Simulating the Neolithic

Thursday, 19.02.2015, 9.30 am – 6.00 pm
Institute of Archaeology, UCL
Room 612

Prof. Joaquim Fort (Universitat de Girona)
Dr. Amelie Scheu (Johannes Gutenberg-University Mainz)
Dr. Adam Powell (Johannes Gutenberg-University Mainz)
Prof. Dorian Fuller (UCL)
Dr. Fabio Silva (UCL)
Dr. Marc Vander Linden (UCL)
Prof. Mike Parker Pearson (UCL)
Salvador Pardo (University of Valencia)
Dr. Marko Porcic (University of Belgrade)

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BEAN

BRIDGING THE EUROPEAN AND ANATOLIAN NEOLITHIC
Demography, migration, and lifestyle at the advent of civilisation

	Conference day	
9:30 – 10:10	**Joaquim Fort**	Modelling Neolithic transitions at continental and regional scales
10:10 – 11:50	**Amelie Scheu**	Simulating domestication
11:50 – 11:30	**Adam Powell**	Palaeogenetics in Holocene Europe
11:30 – 12:00	Coffee break	
12:00 – 12:40	**Dorian Fuller**	Taking the Mediterranean North: archaebotanical perspectives in crop varieties, crop packages, and new genotypes in agriculturalization of high latitudes or high altitudes
12:40 – 13:20	**Fabio Silva**	Reconstructing routes and rates of Neolithic dispersal in biogeographically realistic domains: from Europe to Asia
13:20 – 14:20	Lunch Break	
14:20 – 15:00	**Marc Vander Linden**	S(t)imulating the Neolithic? Devising and using simulations from an archaeologist's point of view
15:00 – 15:40	**Mike Parker Pearson**	Aggregation and dispersal: the evidence from Stonehenge
15:40 – 16:10	Coffee break	
16:10 – 16:50	**Salvador Pardo**	New ways to old problems: Modeling the spread of the Neolithic in the Iberian Peninsula.
16:50 – 17:30	**Marko Porcic**	Simulating cultural transmission in the Central Balkan Neolithic: patterns in space and time
17:30 – 18:00	Panel discussion	
18:00 – 19:00	Wine reception	
19:00	Joint dinner (Curry house)	

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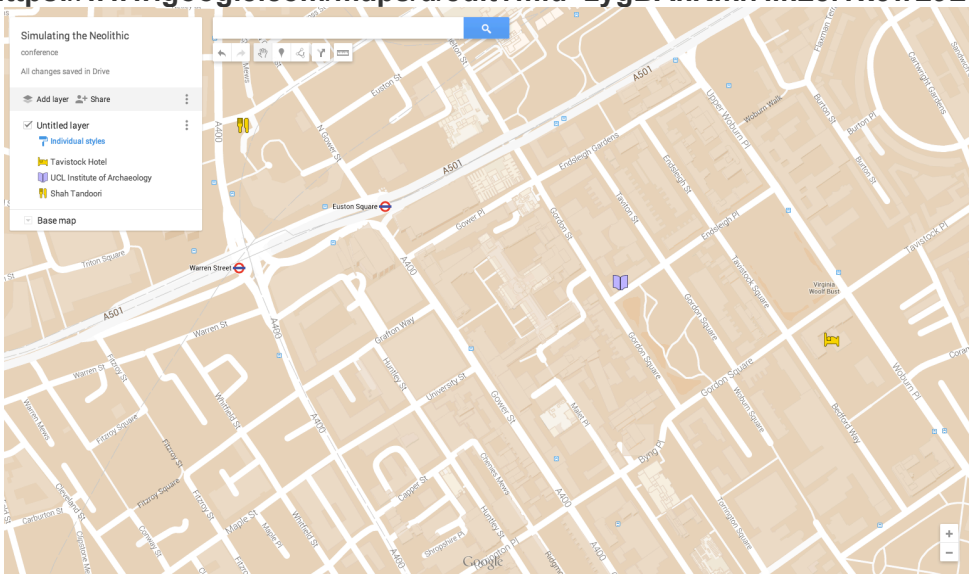
Map:

Conference venue: At the Institute of Archaeology, Room 612

https://www.google.com/maps/d/edit?mid=zygBAkKfki7I.kLelYx5wL9LY



Simulating the Neolithic workshop
February 19, 2015

Abstracts

Modelling Neolithic transitions at continental and regional scales

By Prof. Joaquim Fort Viader
Departament de Fisica, Universitat de Girona

Demic and cultural diffusion were integrated in a unified description of Neolithic transitions (Fort, PNAS 2012). That approach has been applied to disentangle the importance of demic and cultural diffusion at the continental scale in Europe and, more recently, Southern Africa (Jerardino, Fort, Isern & Rondelli, PLoS One 2014). A very recent regional analysis for Europe highlights the limitations of such models, mainly due to uncertainties in the parameter values. It will be argued that archaeological, ethnographic and mathematical modelling work are not enough to overcome these limitations. In order to do so, it seems absolutely necessary to collect a new kind of genetic data.

