavenging debate and the identification of the agent modifying the carcasses, including the recognition of carnivore species based on the marks they leave.
The methodology exposed here offers new solutions to current taphonomic problems based on low-cost and readily available techniques, though this technology also presents some disadvantages (e.g. data collection and processing, expertise) worth further discussion.

Keywords: Taphonomy, geometric morphometrics, virtual models, carnivore marks, anthropogenic marks

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Protohistoric and Historic monumental funerary structures in the "Chott el Jérid" area (Southern Tunisia): the importance of photogrammetry for rapid and complete documentation in the Saharan context.

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As part of the research programme of the joint archaeological Tunisian-Italian mission in the Sahara, in 2015 we started to investigate the funerary practices of late Prehistoric, Protohistoric and Historic societies in southern Tunisia. The funerary archaeology of the northern edge of the Sahara is currently not well known given the few systematic research projects carried out in the past. Using the reports of funerary monuments, during surveys carried out by the "*Service Géographique de l'Armée Française*" in the early 20th century, along with information collected on the field by Francois Paris, a sample study area was selected in the south, south-east of the "Chott el Jérid" depression, within the governorates of Kebili and Gabès. The density analysis of "Megalithic ruins", obtained through data processing in the GIS environment revealed some major concentrations of tumulus necropolises, alternating with isolated monuments scattered in the landscape in the southeast area of Douz. The fieldwork strategy was planned taking into account the social and political situation characterizing several North African and Middle Eastern countries in recent years. To optimize the documentation of funerary structures, 3D photogrammetric models were used to reduce the time taken and the number of people in the field.

Photogrammetry was used during all the various stages of the archaeological investigation, from the survey phase, to collect information about the overall conditions of the tumulus structures, to the excavation of individual structures to obtain as complete as possible a picture of all the excavation phases. Overall, 6 structures excavated during the archaeological campaigns of 2016 and 2017 were recorded with photogrammetry; for one site, where six tumuli were clustered on top of a small hill, we attempted a photogrammetric survey of the entire area. The most significant problem for the application of photogrammetry in a desert context is the sand, a highly mobile element with an indistinct surface. On the other hand, among the several advantages,

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considering that some of the tumuli investigated were characterized by a small burial chamber cut into the geological bedrock, was the potential for detecting the profile of these burial chambers retaining the upper dome.
The use of photogrammetry provided us with a complete documentation of the features investigated before the end of the fieldwork. Using the dense point cloud and the scaled 3D model we can remotely observe the peculiarities of the different types of monument.

Keywords: photogrammetry, Tunisia, funerary structures, Chott el Jerid, Sahara, 3D

Lithic Refits: A Romance of Many Dimensions

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The study of lithic objects has always been at the core of our attempts to understand prehistoric traditions throughout time and space, regardless of the influencing school of thought. Nevertheless, since the methodological adaptation of the *chaîne opératoire* concept from ethnology during the 1970s and '80s, little has changed when it comes to documenting these dynamic processes from the past. When feasible, systematic refits provide empirical manifestations of prehistoric 'ways of doing', and concrete instances of 'a' *chaîne opératoire*, while in the absence of refits this concept provides an analytical tool to tie disparate elements together into an organised knapping project.
When relatively complete, a lithic refit becomes a multi-dimensional object of study: it has significance as a three-dimensional volume and as a process in time, as well as from an economic, technical, and social point of view. However informative, refits are recalcitrant to quantification, making it difficult to describe them in an objective way. This has led some lithic technologists to turn to alternative methods, such as attribute analysis, claiming that the *chaîne opératoire* approach lacks reproducibility.

We believe the expanding adoption of 3D modelling techniques in archaeology is an opportunity to reaffirm lithic refits, not as the one and only way to study technology, but as a solid frame of reference for broad scale comparisons.
Here we present our attempts to document a particular blade debitage system from the Magdalenian site of Etiolles, through the use of systematic photogrammetry as well as simple geometrical analysis of the resulting 3D meshes. This approach is part of a broader enquiry into variability within Magdalenian knapping techniques, which we cannot hope to solve without new means of comparing blade production from one site to another.

