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ABSTRACTS: LECTURES and POSTERS

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The food-producing economy in earliest Shomutepe-Shulaveri culture, western Azerbaijan

L'économie de subsistance durant la phase précoce de la culture Shomutepe-Shulaveri, Azerbaïdjan occidental

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The Neolithic era of the southern Caucasus has, in terms of archaeology, been one of the least studied areas. However, recent international projects in the Araxes and Middle Kura Valleys provided important new data and enabled the researchers to discuss the chronology, cultural change and subsistence economy of the period in greater detail.

The Azeri–Japanese joint mission has been conducting excavations in western Azerbaijan since 2008. The first target was a large Shomutepe-Shulaveri site, Goytepe (mid-6th millennium B.C.). Shomutepe-Shulaveri culture is the oldest agricultural society known in the southern Caucasus. In 2012, we also started excavation in a neighbouring site called Haci Elamxanlı Tepe. This site produced older radiocarbon dates (early 6th millennium B.C.) than Goytepe and showed evidence of agriculture. In fact, this is one of the oldest series of dates for domestic plants in the Middle Kura at present.

We present here the results of preliminary analyses performed for plant macro-remains excavated in Haci Elamxanlı Tepe and discuss the choice of crop plants, use of wild plants and utilization of cereal by-products. The interesting differences between Haci Elamxanlı Tepe and Goytepe provided clues to reconstruct the establishment of agriculture in the southern Caucasus.

Keywords: Azerbaijan, Neolithic, Shomutepe, Shulaveri, Haci Elamxanlı Tepe, Goytepe

The meadow of Onoldswil (Switzerland) in the summer of AD 1295 - an example of a palaeobiocoenosis

La prairie d'Onoldswil (Suisse) à l'été 1295 ap. J.-C. - un exemple de paléobiocénose

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In the early summer of the year AD 1295 a landslide destroyed the former village of Onoldswil in the Swiss Jura mountains. During construction work in 2014 a small area of the former land surface was unearthed. Five metres of compact clay had caused the complete lack of oxygen, and the excavators came upon mosses and leaves of grasses and other plants that were still green. Samples were taken for plant macro- and microfossil and geoarchaeological analysis.

This offered the rare opportunity to study the vegetation of a small spot of land preserved *in situ*. Even subterranean organs had survived like the root nodules of Fabaceae. Grassland species are dominating the pollen and macrofossil spectra. Of the nine species of Poaceae, *Cynosurus cristatus* and *Bromus hordeaceus* were most frequent. Entire capitula of dandelion (*Taraxacum officinale*) in fruit indicate that the landslide must have happened in late spring or early summer. Further frequent plant species were *Centaurea jacea*, *Crepis biennis*, *Heracleum sphondylium*, *Leucanthemum vulgare*, *Picris hieracioides*, *Plantago lanceolata*, *Potentilla reptans*, *Ranunculus spec.*, *Rhinanthus alectorolophus*, *Trifolium pratense* and *T. reptans*. The species composition and the presence of spores of coprophilous fungi show that this spot was pasture land rather than a hayfield. Grazing animals favoured the spread of juniper (*Juniperus communis*). The soil was rather moist and lightly manured. Pollen of fruit-bearing trees indicate the presence of orchards in the vicinity. Pollen analysis shows that the slopes of the surrounding mountains were deforested. This was probably the cause of the landslide.

Keywords: Middle Ages, Switzerland, Grassland, Palaeobiocoenosis

Crop production and consumption in coastal Languedoc in the 3rd century BC: new data from Le Cailar (Gard), Lattara (Hérault) and Pech Maho (Aude)

Culture et consommation sur le littoral du Languedoc au 3^e s. BC : nouvelles données des sites de Le Cailar (Gard), Lattara (Hérault) et Pech Maho (Aude)

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Since the last 15 years archaeobotanical research in southern France, especially in Languedoc coastal areas, is well developed and concerns several major sites to understand not only the role of local crop productions but also exchanges with many Mediterranean societies. As regards to the Iron Age period, recent excavations and works (for instance, at *Lattara*) have provided new information to the knowledge of the agricultural systems and plant consumption practices of the 5th and 4th centuries BC. They highlight a well-structured crop production based on cereals (mostly barley, naked wheats and emmer) and pulses together with an increasing development of fruit growing. During the 3rd century one can observe the appearance of changes mainly in crop productions and plant consumption.

The main aim of this presentation is so to discuss about this transition period focusing on both economic aspects through the comparison of the early Iron Age basis (5th-4th c. BC) to the new agricultural and alimentary strategies adopted from the 3rd century BC onwards. For instance we can observe the gradual disappearance of emmer (*Triticum dicoccum*) in favour of naked wheat (*Triticum aestivum/durum/turgidum*), as well as an increasing development of local fruit growing (in particular viticulture).

For this, we present here new archaeobotanical data (based on seed and fruits analysis) concerning three archaeological sites (Le Cailar, Lattara and Pech Maho) sharing many environmental, economical and cultural characteristics: for instance, their location in a fluvial-lagoon environment (opened to the sea and the hinterland), and continuous occupation levels from at least the first Iron Age (6th or 5th centuries BC) until the end of the second Iron Age (1st century BC) with a significant presence of different elements of Mediterranean origin (Greek, Etruscan and Iberian) within a strongly indigenous community.

Keywords: Seed and fruit remains, Iron Age, Southern France, Agriculture, Consumption

Wild West Frisia: elucidating the collection of wild plants for different edible plant parts in Bronze Age subsistence

La province de Frise ou "l'Ouest sauvage" : documenter la collecte des plantes sauvages comestibles, dont différents organes sont prélevés, pour agrémenter le menu des populations de l'âge du Bronze

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Mixed farming in the Dutch Bronze Age is considered to form the major part of the subsistence economy, providing people with adequate amounts of produced domestic animal and plant food. Wild plant exploitation is deemed unnecessary during this period, because people can now fully rely on their own production potential, resulting in the phenomenon that "man starts living with his back towards nature". However, the combined information obtained from ethnographical, ethnobotanical, nutritional, and physical anthropological sources consulted for the present study has indicated that the opposite was the case: the vegetative parts of wild plants have proven to be vital to subsistence by providing people with essential micro-nutrients which are unavailable in a staple diet based on cereals and meat alone. Besides giving clear indications that wild plant collection was still required during the Bronze Age, the present study has also been able to show the possibility to elucidate whether plants were specifically collected for their seeds or their vegetative parts. By taking into consideration several inherent characteristics of these different plant parts, an expectation was created for how different plant remains are most likely to become preserved in the archaeobotanical record. Factors which were considered for this expectation include the prevailing preservation state (i.e. charred vs. uncharred), the relative frequency of seeds (i.e. high vs. low), and the chance of being preserved under different soil preservation conditions (i.e. dry vs. waterlogged). By applying this expectation to the available macro botanical data from Bronze Age West Frisia, the Netherlands, it was possible to identify several edible wild plant species, of which the majority will have been collected for their vegetative parts. So, even though this type of wild plant collecting is usually underrepresented as a practice due to a scarcity of preserved seeds from these plants, this study has been able to identify the vital role of wild plant collection and vegetative plant part consumption in the Bronze Age based on a comparison between expectation and data.

Keywords: Edible wild plants, Taphonomy, Diet, Vegetative plant

parts, Health

Village people. Spatial approach to crops and gathered plants at a late Neolithic occupation phase of the Lakeshore site Parkhaus Opera in Lake Zürich (Switzerland)

Village people. Approche spatiale des plantes cultivées et cueillies associées à la phase d'occupation du Néolithique final du site palafitte de Parkhaus Opera sur le Lac de Zürich (Suisse)

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Lakeshore settlements in central Europe have produced some of the richest and most-accurately-dated botanical assemblages available for the Neolithic period in the continent thanks to optimal preservation conditions and the availability of dendrochronology. Our knowledge of the evolution of plant economy in the region is consequently quite consistent. Nevertheless, large-scale sampling of Neolithic lacustrine sites with waterlogged preservation is still rare, especially with a systematic investigation of large-volume samples (3-5 litres of sediment), which are necessary for a representative evaluation of large-seeded plants. Over 250 samples of large volume and over 120 samples of small volume, covering an area of ca. 3,000 m², were analysed from a late Neolithic settlement phase (dendrodated to around 3160 BC) of the pile-dwelling site of Parkhaus Opéra (Zürich, Switzerland). Over 80,000 plant macroremains of large size (> 2 mm) and 140,000 of small size (< 2 mm) were recovered. This allows for the representative evaluation of the economy of the settlement, including comparisons between precisely dendrodated buildings, after taking into account taphonomic and methodological factors.

Keywords: Waterlogged sediments, Prehistoric agriculture, Wild plant use, GIS, Taphonomy

Tubers, grains, dung and wood: studying hearth contents at the early Natufian Shubayqa 1 (north-eastern Jordan)

Des tubercules, des grains, des excréments et du bois : étude du contenu de foyers du site Natoufien ancien de Shubayqa 1 (N-E. de la Jordanie)

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Unfortunately, very few are the Natufian sites in southwest Asia that have provided large and securely dated archaeobotanical assemblages. As a result, our knowledge regarding the exploitation of plant resources during this time period is very limited. This general paucity of data largely contrasts with the extraordinary well-preserved archaeobotanical

assemblage found at the site of Shubayqa 1. This site is located in the Qa' Shubayqa area of north-eastern Jordan and is dated to the early and late phases of the Natufian. In this paper, a multi-disciplinary approach is applied to characterise the charred plant macroremains found in situ in two stone-made hearth structures dating to the early Natufian. The content of the hearths includes a large variety of plant macroremains comprising more than 45,000 rhizome tuber remains, wild plant seeds, including wild wheat and barley, dung remains and large numbers of wood charcoal. The results of the analyses highlight new practices in terms of plant food consumption and use of fuel resources during the Natufian period. The analyses reveal the importance of storage organs of wild plants in the subsistence strategies as well as the use of dung and specific wood taxa as fuel. The remains also indicate a landscape characterised by wetland vegetation in the nearby area. Overall, the study of plant macroremains at Shubayqa 1 constitutes an important contribution in order to understand the vegetation and the plant-based economy in a region and time period for which little evidence is so far available.

Keywords: Southwest Asia, Tubers, Founder crops, Wild plants, Hunters-gatherers

The Nowy Dworek Island (Lubuskie Voivodeship, W Poland) - An early medieval place of worship ? Results from plant macro and pollen analysis

L'île de Nowy Dworek (Lubuskie Voivodeship, Ouest de la Pologne), un lieu de culte du début de la période médiévale ? Résultats des analyses carpologiques et palynologiques

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The archaeological research carried out by the Institute of Archaeology of the Nicolaus Copernicus University in Toruń (11H 12 0526 81) resulted in the discovery of a small island on the Paklicko Lake, near Nowy Dworek (Lubuskie voivodship, W Poland). An exceptional location of the site, unique technique of the construction of the island (wooden grate), traces of a wooden bridge and archaeological artefacts indicate that the island in the early Middle Ages (9th-10th c.) was a very special place (worship?) for the local community. Macroremains and pollen analysis also indicate the uniqueness of this place. On the list of taxa a great number of plants, both cultivated and collected were found. Many of them could be linked with the Early Medieval beliefs, superstitions and folk medicine. Particularly interesting is the concentration of undamaged glumes of *Panicum miliaceum*.

According to the ethnobotanical data, in the past crops were an important element of beliefs, and millet is named as part of the agrarian rites. People brought to the island fruits of *Cerasus avium/vulgaris*, *Malus* sp. and *Pyrus* sp. In the material only a few remnants of vegetables, spices and oil/fibre plants were found. The traces of gathering consisted plants from forests and forest edge (eg. *Fragaria vesca*, *Rubus idaeus*, *R. caesius*, *Viburnum opulus*). In the samples remains of ornamental plants, species characteristic for dry grassland, were found. Plants of medicinal and magical character could have

been *Pteridium aquilinum*, *Corylus avellana*, *Fagus sylvatica* or *Quercus* sp. However, one needs to keep in mind that these plants could have also been used as animal fodder or lining. The presence of coprolites of goat/sheep in the samples might indicate that animals were kept on the island. The dominance of pollen of flowering plants in different seasons proves that they were excreted in different seasons. One of the main components of pollen spectra from coprolites was *Corylus avellana* and *Artemisia*. Other remains represent mainly segetal weeds (taken on the island together with millet) and ruderal plants (unintentionally taken by man). Diaspores of water and above-water plants are associated with the location of the site on the lake. However, despite the close distance to water, participation of their remains was insignificant.

Keywords: Archaeobotany, Island, Early Middle Ages, Worship

Archaeobotanical evidence of fig (*Ficus carica* L.) in Europe on the axis of South-North gradient. The inter-network data of the Papaver Centre research project

*Occurrences de la figue (*Ficus carica* L.) en Europe selon un gradient Nord-Sud. Le réseau de données du Papaver Centre research project*

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Ficus carica L. is one of the oldest domesticated fruit trees in the world. The sweet fruits were widespread across Europe and seeds frequently recorded in many archaeobotanical datasets. The use of figs in diet varied substantially along the geographical South-North European axis. The question is whether this has been determined by its local availability, by cultural factors or both. The aim of the project, in framework of the research of the Papaver Centre, is to collect every available information about chronology and distribution of fig finds in archaeological contexts using archaeobotanical databases in Italy (BRAIN research group), in the Southern part of Germany (ARBODAT Ba-W'ü), in Czech archaeobotanical database (CZAD) and in the archaeobotanical databases of Scandinavia (HANSA network project). The main effort of the study is an attempt to explain patterns of fig occurrence in time and trace its diffusion from the Mediterranean to Central and Northern Europe. An additional goal is to explain fig finds in archaeological context by correlating the finds with human behaviour and popular traditions.

Keywords: *Ficus carica*, Europe, Macroremains, Chronology, Archaeological context

An interdisciplinary approach to changes in plant use from the Mesolithic to the Neolithic period at the Wetland site Zamostje 2 (Sergiev Possad, Poland)

Une approche inter-disciplinaire des changements qui s'opèrent entre le Mésolithique et le Néolithique dans l'utilisation des plantes sur le site en milieu humide de Zamostje 2 (Sergiev Possad, Pologne)

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The archaeological site Zamostje 2 is located 50 km North from Sergiev Posad (Moscow, Russia). It is situated at the shore of the Dubna River. Consisting of four archaeological layers, which have been dated between the late Mesolithic and the middle Neolithic, the constant waterlogging conditions of the older layers has allowed an exceptional preservation of organic remains. The Neolithic phase in Zamostje 2 is characterized by the appearance of ceramics, while agriculture is absent. Very little is known about plant use in the region, and the present work constitutes one of the first archaeobotanical studies. It is supposed that the exploitation of wild vegetal resources played an important role among the Mesolithic communities, and probably during the latter Neolithic period too. The first systematic archaeobotanical sampling performed at the site consists of a profile column retrieved from Test Pit 2 during the 2013 field season. It yielded more than 4000 plant remains corresponding to over 50 taxa.

The combination of the macrobotanical data (seeds, fruits and wood charcoal remains) with the pollen evidence has provided a better picture of how the environment where the inhabitants of Zamostje 2 lived was, as well as a good basis for the interpretation of the use of plant resources at the site. The comparison and evaluation of the archaeobotanical evidence coming from the different periods shows variations that could be the reflection of distinct plant management strategies along time by the inhabitants of Zamostje 2. On the table are several possible explanations: a change in the ecosystems being exploited, the arrival of people with new traditions or the importation of new knowledge. Other reasons could be a change in the economic organization where new staples were privileged, or even a change due to the new possibilities that pottery offers, regarding cooking and storage.

Keywords: Mesolithic, Neolithic, Wet environments, Wild plants, Food, Diet, Cooking

Continuity and change in plant use in Mesolithic-Neolithic Scotland

Continuité et rupture dans l'usage des plantes entre le Mésolithique et le Néolithique en Ecosse

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The breakdown of the traditional rigid distinction between hunter-gatherers' and farmers' has led to increased interest into the different types of human-plant relationships that existed in hunter-gatherer and early farming societies during the Mesolithic-Neolithic transition. It has been claimed that Mesolithic hunter-gatherers may have actively managed 'wild' plants like domestic crops and that not all Neolithic farmers carried out large-scale cultivation. The 'transition' may therefore have been a continuum and its nature remains a matter of considerable contention. Until recent years the Scottish archaeobotanical dataset has been largely ignored in discussions about the nature of human-plant interaction during the Mesolithic and Neolithic, in part due to the supposed rarity of plant remains on early prehistoric Scottish sites. In the last decade, new syntheses of archaeobotanical data in Scotland have sought to challenge this perception, showing the large number of sites where archaeobotanical remains have been recovered. This paper will summarise the current evidence for continuity and change in plant subsistence during the Mesolithic and Neolithic in Scotland using a synthesis of archaeobotanical evidence from 47 Mesolithic and 75 Neolithic archaeobotanical assemblages, and will discuss the future potential of the archaeobotanical evidence from the region for advancing understanding Mesolithic-Neolithic people-plant interactions. The challenges in integrating this site based data at a regional-level and the mechanisms for developing the dissemination of this dataset will also be considered.

Keywords: Mesolithic, Neolithic, Scotland, Regional archaeobotanical synthesis

In search of a very local palaeoenvironmental record: Using 13C isotopes to track water stress at the Epipalaeolithic hunter-gatherer site of Kharaneh IV in the Azraq Basin, Jordan

A la recherche d'un enregistrement paléoenvironnemental micro-local. Se servir des isotopes du carbone pour mettre en évidence un stress hydrique sur le site épipaléolithique de chasseurs-cueilleurs de Kharaneh IV dans le Bassin de l'Azraq, en Jordanie

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This paper presents a multi-proxy study that investigates, at a local scale, changing water stress during occupation at the Epipalaeolithic, hunter-gatherer site of Kharaneh IV, in the Azraq Basin, Jordan. Archaeobotanical data are combined with the use of stable carbon isotope values from 20k year old, wild, carbonised seeds from archaeological contexts and are interpreted within the regional archaeological and palaeoenvironmental framework.

Stable carbon isotopes can be used as a direct means of inferring water conditions from archaeological crop remains. Here, we apply this method to pre-agricultural wild seeds to test the hypothesis that increasing water stress throughout Kharaneh IV's occupation history contributed to its final abandonment. We present our initial results and discuss the rationale of the approach and the implications for regional vegetation reconstructions and the patterns of subsistence and movement of

the inhabitants of Kharaneh IV both on site and within the Azraq Basin. This method contributes to our ability to examine the complex interplay between early communities and environmental factors in this area and how hunter gatherers may have adapted and responded to micro-ecological changes.