Simulating domestication

By Dr. Amelie Scheu, Palaeogenetics Group, Institute of Anthropology,
Johannes Gutenberg-University Mainz

Animal domestication was one of the core features of the Neolithisation process that started more than 10.000 years ago in the Near East and Southeastern Anatolia. In a minimum of time, animal farming became a crucial part of the Neolithic lifestyle. Domesticated cows, sheep, goats and pigs then accompanied the Neolithic westward expansion towards and through Europe.
DNA analyses of ancient faunal remains can provide further deep insight into the population history of the early farm animals. We use coalescent simulations and ABC on a comprehensive and spatiotemporally widespread DNA dataset of ancient cattle, goat and pig remains covering vast areas of the Near East and Europe. We estimate key parameters of the domestication process, such as the number of wild animals that constitute the founder population of the domesticated stock, the population size of the population that migrated into Europe, possible gene-flow with local wild populations on the way, and also coat colour variation due to selection or genetic drift over time.

Palaeogenetics in Holocene Europe

By Dr. Adam Powell
Johannes-Gutenberg University, Institute of Anthropology

Ancient DNA (aDNA) data have begun to revolutionize our understanding of the human past, providing a direct means of testing long-standing archaeological hypotheses. The nature of the Neolithization of Europe during the Holocene is still far from comprehensively understood, and aDNA has begun to demonstrate that it was likely a highly regionally and temporally heterogeneous process. In this talk I present recent work on the demography of pre-Neolithic European hunter-gatherers, their interaction with incoming farmers and on the domestication of pigs and cattle.

Taking the Mediterranean North: archaebotanical perspectives on crop varieties, crop packages, and new genotypes in the agriculturalization of high latitudes or high altitudes across Eurasia.

By Prof. Dorian Fuller
UCL Institute of Archaeology

The transition to the Neolithic in Europe and many other parts of Eurasia is often seens in terms of technological progress in subsistence introduced from origins in the Fertile Crescent, which inevitable increased the land's carrying capacity and human population levels. However, evidence from archaeobotany and crop genetics indicates that this was anything but a straight forward. Crop varieties introduced in the early Neolithic failed to persist, went extinct, were replaced by later improved varieties either from different wild genetic sources or through de novo mutations, and were added to by new secondary domestications and improved crop packages. This most of the cereal varieties that constituted the initial Neolithic package in Europe and in Central Asia went extinct in these regions, most of the pulses that were key to origins of agriculture did not make it to northern areas, and the cereals that have persisted either evolved or spread later, in the Bronze and Iron Age, including new domestications (oats, rye) and varieties with new genetic adaptations, for example allowing summer cultivation. Similar processes were necessary in northern Europe as in northeast Asia and high elevation zones such as Kashmir and Tibet, which raises the question as to whether adaptation to these varied cool temperate conditions occurred through parallel adaptations or dispersal from a single origin of these adaptations.

Reconstructing routes and rates of Neolithic dispersal in biogeographically realistic domains: from Europe to Asia

By Dr. Fabio Silva
UCL Institute of Archaeology

Modelling archaeological dispersals have been done using a reaction-diffusion approach which assumes demography as the primary agent of dispersal. Scholars have particularly focused on the dispersal of Neolithic material culture in Europe. However, on a spatial domain this approach requires solving partial differential equations, making it computationally slow and unstable, meaning that only the simplest of problems can be tackled. More recently, the author has been

spearheading a new approach that uses the Fast Marching algorithm developed by Sethian (1996), which simulates an expanding wave-front and is numerically stable and fast (Silva and Steele 2014). This algorithm has allowed for a number of modular expansions that permit new archaeological problems to be tackled, such as competing expanding wavefronts, biogeographically realistic spatial domains and phylogeographic reconstruction (eg Silva and Steele 2014; Russell et al 2014). This paper will introduce the Modified Fast Marching algorithm and showcase its potential by presenting results of analyses conducted for Neolithic Europe, using the Pinhasi et al dataset (2005), as well as present work on the expansion of rice farming in Asia, using an expanded version of the Fuller et al dataset (2011).

S(t)imulating the Neolithic? Devising and using simulations from an archaeologist's point the view

By Dr. Marc Vander Linden
Institute of Archaeology, University College London

Using – let alone devising – simulations is no easy, straightforward task for traditionally-trained, quantifying-illiterate archaeologists. Yet, speaking from personal experience, the biggest feat does not lie in embracing esoteric mathematical equations, but rather in a self-critical approach to offer a discourse which articulates hypotheses and corresponding propositions in a formal way. Although such level of formalisation ought to be present in literary models, this process has to be explicit in order to devise numerical and analytical models, as hypotheses, ideas, and hunches have to be turned into parameters, variables and, eventually, algorithms and codes. This is particularly crucial when working with modellers who conversely might have a limited, if any, level of proficiency with archaeology. In this sense, one could say that the successful dialogue between archaeologists and modellers does not lie in complexity, but rather in respective 'dumbing down'. This step is necessary in order to evaluate what can and should – or cannot and should not – be modelled.