Keywords: Magdalenian, lithic refit, 3d, photogrammetry, morphometric analysis, lithic technology, Paris basin

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Le site dans les nuages : approche comparative entre différentes acquisitions de données 3D archéologiques

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De la même manière que la recherche a été enrichie par les nouvelles techniques d'acquisitions 3D, la prospection archéologique s'est vue modifiée par l'utilisation possible de différent(e)s méthodes et/ou supports d'analyse. Dans le cadre de l'étude d'un site archéologique localisé dans le Finistère Sud (Nord-Ouest de la France), plusieurs approches ont été croisées de manière à pouvoir progresser dans sa caractérisation et l'état de conservation de ses vestiges, tout en adoptant une démarche exclusivement non intrusive.
Basées sur des traitements issus du projet Litto3D® (issu du partenariat entre l'IGN (Institut National de l'Information Géographique et Forestière) et le SHOM (Service Océanographique de la Marine) et visant à produire un modèle numérique altimétrique continu sur la frange littorale), ces données LiDAR ont également fait l'objet de traitements spécifiques afin de pouvoir mieux les exploiter du point de vue archéologique. Par la suite, une opération de terrain a permis l'obtention d'un modèle photogrammétrique de haute résolution pour lequel le nuage de points dense a été comparé avec les précédents. Parallèlement à ces acquisitions, et de manière à tenir compte de l'impact de la végétation haute sur la caractérisation des vestiges archéologiques sous-jacents, la réalisation de relevés microtopographiques a permis de déterminer certains écarts de précision. La complémentarité de ces technologies à l'échelle d'un site soulève de nouvelles perspectives d'étude, de restitution, mais aussi de valorisation. Pour autant, l'apport croisé de ces sources d'informations confronte l'archéologue à une importante phase de traitement où son objet d'étude ne peut se concevoir sans une phase de terrain, nécessaire à la bonne exploitation des ressources informatiques désormais à sa disposition.
Cet exercice méthodologique, s'il vise d'abord à mettre en regard plusieurs modes d'acquisitions 3D, propose aussi de faire le lien entre ces technologies et l'apport qu'elles peuvent avoir sur la prospection archéologique. En posant un regard critique sur les moyens employés pour cette étude, la communication espère participer d'une discussion plus large sur une approche pouvant certainement être développée dans ce domaine de la recherche.

Keywords: Acquisitions 3D, Données LiDAR, Photogrammétrie, Méthodologie

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Open Data, Global Digitization and Cultural Heritage

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GDH is a new not-for-profit, private research and education organization dedicated to documenting, monitoring, and preserving our global cultural heritage and natural heritage. We use digital visualization, 3D virtualization, geospatial informatics, and open data to provide digital data and 3D models to governments, regional institutions, museums, local scholars, and the public.
A key element of our mission is the democratization of science - we make all data freely available to the world in support of cultural heritage, heritage management, education, public interest, scientific research, and the digital humanities.
Over the last two years, more than 30 monuments and sites have been digitally documented in Spain. Using terrestrial and UAV photogrammetry, high resolution laser scanners, and photography, we have collected over 40 terabytes of data and produced an extensive suite of outputs. Spanning from the Bronze Age to the 19th Century, and including everything from Neolithic caves to fortifications, public plazas, and bull rings, this project includes nearly every type of data and acquisition technique required for the modern documentation of cultural heritage.
In this paper we will use three sites to illustrate our work: an Iberian archaeological site, Cerro de las Cabezas, in Valdepeñas, in the region of Castilla-La Mancha ; a Bronze Age well and granary, the Motilla del Azuer, in Daimiel, in the region of Castilla-La Mancha ; a Neolithic painted cave, the Cueva de la Serreta, in Cieza, in the region of Murcia.
We will discuss our bumps along the road and successes on how we digitized the sites, processed the data acquired, produced documentation for the sites' researchers and museums, what it meant for those sites, and how we made everything accessible to the public.