Keywords: Archaeobotanical methods, Palaeoenvironmental reconstruction, Near East, Epipalaeolithic, Stable isotopes

The ordinary & the particular. LBK macrofossils in a ritual context at Herxheim (Rhineland-Palatinate, Germany)

L'ordinaire et le particulier : macrorestes du Rubané issus d'un contexte rituel sur le site de Herxheim (province de Rhénanie-Palatinat, Allemagne)

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While it is generally not easy to proof a ritual context in prehistoric times, occasions are extremely rare in Neolithic times. Due to the absence of metal finds, which give reasons to archaeologists to investigate e.g. sacrificial sites in later periods, probably lots of situations demonstrating a ritual and/or cultic habit stay undetected. Usually just obvious hoards, stone settings or grave contexts witness aspects of ancient spiritual thinking. Therefore it seems interesting to follow the question, how to detect patterns of ritual and/or cultic activities by the archaeobotanical evidence of an archaeological site.

The settlement area with a surrounding double ditch in Herxheim (Rhineland-Palatinate, Germany) offers a good instance to investigate this problem. The enclosed settlement could have been an ordinary LBK settlement, if not thousands of human skeleton parts belonging to more than 450 individuals would have been detected in the excavated part of the surrounding "ditches". Even the construction of these "ditches" is special, because the structures had been dug out in the form of long connected pits forming ditch segments with lengths between 20 and 40 m. Associated with deposited bulks of human and animal bones, pottery and stone artefacts inside the filling are also lots of charred plant remains.

Due to the particular character of the skeleton parts as well as other archaeological artefacts it is obvious that in Herxheim specific ritual practices took place. In contrast to this - although the charred plant remains are quite rich with slightly more diverse (weed) seeds than normal - the archaeobotanical record at the first glance show up more or less the typical patterns of Neolithic settlements with Emmer (*Triticum dicoccum* Schrank) and Einkorn (*Triticum monococcum* L.) as the main cereals, some evidence for pulses, fruits and nuts as well as a variety of weed seeds.

The paper focuses on the question how to bring those things together. How "normal" evidences could conceivably verify "special" situations? This is considered first with a basic analysis if the botanical material is just the accidental admixture of waste inside the features or part of a deposition following specific patterns. Further on it will be questioned which con-

clusions for the live of the inhabitants and/or the participants of the activities around the pits can be drawn based on the archaeobotanical remains.

Keywords: LBK, Ritual, Diversity, Plant macrofossil analysis

Exploring the role of agriculture in urbanisation: a multi-stranded approach using functional weed ecology and crop stable isotope analysis

Comprendre le rôle de l'agriculture dans l'urbanisation : Une approche multidisciplinaire basée sur l'écologie fonctionnelle et les isotopes stables

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In this talk we consider how cropping regimes and farming practices supported alternative pathways to urbanization in different parts of western Eurasia. Agricultural intensification' is often invoked to explain how societies adapted to social nucleation and stratification, but this concept is ill defined, and different agroecologies likely developed in contrasting social and ecological settings.

Functional weed ecology and crop stable isotope values offer complementary insights into crop growing conditions, present and past. As a multi-stranded method, this combined approach has the potential to triangulate onto' farming regimes for which no close present-day analogues exist. We illustrate these techniques using case studies from western Eurasia (in northern Mesopotamia, central Anatolia, the Aegean and south-west Germany) under investigation in the ERC-funded Agricultural Origins of Urban Civilization' project at Oxford.

Keywords: Urbanization, Intensification, Weed Ecology, Isotopes, Eurasia

Farming and cereal crop selection in the oases of the Arabian Peninsula (4th c. BC-AD 4th c.)

Culture et sélection des céréales dans les oasis de la Péninsule arabique (IV^e s. av.-IV^e s. apr. J.-C.)

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The recent flourishing of archaeological missions in Arabian Peninsula, notably in Saudi Arabia, provides new archaeob-

otanical data for the Historical periods, times of intense trade and cultural exchanges. In addition to survey and geomorphological studies, the carpological and anthracological results highlight the importance of the oasian agrosystems for the economic sustainability since the Bronze Age at least. Beside the date palm, several annual and perennial plants constitute regular products for both staple and commercial economies. The study will focus on the cereals in order to analyse their spatial and diachronic dynamics and their local and regional economic functions through the archaeobotanical study of three sites located on important trade roads between the Levant, the Southern Arabian Peninsula and the Persian Gulf: Madâ'in Sâlih, the antique site of *Hegra* in northwestern part of Saudi Arabia, Dûmat-al-Jandal to the north, and al-Yamamah, in the eastern oasis of al-Kharj. In these sites, the main cereals are the durum wheat (*Triticum turgidum* subsp. *durum*) and hulled barley (*Hordeum vulgare*). The emmer (*Triticum turgidum* subsp. *dicoccon*) is very rarely identified and no characteristic bread wheat (*T. aestivum* subsp. *aestivum*) has been identified to date. First, intrasite spatial and diachronic analysis, as well as sample-by-sample studies made in household contexts at Madâ'in Sâlih highlight some differences of use between the two main cereals. Secondly, the comparison with the archaeobotanical data from the whole Arabian Peninsula and the adjacent regions (Levant and Egypt) underline the existence of regional agricultural identities and give some insights into the processes of crop selection.

Keywords: Arabian Peninsula, Historical period, Cereal crop selection, *Triticum turgidum* subsp. *durum*

Integrated archaeobotanical analysis, agricultural activities and wood resources at the late Bronze Age: three settlements near Leman Lake (Chens sur Léman, Haute Savoie, France)

Analyse archéobotanique intégrée, activités agricoles et ressources en bois à l'âge du Bronze final : trois établissements près du lac Léman (Chens sur Léman, Haute Savoie, France)

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An urban area of about ten square kilometres was found nearby the Geneva lake (french Leman Lake)), which straddles the border between Switzerland and France in the northern Alps. This large late Bronze Age agglomeration includes four sites: "Tougues" lakeside, "Véreître", "Pré d'Ancy" and "Charnage". After 2010, preventive excavations were undertaken in the last three sites. Archaeobotanical analyses have been carried out on thirty samples per site, comprising a volume of more than 900 litres of sediment. About a thousand charred seeds and fruits, and more than six hundred charcoal fragments were identified, including 7 cereals, 5 pulses and 5 possibly cultivated/gathered fruit species. Globally, the spectrum of cereals is made of millets, emmer and spelt, followed by naked wheat, barley and oat. Barley is the most common cereal in the "Pré d'Ancy" site. The assemblage of cultivated pulses from the late Bronze Age is diversified.

Lentil and pea are found in the "Pré d'Ancy" site while faba bean and common vetch are present in the "Charnage" site. Amongst gathering plants, *Sambucus* spp., *Prunus spinosa*, *Rubus fruticosus* or charred acorns are encountered. These results question the role of gathering plants, especially acorns, in the subsistence strategies of late Bronze Age communities. Dendro-anthracological analysis were significant in this study, being tree ring-widths measurements performed on more than one hundred oak charcoals. The high diversity of heliophilous taxa (*Prunus*, *Corylus*, *Buxus*, Pomoideae, *Juniperus*, *Ostrya*) reveals a heterogeneous vegetation including a low undergrowth cover with hedges and thickets. A riparian forest with *Alnus*, *Fraxinus* or *Populus/Salix* was also present during the Bronze Age.

Keywords: Bronze Age, French Alps, Crops, Charcoal, Wood resources

Spicy, Sweet, Weedy, and Wild: Micro- and Macrobotanical Remains from Feasting Deposits at the Late Classic Maya site of La Corona, Guatemala

Epicé, sucré, psychotrope ou sauvage. Restes micro- et macroscopiques associés à des dépôts festifs de la fin de la période classique dans le site Maya de La Corona, Guatemala

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Ritual feasting was an integral part of ancient societies; the Maya were no exception. Archaeologists working in this region have used various lines of evidence, including the study of beautifully painted polychrome drinking vases and reading ethnohistoric sources written by Spanish colonists, to attempt reconstructing ancient Maya feasts. Thus, while feasting deposits have been identified across sites in the Maya world, few have been studied from an archaeobotanical perspective. In this paper, I present macro- and microbotanical results from two Late Classic feasting (A.D. 600-900) deposits from the site of La Corona, located in northwestern Petén, Guatemala. To reconstruct the meals that participants may have enjoyed in the past I consider the plant remains but also the other cultural materials that were also part of the feasting deposits, as "people do not eat species, they eat meals" Sherratt (1991:221). Based on the ceramic attributes, as well as the faunal and botanical data, I argue that while the sounds of music-drums and whistles- played in the background, and aromatic resins and flowers burned in censers, participants were served sweet and spicy foods and drinks, made from ingredients collected from wild and domestic landscapes. The senses of those attending these feasts were further stimulated, as mind-altering plants may have also been part of the menu.

These results suggest that ancient Maya feasts were events that cannot be simply recreated through painted ceramic vases or from reading historic records. If we are to appreciate the nuances of ancient Maya feasts the archaeobotanical record needs to be further evaluated. Studies whereby ancient plant remains are considered with other lines of evidence render the past more vibrant, bringing to life the smells, sounds, and tastes of the past.

Keywords: Ancient Maya, Feasting, Ritual Archaeobotany, Macrobotanicals,

Starch Grains

The role of isotopes to reveal the early history of faba bean in the Southern Levant: an overview of the Neolithic evidences

Apport des isotopes à la connaissance de l'histoire ancienne de la fève au Levant méridional. Revue des occurrences néolithiques

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The cultivation of *Vicia faba* L. is widely spread, but very few is known about the origin of this crop. Taxonomical and genetic analyses point out at the Near East as the core area of origin. New discoveries of *Vicia faba* L. in three Neolithic sites in the Lower Galilee (Israel), open the debate about the pristine centre of domestication.

Experiments were carried out on modern faba bean to estimate the variability of morphometry due to exposure to the fire (charring effect). Classical size analysis was used to measure the biometrical traits of charred small faba beans coming from the Neolithic sites of Ahihud, Nahal Zippori 3 and Yiftah'el, in the Lower Galilee. Archaeological faba beans were radiocarbon dated to assess their absolute chronology; the $\Delta 13C$ measured to infer information on the water status of the seeds during their life cycle.

Experiments were conducted on modern faba beans to assess the influence of charring on the fresh material; the results demonstrate that archaeological seeds must have been charred at a temperature around 200°C and, under these conditions, the decrease in size is homogenous for all the beans.

Once the effect of charring on the size was assessed, the biometric analysis of archaeological faba beans revealed that seeds from earlier site of Ahihud were found significantly longer (~20%) than those coming from the sites of Nahal Zippori 3 and Yiftah'el ($p < 0,001$). $14C$ dated confirm that the relative-bigger legumes from Ahihud belong to the Early Pre-Pottery Neolithic B (10,200-10,000 cal BP), while the dates of the legume coming from Nahal Zippori 3 and Yiftah'el were consistent with a later chronology. The $\Delta 13C$ proved that size (length) of the legumes was dependent on the water received during the life cycle and not related to the degree of domestication of the legumes.

Keywords: *Vicia faba* L., Neolithic, Lower Galilee (Israel), Radiocarbon, $\Delta 13C$

Advances in the archaeology of rice in Asia

Avancées dans l'archéologie du riz en Asie

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This paper will present some of the latest research derived from the Early Rice Project, which has been looking at the im-

port of evolving rice systems from China to Southeast Asia. Here, I will focus on mainland Southeast Asia and the history of rice in this region using macroremains analysis. More than ten sites spanning a wide chronological period (Hunter-Gatherer to Historic Periods) in mainland Southeast Asia have been studied during the duration of the project and are providing evidence to reconstruct rice use and adoption in the region. Discussions will revolve around the crops and weeds found in the archaeobotanical assemblages which help define diets, farming systems and habitats. Hypotheses on the movements of rice from China and India into Southeast Asia will also be presented. Lastly, archaeogenetic work conducted on rice from Thailand and India will be presented which corroborates some of the findings from the archaeobotanical research and morphometric analysis.

Keywords: Cereals, Genetics, Morphometric analysis, Southeast Asia

The *Pandanus* and the Trees: carpo-anthracology of fuel management strategies on the island of Eiao, Marquesas archipelago, French Polynesia

Le Baquois et les arbres. Approche carpologique et anthracologique des stratégies d'approvisionnement en matières combustibles sur l'île d'Eiao dans l'archipel des Marquises, en Polynésie française

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Eiao is a small isolated island (with a surface of less than 40km²), today part of the archipelago of the Marquesas in French Polynesia. The island is currently inhabited but is rich in archaeological remains dating to the second millennium AD. It is uncertain whether it supported permanent population before European contact or more temporary forms of settlement, especially associated to the exploitation of its basalt quarries – producing valued adzes found to have been exported throughout Central Polynesia, to islands situated several thousand kilometres away.

The island also presents a highly degraded vegetation, with almost half of Eiao's land surface being eroded soils devoid of vegetal cover, 10% of it covered by invasive introduced species, and the remaining conserving some forms of relict forests that also contains Polynesian crops such as the breadfruit tree (*Artocarpus altilis*). An extensive archaeological investigation of the island's pre-european past has been conducted by the first author over the past 6 years, including the excavation and sampling of habitation soils and various archaeological features rich in charred botanical remains. A pilot archaeobotanical study was conducted on some of these samples, comparing two different types of deposits: one identified as an occupation level containing the remains of possible oven or hearth rake-outs, the other representing the remains of a large isolated and peculiar hearth, possibly associated to heat-treatment of basalt sources. A sharp difference in composition emerges from the results of the analysis, showing an extreme domination of *Pandanus* drupes that seem to have been used as a preferred fuel in the habitation site, vs a majority of wood charcoal (or monocotyledon stem charcoal) recovered in the isolated hearth feature. These results will be presented

in relation to the chronology and general archaeological interpretations of the sites, and their meaning will be discussed in terms of past practices of fuel and vegetation resources management used by the people who inhabited this small secluded island.

Keywords: Vegetation resources management, Tropical archaeobotany, Pacific Islands

Early Neolithic plant processing and use in the Balkans: new data from microfossils

Transformation et utilisation des plantes au Néolithique ancien dans les Balkans : apports nouveaux des microfossiles

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The shift from foraging to farming is arguably one of the pivotal events in human prehistory.

The Balkan Peninsula is a zone of transition from semi-arid to temperate environments and therefore a key region for the adaptation of Near Eastern farming technology and its spread into the European continent in the sixth millennium BC. Radiocarbon dates suggest that in less than 500 years, between 6000 and 5500 calBC, thousands of new farming villages emerged between the southern Balkans and the northwestern fringes of the Carpathian basin.

Nutrition was of primary importance for the survival and success of early agricultural societies. Thus, the spread of agriculture was possible only by rapid adaptation of food acquisition strategies, diet and food processing technology to new environments.

The importance of domestic cereals as dietary staples of the Early Neolithic farmers in Europe is demonstrated by charred remains from the settlements but we are poorly informed about plant foodstuffs that are not represented among the carbonized remains. Waterlogged sites and tells with better preservation of organic materials give an idea of the unexpectedly wide spectrum of plant foods consumed on a daily basis in the Early Neolithic.

The extraction and morphological identification of microscopic remains of plant parts (phytoliths and starch grains) is therefore the best analytical methods for areas with less favorable conditions of macrofossil preservation whether from stone tools, cooking recipients or from dental calculus.

These methods are also especially suited to track staple plant foods that are not (or only poorly) represented in the macrobotanical record. For our research area such elusive species are for example the starchy parts of wild plants like acorns and tubers, wild grain plants and domestic cereals like millet. The recognition and study of their use by microbotanical studies will expand and may even modify traditional models of Early Neolithic (and in the case of Lepenski Vir also Mesolithic) diet.

We will present the results of the starch and phytolith analyses carried on twenty-four stone saddle querns from Neolithic contexts (Yabalkovo, Kapitan Dimitriev, Lepenski

Vir, Blagotin, Ecesgfalva 23 and Alsónyék) and human dental calculus from four Mesolithic individuals from Lepenski Vir for botanical microrests.

Keywords: Early Neolithic, Food plant, Microfossils, Stone tools, Southeastern Europe

Erysimum crassipes as neglected medicinal plant: Storage at Early Bronze Age Küllioba, Turkey

Erysimum crassipes, une espèce médicinale méconnue : découverte d'un stock sur le site de l'âge du Bronze ancien de Küllioba, en Turquie

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As a part of Iranio-Turanian vegetation, species of genus *Erysimum*, *E. crassipes* is widely distributed in Anatolia and in the Near East. Despite the extended use of numerous *Erysimum* species for medicinal purposes, ethno-medicinal use of *E. crassipes* is briefly mentioned solely from the Highlands of Northern Jordan. Archaeologically, at an Early Bronze Age site in Turkey, *Erysimum crassipes* found in a small pot with ca. 2,5 million seed counts, constitutes the first recorded find on the World. At present, in modern medicine, numerous species of *Erysimum* are well known as containing chemical compounds in form of the steroid glycosides used against cardiac diseases, and essential oils with expectorant, laxative and diuretic effects. Essential oils like dillapiole were detected recently in other medicinal *Erysimum* species as anti-inflammatory compounds. Essential oil and glycoside profile of modern *E. crassipes* seeds are obtained using different chromatographic and spectrometric methods like FITR, GS/MS and HPLC/MS/MS. Thereafter, on the modern seeds, thermal experiments have been applied to detect the effects of charring on the chemical compounds. Comparison of the chemical profiles of archaeological seeds and those of the modern seeds allow reconstructing degraded chemical compounds in archaeological seeds. Identification and definition of chemical compounds of *Erysimum crassipes* and their effects on human body may enlighten not only its possible medicinal use at EBA Küllioba, but also its potential for the modern biochemistry and medicine.

Keywords: Medicinal plant

Plants and aromatics for embalming in Modern Times: A synthesis of archaeobotanical and historical data (France and Italy)

Plantes et aromates utilisés dans les pratiques d'embaumement durant la période moderne. Synthèse des données archéobotaniques et historiques (France et Italie)

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Until recently, investigations on Late Medieval and Early Modern embalming focused on osteological evidences observed by anthropologists on archaeological human remains. These evidences lead to a better knowledge of dissection modalities (e.g. craniotomy and sternotomy) but do not allow a comprehensive approach of these mortuary practices into elite social circles. Recent studies have investigated written and archaeobotanical sources, especially in France and in Italy. The authors have demonstrated that many plants and exudates, such as wormwood, mint, myrrh and frankincense, were used by surgeons to prepare the corpse. Based on a synthesis of these works, this paper aims to understand which properties of these drugs were expected to stop the decay process and honor the defunct.

Keywords: Embalming, Mortuary practices, Archaeobotany, Written sources, Modern Times

Agriculture and diffusion of plants in the Oman peninsula during the 3rd century AD: recent archaeobotanical research in Mleiha (U.A.E.)

Agriculture et diffusion des espèces végétales dans la péninsule d'Oman durant le IIIe s. ap. J.-C. Recherches archéobotaniques récemment menées à Mleiha (Emirats Arabes Unis)

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Little archaeobotanical data has been so far recorded from historical periods in the Oman peninsula. The excavations carried out under the direction of M. Mouton (CNRS) in 2010 and 2011 of a burnt building at Mleiha (Sharjah Emirate) dated to the end of the pre-Islamic period (middle of the 3rd century AD) have now provided a large amount of exceptionally well-preserved organic remains such as seeds, fruits, charcoals, fibres and amorphous remains. This discovery gives us the unique opportunity to reconstruct the agrarian economy and bring to light new information about the diffusion of plants during this period.