This paper will investigate these questions from the point of view of the ERC-funded project EUROFARM, which investigates the Mesolithic-Neolithic transition in the western Balkans. Because of its importance in human history, this period has been privileged for the use of simulations, for instance to assess patterning in genetic data, and the chronological structure of this process. In the latter case, timing has often been used as a proxy for identifying the respective role of local foragers and incoming farmers in this process, reflecting a long-standing limiting debate which only envisages the Mesolithic-Neolithic transition from the point of view of its alleged actors. EUROFARM develops another approach, focusing on the characterisation of the skills involved in the transmission of the many technologies associated with this transition (e.g. agriculture, stock-breeding, pottery, settlement pattern and lithics): in a way, EUROFARM aims at knowing how does one become a farmer. Although no simulations have been conducted yet, this paper will highlight how the project, and especially the data collection, is explicitly devised towards the modelling stage, considered as one of the main key integrative and synthetic tools towards the completion of its goals.

Aggregation and dispersal: the evidence from Stonehenge

By Professor Michael Parker Pearson
Institute of Archaeology, University College London

Evidence for Neolithic settlement across much of northwest Europe consists of single houses or small hamlets on the one hand and large gathering sites such as causewayed enclosures on the other. There has been a tendency to think of their relationship as different elements of a 'central place' hierarchy but recent research in Britain reveals the gathering sites to be largely peripheral to the settlement areas. There is also a marked temporality in the use of gathering sites that does not accord with the model of their long-term seasonal use by inhabitants of an associated territory. The detailed results from Durrington Walls, a large settlement later turned into a henge, reveals a complex history of aggregation and dispersal that opens up new perspectives on how Neolithic settlement patterns can be better understood.

New ways to old problems: Modeling the spread of the Neolithic in the Iberian Peninsula

By Salvador Pardo Gordó & Joan Bernabeu Auban
Departament de Prehistòria i Arqueologia, Universitat de València

The Iberian peninsula is a particularly good region to study the process of agricultural dispersals due to its geography and the presence of significant populations of foragers during the final Mesolithic. Situated at the western extreme of the Mediterranean, and serving as a bridge between Africa and Europe, Iberia is a subcontinent where it is possible to encounter great socio-ecological diversity at local scales important for the transition to the agriculture.
In this talk we will focus in the problems of the neolithic spread in this region: first, we discuss the importance of using the rich and growing database of high-precision radiocarbon dates; second, we describe an ABM model in order to simulate and evaluate the relative importance of different variables. We use statistical methods to compare the virtual outputs with the archaeological data, mainly, radiocarbon dates.

In order to test severals scenarios for the spread of farming, we create a set of different algorithms for the neolithic spread: a) the neighborhood movement: this corresponds to the classical “wave of advance” model described by Fischer and applied to the Neolithic expansion by Ammerman and Cavalli-Sforza. This algorithm simulates the expansion of agriculture from one cell to all neighboring cells that lack agriculture; b) the punctuated movement: This correspond to the leap-frog model and this algorithm simulates the expansion of agriculture from any cell that has agriculture to another randomly selected within a given distance radius [established by a slider on the user interface] which does not yet have agriculture.

If, as is commonly assumed, the Neolithic expansion was essentially due to a process of demic diffusion, then it can be assumed that this kind of process has had some effect on the variability of cultural items over time and space. We can hope that during its expansion, there was a continuous shift of the know-how and the stylistic rules, so that at a general scale, the western Mediterranean

shows a certain degree of polymorphism in the pottery productions. In this sense, we also show some approaches that are being carried out by the Neolithic research group in the Departament de Prehistòria i Arqueologia de la Universitat de València, and more specifically, our work about the viability of the hitchhiking hypothesis like cultural spread process.

In short, regardless of the modeling process (demic or cultural), there is no doubt that this methodological approach [modeling] allows us to investigate several types of agricultural expansion and the routes of movement that characterize the western Mediterranean in general and the Iberian peninsula in particular.

Simulating cultural transmission in the Central Balkan Neolithic: patterns in space and time

By Dr. Marko Porčić, Department of Archaeology Faculty of Philosophy, Belgrade

The theoretical framework of cultural transmission theory enables archaeologists to simulate processes of cultural interaction in order to derive empirical expectations related to different "versions" of (pre)history. In this study a set of cultural transmission models is simulated with the initial conditions and parameters adjusted to broadly mimic the spatial and cultural properties of the Balkan Neolithic. Simulation results are used in two ways: 1) they are compared to the actual patterns in the archaeological record of the Balkan Neolithic 2) they are projected against different analytical frames of reference in order to draw theoretical and methodological conclusions about the relations between the processes and resulting patterns of cultural transmission. The results show that simple transmission models such as unbiased transmission conditioned by geographical distance can produce stylistic patterns in space generally matching the distribution of the Late Neolithic archaeological cultures in Central Balkans. The results also suggest that the processes of cultural transmission produce complex patterns of formal variation of material culture in space and time.