Keywords: Digital cultural heritage, Open Data, 3D digitization, Public Science

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III-3 (CA). Shared referentials : Webmapping and archaeology

CHRONOCARTO, Web-SIG interactif

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Chronocarto concilie l'approche ouverte, **mutualisée** et **générique** d'un **métaportail** et les exigences de précisions de nos domaines de recherche.
Chronocarto permet un travail de réflexion en réseau entre chercheurs, depuis la phase d'élaboration jusqu'à celle d'enrichissement de documents géoréférencés à grande, moyenne ou petite échelle. Dans un premier temps, il s'agit de permettre à un petit groupe de créer son propre environnement de travail, protégé par mot de passe, connu des acteurs du projet scientifique et des web masters. Cet environnement permet l'élaboration des documents et de suivre leur évolution. Prenons l'exemple pour des **grandes et moyennes échelles** des liens entre archéologues et géophysiciens: une prospection géophysique est réalisée sur un site archéologique, puis traitée en laboratoire tandis que la fouille se poursuit sur le site. Les premières cartes des anomalies sont déposées sur le serveur et l'archéologue y ajoute une nouvelle couche avec les premiers résultats de la fouille. Une discussion s'engage alors pour mieux exploiter les données, faire ressortir certains types d'anomalies qui sont pertinentes sur ce terrain. On peut aussi associer des couches de répartition de structures ou d'objets, un fonds Google ou IGN, une photo aérienne... Tous ces calques peuvent être superposés avec exactitude et apparaître sur l'écran avec des degrés de transparence et de priorités définis par simple cochage ou décochage. Les chercheurs peuvent alors dessiner à l'écran avec des outils basiques des zones à contrôler, faire des calculs de surfaces et des mesures. Ces modifications sont immédiatement visibles par toutes les personnes connectées au projet. Des couches (calques) et des boutons permettent de combiner des fonds, des lignes, des points, des surfaces, et de faire apparaître des documents associés (texte, photos, statistiques, liens avec des bases de données ...) en cliquant sur un objet spatialisé.

L'objectif des **atlas (petites échelles**) est d'offrir des cartes de répartition d'objets, de lieux remarquables, de coutumes ou d'évènements, et éventuellement d'analyser les corrélations entre ces différents phénomènes. Grâce aux méthodes de **l'analyse spatiale**, il est possible de démontrer la portée et le développement d'un événement, d'une innovation technique, d'échanges culturels ou commerciaux.

Notre souhait est de faire de Chronocarto un **outil de travail** à la disposition des chercheurs

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et des étudiants en interne, avec mots de passe (projets en cours), un **outil d'archivage en " open source "** (projets achevés) et un **outil de diffusion** de nos travaux sur le net, ce qui implique un comité de validation avant l'ouverture des projets au public (projets publiés). Une attention particulière est portée au **contrôle-qualité** et à la **traçabilité** des sources.
www.chronocarto.eu

Keywords: web, mapping, sig, atlas, réseaux, analyse spatiale

Le thésaurus PACTOLS, système de vocabulaire contrôlé et partagé pour l'archéologie dans le web des données

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Au moment où les systèmes de publication et les données de la recherche s'exposent sur le web, les producteurs de données et d'information ont besoin de métadonnées thématiques nécessaires à la caractérisation et à la recherche efficiente des contenus. Des communautés de spécialistes développent des terminologies propres à leur domaine de recherche ou leurs besoins individuels, pour décrire faits, artefacts, analyses,... Si elles peuvent être déjà multilingues, elles sont cependant rarement normalisées et encore plus rarement disponibles sur le web.
Le thésaurus PACTOLS (acronyme de Peuples et cultures, Anthroponymes, Chronologie, Toponymes, Œuvres, Lieux, Sujets) est un vocabulaire contrôlé, évolutif, multilingue et normalisé. Il porte sur l'archéologie et l'archéoscience, depuis la Préhistoire jusqu'aux périodes contemporaine. Ses 30.000 concepts (termes préférentiels français) sont répartis en six domaines et reliés entre eux par un jeu de relations (hiérarchie, polyhiérarchie, équivalence, association).

Créé par le réseau Frantiq (Fédération et Ressources sur l'Antiquité), initialement pour l'indexation documentaire de la littérature scientifique, ce vocabulaire sur l'archéologie est un réservoir unique de métadonnées thématiques réservé à l'archéologie. Le gestionnaire de thésaurus sur lequel il s'appuie, Opentheso, lui confère en outre des capacités techniques d'ouverture et d'interopérabilité qui complètent sa normalisation. De plus, l'attribution d'un identifiant pérenne à chaque concept fait de chacun un objet web, repérable et citable. PACTOLS constitue ainsi, de fait, un vocabulaire pivot qui répond aux standards du web sémantique et de la science ouverte. Il respecte les principes FAIR : il est consultable et accessible librement en ligne, il est interopérable et réutilisable. Ses caractéristiques lexicales et normatives représentent un outil au potentiel rare, proposé aujourd'hui à tous les acteurs de l'archéologie.