The results of both seed and charcoal analysis show the presence of an oasis agrosystem nearby the site, mainly based on the cultivation of date palms, irrigated thanks to wells giving access to the groundwater. The seed and fruit assemblages reflect the typical vertical organisation of date palm garden containing also cereals (*Hordeum vulgare*, *Triticum aestivum/durum*), pulses (*Lens culinaris*, *Lathyrus sativus*), vegetables (*Allium sativum*) and fruit trees (*Vitis vinifera*, *Punica granatum*). In addition to these common plant products regularly found within contemporary Middle Eastern oasis agrosystem, several new species highlight the important connections between Mleiha and the Indian sub-continent, especially pepper (*Piper nigrum*), rice (*Oryza sativa*), kodo

millet (*Paspalum scrobiculatum*), cotton (*Gossypium* sp.), sesame (*Sesamum indicum*), cowpea (*Vigna unguiculata*) and urd/mung gram (*Vigna mungo/radiata*). For most of these (pepper, rice, kodo millet and pulses), they constitute the earliest evidence of their presence in the Arabian Peninsula and likely represent imported products. Nevertheless, we will question if some species may also have been cultivated locally by examining the ecological features, the agronomic requirements and others archaeobotanical evidence for the Arabian Peninsula as well as from surrounding regions. From this perspective the case of rice and cotton appears as of particular interest.

Keywords: Diet, Oasis agrosystem, Trade, Oman peninsula, pre-Islamic period

The chalcolithic refuge cave in Masada - food sources in an hostile environment

La grotte-refuge chalcolithique de Massada. Se nourrir dans un environnement hostile

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The Chalcolithic period in the Levant marks a transitional phase in human history between the first agricultural societies of the Neolithic and the urbanized societies of the Bronze Age. It is characterized by settlement in primitive farming villages, and developments in religion, technology and art.

Yoram Cave is a karst grotto in the southern cliffs of Masada, where a Late Chalcolithic period (Ghassulian culture) anthropogenic layer was exposed, from which plant remains were collected and taken for analysis. This plant assemblage is rich in both number and variety of species, and includes edible plants (cereals, pulses and fruits), weeds, and wild plants. In addition, the environmental conditions in this desert cave brought about complete desiccation of the archaeobotanical remains, preserving flowers and other fragile plant organs.

In this lecture, we will describe these plants and reconstruct the diet and economy of the cave's inhabitants. Based on current conditions in the Dead Sea environment, the Yoram Cave assemblage indicates that some food plants were imported from other regions. Interestingly, some of the imported grains came in the form of whole ears. Additionally, we will reconstruct the environment around the cave, and discuss the possibility that the cave's inhabitants were not local residents but arrived as refugees from a distant land.

Keywords: Chalcolithic period

Vegetation and plant exploitation in the Southern Caucasus, from Neolithic to Early Bronze Age

Couvert végétal et exploitation des plantes dans le sud Caucase, du Néolithique au début de l'âge du Bronze

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Southern Caucasus, between Black Sea and Caspian Sea, and at the crossroads of several phytogeographical provinces, is the subject of new archaeobotanical studies since the 2000's. Studies of seeds and fruits were already undertaken during the 1960s-1970s and gave a first idea of the uses of plant by inhabitants of several sites. New methods of sampling but also of identification allow since 20 years to characterize more precisely the diet of inhabitants of settlements of the Southern Caucasus, but also to precise the diachronic evolution of the relationship between humans and their environments. The aim of this presentation will be to describe the cultivated plants and the vegetal diet of people living in the Southern Caucasus, from the Neolithic to the Early Bronze Age.

Keywords: Southern Caucasus, Neolithic, Chalcolithic, Early Bronze Age

47, 000 years of plant exploitation on the edge of the Great Sandy Desert: multi-proxy archaeobotanical analyses at Riwi cave, south central Kimberley, Western Australia

47.000 ans d'exploitation des plantes à la frange du Grand Désert de Sable : analyses archéobotaniques multi-niveaux à la Riwi cave, dans le centre-sud du Kimberley, Australie occidentale

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Despite the known importance of plants in hunter-gatherer economies, poor preservational environments have restricted the application of archaeobotanical studies on the Australian continent, inhibiting our understanding of human-plant interaction in the past. Excavations at Riwi cave located in south central Kimberley, northwest Australia, have revealed exceptional preservation of botanical remains stretching back 47, 000 years. Wood charcoal, uncharred wood, seeds, other floristics, and botanical artefacts (wood shavings, string, and two wooden artefacts) were recovered. This paper presents the results of archaeobotanical analyses (carpology, anthracology, and the taxonomic identification of two wooden artefacts using X-ray computed microtomography) for which region specific botanical reference collections were created, one anthracological and the other carpological, using appropriate methods. These high-resolution, local scale analyses have been used to develop a detailed model of plant exploitation in the past, which is unprecedented in the Australian archaeological context.

Carpological analysis revealed that monsoonal vine thickets, which are isolated patches of dry rainforest, were the primary ecological environments exploited for food plants by hunter-gatherer groups occupying Riwi cave. The carpological data also indicate that occupation of the site was seasonal. Analyses of charcoal were used to reconstruct woody vegetation surrounding the site during periods of occupation, which revealed a shift in vegetation composition during the Pleistocene that can be related to an arid event observed in other regional palaeoecological archives. The identification of the material used to produce two Riwi wooden artefacts, using X-ray computed microtomography, illustrates that the past inhabitants of Riwi selected certain woods for specific purposes within the

last 1,000 years of occupation at the site. Limited palaeoethnobotanical and archaeobotanical studies have been conducted in Australia and this approach using a variety of types of plant remains contributes substantially to region specific traditional ecological knowledge and to the overall understanding of human-plant relationships in hunter-gatherer societies in Australia.

Keywords: Palaeoethnobotany, Australian Archaeology, Carpology, Anthracology

Investigating the Domestication of Forests in Tropical Pacific Islands: the differential roles of wood charcoal and carpo-remains as proxies

Appréhender la domestication des forêts dans les îles tropicales du Pacifique : l'utilisation différenciée des restes carpologiques et anthracologiques comme intermédiaires

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Archaeobotany has played an essential role in archaeology by documenting and advancing knowledge on the history of domestication and cultivation. Traditionally, carpo-remains represent the main proxy to inform on anthropogenic manipulations of plants, on their specific uses and processes of exploitation. When combined with wood charcoal remains documenting the composition and human use of a site's surrounding woody vegetation, archaeobotanical studies of carpo-remains can often produce a very fine reconstruction of past practices of trees resources, including arboriculture.

In tropical regions however, and in the Pacific Islands in particular, specific environmental conditions as well as socio-cultural trajectories have created both human-vegetation interactions and archaeobotanical preservation settings that tend to reverse this pattern. Indeed, in such regions, it appears that the ubiquitous and resistant wood charcoal macro-remains present a high potential to investigate past practices of arboriculture or, in a more complex perspective, forests' domestication.

Carpo-remains, in turn, emerge as supplementary proxies, and are often associated to non-anthropogenic layers with unusual preservation conditions, such as waterlogged deposits. This issue will be discussed through several case studies focusing on two islands of French Polynesia, where archaeological sites were excavated recently at various locales on the islands and produced archaeobotanical material from pre-human to post-European contact deposits. We will show the differential roles played by wood charcoal and carpological macro-remains in our investigations of forests transformations, trees management and arboriculture on the islands of Mo'orea and Maupiti, French Polynesia.

Keywords: Macroremains, Arboriculture, Forest, Tropics, Pacific

Comparing the emergence of agriculture in the northern and the southern Levant through the archaeobotanical data from two PPN sites: Dja'de El-Mughara and Tell Aswad

Comparer l'émergence de l'agriculture au nord et sud Levant à partir de deux sites PPN : Dja'de el-mughara et Tell Aswad

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Dja'de el-mughara is situated in northern Syria and was occupied during the X-IXth millenium, which corresponds to the transition period from PPNA to early PPNB. The village was settled on a Pleistocene terrace on the banks of the Middle Euphrates river. Today, the mean annual rainfall is between 250 and 350 mm.

Tell Aswad, located in southern Syria, was occupied from the mid-IXth until the end of the VIIth millennium, that is to say early to late PPNB periods. While today the site is situated in the irrigated farming area (receiving between 100 and 200 mm/year), the Neolithic village - covering approximately 4 ha - was established on the edge of an ancient Pleistocene lake surrounded by a marshy area.

On both sites, tens of thousands of charred macro-botanical remains were recovered from different archaeological contexts by flotation. They provide a good opportunity to observe the local variations in the development of agriculture. These variations may be due to chronological differences, local agricultural traditions, or different environmental conditions such as for example availability of wild cereals and pulses.

The two sites are situated in two distinct and very different cultural and climatic zones. In this presentation we will compare charred remains from each site and attempt to show how farming emerged simultaneously but quite separately and independently in these two different regions.

Keywords: PPNA, PPNB, Levantine area, Beginnings of agriculture

Early Food Production in Central Anatolia: Role of cultivars and wild plant resources in a transitional community

Les débuts de la production alimentaire en Anatolie. Rôle des plantes cultivées et sauvages dans une communauté en évolution

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Food production is considered to be one of the main shifts in human prehistory as it changed over time the behaviour of late hunter-gatherer communities and led to the emergence of early farming economies. The nature of this phenomenon that is also related to sedentary life has been of great interest to archaeobotanical researches as well as more generally for early Neolithic investigations.

From an economical point, hunter-gatherers or foragers are defined as more or less mobile groups whose subsistence is based on diverse wild animal and plant foods, while they have no direct control on these resources. On the other hand, the diet of farmers depends on managed food resources, with a great impact on these populations and the reproduction of the new generations. For the latter, a co-dependency can be suggested where humans generally believed to be more effective or dominant. However, when the early Neolithic communities are considered, these definitions require detailed question-

ing such as the scale of food production and exploitation of wild resources; their nature; and to what extent the emergence of productivity points out the abandonment of forager subsistence traditions.

In this manner, the presentation aims to reconsider the role of domestic and wild plant foods as well as plant related subsistence activities of an early Neolithic community in Central Anatolia, where the latest data contributes to our understanding of initial food production. The focus will be on Aşikli Höyük, the earliest sedentary community in Western Cappadocia dating to the 9th to 8th millennia BC, exhibiting a transitional community both on social and economical manners, for approximately one thousand years of occupation without interruption. The recent archaeobotanical results from Aşikli Höyük points out cultivation of the founder crops known from Southwest Asia, and also a diverse wild plant assemblage. The detailed results will be presented by the diversity and intensity of these resources and their spatial distribution in domestic spaces through occupation. Cultivated plant resources, possible wild plant co-stables, related subsistence activities and their impact on diet will be discussed within the framework of the general picture of Central Anatolian early Neolithic period and the emergence of food production in this region.

Keywords: Food production, Plant resources, Early Neolithic communities, Central Anatolia, Aşikli Höyük

Stable isotopes through time and space in the Netherlands

Les isotopes stables à travers le temps et l'espace aux Pays-Bas

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The isotopic analysis of preserved plant remains may provide important contributions to the reconstruction of past environments and human activities. The most commonly used isotopic proxies in archaeobotanical-related research are the stable isotopes of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$). These isotopic signals are determined by the physiology of the specific plant species, local soil and environmental conditions, and farming practices. This large potential for archaeological information was explored in a new wide-range isotopic study that included measurements on 100 samples of cereals, pulses, linseed and gold-of-pleasure. These samples were recovered from various archaeological sites in the Netherlands assigned to different archaeological periods and soil types.

In a first research phase, an already completed preliminary study containing 22 samples was undertaken to compare the efficiency of acid-only and acid-base-acid pre-treatments in removing foreign carbon contaminants (Brinkkemper et al., in prep.). Obtained results demonstrated that there were no significant statistical differences between untreated and treated samples provided that the isotopic results are reported with adequate uncertainties. Also investigated, was the use of pre-screening methods, FTIR and elemental measurements using p-XRF, to determine sample preservation status. This comparison demonstrated that p-XRF was more efficient than FTIR in detecting the presence of humic contaminants by measuring the presence of specific elements (e.g. Fe and Mn). The

outcome of the preliminary study defined the sample treatment and screening strategies applied to the remaining 80 samples. In general no pre-treatment was applied, however, for samples requiring isotopic measurements with higher precisions elemental measurements were done to establish the need for an acid-base-acid pre-treatment.

At the time of writing the study is not yet complete. However, valuable results have been already obtained. There were significant differences in $\delta^{15}\text{N}$ values of acorns and pulses vs. cereals. The latter were noticeably higher and overlapped with known values from animal bone collagen. This result has important implications in human paleo-dietary studies employing isotopic analysis and suggests that previous estimates of dietary contributions from plant foods are likely underestimated. In addition, cereal $\delta^{15}\text{N}$ differed among time periods. Cereal samples from pre-historic periods (Neolithic, Bronze Age, Iron Age) showed higher $\delta^{15}\text{N}$ values than those from historical periods (Roman, Medieval). This diachronic trend is likely linked to shifts in agricultural practices, namely a comparatively more intensive use of animal manure during pre-historic periods.

Keywords: Stable isotopes, Cereals, Pulses, Manuring

Suburban gardens from the 14th-17th centuries: the example of Forum des Carmes, Istres (Bouches-du-Rhône, Southern France)

Jardins sub-urbains des XIVe-XVIIe s. : l'exemple du Forum des Carmes, Istres (Bouches-du-Rhône, sud de la France)

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Excavation work carried out in the heart of the town of Istres (southern France), prior to the construction of a new shopping centre, uncovered the remains of a section of the medieval and modern towns, with their buildings and adjacent gardens. The study of the material remains, in association with data from soil morphology, land molluscs, archaeobotany and written documents, provides the means to reconstruct human activities and their intensity within their environmental setting. The geoarchaeological profiles also allow us to go beyond our limited time scale and understand how the local ecosystem evolved since the beginning of the Holocene.

The excavation of the garden areas turned out to be particularly interesting due to the discovery of three wells filled with organic material. The archaeobotanical waterlogged remains (fruit/seeds/wood/charcoal) recovered are unlikely to reveal the full diversity of cultivated plants; however they provide evidence of a whole range of fruits (grapevine, fig, olive, peach, cherry, pomegranate, plum, almond, walnut, hazel), vegetables (beet, two types of gourd, spinach, cucumber) and condiments (celery, coriander, rosemary, laurel), which contrasts with written records suggesting that, in Provence, diet lacked vegetables and fruits. The variety of food plants thus revealed may be related to the social status of the urban landowners. Ornamental / medicinal plants also figure among the finds (lime

and castor oil plant). As far as we know this is the first archaeobotanical evidence of *Ricinus communis* in Europe, a highly toxic plant formerly used for medicinal purposes.

Cereal remains recovered from one of the ditches suggest local cultivation of naked wheat, barley and rye during a slightly earlier phase (12th century). However, it is the information provided by the study of land molluscs that allows us to acknowledge the structure of these gardens' and identify a clear separation between orchards and areas destined to cereal cultivation. This division is further confirmed by a local document (dated 1484) mentioning houses, orchards, vineyards, cereal plots, gardens, interior yards and stables in and around the urban area.

Keywords: Medieval, Modern town, Urban gardens, Bioarchaeology, *Ricinus communis*

What's under the rubble ? Exploring and comparing botanical inventories of the Neolithic Vinča houses

Qu'y-a-t-il sous les décombres ? Analyser et comparer les séries botaniques associées aux habitations néolithiques du site de Vinča

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The paper focuses on the charred plant assemblage from the Neolithic tell-settlement of Vinča-Belo Brdo near Belgrade in Serbia. The Vinča tell was inhabited over much of the SE European Neolithic sequence, from c. 5600 to 4500 cal BC. It represents the type-site of the cultural phenomenon that developed across large parts of the central, western and northern Balkans. Although only one of many Vinča culture settlements, Belo Brdo site remains unique in the central Balkans for the continuity and duration of its Neolithic occupation. The settlement consisted of closely placed, rectangular wattle-and-daub buildings most of which were equipped with features such as ovens and clay bins/basins and contained grinding stones and other tools, ceramic vessels of various sizes and shapes, ornaments and symbolic objects. A number of the buildings were burned in the past enabling *in situ* preservation of the structural elements and indoor features and inventories. Most recent investigations at the site included excavations of the three final horizons of Neolithic occupation of the settlement (i.e. uppermost levels of the tell) over an area of about 1400 m². Remains of some 17 buildings, of which most were burnt, were identified; few well preserved ones were C14-dated to c. 4540-4500 cal BC.

Several of these buildings were systematically sampled for macro-botanical remains that were recovered using flotation and were morphologically analysed. The paper presents the primary archaeobotanical data and goes on to compare the datasets from individual buildings. The main bases for comparison are: the range of crop and wild plants; the quantities of different crop and wild taxa; and the representation of different plant parts (i.e. plant products vs. discard). Further, archaeological contexts from which (concentrations of) plant remains derive are examined and compared. The location of the analysed deposits and their botanical density are plotted using GIS; such visual presentation of the results enables better understanding of the spatial distribution of plant remains (and

plant-related activities) and the identification of variations in botanical content of the houses.

Finally, possible implications of the observations from Vinča for two issues frequently discussed in the literature on the Balkan Neolithic are assessed: (1) the previously suggested ritual nature of the house burning and thus potentially symbolic role of (large) plant deposits in burnt houses, and (2) the emerging socio-economic differentiation and household inequality suggested for Vinča culture communities.

Keywords: Neolithic Vinča, Burnt and unburnt houses, Spatial distribution of plant remains

Archaeobotanical analyses at Malta Islands

Investigations archéobotaniques à Malte

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The archaeobotanical analyses carried out at the site of Tas-Sil (Malta), allowed to investigate the strategies adopted by human groups for exploiting plant resources in this island landscape from Neolithic to Roman period.

The sampling strategies applied to Tas-Sil, were individually tailored to the type and function of the contexts being investigated and were aimed at the recovery of plant macro-remains, specifically charcoals and seeds/fruits.

The gathered data were used to determine the relationship between the environment and human beings by reconstructing (i) the ways in which the trees and wooded areas were exploited for firewood and carpentry and (ii) patterns of agriculture for food production.

The anthacological analysis show the presence of olive associated with mastic, myrtle buckthorn/phillyrea, indicate a typical Mediterranean maquis environment, while remains of deciduous oak (*Quercus* type *robur*) and hornbeam (*Carpinus* sp.) highlight the presence of woodland during Neolithic period. The presence of *Hordeum vulgare*, *Triticum dicoccum* and *T. aestivum/durum* testifies the local cultivation of cereals and it is confirmed at a regional level by the increase in Cerealia pollen in core sequences at Marsa and Salina Bay.

During the Bronze Age, the vegetation seems to be affected by micro-climate change.

In the Early Bronze Age, from the Thermi Ware phase onwards (2300-2150 BC), climatic conditions tend to become drier, with an increase in Leguminosae and *Rhamnus*; in this period cereal cultivation is testified by barley associated with hulled wheat. During the Tarxien Cemetery period (2150-1450 BC) we reconstruct the return of more humid conditions, with the reappearance of naked wheat and a reduction in xerophilous taxa, particularly of typical garrigues. The anthracological sequence indicates an increase of vegetation typical of the garrigue for the Bor in-Nadur period (Late Bronze Age), probably related to a phase of relative drier climate.

The currently available archaeobotanical data pertaining to historic period (Phoenician-Punic-Roman phases) indicate a landscape characterized by the dominance of olive trees and the change in the management of plant resources, probably linked to olive cultivation.

Archaeobotanical analyses show that the resilience of the human groups in these Mediterranean island contexts manifests

itself in the rich variety of strategies adopted for exploiting the plant resources, whatever the climatic conditions.

Keywords: Archaeobotany, Environment, Crops, Maltese Islands, Prehistory, Antiquity

Burnt to a crisp ? The high-throughput DNA sequencing of charred grains

Brûlé à coeur ? Le séquençage haut-débit (HTS) des grains carbonisés

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The genetics behind the spread of agriculture is important to determining not only how and when it occurred but also its sustainability in our changing climate. Most studies using archaeological grains to answer the many questions about the origins and spread of agriculture use desiccated or water-logged grains because of their better DNA preservation. The work presented here builds on studies using charred archaeological grains, a generally under-utilised resource due to the many problems associated with the extraction and characterisation of DNA from charred material. We used charred barley from the late Bronze/early Iron Age site of Assiros Toumba (from Phase 9, 1395-1343 BC) in Greece to evaluate different extraction methods. Each extraction method was tested using different numbers of seeds and the most promising extract was prepared and sent for high-throughput sequencing (Illumina HiSeq). High-throughput sequencing, unlike the standard polymerase chain reaction (PCR) technique most commonly used, does not require a specific sequence to be targeted and so is not as restricted by fragmentary DNA and allows DNA from unexpected origins to be sequenced, if present. The DNA sequences obtained by high-throughput sequencing will be assessed for authenticity and composition to determine if the sequences originated from endogenous ancient DNA or contaminating environmental DNA, the results of which will be presented here.

Keywords: Ancient DNA, Charred grains, Domestication, Barley

Multi-period and multi-cultural Tell e-āfi/Gath, Israel - variation in dietary preferences and palaeoenvironment

Le site multiphasé et pluriculturel de Tell e-āfi/Gath, Israël. Diversité des préférences alimentaires et des environnements

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A large and rich Biblical site of the southern Levant revealed four consecutive periods, which allowed a rare opportunity for a comparative analysis of ancient diet and environment. Tell e-āfi/Gath is a multi-period site, one of the five Philistines cities. In this investigation, we analyzed and compared archaeobotanical assemblages from its four periods of occupation – Early Bronze Age, Late Bronze Age, Iron Age I and Iron Age II – from the middle of the third millennia BCE to

the 8th century BCE. Culturally, this is a Canaanite city during the Bronze Age, a Philistine city at Iron Age I and at the beginning of the Iron Age II, after which it becomes a city with Judahite cultural affinity. This large database of varying plants used by these four different cultural groups is an opportunity to identify their dietary preferences. Moreover, comparing the crops and their weeds reveals some distinctive changes which relates to both the cultural shifts within the site and environmental changes during the ca. 1,700 years of occupation. In this lecture we would like to present our results related to the crops, their weeds, and wild plants.

Keywords: Palaeoenvironment, Near East, Bronze and Iron Ages, Philistines

Long and attenuated: comparative trends in the domestication of tree fruits

Long et atténué : Tendances comparatives dans la domestication des arbres fruitiers

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This paper asks whether we can identify a recurrent domestication syndrome for tree crops (fruits, nuts) and track the evolution of tree domestication archaeologically. While archaeobotany has made major contributions to documenting the domestication process in cereals and other annual grains, long-lived perennials have received less comparative attention. Drawing on examples from across Eurasia, including each Asian peach, jujube and chestnut, west Asian olive, almond and grape, and South Asian mango, comparisons suggest a tendency for the larger domesticated fruits to contain seeds that are proportionally longer, thinner and with more pointed (acute to attenuated) apices. Therefore, although changes in flavour, such as increased sweetness, is not recoverable, seed metrics and shape provide an archaeological basis for tracking domestication episodes in tree fruit. Where available, metrical data suggest length increases, as well as size diversification over time, with examples drawn from the Jomon of Japan (chestnuts), Neolithic China (peach, jujube) and the later Neolithic of the Near East (olive, date) to estimate rates of change. Despite the long generation time in tree fruits, rates of change in their seeds is generally faster than rates of phenotypic evolution in annual grain crops, suggesting that conscious selection played a strong role in tree domestication in contrast to the unconscious selection processes in cereals and grain legumes.

Keywords: Arboriculture, Nuts, Conscious selection, *Ziziphus*, *Prunus*, *Castanea*, *Olea*, *Vitis*

The role of food in shaping Harappan identities

Le rôle de l'alimentation dans la construction identitaire harappéenne

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The distribution of Harappan material culture throughout the Greater Indus Valley is considered a marker of Harappan identity in socially and ecologically diverse regions of the Indus Civilisation (3300-1500 BC). In this presentation we argue that food production and consumption patterns also reflect social identity at multiple levels, including the integration of local populations into wider regional dynamics. Our case studies outline results from combining recent macro and microbotanical research in two semi-arid regions of the Indus Civilisation: Gujarat and Haryana (NW India). Monsoon-adapted small millets and tropical pulses were the staple crops in Harappan Gujarat, while wheat was consumed but not locally produced. Similarly, the evidence from Haryana suggests that a mixture of millets, rice and barley formed the staple of the diet with a small proportion of wheat used only occasionally, potentially traded in from other regions. When combined with previous archaeobotanical research in the Greater Indus Valley, our evidence suggests that wheat was produced in areas related to the Indus hydrological dynamics and traded to peripheral regions, playing a key role in defining Harappan identities in areas unsuited for its cultivation.

Keywords: Greater Indus Valley, Multi-proxy, Food, Social identity

A comparative archaeobotanical study on charred food remains from Neolithic Çatalhöyük (Turkey), Tepe Marani and Gurga Chiya (Iraq)

Analyse archéobotanique comparative de vestiges de préparations alimentaires carbonisées des sites néolithiques de Çatalhöyük (Turquie), Tepe Marani et Gurga Chiya (Irak)

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Archaeobotany as a scientific approach uses ancient plant remains in order to reconstruct and interpret the environment context of past societies. However, traditional archaeobotanical methods prove problematic when trying to recreate aspects of daily life and domestic activities such as food preparation and cooking practices. To solve this issue, my PhD project introduces a new archaeobotanical perspective on the social study of preparation of daily meals in the Near East. This study integrates archaeobotanical analyses of unstudied plant evidence, such as amorphous organic food fragments and food crusts from ceramics, combined with the archaeological and ethnoarchaeological examination of artefact assemblages (ovens, clay balls, pots, ground stones, etc.) and experimental food preparation following traditional recipes. This paper presents the preliminary results from the comparative investigation into the botanical composition of fragments of amorphous charred plant materials found at Neolithic Catalhöyük, Tepe Marani and Gurga Chiya which are thought to represent burnt food preparations (e.g. cereals processed into bread, bulgur, and/or porridge). Scanning Electronic Microscope analyses of micro-structure within these charred food remains had the potential to directly examine their plant composition and also the cooking processes and choice of techniques and ingredients that led to the preparation and creation of prehistoric meals.

Keywords: Neolithic, Çatalhöyük, Archaeobotany, Organic residues, Parenchyma

Assessing the nature of early farming in Neolithic western Asia: A functional ecological approach to emerging arable weed flora

Explorer les premières pratiques agricoles du Néolithique en Asie occidentale, avec l'aide de l'écologie fonctionnelle appliquée aux flores adventices émergentes

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Research on the origins of agriculture in western Asia has placed great emphasis on the location and pace of domestication. However, much less attention has been given to reconstructing the specific nature and social implications of early cultivation practices across the agricultural transition, and to the potentially varied land management strategies involved. By employing a functional ecological approach to the interpretation of arable weed taxa associated with early cultivars, this research addresses this gap in archaeobotanical research by enabling detailed analysis of the growing conditions and farming methods involved in early plant cultivation in western Asia.

The core methodology analyses the functional ecological attributes (e.g. leaf area and thickness; canopy dimensions; stomatal density and distribution) of the relevant arable weed taxa isolated from archaeological contexts to determine the specific growing conditions of early crops and hence the nature of management practices. Functional attributes are morphological or behavioural characteristics that predict species' potential in relation to major environmental variables, such as soil productivity, disturbance and moisture. Statistical analysis of these attributes will explore variation amongst early cultivation contexts and compare them with weed survey data from relevant (semi-)arid modern regimes, including a recent study of traditional cereal farming in Morocco. With the identification of specific agricultural strategies, the dynamics and innovation of early farming societies will be explored, as well as their resilience and long-term sustainability.

Ecological signatures will be determined from the now substantial weed dataset available from four well documented and contextually rich Pre-Pottery and Pottery Neolithic sites, which have been strategically selected to explore agricultural strategies from its initial stages through to the established Neolithic, as well as taking advantage of detailed sample-by-sample data and extensive in situ deposits. The sites investigated include PPNA Jerf el Ahmar and PPNA/EPPNB Dja'de in northern Syria, PPNB Tell Aswad in southern Syria, and PPN-PN Çatalhöyük in Central Turkey. Refined identification of selected weed genera at these sites enables more accurate indications of their ecological implications. Furthermore, the results of the ecological analyses will be closely explored in relation to other contextual data at the selected sites and will aim to determine the cultural context of specific farming practices and processing regimes.

Keywords: Weed ecology, Agricultural regimes, Early cultivation, Neolithic, Western Asia

Could seed image analysis be helpful in the archaeobotanical studies?

L'analyse d'images peut-elle être utile à la démarche archéobotanique ?

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Application of computer vision techniques in archaeological plant remains, proved to be an effective tool for the identification both of charred and waterlogged seeds. Due to its strategic geographical position, its isolation and climatic conditions, and owing to the existence of many archaeological settlements, perfectly preserved and distributed in the whole island, Sardinia can undoubtedly be considered a wonderful archaeobotanical laboratory.

In this study, the results about seed and endocarp remains, recovered from the archaeological sites of Sa Osa and Santa Giusta (Oristano, Sardinia), respectively dated to the 12th-10th BC and to the 5th-2nd century BC, are presented.

Samples digital images were acquired, processed and analysed applying image analysis techniques. A total of 98 morphometric features were measured on each seed and endocarp. The recorded morphometric data were statistically elaborated using a stepwise Linear Discriminant Analysis, allowing statistical comparisons among archaeological remains, modern wild populations and traditional cultivars.

Considering the importance of a correct remains identification for the comprehension of the history and origin of the domestication processes; and the extreme difficulties to recognize archaeological charred seeds because of the morphological alteration of seeds shape, different carbonisation experiments were carried out on grape seeds. Using both a hearth to reproduce the same burning conditions occurring in archaeological contexts, and a muffle furnace to set and fix experimental conditions, modern cultivated and wild grape seed samples were treated applying different burning temperatures and then compared with archaeological grape seeds.

This analytical procedure allowed to identify the archaeological seeds from the Middle Bronze Age as intermediate forms between modern wild and cultivated grape pips; while, those from the Late Bronze Age showed a high degree of similarity with the modern cultivars.

Furthermore, high correspondence between the archaeological endocarps of *Prunus spinosa* and *P. domestica* and the modern ones, was found, identifying the most similar modern wild populations and cultivated varieties.

The exceptional state of preservation of the waterlogged remains allowed to investigate the domestication process of *Vitis vinifera*, verifying the possibility that primitive grape cultivars might have existed in Sardinia, during the Bronze Age. Moreover, it was possible to hypothesize in Sardinia the earliest evidence of *P. domestica* in the Western Mediterranean Basin, during the Phoenician-Punic period. This method can be considered a valid support for advances in the knowledge and comprehension of agriculture adoption and domestication

processes.

Keywords: Carbonisation experiment, Computer vision, *Prunus domestica*, Seed remains identification, *Vitis vinifera*

Tracing the origin of the early medieval crop spectra in east central Europe. Ex oriente lux ?

Sur la piste de l'origine du spectre des cultures du haut Moyen Âge en Europe orientale et centrale. Ex oriente lux ?

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In Europe the period spanning from the end of the Roman period (through the migration period) until the beginning of the Early Middle Ages is recognised as a time of the prominent changes in arable farming and to it connected economy. It is a moment when prehistoric assortment of "archaic" cereals represented mostly by glume wheats (*Triticum dicoccon*, *T. monococcum*, *T. spelta*) diminished and was replaced by free-threshing wheats (*Triticum aestivum*, *T. compactum*), oat (*Avena sativa*) and rye (*Secale cereale*). This rebirth of farming survived without much damage only barley (*Hordeum vulgare* s.l.) and millet (*Panicum miliaceum*), still favoured in later medieval times.

The switch from "prehistoric" to "medieval" assortment of crops end economy emerges simultaneously in western (France, Netherlands, Germany...) as well as in the east-central Europe (Poland, Bohemia, Slovakia, Hungary, Ukraine...), yet for explanation of this phenomenon national(istic) paradigms are often considered (e.g. introduction of the new crops and techniques by "Slavs", "Germans" or "Celts"). This paper aims for more detailed temporal and spatial description of this phenomenon, and targets also its possible causes.

Keywords: Archaeobotanical methods, Europe, Middle Ages, Agricultural systems, Diffusion, Trade

Ancient desert agriculture systems: The example of the monastery of Kilwa (8th century A.D.)

Agricultures anciennes en contexte désertique : l'exemple du monastère de Kilwa (8e siècle de notre ère)

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Kilwa is a monastic site inhabited by a Christian community around the eighth century A.D. The site is in a physical environment so harsh that the main object of the study is to understand how the community maintained itself in such an environment. The site is located in the northwest of Saudi Arabia, 250 km east of the Gulf of Aqaba in a mountainous region

characterized by an arid environment. The average rainfall is estimated at less than 50 mm/year excluding any dry farming. The research undertaken on the site has raised a number of questions about the subsistence strategies, modes and means of production or supply.

The archaeobotanical analyses performed on archaeological sediment samples, showed exceptional richness. The importance of fruit remains (olive, peach, date, plum stones for example) associated with the presence of olive charcoal and *Prunus*, raises the issue of whether these plants were imported or were grown locally. A multidisciplinary research program (archaeology, geophysics, sedimentology and ethnographic) has identified a number of areas suitable for agriculture and reveals the presence of systems used to harvest runoff rainwater. This research provides an array of presumptions allowing us to hypothesize that local cultivation, despite a very arid environment, was possible during the occupation of the site.

Thus the results presented here allow us to envisage an agricultural vocation for the monastic establishment, which is characteristic of monastic facilities elsewhere in the Middle East and essential to the life of the community. Furthermore, Kilwa is a good example of where agriculture exploits rainwater run-off and floodwaters. Research at Kilwa has enriched our general knowledge about the use of the environment by man and the means implemented to face strong environmental constraints in arid environments.

Keywords: Saudi Arabia, Desert, Monastery, Agriculture, Water management

Processing, Storage and Symbolism of Wild Nuts in the Past and Present: Comparative ethnoarchaeobotanical studies of Japan and California, USA

Préparation, stockage et symbolique passés et présents des "noix" sauvages. Approches ethnobotaniques comparatives au Japon et en Californie (Etats-Unis d'Amérique)

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Recent archaeobotanical research revealed the high significance of wild plant food, particularly nuts, even in early agricultural periods in Chinese rice farming area (eg. Fuller *et al.* 2009). In Japan, significance of wild nuts in prehistoric diet has been discussed for some decades, and now human exploitation of wild food plants is the central issue in discussion of East Asian prehistoric diet.

To develop the discussion, we need to reconstruct not only which plant people exploited but also how they scheduled the uses of diverse resources, and the processing and storage technique, namely routine'. Studying regional diversity and chronological shifts of the routine, we can discuss the East Asian prehistoric subsistence strategies on substantial basis. Recently some new archaeological methods such as ancient starch analyses and carbon/nitrogen isotope analyses to reconstruct food processing techniques have been developed to much contribute the discussion, but at the same time, we need to obtain knowledge about diverse ways to utilize various food resources and their interconnection with social organizations. Ethnographic research of modern traditional culture will provide such knowledge to be usefully referred to the archaeolog-

ical interpretations.

In Japan, domestic ethnographic research for this purpose has been conducted by several archaeologists from 1970s, to accumulate data of diverse non-mechanized food plant processing techniques, particularly with wild nuts, that were possible prehistoric major food. On the other hand, all available ethnographic examples within Japan are of the uses of wild nuts as minor food, such as famine food or relic' food, and thus it is difficult to observe routine organization of nut uses as the major food. However, to develop comprehensive discussion on prehistoric subsistence strategy, we need the ethnographic information on such a routine organization, in addition to information on individual nut processing techniques.

Native Americans are also known by the tradition of intensive nut uses and there are good accumulation of the ethnographic studies, but substantial comparison with Japanese examples has not been conducted. Yet their late 19th - early 20th century records do show the state of society with wild nuts being used as the major food, in connection with organization of processing activities and symbolism. Therefore, proper comparative studies, on the social level, of the native American and Japanese cases can surely introduce a new insight to the East Asian study of prehistoric subsistence strategies. It is quite useful to promote such a global comparative study also in the ethnoarchaeological domain.

Keywords: Ethnoarchaeology, Native Californian, Japan, Wild nuts, Routine

The late adoption of farming in the SW Baltic region in the Neolithic

L'adoption tardive de l'agriculture dans le Sud-Ouest de la Baltique, au Néolithique

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The rather late adoption of farming practices in the south-western Baltic region is generally regarded to reflect the marginal role of this region for the Neolithisation of Europe. Despite earlier contacts with agricultural societies, it was only during the early 4th millennium BCE that farming gained importance with the Funnelbeaker Culture. Within the research program on "Early Monumentality and Social Differentiation" funded by the German Research Foundation over the last six years (2009–2015), intensive archaeobotanical investigations were carried out. Based on the new large dataset, a refinement of our understanding of the transition from hunting/gathering to farming and the establishment of new subsistence strategies in the North-European Plain is possible on a high temporal and spatial resolution.