Le projet de développement des PACTOLS, conduit dans le cadre du Consortium MASA de la Très Grande Infrastructure de Recherche Huma-Num, est destiné à offrir à la communauté des archéologues un vocabulaire de référence qui facilite le partage, sur le web, des données et des productions scientifiques en archéologie. Il s'oriente dans deux directions : il s'agit d'une

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part de consolider la structure sémantique qui aboutit à la réorganisation des domaines, facilitant la navigation dans le thésaurus. D'autre part, les contenus terminologiques sont enrichis, notamment par l'ajout de vocabulaires de spécialités et par l'alignement avec des vocabulaires et des programmes scientifiques du domaine, présents sur le web. La réorganisation du thésaurus se conduit en étroite collaboration avec les experts concernés. Pour cela, les modalités de contribution dynamique au thésaurus sont élargies à tous les acteurs de la discipline, sur la base de niveaux d'autorisation spécifiques. Une communauté élargie s'organise, formée et accompagnée à la prise en main partagée du thésaurus.

Car PACTOLS, comme vocabulaire de référence, est préconisé dès le traitement des données de fouilles, par exemple à l'Inrap. Il est aussi associé à des programmes de valorisation des données de la recherche et intégré par plusieurs revues d'archéologie à leur production, via la chaîne de production éditoriale *Métopes* en XML-TEI.
PACTOLS, réservoir commun pour les métadonnées en archéologie et archéoscience, constitue une brique à l'interopérabilité des données. Il s'insère aisément dans des systèmes simples de bases de données ou organisés plus puissamment avec des ontologies pour un web des données liées.

Keywords: thesaurus, archaeology, LOD, web, controlled vocabulary, peer production, vocabulaire controlé, travail collaboratif, données liées

Création de référentiels communs : la coordination complexe du travail collaboratif

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Les pratiques actuelles de la recherche en archéologie confirment une tendance forte au regroupement des chercheurs et à la mutualisation des données imposant désormais la mise en place de plateformes partagées. Ce changement des pratiques se traduit par le passage du travail en local à l'ouverture vers des bases de données partagées entre plusieurs équipes, plusieurs

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institutions voire plusieurs pays.
Depuis 2005, l'expérience de sept travaux réalisés au sein du laboratoire Traces (Architerre, Chasséolab, Départ, Graph-Comp, Modelespace, Monumen, M&P) en collaboration avec des institutions partenaires françaises et étrangères (ministère de la Culture, services régionaux, CNRS, universités, organismes et entreprises de l'archéologie préventive, associations, etc.) permet de préciser les principes de la coordination, complexe, du travail collaboratif et l'impact des choix effectués.
La création de référentiels communs passe par l'établissement de conventions entre les différents partenaires/fournisseurs de données. Elle définit le cadre déontologique permettant une bonne collaboration entre les organismes impliqués ainsi que les rôles et devoirs de chacun, tel que l'accès à la BDD, son alimentation, l'édition des données, mais aussi la propriété, la protection et le traitement de l'information.
Le comité de pilotage du projet ajuste les choix en fonction des contraintes scientifiques et techniques. Regrouper des données, qu'elles soient nouvelles, anciennes ou mixtes, définir le "socle commun", impose de s'interroger sur leur mode d'acquisition, les traitements souhaités (requêtes spatiale ou attributaire et la modélisation) ainsi que l'export des ressources. Le croisement des informations (fouille/diagnostics/prospection, géophysique, documentation, etc.) nécessite une sélection et l'élaboration d'un vocabulaire commun. L'agencement du travail se fait par l'accès aux données : affichage cartographique, représentations graphiques, interface de requêtes, tableaux statistiques... Quel que soit le mode de visualisation et de saisie choisi, le référentiel ne doit pas appauvrir les champs de la recherche.
L'ensemble de ces choix a des répercussions sur les solutions et les techniques à déployer. Le premier est celui des logiciels (libres et/ou propriétaires) et de la plateforme de stockage (cloud, site internet, SGBDR sur serveur Huma-Num). Selon les problématiques et afin de fluidifier le travail collectif, ces choix auront des influences sur la conception de la base de données elle-même qui sera plus ou moins complexe.
Chaque projet est donc unique dans ses démarches scientifiques et son développement techniques. Toutefois, tous les choix doivent tendre à l'interopérabilité et la bonne diffusion de l'information entre les partenaires.