The Early Neolithic (4100–3300 cal BCE) adoption of farming practices is characterized by a stepwise development. From ca. 4100 cal BCE onwards, animal husbandry became important whereas evidence for crop growing is scarce. Woodland pasture led to a change in woodland composition and a more open woodland structure, i.e. favouring light demanding trees and shrubs. Around 3750 cal BCE an intensive cereal cul-

tivation practice of a variety of species, emmer, barley, free threshing wheat and einkorn, was widely adopted on the level of single farmsteads. In some regions, it was already accompanied by the gradual introduction of a new tillage technology, the ard. The innovation of crop growing was one trigger for new collective human-environment interaction, like clearing the landscape of big erratic blocks that were distributed in the region with the late Pleistocene ice-cover, and social change expressed in the emergence of monumentality between 3600–3200 BCE. The development of a cultural landscape with megalithic tombs, i.e. on abandoned arable plots or former farmstead areas, was associated with a strong population growth and resulted in a widening of the landscape openings. With the Early to Middle Neolithic transition, distinct economic, social and environmental changes are observed, i.e. the population concentration in villages of up to 40 houses. The subsistence regime was conversed towards growing of only the two species, emmer and barley on large-scale arable fields. The weed record shows that arable fields were less intensively managed than before. With strong variation between different regions, palynological evidence for land-use intensity generally decreases until after ca. 3100 cal BCE a widespread lull in human activity favoured woodland regeneration and goes along with the end of the Funnelbeaker tradition.

Keywords: Neolithic, North European Plain, Plant Economy, Subsistence, Landnam

Early Agriculture in the Levant

Les débuts de l'agriculture au Levant

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The agriculture revolution can be divided into seven sub-revolutions:

- 1.Storage. Already during the Epi-Paleolithic, 20,000 years BP, as demonstrated in the site of Ohalo II, we assume that the inhabitants were the owners of the immediate environment where they collected thousands dispersal units of ripe wild barley. They stored the hulled grains after removing of the sharp awn and spikelet base, and from time to time they ground them for making flour and baked then in different forms.
- 2.Early cultivation. Sedentary settlements accompanied by annual exploitation of the natural wild barley fields around, probably caused the decrease of this resource and opening a larger habitat for wild weeds. It seems that already during the Late Natufian (12,000 BP) and definitely during the Pre-Pottery Neolithic A period (11,000 BP) when humans solved the problem by sowing the fields with dispersal units or barley grains.
- 3.Cultivation of additional plants. Beside wild wheat, they sowed also legumes, such as wild lentil, broad bean, pea and chickpea, growing in nature in small patches. Beside, some of them are poisonous without cooking.
- 4.The expansion of agricultural systems.
- 5.The outcome of the domestication process.
- 6.Growing fruit trees. The agricultural revolution reached the phase of growing fruit trees during the Chalcolithic period. Finding of carbonized fig fruits in Gilgal I, an early Neolithic site in the Jordan Valley, some 11,000 years ago led to the proposal that trees were planted by humans in the immediate humid environment of the site.

7. Adopting beneficial mutations.

Keywords: Early Agriculture

Staple foods in Zambrone (Calabria, Southern-Italy) during the Bronze Age

Les denrées de première nécessité à l'âge du Bronze dans le site de Zambrone (Calabre, Italie du sud)

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Up to now, archaeobotanical investigations of Bronze Age sites in Southern Italy have been rare. The results of the study of carbonized seeds and fruits from the fortified Bronze Age settlement of Punta di Zambrone on the coast to the northeast of Tropea (Calabria), contribute essentially to the knowledge of subsistence strategies in the region.

Two main habitation phases could be identified dating to the Early (EBA, 20th – 16th centuries BC) and the Recent Bronze Age (RBA, 13th – 12th centuries BC) respectively. There is a hiatus during the Middle Bronze Age.

The plant remains can be assigned to three groups: staple crops (cereals and pulses), fruits and nuts, and wild herbaceous plants. During the Bronze Age emmer wheat is the dominant. Both chaff and grain was recovered. Barley and field bean are present but of minor importance. During the Recent Bronze Age (RBA) the importance of the individual staple crops is more evenly spread. A newcomer, broomcorn millet, became an important cereal. Particularly interesting are the finds of lentil, acorn, olive and grapevine.

The recovered plant remains can be interpreted as clean food supply, ready for consumption. Was Zambrone a consumer place where people were supplied with good quality food products, which did not require further processing?

The results imply a complex pattern of resource utilization in the area during the Bronze Age. The agricultural production during the RBA at Punta di Zambrone does not give the impression that it set itself apart from that in other contemporary settlements in southern Italy.

Keywords: Archaeobotany, Charred seeds and fruits, Southern Italy, Bronze Age, Subsistence strategy

Tracking the depositing process: stratigraphical differentiation in distribution of plant remains

Comprendre le processus de dépôt : différenciation stratigraphique dans la distribution des restes végétaux

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Provided data comes from the late Neolithic settlement of Mozgawa, central Poland, dated to the Funnel Beaker culture (TRB). Significant number of samples has been taken from different levels of three separate features. Archaeobotanical

examination revealed the remains of several groups of species. Well preserved charred materials were dominated by cereals mostly wheats (*T. dicocum*, *T. monococum*), and cultivated plants pea, lentil and flax. Worth to mention is also relatively high saturation of sediment with plant material (5,69 macroremains per 1 litre on average). Analysis were taken to determine the macroremains density differences between the features. Abovementioned studies revealed that differences between the features were far less significant than those in saturation occurring on different levels of the same features. Further analysis were taken to prove a lack of direct correlation between amount of studied sediment and the number of found macroremains. Results suggest strong irregularity in deposition of plant macroremains, both charred and non-charred, among levels. Hypothesis which could explain unequal distribution of well preserved burned plant remains is occurrence of unique episodes, connected with high temperature which allowed the preservation of seeds and awns, or some stages in forming the layers of the feature. Another studied problem is the occurrence of recent plant remains, found on various level inside the features, which proves the significance of post-depositional intrusions inside the once sealed sediments.

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Keywords: Stratigraphy, Distribution, Post-deposit processes, Environment

Considering Early Neolithic agricultural decision-making in Europe and its archaeobotanical display

Considérer les choix agricoles effectués par les agriculteurs du Néolithique ancien en Europe et leurs représentations archéobotaniques

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During the seventh/sixth millennium cal BC the transition from foraging to farming took place in Europe represented among others by the archaeological remains of the Early Neolithic cultures concerned. Ten years after our publication "A comparison of Early Neolithic crop and weed assemblages from the Linearbandkeramik and the Bulgarian Neolithic cultures: differences and similarities" in VHA the state of archaeobotanical research in Europe has been further advanced and the scientific focus has been directed to new questions searching for a deeper understanding of the Neolithic way of agricultural production and the exploitation of natural resources.

The by now available Early Neolithic Linearbandkeramik, Starčevo, K'or'os and Karanovo data from the working groups in Brussels and Wiesbaden comprise the determination of 864123 plant remains from 78 settlement sites and from 1040 archaeological features in Germany, Austria, Hungary, Romania and Bulgaria. The fully quantitatively generated results have been archived with the database program ArboDat in order to be evaluated in detail and used to discuss the following two subjects:

1) To which extent is it possible to compare feature types and the taphonomy of different site types? Or is this attempt similar to comparing "apples and oranges"?

2) How indicative are Early Neolithic crop and weed assemblages in the different regions and site types for the crop growing systems and the dietary decisions or the environmental factors underlying?

Keywords: Early Neolithic, Europe, Crop growing, Diet, Methodology

Plant foods in Mesolithic Netherlands - splendid harvest on the river dune sites of the Maasvlakte 2 near Rotterdam

Les aliments végétaux aux Pays-Bas au Mésolithique - magnifique récolte sur les sites de la dune fluviale de Maasvlakte 2 près de Rotterdam

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Plants are important for human life. They provide food, fuel and raw material. So it is now and so it was for Mesolithic hunter-gatherers who lived around 7000BC on the river dune sites of the Maasvlakte 2 area near Rotterdam. The great diversity of plant foods available to and used by these groups who made recurrent visits to the same locations during the early Holocene is the main subject of this presentation. These Mesolithic hunter-gathers explored various ecological zones, from the forest through the wetland and into the open water, in their search for fruits and seeds, nuts, berries, roots and tubers. There was so much food out there.

Keywords: Mesolithic, The Netherlands

Xerothermic communities and Neolithisation of Central Europe

Communautés xéothermiques et néolithisation en Europe centrale

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Xerothermic communities are widespread nowadays in south-eastern and southern Europe in areas with dry and warm summers. They also appear extrazonally in areas with strong sunlight exposure containing dry and alkaline grounds, which are rich in calcium. This kind of patches of vegetation, characterized by a richness of flora, provides favourable conditions for species adapted to them. At the current stage of research, there is a discussion whether these communities are of natural or anthropogenic origin, especially in regions located north of the Carpathian Mountains. Interestingly, these plant communities were in direct contact with the people of the early Neolithic cultures of Central Europe, as evidenced by the presence in the archaeological features and layers of macroscopic plant remains such as *Stipa* spp. Grasses of this genus, according to the phytosociological approach, are characteristic

of xerothermic grasslands. Their caryopses and awns were found in archaeobotanical assemblages from Poland and Hungary. These plants are characterized by a low nutritional value and only young specimens can be used as food. Instead, they could probably be used for insulation or for decorative purposes. They could also be connected with some rituals of pre-historic communities.

The presence of *Stipa* remains in archaeological sites and the history of xerothermic vegetation can be interpreted differently. On one hand, there is an assumption of a strong connection between these communities and human activities, which due to the deforestation for cultivation and grazing purposes, resulted in the creation of more open landscapes, suitable for the development of grasslands. On the other hand, the majority of feather grass remains were associated with the oldest phases of Neolithic occupation. This may suggest that xerothermic grasslands already existed in the moment when the first Neolithic groups appeared. Therefore, current archaeobotanical investigations conducted in southern Poland and north-eastern Hungary are focused on this research problem. Analysis of plant macro-remains associated to xerothermic grasslands has been performed. Also, inferences about the presence of more open landscapes is discussed in the context of anthracological assemblages, which indicate that near the human settlements, wooded steppe (Hungary) and oak-dominated forests of rather open canopy (Poland) could have predominated. These preliminary results may lead to the hypothesis that during the Atlantic period, patches of open- and semi-open vegetation existed naturally and that the Neolithisation of Central Europe was somehow linked to the presence of such habitats.

Keywords: Neolithic, *Stipa*, Plant communities, Poland, Hungary

Farming and Food in Roman Britain: an Archaeobotanical Synthesis from the Roman Rural Settlement Project

Agriculture et alimentation en Grande-Bretagne romaine. Une synthèse archéobotanique issue du projet : établissements ruraux à l'époque romaine

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Arable farming in Roman Britain was a diverse and widespread activity. Identifying the variation in how crops were grown is now possible, due to over 40 years of archaeobotanical analysis, largely as a result of developer-funded archaeology. Rescue excavations took place in the late 1970s and 80s in advance of rural gravel extraction in areas such as the Nene and Thames Valley. These produced pioneering datasets, from sites such as Ashville and Barton Court Farm, which have formed the basis of synthetic work for the last decades. Since the introduction of planning policy guidance 16 (PPG16) in 1990, there has been a dramatic growth in archaeological interventions and subsequent archaeobotanical analysis. Much of this work results from evaluations undertaken in advance of planning permission being granted, or small-scale excavations leaving the bulk of archaeological deposits preserved in situ. The quality of the resultant dataset is very variable. Synthesis undertaken so far has focussed on the introduction and consumption of new plant foods, whilst the practices and outcomes of developer-funded archaeobotany

have been heavily criticised.

The Roman Rural Settlement Project (2012-16) has collated all excavated evidence for Roman rural settlement in England and Wales, the initial dataset of which is freely available (<http://archaeologydataservice.ac.uk/archives/view/romangl/>). Both published reports and grey literature were collected, resulting in records of 2523 individual settlement. This dataset has now been complemented with excavated evidence from small towns' in Roman Britain, which acted as centres for industry, trade or agriculture.

This paper will present the key results of the archaeobotanical aspect of this major project. The regional and chronological distribution of the key cereal, pulse and oil crops will be presented, identifying patterns in the use of crops against the physical and cultural landscape. Emerging evidence for horticultural activity in the area north of London will be synthesised, the current evidence for vineyards highlighted, as well as the growing evidence for grain malting in the Mid and Late Roman periods. Evidence for the consumption of wild plant foods will also be summarised, and the key results of Van der Veen et al's conclusions on new plant foods will be reappraised. Crucially, the relationship between cereal production in rural communities and the role of small towns in processing these crops will be investigated. The key conclusions of 40 years of archaeobotanical research into Roman Britain will be drawn and future directions highlighted.

Keywords: Roman Britain, Developer, Funded archaeology, Cereals, Horticulture, Plant foods

Feeding complexity: Early Bronze Age plant economy of Tel Beit Yerah, Israel

Complexité de l'alimentation : économie végétale du site de Tel Beit Yerah (Israël), à l'âge du Bronze ancien

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This paper will present evidence on agricultural production and crop choices at Tel Beit Yerah during the Early Bronze Age. Tel Beit Yerah on the Sea of Galilee is the largest tell site in the Southern Levant and is important due to its links with disparate cultures across the Near East. In the Early Bronze II period (EBII), Tel Beit Yerah was a well organised urban society with trading connections to Early Dynastic Egypt. High status Egyptian artefacts were found within local houses. By the end of the EBII, the well organised urban society had collapsed and a new pottery tradition, Khirbet Kerak Ware, with links to the Kura-Araxes of the Caucasus, appeared at the site in the EBIII. Archaeobotanical data provides important insights into the development of urban society in the EBII and the cultural affinity of the Khirbet Kerak Ware users at the site. Over time, food processing and distribution changed at Tel Beit Yerah, shifting from household crop processing in the EBI to centralised grain distribution in the EBII and back to household crop processing after the collapse of the well organised urban society. In the EBIII, the crop assemblages from Khirbet Kerak Ware contexts include a greater variety of cereal taxa than those in earlier periods or contemporary local contexts. By comparing the crop preferences at Tel Beit Yerah to other sites in the Near East, the relationship between Khir-

bet Kerak Ware and Kura-Araxes sites will be explored. As an expression of identity, food preferences can reveal the group to which a person belongs and can also act as an exclusionary tool to emphasise cultural and social difference. The crop choices at Tel Beit Yerah have ramifications for understanding the nature of the Khirbet Kerak Ware occupation at the site.

Keywords: Tel Beit Yerah, Early Bronze Age, Kura, Araxes, Urbanism

Archaeobotany in central Argentina. Macro and micro remains at several archaeological sites from early Late Holocene to early Colonial Times (4000-250 BP)

L'archéobotanique dans le centre de l'Argentine. Etude des macro- et microrestes du début de l'Holocène tardif au début de l'Epoque Coloniale (4000-250 BP)

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Archaeobotanical research has been developed in Central Argentina since 10 years ago. A total of 15 archaeological sites in Cordoba province from early Late Holocene (4000 BP) to early Colonial Times (250 BP) have reported macro and/or micro botanical remains. This work presents the results of the archaeobotanical study of these open-air and rock-cave archaeological sites, especially from a subsistence point of view. Concerning methodology, systematic sampling with the use of fine-sieving methods was carried out for carporemain recovery in deposits related to human activities, especially of food production and consumption. On the other hand, microscopic remains such as plant opal particles (phytoliths) and starch grains were recovered from hand-stone and pottery vessel walls as well as from sediment samples, followed standard methodology without use of heavy-liquids. Microremains analysis have played an important role in the recovering of different plant taxa mentioned in Spanish chronicles of 17th century, from which no carpological remains were recovered. Results of this work show a characteristic distribution and composition of the archaeobotanical assemblages, which were chronologically well defined. From a general perspective, it was observed that, since 4000 BP, a process of intensification of plant consumption appear to have been developed by hunter-gatherer groups. Later, crops had been incorporated by these groups post-2000 BP. Finally, a mix of foraging and cultivation economy characterized the semi-sedentary residential groups of later Pre-Hispanic Period (1000-300 BP) and early Colonial Times (250 BP). However, analyses of the taxa recovered have revealed differences and similarities between northern and north-western areas of Cordoba province. In the spectrum of wild plants, mistol (*Ziziphus mistol*) dominated the northern archaeobotanical assemblages among other taxa, while algarrobo (*Prosopis* sp.) was the only wild taxa present in north-western ones. On the other hand, the spectrum of cultivated plants showed abundant maize (*Zea mays*), and quinoa (*Chenopodium quinoa*) and *Phaseolus vulgaris* presence in northern area, while scarce maize, abundant beans (*Phaseolus vulgaris* and *P. lunatus*), and squash (*Cucurbita* sp.) presence in north-western area. In sum, this whole approach, which includes multiple evidences analysis, have allowed knowing about the types and manners in which wild and cultivated re-

sources had been consumed in central Argentina in ancient times, an area from where archaeobotanical information was very scarce.

Keywords: Archaeobotany, Hunter-gatherer groups, Agricultural societies, Córdoba province, Argentina.

Microbotanical remains from sediments and pottery of Terra Preta do Índio settlements: an approach to food-ways in the Amazonian rainforest

Macro-résidus botaniques de sédiments et de poteries provenant d'établissements de Terra Preta do Índio : une approche des pratiques alimentaires en forêt tropicale amazonienne

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Amazonian dark earths (ADE) are anthropogenic soils called Terra Preta do Índio (TPI) in Brazil, created by indigenous people hundreds or thousands years ago. TPI is a black soil, associated with long lasting Indian settlement sites, and it is filled with ceramics and other cultural debris. The site object of this research is part of the protected area (partially under cultivation) in the Embrapa Amazônia Ocidental outside Manaus (Amazonas, Brazil). The area of the Rio Solimões-Rio Negro confluence, where our site is located, has been systematically studied from 1995 to 2010 by the Central Amazon Project (Rebellato *et al.* 2009). The project confirmed the existence of large settlements associated to Terra Preta (ADE) and mounds associated with the Tradição Borda Incisa (TBI). The archaeological sites of the confluence area are often large settlements or mounds associated to Terra Preta (ADE) with thick multicomponent deposits, reaching in some cases almost 300 cm depth. Earlier occupations are associated with the Tradição Borda Incisa (TBI) while later occupations (which are the focus of this study) are connected to the cultural tradition of the Guarita phase, starting at around 1000 AD. Such occupations mark a break in the forms of the settlements and in the ceramic production technique. Two test trenches were excavated in 2013, in order to understand the pedological development of the ADE. Various pottery sherds were collected for phytoliths and starch grain analyses. Sediments from the pedo-cultural sequence were also collected. Extractions were carried out at EMBRAPA and BioGeoPal Laboratory in Barcelona. In this paper, we present the results of the microfossils study from both sediments and pottery, and discuss their relevance in relation to Terra Preta taphonomy, food processing and plant exploitation in the Central Amazon.

Keywords: Food, Amazonia, Rainforest, Terra Preta, Microbotanical remains

"El Árbol y el Páaj". A dialogue between archaeobotany and ethnography in northwestern Argentina

"El Árbol y el Páaj". Un dialogue entre archéobotanique et ethnographie dans le N-O de l'Argentine

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We propose a dialogue between our results of ethnographic and archaeobotanical research in northwestern Argentina. Generally this link has been controversial in the history of these disciplines, avoiding the long-discussed ethnographic analogy in archeology. However we want to retake it considering that ethnography is an excellent tool to break our ideas when interpreting the archaeological record. The links between humans and plants in our area of research, and in general among native populations of South America, differs significantly to western logic that views plants as mere resources. As this relationship is richer than this western simple approach, we are interested to discuss our results based on broader patterns linking humans and plants.

We can take the case of two particular tree taxa. On one hand, a highly prevalent genus in the archaeological record of the region, the "algarrobo" *Prosopis* sp also known as "the tree"; and on the other hand the "Quebracho colorado" or Paaj belonging to the *Schinopsis* sp genus. Both types of tree are quite abundant in our region, however in archaeological contexts the abundance of the "algarrobo" contrasts with a remarkable absence of the "quebracho". Paleoenvironmental, taphonomical or economical explanations, do not account for this difference. Trying to understand the archaeological evidence, took us to explore other ethnographical logics, moving away from interpretations that end up approaching dangerously to modern mining logic.

Keywords: Archaeobotany, Ethnography, Trees, Northwest Argentina

Plants in the ritual landscape of Prehistoric Greece

Les plantes en usage dans le paysage rituel de la Grèce préhistorique

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Recent work on plant remains in archaeological deposits has revolutionised our understanding of fundamental aspects of the past: agriculture, domestication, environmental change, diet, economy and daily life. A key missing element is the place of ritual: this paper explores the use of plants in ritual and funerary contexts. Ritual, cult and religion are subjects that have been a focus of Greek archaeology, emphasising such aspects as architecture, pottery and other material culture and employing theoretical models, especially concerning mortuary practices. While animal sacrifice has been a focus

of research, other practices, particularly involving the role of plants, have been passed over in silence. The ritual deposits examined in this paper are burials, altars, domestic sacrificial pyres and temple offerings. These assemblages offer a wide spectrum of ritual practice linked by the common theme of the deposition of plant material.

The detailed sampling undertaken at the sites in question allows clarification of whether plant remains are present as deliberate sacrifice by fire, as food remains consumed during the ritual performed, or as part of the original fuel of the fire. The clarification of these issues plays a crucial role in a developing full understanding of the observed practices and the subsequent interpretation of people's choices. In this way, it is possible to reconstruct funerary and ritual practices. Specifically, this paper will: 1) identify rites and their stages through the composition of the deposits; 2) observe variation of the plant remains by context (burials vs altars and ritual vs quotidian); 3) examine whether plant remains are imports from other areas, whether they are edible and whether they are intended to be consumed; and 4) determine whether plants mentioned in the literature as symbols of sleep, death, reincarnation, immortality were actually used. For the first time, the plant remains will contribute to a holistic interpretation of the ritual past.

Keywords: Ritual, Funerary, Neolithic, Bronze Age, Intentional deposition

Life in the mountains: plant exploitation in the Alps during the Bronze and Iron age

La vie dans les montagnes : exploitation des plantes dans les Alpes au cours des âges du Bronze et du Fer

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The alpine environment is both attractive and restrictive: on the one hand, mountains have delivered significant resources as obsidian, greenstone or rock crystal, and since the Neolithic they are frequently assigned to pastoralism; on the other hand, to exploit these territories, people had to adapt to the effects of altitude, elevation changes and steep slopes. Thus, in mountainous context, plant economy – including harvesting of plants and agriculture – is organized seasonally.

Considering these natural requirements and different technical choices, archaeobotanical research helps to understand how prehistoric communities have adapted to these environmental constraints, especially in altitude, above 1000 m a.s.l.

Since the Bronze Age, human impact on the environment is clearly visible. Agriculture is clearly attested up to 1500 m a.s.l and farming practices are diversifying. Furthermore, plant diversity is growing and new cultivated species are introduced, like spelt or millet.

This presentation shows new data from three sites around the Petit-Saint-Bernard Pass, on the French-Italian border: Chate-lard Derrière-la-Motte in Bourg-Saint-Maurice (Savoie, 971 m a.s.l), and in the Aosta valley: Grande Golette and Pian del Bosco, respectively located at 1525 and 1240 m a.s.l. Situated on an important circulation route, between the Rhône valley and the Po plain, these three settlements have delivered several thousands of charred plant remains. Our archaeobotanical

study aims at :

- Determining which crops were cultivated for human consumption and which wild plants were gathered for consumption, medicine or other purposes;

- Identifying processing techniques and their possible location;
- Describing agricultural practices and rhythms of agriculture (summer/winter crop weed communities, low/high sickle cuts, weed phytosociology, storage, etc.), and studying their effects on soil and landscape.

Finally, our analyses will help clarify the function of these sites and establish whether these settlements were occupied all year round or not.

Keywords: Alps, Archaeobotany, Highland agriculture, Bronze Age, Iron Age

Gathering plants in Upper Paleolithic: seeds and fruits from Cova de les Cendres (Teulada-Moraira, Alicante, Spain)

La cueillette des plantes au Paléolithique supérieur. Fruits et graines issus de la grotte des Cendres (Teulada-Moraira, Alicante, Espagne)

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Fruits, tubers, leaves and other plant parts constitute an important part of Palaeolithic hunters-gatherers diet. Moreover, these groups must have used plants with other purposes. However they haven't been studied in depth by the traditional research. Nevertheless, this situation is currently changing and the evidences of the use of vegetal resources are increasing thanks to several methods.

The available data for the Iberian Peninsula were scarce, the reason why we explored this question in the Spanish Mediterranean Region. We present the first results of the carpological analysis of Cova de les Cendres (Teulada-Moraira, Alicante, Spain). In this cave, a wide Paleolithic sequence has been documented, with Gravettian, Solutrean and Magdalenian levels. In all occupation levels, charred seeds were highly numerous and their analysis is in process. For now, we are going to present the first results of the Middle Magdalenian level, from which we recovered 804 charred and mineralised macro-remains in 138 litres of sediment. The density is high, with 5.8 remains/litre. Twenty-five different taxa have been identified among the assemblage. We have interpreted them as remains of food, like some Rosaceae or *Ficus carica*, or basketry, like *Stipa tenacissima*.

Moreover, this study allowed us to reconstruct the landscape and climate more accurately, joining anthracological and carpological results. In the east of the Iberian Peninsula, during the cold and dry stadial periods, the formations dominated by *Juniperus* were really prominent. Although it is not possible to identify *Juniperus* species on the basis of the anatomy of their wood, by contrast, this can be achieved through the botanical identification of their seeds. In the Middle Magdalenian level of Cova de les Cendres, seeds of *Juniperus sabina*, *J. communis* and *J. oxycedrus* have been identified. These, along with other species identified among the carpological and anthracological remains, allow for a high-resolution paleoclimatic reconstruction. This has shown that the bioclimatic conditions in Middle Magdalenian at Cova de les Cendres were similar

to those currently prevailing on the Iberian ranges, implying a 10C decrease in temperature.

All the 14C dates from Cova de les Cendres have been obtained on charcoals and seeds previously identified botanically. At Middle Magdalenian level, charred seeds of *Juniperus sabina*, mineralised nutlets of *Lithospermum* cf. *arvense* and charcoal of *Ephedra* sp. have been dated. The three radiocarbon dates, including mineralised seeds, are coherent among them, with the cultural assignment of the level and with the indicated ecological conditions.

Keywords: Hunters-Gatherers, Middle Magdalenian, Landscape, Seed, Iberian Peninsula

Wood, food and landscape: the archaeobotany of the Terramare

Bois, alimentation et paysage : l'archéobotanique des Terramare

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Terramare is the Middle Bronze Age culture that developed at c. 1650–1150 BC in the Po Plain (Northern Italy), reaching a very high demographic density at the peak of its development at c. 1400–1250 BC. Pollen and macroremains from settlements and necropolis have been analyzed and permitted to reconstruct the cultural landscape that developed from a combination of wood and water management, and a complex agriculture economy. The plain was characterised by a natural openness of the landscape yet with a presence of thin woodlands, a good water supply and fertile soils of the alluvial plain of the river Po. The landscapes had general features and local peculiarities of the area of influence of each terramara settlement. Cereal fields were not uniformly distributed around the villages but, together with pastures, constituted an important trait of the agrarian landscapes. Besides cereal grains, grapevines and cornelian cherries marked the carpological records. Also fruits of hazelnut and sloe, and other trees/shrubs growing in woods, are evidence that diversified food resources were available.

Keywords: Bronze Age, Po Plain, Environment management, Agriculture, Food

Values of isotopic composition of carbon ($\delta^{13}C$) in samples of *Vicia faba* L. seeds from Eras del Alcázar (Ubeda, southeastern Spain): agricultural production, climate change and human impact

*Valeurs isotopiques du carbone ($\delta^{13}C$) obtenues à partir de graines de *Vicia faba* L. du site de Eras del Alcázar (Ubeda, S.-E de l'Espagne) : production agricole, changement climatique et impact anthropique*

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In this paper we present preliminary results of carbon isotope analyses ($\delta^{13}C$) of *Vicia faba* L. seeds from the archaeological site of Eras del Alcázar (Ubeda, Spain). Samples range chronologically from early 3rd Millennium to the mid-2nd Millennium cal. B.C. Results have been compared to carpological and others archaeobotanical data of this settlement. The aim of this study was twofold: firstly, to assess land management strategies and the available conditions for agricultural production to the inhabitants of this settlement; secondly, to verify climate changes and the advance of the process of aridity in the studied area. The results highlight a strongly anthropogenic context in which new farming systems were implemented due to the trend towards drier weather conditions.

Keywords: Isotopic composition of carbon $\delta^{13}C$, Iberian Peninsula, Middle Holocene, *Vicia faba* L., Agricultural practices

Palaeolithic plant exploitation in the Western Mediterranean: macrobotanical evidence of food and basketry at Middle Stone Age and Later Stone Age sites in Morocco and Tunisia

Exploitation des plantes durant le Paléolithique en Méditerranée occidentale. Témoins macroscopiques de résidus alimentaires et d'activités de vannerie dans des sites du Paléolithique moyen et final au Maroc et en Tunisie

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This contribution presents the preliminary results of the Paleoplant project (Palaeolithic plant exploitation in the Western Mediterranean) funded by the European Research Council. The paper aims to explore the presence of macrobotanical remains and to assess the role of plants during the Middle Stone Age (MSA) and Later Stone Age (LSA) of North-Western Africa. Previous research on the Palaeolithic economy in this region has emphasized the role of land snails and animal resources, but little attention has been paid to the use of plants. Here we present the preliminary results from systematic analyses of charred macro-botanical remains at several MSA and LSA sites in Morocco and Tunisia. We identified abundant

remains of several plants in all the sites, with wild legumes, pine nuts, acorns, and Alfa grass being the most frequent. Archaeobotanical and ethnographic evidence suggests that wild legumes, pine nuts and acorns could have been used for human consumption while Alfa grass may have been utilized as a source of fiber for basketry. We propose that food plants could have played an important role in the diet, providing a highly nutritious food source which could also be stored. Palaeolithic hunter-gatherers have been depicted as meat-eaters in which plants played a secondary role; but data from MSA and LSA sites in North-Western Africa suggest that there was diversity among Palaeolithic groups, and that vegetal sources could play an important role in the economy of some pre-agrarian societies.

Keywords: Macrobotanical remains, Palaeolithic, North Africa, Wild food plants, Basketry

Plants of the second stage of Neolitisation in Poland

Les plantes liées à la seconde vague de néolithisation en Pologne

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Neolithic communities appeared in Polish territories around the mid sixth millennium BC. However, until the beginning of the fourth millennium BC, they primarily inhabited and exploited only small enclaves, distinguished by ecological conditions favourable to farming. This changed during the first half of the fourth millennium BC, when Neolithic settlement spread over the vast majority of what is now Poland. These processes are reflected by the expansion of the Funnel Beaker culture (TRB).

Agricultural activities of these people are mirrored in many off-site data (mainly pollen diagrams). These activities are witnessed i.a. by sporomorphs of Cerealia, which have been regularly recorded since ca. 4000/3800 BC. However, agropastoral economy of the TRB is directly evidenced by on-site analyses. Currently, we have a fairly large amount of data on plants cultivated by TRB people. The identification of cultivated species was possible thanks to the analysis of charred remains scattered in features (e.g. Bronocice, Mozgawa) or found as concentrated in storage pits (e.g. Kraków-Mogila, Kraków-Prdnik Czerwony), or plant impressions on daub (e.g. Donatkowice, Niedźwiedź). On this ground one can conclude that mainly emmer (*Triticum dicoccon*), einkorn (*T. monococcum*) and barley (*Hordeum vulgare*) were grown. The role of other cereals was insignificant. The pattern of deposition of caryopses of these two species of wheat suggests that they could be sown together, in a form of maslin with predominance of emmer (up to 90%). Emmer monoculture could also be practised, as evidenced by pure deposits of this wheat (e.g. Wwolnica).

It should be noted that the degree of weed infestation in grain has been insignificant. This could be due to the low contamination of crops or very good cleaning of grain by the then farmers. The degree of infestation of fields depends i.a. on the duration of their use. Therefore, a small amount of weeds typ-

ical of cereal crops may reflect short use of these fields. This conclusion coincides with hypotheses on extensive, slash-and-burn system of cereal cultivation, practiced by communities of the TRB. An attempt to determine the economic importance of other cultivars is much more difficult because of their low representation. One way or another, the TRB inventories contain remains of pea (*Pisum sativum*), lentil (*Lens culinaris*), linseed (*Linum usitatissimum*) and poppy (*Papaver somniferum*). The occurrence of these species in subfossil materials is indicative of their economic importance.

Keywords: Neolithic, Funnel Beaker Culture, Cultivated plants, Cultivation model, Poland

Staple Crops, Identity and Political Economy in Iron Age and Archaic Italy

Cultures de base, identité et économie politique dans l'Italie de l'âge du Fer et de la période archaïque

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Staple foods offer an ideal opportunity to investigate cultural identity and socio-economic interactions. In Iron Age and Archaic Central Italy several kinds of cereal staples were grown, consumed and possibly exchanged. In recent years there have been a growing number of new projects that have incorporated the study of archaeobotanical remains. Different patterns are emerging suggesting interesting implications for the understanding of the cultural and political landscape of Central Italy in a period of rapid transformations. The resulting picture is compared with the current reconstructions of foodways, diet and staple exchange networks which are typically based primarily on the written sources. Significant differences are notable, pointing to the existence of multiple local cultural traditions, which influenced the choice of crops and their processing. This is in contrast with the more homogenous narratives relying on historical documents that are likely to present, if they are at all accurate, the situation of the city of Rome itself, rather than that of the rest of Central Italy. **Keywords:** Iron

Age, Europe, Diet, Trade, Methods

Breaking borders, neolithisation of the Kujawy region in Central Poland through archaeobotanical data

Briser les frontières : néolithisation de la région de Kujawy dans le centre de la Pologne, d'après les données archéobotaniques

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The studied region is located at the norther frontier of the Neolithic colonisation in Central Europe, out of the preferred

by the first farmers loess zone. The area was covered by ice during the last glacial period. The aim of the study is a presentation of carpological and anthracological on-site data from twelve archaeological sites clustered around Brześć Kujawski, Osłonki and Ludwinowo in the east part of "Black Kuyavia" (Czarne Kujawy). The area is covered mostly by black soils, similar to chernozems but of different origin. The most interesting now Ludwinowo 7 site is located on the border of the Kujawy upland and the Wisła valley, the latter covered mostly by sands. Despite the LBK sites are present north from the studied region, Ludwinowo 7 is the only LBK settlement in Kujawy with more than one house. It was excavated during the large scale emergency works connected with motorway buildings.

The paper will present data from the archaeological features dated to the Danubian cultures (the Linear Pottery culture, the Stroke Band Pottery culture, the Lengyel culture) and the Funnel Beaker culture (TRB) from the same microregion. In the old, already published research the Lengyel culture data dominated. The new studies from most eastern sites Smólsk and Ludwinowo brought important information about the Linear Pottery plants. The most valuable seems the role of *Chenopodium* in the economy of farmers. Unripe, charred seeds of the plant were the most numerous and frequent remains at Ludwinowo 7 site. Sixty *Chenopodium* seeds and 3 einkorn chaff remains from the same archaeological sample were AMS dated as separate two subsamples giving the same LBK dates (ca. 5300-5000 cal BC).

The Danubian cultures plants are compared with the Funnel Beaker data, the latter very scarce till now. In the paper both typical cultivars and plants known as wild growing ones are included as a source of information about past plant economy. The environmental background apart from the geographical information will be highlighted by palynological and anthracological data.

The study is financed by National Science Centre on the basis of decision DEC-2013/10/M/HS3/00537.

Keywords: Economical plants, Environment, Linear cultures, TRB, Kuyavia (Kujawy)

From North to South, New Archaeobotanical and Radiocarbon Evidence from Kirindia and Kandarodai, Sri Lanka

Du Nord au Sud, nouveaux témoins archéobotaniques et radiocarbones de Kirindia et Kandarodai, au Sri Lanka

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This paper will present the new radiocarbon dating and environmental data, specifically the archaeobotanical results recovered from flotation, from the historic coastal sites of Kirindia (400-850 AD), in the southern province, and Kandarodai (300-50 BC), located in the Jaffna peninsula in the north of Sri Lanka. Both Sri Lankan archaeological excavations were carried out as part of the larger SEALINKS Project, investigating trade links across the Indian Ocean. The archaeobotanical assemblages from both these sites, located at the extreme ends of the island of Sri Lanka, are dominated by rice but have key differences which suggest differences in

crop processing, agricultural conditions and preferences and local ecological conditions at the time of occupation.

Keywords: South Asia, Sri Lanka, Archaeobotany, Radiocarbon Dates

Domestication of soybean and azuki bean in prehistoric Japan

Domestication du soja et du haricot azuki dans le Japon préhistorique

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This paper presents new data on size of carbonized seeds and seed impressions of soybean (*Glycine max*) and azuki bean (*Vigna angularis*) from prehistoric Japan, and discusses the timing of size enlargement and the process of domestication. I also compared the data with prehistoric Korea and China. The results show that the earliest record of use of small soybean and azuki bean seed (probably wild type) starts from Incipient to Initial Jomon period (ca. 13500-9000 cal BP). The statistically significant seed size enlargement of soybean has been seen from the late part of Middle Jomon samples (ca. 4500 cal BP) both in carbonized seed and seed impressions. For azuki bean, seed enlargement is found from the late part of Late Jomon period (ca. 3500 cal BP) in carbonized seed data, however seed shape is getting round from the late part of Middle Jomon (ca. 4500 cal BP), and also seed impressions are getting larger from this period onward. Thus, the selection pressure for the large seed and/or round shape has increased in the late part of Middle Jomon period both in soybean and azuki bean. The rate of seed size enlargement is faster than in prehistoric Korea and China, probably because the selection pressure for the large seed by Jomon people was higher than by cereal users in prehistoric Korea and China. The selection pressures probably increased during the Early to Middle Jomon period in prehistoric Japan, because the date is just after the mid Holocene cooling event (5000-6000 cal BP) and the population expansion in the central Japan. I will discuss the reason why the domestication has occurred in this timing, along with climate change, population pressure and resource balance during the period.