Keywords: archéologie, BDD partagées, webmapping, mutualisation, interopérabilité, gestion de projet

Learning through connecting: data management as a basis for meaningful use of legacy data - The African Archaeology Archive Cologne

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For more than 50 years the African Archaeology at the University of Cologne has conducted field research in various parts of Africa, particularly in the Eastern Sahara and in Namibia. The focus was on environmental history and on rock art, with internationally renowned research schemes like ACACIA (Arid Climate Adaptation and Cultural Innovation in Africa) and 'Rock Paintings of the Upper Brandberg'. Much of it was published in close co-operation with the Heinrich-Barth-Institut, including six voluminous catalogues of rock art and 26 monographs on African archaeology.
Most of the materials accumulated in the research projects are not digital in origin and are now digitized and made accessible in the digital online archive AAArC (African Archaeology Archive Cologne). Besides being a repository for tens of thousands of pictures, also whole documentations of excavation are made accessible here.

Digitising the repositories of Cologne's African Archaeology within the AAArC project started in 2012, using the DAI (German Archaeological Institute) data-interfaces Arachne, DAI-Gazetteer and DAI-Zenon. Today AAArC opens web access to thousands of fieldwork documentations, pictures and tracings of rock art. Open access interoperability of metadata integrated to picture formats is achieved. Exploiting database management systems of highly varied structure in a digital repository is achieved through collaboration with IANUS (Research Data Centre Archaeology & Ancient Studies), a national long-term preservation digital archive for archaeological data.
AAArC offers participation in digital heritage content management, thus perpetuating the long lasting cooperation of Cologne's African Archaeology with a number of African countries. The AAArC online archive aspires to make the full range of archaeological documentations accessible online and not just pictures. Thus AAArC ultimately enables a digital homecoming of complex research data to their countries of origin.

Keywords: digital archive, open access, African archaeology, rock art, cultural heritage management

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Webmapping d'une bibliothèque : l'exemple de Dolia

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L'Inrap réalise plus de 2000 opérations d'archéologie préventive par an et produit à chaque fois une masse considérable de documents : relevés de terrain, photographies, plans, dessins, système d'information géographique, bases de données d'enregistrement de terrain et les rapports d'opération. En 2006, l'institut entreprend d'organiser la gestion de cette documentation afin d'en permettre la consultation et la réutilisation. Systématique et structuré par la loi de 2004 qui en définit et organise le contenu, le rapport s'est très vite imposé comme le point d'entrée de cette documentation.
Dolia, la bibliothèque numérique de l'institut a été développée dans l'objectif de signaler, recenser, localiser et diffuser une partie de la documentation produite dans le cadre des opérations (les rapports exclusivement). Respectant des normes d'échange de données, Dolia est outil riche de presque 30 000 notices et propose un accès à plus de 9000 rapports en ligne. L'utilisation d'un format standard de description des données bibliographiques assure l'interopérablité avec d'autres catalogues de bibliothèques ; mais surtout, en garantissant le respect des normes actuelles de description des données, elle rend possible la réutilisation des données de Dolia dans des bases de données autres que des catalogues bibliographiques.

Ainsi, dans le cadre du projet européen Ariadne, à l'issue d'un travail de mise en concordance des grilles de description, d'alignement des vocabulaires utilisés pour décrire les contenus et enfin, de géocodage des opérations, plus de 28 000 notices de rapports d'opération ont été partagés sur une plateforme de données archéologiques européennes. L'export des données de Dolia dans Ariadne induit un changement d'objet, du signalement d'un document à celui d'une opération archéologique, rendu possible par la réutilisation des données de Dolia comme métadonnées décrivant le cadre scientifique général de l'opération.