Keywords: Domestication process, East Asian archaeobotany, Use of pulse, Preagricultural plant use

Inferring changes in crop cultivation regimes in northern France by investigating the weed flora composition from the Late Bronze Age to the Roman period

Appréhender les changements intervenus dans les pratiques culturales en France septentrionale par l'analyse des cortèges adventices, de l'âge du Bronze à la fin du Bas-Empire

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The evolution of crop production in northern Gaul is now easier to reconstruct thanks to the high number of archaeobotanical studies of rural settlements, in addition to the dozen concerning the oppida. The mapping of the results has revealed sharp regional patterns in cereals exploitation, in relation with the cattle breeding and storage specificities (Zech-Matterne *et al.* 2013). We have then proceeded further with the reconstruction of agrarian practices by applying and exploiting some aspects of weed ecology on archaeobotanical data deriving from more than hundred sites, located in the regions Picardy, Île-de-France, Champagne-Ardenne, Lorraine and Alsace. The characteristics of the weedy vegetation associated with the cultivated fields were analyzed using parameters like flowering season, soil-disturbance indicators and the use of fertilizers. The aim of our study was to gain a better insight into the cultivation techniques, the appearance of fallow land and the spread of new segetal species (Zech-Matterne & Brun 2016 ; Toulemonde *et al.*, forthcoming). In this paper, we apply this approach to the archaeobotanical data set obtained from the central and northern part of France (north of the river Loire). The chronological frame covers a time span from the late Bronze Age until the end of the Roman period. This chronological sequence is patterned by some major events, in particular the appearance of an urbanization phenomenon during the late Iron Age and the conquest of Gaul by the Roman armies. Increasing soil occupation is occurring in the late La Tène period, followed by the concentration of important populations in the oppida and a struggle concerning access to cultivated land. Studying the important changes in agricultural practices through time allows to understand different aspects of resource management, in particular cereal exploitation and food supply. It is indeed important to estimate to what extent these agricultural changes were relevant and sustainable enough to meet the requirements of these new proto-urban centres and how and to what extent they contributed to a trade mainly based on staple foods, which developed considerably after the Roman conquest.

Keywords: Weed flora, Crop production, Northern France, Bronze Age, Iron Age, Antiquity

The plant remains of the “Ice-maiden”, the Inca mummy from Mt. Ampato, Peru

Restes végétaux associés à la momie inca “Juanita” découverte dans les Monts Ampato, au Pérou

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In 1995 the frozen body of an Inca girl, named the “Ice-Maiden” or “Frozen Lady” in analogy to the Neolithic Tyrolean Iceman, was discovered by the anthropologist Johan

Reinhard on Mt. Ampato, a stratovolcano in southern Peru. In between 1440 and 1450 AD the girl at the age of 12 – 14 years was offered on the Ampato summit at about 6300 m altitude and was buried on a platform. Due to Global Warming the platform collapsed and the mummy had fallen inside the crater about 65 m below the summit together with female figurines, food and pottery. This combination of material offerings and human sacrifices in the Inca ritual is termed a “capacocha complex”. Here we present the analysis of the plant remains recovered with the body. All of the committed plant remains are edible and most of them belong to crops. Predominant are carbohydrates delivering plants, e.g. *Zea mays*, *Chenopodium quinoa*, *Solanum tuberosum*, *Ipomea batatas*, but also legumes like *Phaseolus lanatus* and *P. vulgaris* are detected. Single fruits of *Psidium guajava* and *Pouteria lucuma* represented also in the find assemblage. Furthermore a bundle of leaves from the Coca tree (*Erythroxylum coca*) suggests its consumption. The implications of the plant findings and the Inca offering rite are discussed.

Keywords: The Andes, Human sacrifice, Capacocha

The reticulated origins of domesticated tetraploid wheats: novel evidence from whole-genome polymorphisms and organelle genome sequencing

Emergence par réticulation des blés tétraploïdes : nouveaux indices issus du séquençage des polymorphismes de génomes entiers (SNPs) et des organites

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Emmer (*Triticum dicoccum* L.) was one of the first crops to be domesticated in the Near East Neolithic. Based on genetics, archaeobotanical and experimental data, two models explaining how the domesticated forms and full-fledged agriculture emerged have been proposed. One postulates a fast process occurring in a core area, the other a protracted model with domestication occurring slowly after a mixing of wild genotypes with piece-meal emergence of domesticated traits all around the Fertile Crescent rather in a single or small number of core areas.

We postulate a reticulated origin of emmer wheat. Reticulation refers to the genetic pattern arising when different parts of a genome have different genealogical histories due, for example, to introgression, incomplete lineage sorting, or hybrid speciation. To test the hypothesis that the relationship between wild and domesticated emmer is reticulated rather than linear we genotyped-by-sequencing (GBS) 72 accessions of wild emmer, 35 emmer and 57 other cultivated tetraploids from the Near East and nearby regions. We generated > 10,000 unbiased single-nucleotide-polymorphisms (SNPs) specific to our accession panel. In addition to these bi-parentally inherited SNP markers, we sequenced the maternally inherited mitochondria and chloroplast genomes of 92 accessions of wild emmer and emmer from the Near East.

Our data suggests that introgression and lineage sorting shaped the population structure of wild and cultivated cereals in the Near East, with domesticated genotypes acquiring alleles from different wild populations. Our genetic data is in accordance with a protracted model, the archaeobotanical record,

and falsifies previous studies suggesting single-domestications in a single core-area.

Keywords: Emmer, Domestication, GBS, Genomics, Protracted model

The archaeobotanical material from Late Bronze Age Jaffa / Israel

Le matériel archéobotanique du site de l'âge du Bronze final de Jaffa, Israël

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Jaffa is situated on the coast of the Southern Levant. Next to Ashkelon and Dor it was one of the few larger harbours along the coastline. Therefore during the Late Bronze Age Jaffa was an important outpost of the Egyptian suzerainty over Canaan. One evidence of its importance are the remains of two pillars built by Ramses II. (13th cent. BC) which belong to a gate.

In 2013 and 2014 this gate area was excavated by the Jaffa Cultural Heritage Project (cooperation project of the UCLA, the University of Mainz, and the IAA). The excavation revealed a scenario of an occupation and attacking of the Egyptian bastion which culminated in the destroying of the Egyptian gate by fire. The burnt beams from the upper levels of the gate building covered the gateway. Due to the sudden destruction and burning down of the gate, crop that was stored along the gateway passage was sealed under the wooden beams.

The aim of this contribution is to present the significance of the archaeobotanical material from Jaffa. Since the material was found *in situ* a contamination from later periods can be excluded. Archaeobotanical publications working on the Late Bronze Age II period are rare. So the data from Jaffa will contribute to the investigation of the final years of the Egyptian sovereignty.

The archaeobotanical material from Jaffa is dominated by free threshing wheat. The comparison to other sites might show if the material from Jaffa corresponds with other sites which also have been under Egyptian control like Beth Shean and Tel Aphek.

Keywords: Jaffa, Late Bronze Age, Egyptian outpost, Macro remains, Free-threshing wheat

Towards the identification of cereal by-products by phytolith analysis

Vers une identification des sous-produits céréaliers à partir de l'analyse des phytolithes

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Better detection and taxonomic identification of cereal leaves is expected to result in an improved understanding of the presence and function of crop products at archaeological sites. For this reason, this study focuses on bilobate phytoliths from

leaves of two pairs of crops, *Panicum miliaceum* L. (common millet) and *Setaria italica* (L.) P. Beauv. (foxtail millet) on the one hand and *Pennisetum glaucum* (L.) R. Br. and *Sorghum bicolor* ssp. *bicolor* (L.) on the other hand. These four taxa have been of major economic importance since Prehistory and regularly occur at archaeological sites in Eurasia and Africa respectively. Occasionally the Asian and African crops also co-occur, for example in India.

Leaves of two plants of five modern-day populations of *Panicum miliaceum*, *Setaria italica*, *Pennisetum glaucum* and *Sorghum bicolor* were systematically sampled to collect 27 morphometric variables of size and shape of ca. 2000 bilobate phytoliths per species with new, open-source software. The results show that it is possible to distinguish between the bilobates from leaves from *Panicum miliaceum* and *Setaria italica*, which offers potential for archaeobotany. In contrast, it is not possible to distinguish between *Pennisetum glaucum* and *Sorghum bicolor* in the same way. Nevertheless, comparison between the four taxa shows that it is possible to distinguish the bilobates from *Pennisetum glaucum* and *Sorghum bicolor* from those of *Panicum miliaceum* as well as from those of *Setaria italica*.

While the populations of most species are relatively well comparable, in *Pennisetum glaucum* one population stands out. Although the experiment does not allow explaining this observation with certainty, it seems probable that environmental variation affects phytolith morphometry. This has implications for sampling strategies of future research and for the application of identification criteria for cereals based on phytolith morphometry to archaeological case studies.

Keywords: Cereal identification, Millets, Crop by-products, Bilobate phytoliths, Morphometry

Olive tree (*Olea europaea* L.) domestication and cultivation in Greece from Bronze Age to Roman times: evidence from seed shape and written sources

*Domestication et culture de l'olivier (*Olea europaea* L.) en Grèce, de l'âge du Bronze à l'époque romaine, d'après la morphométrie des noyaux et les sources écrites*

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The domestication of the olive tree (*Olea europaea* L.) took place independently in several regions of the Mediterranean basin, and not exclusively in the Near Eastern centre, from which emerged the most prevalent and diverse agrolinesages during the 4th millennium BC. The contribution of the occidental genetic pool in the constitution of the olive varietal heritage, even if a lesser one, is supported by numerous data from genetics and archaeobiology. From the southern Levant, do-

mesticated forms and cultivation practices would have spread to the Western Mediterranean and reached the Aegean world during the 3rd millennium BC. In Greece, the introduction of domesticated varieties and the development of olive tree cultivation are considered as factors explaining the rise of the Minoan civilization during the Middle Bronze Age. As in the case of western Mediterranean areas, a domestication event may have occurred in Greece before the introduction of new varieties from the Levant. In fact, an increase of olive pollen in Crete is reported during the middle Neolithic, which may reflect an increase of olive cultivation.

This study aims to understand the past and present diversity of olive trees in Greece, according to the shape of modern and archaeological stones from various sites. It is based on a modern set of reference, which includes cultivars and wild populations from Greece and other countries around the Mediterranean Sea where olives trees grow spontaneously and have been cultivated for a long time (Turkey, Syria, Lebanon, Egypt, Tunisia, Algeria, Morocco, Spain, France and Italy). Analysis of variation in stone shape aims to provide accurate criteria for the discrimination between wild and domesticated forms, and between different groups of varieties. To investigate the chronological evolution of the cultivated olive forms and their geographic distribution in ancient Greece, archaeological seeds from 18 sites located in Macedonia, Central Greece, Peloponnese and Crete are studied. The samples are dating back to a period ranging from the middle Bronze Age (2100-1700/1500 BC) to the Roman times (1st century AD). In addition, Greek and Latin literature may give insights into the culture, uses and perception of olive varieties. Archaeological material is compared to this reference collection, to show possible relations between ancient olives and modern groups of varieties.

Keywords: *Olea europaea*, Archaeological seeds, Greece, Geometric morphometrics, Written sources

Standing apart from the Ceramic Neolithic of the Near East, the Cypriot Site of Khirokitia: New Data about the Plant Economy

A l'écart du Néolithique Céramique du Proche Orient, le site chypriote de Khirokitia : nouvelles données sur l'économie végétale

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Cyprus is nowadays the first example of colonisation and diffusion *trans mare* of wild and domestic plants and animals from the Near East, during the Neolithic period.

The site of Khirokitia situated on the southeastern part of the island has first defined Aceramic Neolithic of the island. Now known as the best example of the Late Aceramic Neolithic of Cyprus (from 7000 to 5500 BC), Khirokitia presents evidence of an original cultural development compared to the previous period, recently defined (Cypro-Early and Initial Aceramic Neolithic). Whereas connection with the mainland were strong both in techniques and material in early phases, Khirokitia shows an original culture development from 7000 BC onwards, standing apart from the contemporaneous Pottery Neolithic in the west Asiatic continent.

This presentation will present new elements of archaeobotanical analysis of Khirokitia covering for the first time the whole chronological sequence of the settlement. New data allow a better understanding of agricultural practices, cereal process in the village and gathering activities. Products and by-products of agriculture, in particular hulled wheat, form the major part of the remains offering further analysis on spikelet bases and cereal processing. The data on agriculture combined with results in charcoal analysis, published by S. Thiébaud (2003), indicate the use of local, available resources and two changes in plant ratios during time. Some elements of this evolution reflect not only a material differentiation from the mainland but also the assertion of their own cultural characters. First spatial analysis was conducted with the botanical data and accurate archaeological information from inside and outside the village and houses. The study has also made use of questions on possibility of contacts between the continent and Cyprus during the key period of the original development of "Culture of Khirokitia".

Keywords: Island, Neolithic diffusion, Agriculture, Domestic Space, Gathering

The Bronze Age plant economy in the surroundings of the Alps: new results from two sites in N-Italy (Lake Garda region)

L'économie végétale à l'âge du Bronze dans les environs des Alpes : nouvelles données de deux sites du nord de l'Italie (région du lac de Garde)

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A comprehensive archaeobotanical study has been carried out on two Bronze Age lake-dwelling sites currently under excavation in the area of Lake Garda, N-Italy. The two investigated sites are Lavagnone (119 m asl, Desenzano del Garda) and Lucone D (249 m asl, Polpenazze del Garda), both located inside the Garda morainic amphitheatre, about 10 km distant from each other. The Lavagnone lake has been continuously inhabited, from the earliest phases of the Early Bronze Age (EBA), till the end of Middle Bronze Age (MBA) (2077-1400 BC). Thanks to a huge archaeological stratified deposit, it is the main reference site defining the chronological periodisation of northern Italian Bronze Age. The Lucone D site revealed two subsequent EBA pile-dwellings (preliminary dendrodates 2035-1970 BC). The first phase ended with a fire event that led to a partial collapse of the structure.

A total of more than 50'000 botanical remains were recovered and identified. They were deposited in a waterlogged environment and preserved in very good state in both sites. The investigation in these sites south of the Alps is crucial to understand the spread of Bronze Age plant economy in the Po Plain, into the Alpine valleys and finally to the regions North of the Alps. Important results have been obtained in both sites. A large variety of cereal crops have been detected in both age periods. Emmer, the new glume wheat' type (NGW), barley and einkorn resulted to be the most important cereals, while spelt and naked wheat (both, 6n and 4n) were secondary crops. The abundance of the NGW remains is particularly noteworthy.

thy. The spread of broomcorn millet cultivation and of pulses (mainly horsebean) have been precisely detected at the MBA layers onset at Lavagnone. The finds of a conspicuous amount of wild edible plants testifies the large contribution of gathered species in food supply e.g. *Rubus fruticosus*, *Fragaria vesca*, *Cornus mas*, *Corylus avellana*, *Quercus* sp., *Ficus carica*, *Pyrus* sp., *Malus* sp. and *Vitis vinifera* subsp. *sylvestris*.

Keywords: Plant palaeoeconomy, North Italy, Bronze Age

Plant remains from the 2nd and 1st millennium BC in the Balearic Islands

Restes végétaux des Ile et Ier millénaires av. J.-C. dans les îles Baléares

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Each of the four islands forming the Balearic Archipelago has followed different historical processes characterized by different phases of occupation and abandonment. Furthermore, the influence of the Phoenician colonization occurring from the 1st millennium BC was also different in each island. Agriculture has been little studied in the region and our knowledge is still limited. Thus, this paper aims at providing a general overview of the agrarian activity developed in the area through the examination of archaeobotanical datasets.

The earliest data comes from the site of Els Riuets (Formentera) dated to the beginning of the 2nd millennium BC where cereals (*Hordeum vulgare* var. *nudum* and *Triticum aestivum-durum*) and possibly legumes (*Lathyrus cicera/sativus*) were cultivated. In Menorca, the earliest assemblages are dated to the second half of the 2nd millennium cal BC in sites such as S'Alblegall, Torralba d'en Salort and the caves of Es Carritx and Des Mussol; here naked cereals are dominant although *Hordeum vulgare* subsp. *vulgare* and *Triticum dicoccum* are also present.

Information regarding the 1st millennium cal BC comes from the other two islands. In Mallorca, for instance, agriculture is characterized by the cultivation of cereals and legumes while in Ibiza, fruit growing appears as significant feature. Bearing in mind the limited archaeobotanical record, these differences may be explained by the different processes that took place in each island. While in Mallorca the local population maintained limited contact with the Phoenician colonizers, Ibiza was settled, after a period of abandonment, by communities of oriental origin that brought in a new type of agriculture in which fruit tree growing played an important role.

Keywords: Islands, Agriculture, Arboriculture, Phoenician colonization

Monumentalizing landscapes, redefining forest resources management: Merging anthracology and landscape archaeology to approach prehistoric landscape practices and rationalities in Mallorca (Balearic Islands, western Mediterranean)

Redéfinir la gestion des ressources forestières en contexte insulaire, en croisant les approches anthracologique et d'archéologie du paysage pour comprendre les pratiques et

rationalités préhistoriques à Majorque (îles Baléares, Méditerranée occidentale)

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“Landscape” constitutes a challenging arena for archaeological research, as it demands the combination of both natural/environmental and social/cultural issues, necessarily merged in the creation of such a research subject. Moreover, “islands” represent privileged scenarios to address landscape research since they constitute water-delimited (although not isolated) lands in which socio-environmental processes occur. On the basis of this two research subjects, islands and landscapes, we propose to address the study of the construction of “islandscapes” and landscape rationalities of prehistoric communities of the island of Mallorca. To address this objective we propose the integration of two research strategies: landscape archaeology and anthracology (aka charcoal analysis).

The Balearic prehistory is characterized by the emergence and development of a particular monumental cyclopean architecture. During Bronze Age, the so-called “navetiforms” constituted the monumentalization of domestic spaces, being the locus in which social life was developed. Around c.900/800 cal. BC, this monumental architecture experienced a noticeable transformation. New types of cyclopean monuments emerged, with tower-like constructions (the so-called “talaiots”), staggered platforms and villages’ walls. It was now the social buildings, common to the inhabitants of each village, but not the domestic, private spaces, which exhibited the monumental architecture, and these buildings were located in walled villages creating visual networks of connection among them.