Parallèlement au travail réalisé avec Ariadne, deux autres actions ont été développées :

> la réalisation d'un catalogue de données spatiales visant à mettre à disposition des archéologues les données spatiales "brutes", neutres et interopérables, produites dans le cadre des opérations ;

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la structuration des archives numériques des opérations

L'objectif de ces trois actions vise à structurer les données et la documentation numérique associée en vue d'en assurer l'archivage, la diffusion et la réutilisation. Dans cette perspective, la gestion raisonnée des rapports d'opérations a offert un cadre qui permet d'envisager aujourd'hui la mise à disposition de l'ensemble de la documentation de fouilles et a posé les prémices d'une réflexion sur le partage des données. A l'avenir, ces données pourront être accessibles en ligne selon des modalités qui restent à définir.

Keywords: archéologie préventive, bibliothèque numérique, rapports d'opération, archives, SIG, métadonnées

Prospections non destructives et acquisition 3D sur Apollonia d'Illyrie : un modèle d'intégration de l'information au service de la recherche et du patrimoine

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Dans le cadre des activités archéologiques effectuées sur le site d'Apollonia en Albanie *par la mission franco-albanaise*, l'objectif était de favoriser une meilleure intégration des données anciennes de terrain avec celles plus récentes provenant de prospections non destructives. Dans le contexte d'une plus large étude urbaine du site mais également de ces alentours proches, en particulier de la nécropole, il s'agit de mettre en place un système regroupant l'ensemble de l'information géo référencée. Cette recherche d'adéquation de l'ensemble des informations provenant des fouilles, des prospections électriques et magnétiques, des prospections drone et des relevés 3D, permet aujourd'hui d'associer de manière plus étroite les vestiges avec l'espace dans lequel ils se situent. Au-delà de la simple prise de vue, l'acquisition de ces informations offre la possibilité à l'acteur scientifique d'intervenir en amont sur la définition de ses objectifs futurs mais également de permettre aux acteurs patrimoniaux de pouvoir créer une veille par rapport aux dégradations anthropiques ou naturelles sur l'ensemble cet espace patrimonial. L'objectif de l'UMR8546 est également de favoriser à travers des exemples d'étude un meilleur moissonnage des données grâce au développement d'une gestion multimédia, par des moteurs de recherche et par la cartographie spatiale de ces données au sein du portail Chronocarto. L'interopérabilité des données reste la clé du succès d'une telle entreprise permettant ainsi de faciliter l'interrogation des données par une interface graphique géoréférencée, au travers d'une documentation stockée en ligne ou sur poste fixe. L'intérêt pour la fouille d'Apollonia est ainsi de pouvoir disposer de l'ensemble des données via un Web SIG. Notre démarche aujourd'hui ne constitue plus une révolution mais concrétise l'importance des applications à notre disposition aujourd'hui intégrées dans notre quotidien. L'intégration de l'ensemble des données géospatiales (3D et prospection électrique) doit favoriser l'émergence d'une archéologie intelligente en réseau permettant de couvrir de larges spectres thématiques tant du point de vue archéologique, environnemental que patrimonial.

Keywords: SIG, 3D, Apollonia d'Illyrie, Albanie, Survey

*Speaker

Collecte, gestion et valorisation des données sur les formations et les gîtes à silex en France : pour des plateformes cartographique et de publication partagées

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Depuis plusieurs années, des projets collectifs de recherche (PCR) résolument interdisciplinaires ont développé une base de données descriptive des principaux silex marqueurs associés à leurs gîtes primaires et secondaires dans le sud et le centre de la France. L'existence d'objectifs communs à la communauté des archéologues permet d'envisager une valorisation des données collectées en adoptant des pratiques coordonnées aux différentes étapes du cycle de vie de la donnée, de sa collecte à sa publication. Ainsi, pour ce qui est de la collecte et de la gestion des données, les informations rassemblées proviennent d'une fiche de prospection décrivant la formation à silex et d'une base de données scindée en différentes grilles d'observation constituant la carte d'identité complète de chaque type de silex. Par ailleurs, des couches géoréférencées sur les formations à silex ont été numérisées avec ArcGIS et QGis sur la base d'un protocole harmonisé en s'appuyant sur plusieurs couches du *WebMapService* (WMS) Infoterre du BRGM. Aujourd'hui, le partage de ces données, qui deviennent progressivement des référentiels sur les géoressources, est rendu possible grâce à la plateforme *ArcGisOnLine* (AGOL). En outre, des applications sur smartphones et tablettes permettent de compléter les conditions d'accès et de modification des données sur le terrain, en mode synchrone ou asynchrone selon les besoins et les possibilités d'accès à l'Internet mobile.
Chaque jeu de données primaires partagé peut bénéficier d'une diffusion contrôlée par la publication de *data papers,* aboutissement des différentes étapes d'une chaîne intégrée de publication contrôlée (qualité). La mise en place de cette chaîne, ainsi que l'élaboration d'un modèle de *data paper* assurant la qualification, les conditions de réutilisation et la traçabilité des jeux de données primaires, s'inscrivent au sein d'une plateforme de publication des données de l'archéologie,

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en cours de déploiement, qui adopte les principes *FAIR (Findable, Accessible, Interoperable, Reusable)* pour la gestion et le partage des données.
La dimension spatiale des différentes données sur les silex, regroupées sur cette plateforme, permet d'enrichir les raisonnements sur les rapports entre géoressources siliceuses et paléoenvironnements au cours de la Préhistoire. Des hypothèses sur l'itinéraire parcouru par le silex avant sa collecte par l'homme préhistorique peuvent être émises, alimentant des études paléogéographiques renouvelées, en particulier sur l'organisation des sociétés préhistoriques, leur gestion de l'espace et leur rapport aux territoires.

Keywords: silex, plateforme, webmapping, publication, data paper

ArkeoGIS, mise en commun de données spatialisées sur le passé

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En ligne depuis 2009 et actuellement dans sa 4e version, le websig ArkeoGIS bénéficie désormais d'une longue expérience sur les problématiques d'alignement et d'interopérabilité de bases apparemment disparates. En effet, des données en provenance d'études archéologiques, (paléo-)environnementales mais aussi historiques ou actuelles sont disponibles aux professionnels via une interface sécurisée. Ce sont à ce jour plus de 75 bases qui sont consultables et interrogeables via une interface ergonomique, près de 100 000 sites et analyses sont ainsi exploitables. Un protocole unique d'import/export des extraits de base permet ensuite de rebondir vers d'autres logiciels. Dans le cadre de cette communication les freins et accélérateurs du partage des données seront mis en avant après une présentation des solutions de gouvernance choisies, en espérant pouvoir continuer de lier des projets numériques

Keywords: ArkeoGIS, webSIG, SIG, SIA, transfrontalier, interdisciplinaire

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Archéologies du Bassin parisien (ABP) : vers une fabrique numérique de l'archéologie

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Archéologies du Bassin parisien (ABP), réseau de sites et réseau d'acteurs est un programme partagé de l'UMR 7041 *ArScAn*. Depuis les débuts du programme, l'objectif du programme est la mise en commun d'informations et de savoir-faire liés à la dimension spatiale de l'information archéo-historique, au sein de l'UMR ArScAn d'abord, mais aussi vers une communauté plus large. Dans cette perspective, le programme ABP, à la différence d'une équipe ou d'un projet de recherche, n'est pas en soi producteur de résultats propres en termes de connaissances archéologiques. Le fonctionnement d'ABP est fédératif et il s'appuie sur les projets qui le constituent et qui souhaitent s'y associer librement. Cette participation permet de bénéficier d'un accès à l'infrastructure gérée par ABP (données, outils et formation) et d'un accompagnement de projet personnalisé. Chaque projet garde sa propre autonomie financière et scientifique et développe ses propres axes de recherche. Une analyse spécifique de chaque projet menée par les responsables du programme et les chefs de projet permet de dégager des éléments transversaux et des besoins récurrents. Le dialogue entre la coordination de chaque projet et les animateurs du programme permet de définir les priorités pour lancer des actions de développements méthodologiques et instrumentaux et/ou de formation, utiles à chaque projet, et les plus partagées possibles. La présente communication se présente de faire l'analyse rétrospective de cette expérience de partage sur les 5 dernières années, de ses outils et de son mode de gouvernance et d'envisager les perspectives d'évolution pour un développement collaboratif accru.

Keywords: SIG, webmapping, archéologie, partage

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