The construction of a social landscape through monumental cyclopean architecture was manifestly different in each case. The sense of space changed from Bronze to Iron Age and, in this sense, we propose to analyze how the organization of landscape practices related to woody plants (archaeologically observable through charcoal analysis) intervened with these landscape rationalities materially expressed and “semanticized” by monumental architecture. Wood uses and, specially, firewood procurement and consumption constitute recurrent landscape practices, developed in an everyday basis and central to the material life of human groups, as they guarantee the energetic social demands. The dialogue between archaeobotanical data and landscape archaeology reconstructions allows exploring how the “islandscapes” were socially constructed after specific landscape practices, such as firewood procurement, and architectural manifestations. Both elements are archaeologically observable and, thus, allow a holistic approach to how the islandscapes were built, maintained and transformed through time. Both perishable (wood/charcoal) and non-perishable (stone buildings) material culture remains are explored to approach the construction of specific islandscapes through the choices people made in regards to the island landscapes that they inhabited.

Keywords: Landscape practices, Archaeobotany, Anthracology, Landscape archaeology, Monumentality

The development of weed vegetation in the Carpathian-basin during the archaeological ages

Le développement des adventices dans le Bassin des Carpathes, aux époques archéologiques

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Thanks to archaeobotanical investigations, we can now treat it as a fact that the territory of Hungary is one of the longest inhabited parts of Europe. The Carpathian Basin plays a bridging role in the spread of plant cultivation know-how between the Balkans path leading from the region of the Middle East, known as the Fertile Crescent, to Central Europe. The relationship between cultivated plants as well as weeds has been determined by the lifestyles of the populations that have lived in the Carpathian Basin and climatic conditions. The cultivation of several species of plants is only associated with a specific archaeological era or a specific culture. The populations that have lived here have always brought and grown their own cultivated plants with them when they moved into the area. The archaeobotanical research in Hungary reaches back more than 140 years. During this long time 50 researchers were active in this topic and 500 archaeological sites have been processed. About 10 million seeds of 800 plant taxa (mostly species) were identified from the Neolithic to the Modern Ages in the Carpathian Basin. The seed remains also shed light on weed history in the last eight thousand years. Many species, that had been cultivated plants characteristic of individual cultures, became weeds or disappeared almost without a trace. Our catalogue of the weedremains from Hungarian excavations, indicating species and number of items, classified on the basis of periods and sites, ranging from the Neolithic to the late Medieval. The first weeds of Körös-Starčevo culture were: *Avena fatua*, *Bromus arvensis*, *Chenopodium album*, *Fallopia convolvulus*, *Galium spurium*. At the beginning the spring-sown cerealweed or stoop crop weed association (Polygeno-Chenopodietalia) and the autumn-sown cerealweed association (Secalietea) were not differentiated significantly. The number of the segetalweeds at the beginning (mostly in Neolithic and Bronze Age) were very low. In the Iron Age according to the harvesting method (iron sickles and harvest near ground level), their number has increased. The differentiation of segetal vegetation started in the Roman period. During the Middle Ages the weed associations reached the present – but before the large-scale agriculture and significant ruderalization – species composition. We detected with computer assisted image analysis that the size of the weed seeds have increased significantly with the size of the grains of cultivated plants. Among 156 of pieces archaeophyton weed species due to large-scale farming nearly disappeared from the hungarian flora.

Keywords: Europe, Wild plants, Weed, Development

Evolution of plant economy in Medieval and Post-Medieval Belgium, a review of the Archaeobotanical Data

Evolution de l'économie végétale au Moyen Âge et Post-Moyen Âge en Belgique, un bilan des vestiges archéobotaniques

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The first archaeobotanical studies on medieval and early modern sites in Belgium were published in the eighties of last century. Since then hundreds of samples from rescue excavations have been analysed and the increasing amount of data permits a first review. In this presentation we will give a synthesis of the carpological records of cultivated and collected plants of economic importance from medieval and post-medieval sites in Belgium. It will comprise published data from Flanders (the northern part of Belgium) and published and unpublished data from the Brussels region and the Walloon region (the southern part of Belgium), recently collected by the archaeobotanical team of the Royal Belgian Institute of Natural Sciences.

After evaluating the potential and limits of this rich archaeobotanical dataset, diachronic trends related to intensification of crop cultivation, developments in horticulture and fruit cultivation, introductions of non-indigenous species, changing trade networks and changes in food consumption patterns of medieval and post-medieval populations will be discussed. The data will be confronted with information from historical sources and archaeobotanical records from the wider region. Finally we will define some research questions for future studies.

Keywords: Plant macrofossils, Chronological distribution, Medieval and post medieval period, Belgium, Economic plants

Inside cakes: new data on plant components from food offerings at Sanctuary of Monte Papalucio (Oria - Southern Italy) by ESEM analysis

A l'intérieur des gâteaux : nouvelles données sur les composants végétaux des offrandes alimentaires du sanctuaire de Monte Papalucio (Oria - Italie du Sud) par l'analyse par MEBE

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In the studies of ancient bread or bread-like remains, the well-preserved findings from the Messapian/Greek Sanctuary of Monte Papalucio (Oria, southern Italy) represent one of the most famous examples in the Mediterranean region. The sanctuary, dated to Archaic and Hellenistic periods, was dedicated

to the cult of Demeter and Persephone/Kore, strictly associated to agricultural cycles and fecundity rituals; effectively, during the excavation of the terraces where the sanctuary lies, a large amount of charred plants and, above all, cakes and biscuits were recovered and interpreted as food offerings (Ciaraldi 1997-1998). As for the latter finds, the author identified different kinds of dough on the base of macroscopic analysis, some bearing resemblance to modern filo-pastry, possibly corresponding to plakous (typical cakes offered to Demeter), some others decorated with knobs, or ring shaped. For a third type, Ciaraldi suggested the use of broad bean flour among the ingredients.

Given that these unusual finds represent direct and rare evidence of the food products offered by indigenous and south Italian Greeks inside a particular "place of encounter" between the Messapian and the Greek form of the cult of Demeter, their detailed analysis and microscopical re-evaluation seemed crucial for understanding further aspects of food production (the plant components and processes involved), as well as the cultural dimension of the offered foodstuff.

Therefore, ESEM (Environmental Scanning Electron Microscope) analyses were performed on the Monte Papalucio findings: Tissue remains and their particle sizes, along with other parameters, were used in order to elucidate ingredients and production techniques, and the various processes involved (grinding, sieving, leavening, baking). Also, the hypothesis of a connection between ingredients, production techniques and cake/biscuit shape and decoration was tested. The contribution presents and discusses the unexpected results of these analyses.

Keywords: Food remains, Tissue analyses, Ritual offering, Archaic, Hellenistic period, Southern Italy

The Early Byzantine Balkan Area between Caričin Grad and the Lower Danube - An Archaeobotanical Perspective

La période byzantine précoce dans la région des Balkans entre Caričin Grad et le Danube inférieur - une perspective archéobotanique

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The Early Byzantine town Caričin Grad (530-615 AD) is now in focus of archaeological research for more than 100 years. To gain more information about the human daily life, archaeobotanical research was conducted between the years 2013 and 2015 for the first time. The excellent preservation due to the undisturbed occupation layers provide a interesting insight in the plant material of a very short occupation period of only about 80 years. In the three years of investigation 233 soil samples were collected systematically from occupation layers in different parts of the town. Mainly from different structures ex. streets, buildings of the Upper Town Area in the north of the Acropolis. Besides, 35 hand-picked samples from the Upper and the Lower Town areas, collected during former excavations mainly from the 1980s were available for analysis. So far more than 70,000 plant remains mainly preserved in charred condition were found. The plant spectrum is dominated by crop species especially cereals like *Triticum*

aestivum, *Panicum miliaceum* and *Secale cereale*. But also the spectrum of fruits and nuts is very diverse in the Upper Town Area. Especially *Vitis vinifera* occurs in high numbers and abundant in the samples. The whole plant spectrum gives a good insight into different activities of the inhabitants of the town ex. crop processing, stock keeping or waste deposition. Together with the results of the other archaeobotanical investigations of Early Byzantine sites in the Balkan area, mainly from the region of the lower Danube, the results of Caričin Grad help to characterize the crop spectrum of the region and to compare it with the other regions of the Empire. Especially the cereal spectrum differs from the other regions of the Empire. *Triticum aestivum* or *T.durum* and *Hordeum vulgare* were most widely used in all regions of the Empire during the Early Byzantine Period, but the cultivation of *Panicum miliaceum* and *Secale cereale* seem to be unique to the Early Byzantine Balkan area.

Keywords: Byzantine Empire, Balkan Area, 6th century, Cereal Cultivation, Activity Areas

New archaeobotanical evidence from the Northern Fertile Crescent: vegetation, subsistence strategy and possible food plants at aceramic Neolithic Körtek Tepe, SE-Anatolia

Nouvelles données archéobotaniques relatives au nord du Croissant fertile : végétation, stratégie de subsistance, et plantes alimentaires potentielles déduites des résultats du site néolithique acérémique de Körtek Tepe, Anatolie du S.-E.

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The transition from hunter-gatherer to early farming communities is crucial to the investigation of the beginning of agriculture. The Fertile Crescent is one of the key areas for this process and provides a good archaeological record for agricultural research. This presentation will be focussing on Epipalaeolithic and Early Holocene sites of the Fertile Crescent (11th – 10th millennium BC) to gain insight into the beginning of early farming communities and the progenitors of our crops today. The crops were an adaptive response to cultivation as landscape practice with a long-term pre-domestication process at some sites, while others are not conclusive in this regards.

New evidence from the Northern Fertile Crescent, more precisely from Körtek Tepe, located in the Province of Diyarbakir, Southeast Turkey, contributes to the question of whether there is evidence for the beginning of agriculture. The archaeological, archaeozoological and archaeobotanical data indicate multiple features of permanent settlement. A variety of wild resources were hunted, fished or gathered by the inhabitants that occupied the site from ca. 10200 – 9200 cal. BC. Körtek Tepe provides new anthracological information on the development in local vegetation patterns at the transition from the Younger Dryas to the Early Holocene, which will be linked to changes in subsistence strategies visible in the seed record.

Keywords: Fertile Crescent, Aceramic Neolithic, Origins of agriculture, Younger Dryas

Gathering, processing, use and consumption of plant resources during the Archaic (ca. 10.500 – 3.700 years B.P.) in the Atacama Desert highlands (south-central Andes): the case of "Alero El Bajo" site

Récolte, transformation, usage et consommation des espèces végétales durant la période archaïque (environ 10.500 – 3.700 years B.P.) sur les haut-plateaux désertiques de l'Atacama (régions centrale et méridionale des Andes). L'exemple du site "Alero El Bajo"

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The Atacama Desert highlands (2,000-3,800 masl) have provided key information for the understanding of the cultural dynamics of Andean populations that have inhabited continuously the South-Central Andes since the initial colonization of this region by the latest Pleistocene. Our knowledge about cultural patterns for the Archaic period (~10,500-3,700 years BP) is, however, constrained by the preservation of materials (i.e plant remains) beyond the record of lithic artefacts, zooarchaeological vestiges or rock art. Actually, settlement patterns for hunter-gatherers groups and/or features for archaeological archaic sites (e.g. functionality) have been mostly –and traditionally– inferred from analyses on these kinds of evidence.

In order to overcome these limitations, we have focused our efforts in developing methodological frameworks to search and for recover plant remains in archaic sites. Hence, we carried out systematic archaeological surveys and excavations in the Atacama Desert highlands (high Azapa basin, 18°30'S, 3,100-3,900 masl) to evaluate the potential effects of depositional environments (fluvial versus interfluvial) and/or site types (closed versus open sites) in the differential preservation of plants remains. Likewise, we used the manual sieving technique to retrieve botanical macro-remains instead of the traditional flotation methodology. We believe that by implementing this sieving procedure, we are able to recover a large amount of plant materials; including either the small remains fraction (i.e seeds) or bigger fractions (leaves, flowers, fruits). Despite their depositional environment, practically all of the 105 archaeological sites identified in the high Azapa basin lack of macro-botanical remains. Exceptionally, in the cave "Alero El Bajo" (10,565-5,820 cal yrs BP) –located alongside an ephemeral canyon– we recovered in excavation over 1,500 excellent well-preserved plant remains. Our preliminary results show evidence for the use of local species such as Cacti (e.g. *Cumulopuntias* ssp.) and selective gathering of wild Quinoa (*Chenopodium* ssp.). These finding offers the unique opportunity to reconstruct cultural practices regarding the acquisition, management, use and consume of plant resources throughout the Archaic (~10,500-5,800 cal yrs BP), and certainly complement our notion about life strategies for hunter-gatherer groups from the Atacama Desert highlands.

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Keywords: Hunters-Gatherers, Archaic period, Food, Diet and cooking, Archaeobotanical methods, Atacama Desert highlands

Evidence for rare crop weeds of the Caucalidion group in Southwestern Germany since the Bronze Age - Palaeo-ecological implications

Présence de rares mauvaises herbes des cultures du groupe Caucalidion dans le sud-ouest de l'Allemagne depuis l'âge du Bronze – Implications paléo-écologiques

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The crop weed communities of dry calcareous soils, belonging to the Caucalidion association are today very rare and endangered in. In the early days of phytosociology during the first half of the 20th century, when vegetation documentation with modern methods started, this group was already in a late state of disappearing, caused by the intensification of agriculture since the 19th century. Therefore the botanists found these plants only in a few regions with calcareous soils, and the common opinion was, that their distribution reflects the geological conditions. Archaeobotanical macrofossil on-site evidence for example for *Orlaya grandiflora* in the Roman period outside these limestone areas was interpreted as food import. On-site evidence is still scattered in time and space and difficult to interpret. The western Lake Constance region belongs not to those limestone areas where this plant association is expected, and floristic observations of the last two centuries are lacking. The archaeobotanical record of the Late Bronze Age and High medieval period is very scattered. Especially of *Orlaya grandiflora*, which, for a entomogamous species, is rather well represented in the pollen record, there is now proof from several pollen diagrams that this species did occur regularly and with high frequency in the lake Constance region from the Late Bronze Age to the 19th century A.D. Several other species of the Caucalidion are also reflected in the pollen record, but less frequent, reflecting the ecological conditions triggered by agriculture, which determines their occurrence rather than geology. Due to soil erosion most topsoils were thin, specially on slopes, with low water capacity, the competition between crop and weeds was weak, and the yields were low. The weeds were distributed over long distances by migrating domestic animals, whereupon fruits with spines like *Orlaya* or *Caucalis* had an advantage. From scattered finds of their pollen grains in high-resolution pollen profiles of Nordschwarzwald and Allg'au, regions where this plants were not expected at all, we can guess, that the Caucalidion was more or less ubiquitous between Late Bronze Age and early Modern Ages in Central Europe and adjacent regions reflecting the tenuous situation of extensive arid agriculture. To have more than a guess, more better pollen diagrams and more on-site studies of macrofossils would be necessary.

Keywords: Caucalidion, Macrofossil evidence, Pollen evidence, Agriculture, Human impact

Changing peoples, changing plants: Archaeobotanical finds from Northern Tunisia from the Roman to Islamic period

Co-évolution des peuples et des plantes : découvertes archéobotaniques dans le nord de la Tunisie aux périodes romaine et islamique

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Northern Tunisia was an economically vital part of the Roman Empire. The wheat grown in the Medjerda valley was shipped to Rome to feed the city's vast population. The other main exports, produced in enormous quantities, included fish sauce, olive oil and African red slip pottery. Consequently, the region contained some of the largest cities in the Empire including Carthage and Utica. Despite frequent invasion and occupation from the 5th AD century onwards, many of the region's sites were occupied through the Byzantine and Islamic periods.

However, North Africa is one of the most archaeobotanically understudied areas of the Mediterranean. A combination of 19th century clearance excavations and modern political instability has led to little archaeobotanical sampling. The early excavations did not include any form of environmental archaeology and in many countries, such as Libya and Algeria, modern excavations have been postponed due to dangerous conditions. However, the recent excavations at Utica, led by a team from the University of Oxford, have produced a wealth of archaeobotanical data ranging in date from the Roman period (1st-2nd centuries AD) to the Islamic period (9th-12th centuries). In antiquity, the city was situated on Medjerda river estuary with access to the coast. It was second only to Carthage in both size and population. Samples from the site were taken between 2011-2014 from a wide range of contexts including Punic and Roman cisterns, Roman kilns and elite houses, and Islamic houses and storage pits. Changes in dietary patterns reflect the changing religious and economic character of the region. The findings also indicate changes in food production and processing over time as well as domestic and industrial fuel choices. This paper will present the new archaeobotanical assemblage from Utica together with archaeobotanical finds from other nearby sites such as Carthage, Leptiminus and Oudhna in order to trace the shifting relationships between people and plants from the Roman to the Islamic period in Northern Tunisia. Continuity and changes in diet, especially with respect to cereals, will be explored. How strong were the prevailing religious and cultural attitudes on food production and diet? Continuity and changes in diet, especially with respect to cereals, will be explored. How strong were the prevailing religious and cultural attitudes on food production and diet? The importance of plants in the economy of the region during both periods will also be analysed. Finally, similarities and differences in food consumption practices in Northern Tunisia during the Roman period will be compared to those taking place on the northern Mediterranean coast.

Keywords: North Africa, Utica, Roman, Islamic, Olives

Changing crop choices in northern Sudan: past and present

Evolution des choix de culture dans le Soudan septentrional : passé et présent

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Nubian agricultural practices are rapidly altering due to infrastructure development, as well as technological and environmental changes. In this project we interview Nubian farmers about crop choices, land-use strategies and changes over time on Ernetta Island, as well as farmers in other villages between the 2nd and 3rd cataracts to understand variability. This paper discusses changes in the diversity and the relative importance of cereals and pulses grown over the last century, including the use of hulled barley (*Hordeum vulgare*), sorghum (*Sorghum bicolor*) and lablab (*Lablab purpureus*). For example, hulled barley was an important winter cereal grown for food until the 1960s but is now only grown in small quantities, mostly for animal fodder and to make beverages. By examining which crops or practices are considered 'traditional', we are forming new reference points from which to make comparisons with the archaeological record. Equally, considering which 'traditional' crops have a long temporal presence in the archaeological record helps to highlight the role of increasingly marginalised crops. This research is part of a broader project 'Sustainability and subsistence systems in a changing Sudan' (2013-2016) which compares present-day and ancient crop choices to investigate agricultural risk management within Nile settlements. This research is funded by the Arts and Humanities Research Council and part of their broader research theme 'Care for the future: thinking forward through the past – environment and sustainability'.

Keywords: Sudan, Ethnobotany, Archaeobotany, Cereals, Pulses

Diversities in Food Complex over Eurasia

Diversité des régimes alimentaires en Eurasie

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Human being is an omnivorous mammal and thus must necessarily eat both plant and animal food materials. The starch for energy comes mainly from plants, and protein and lipid mostly from animal-derived food. Thus human diet consists of plant and animal food resources, which are obtained from their own ecosystem. In the east of Eurasian continent, typical humans' diet is "rice and fish"; in which rice provides starch, and fish and other aquatic animal species do protein. In the northern regions of the east Eurasian continent, foxtail millet and/or proto millet are used instead of rice. In the vast central and west of Eurasian continent, package of "potato or wheat and milk" has been established.

The animal-derived protein has been mainly provided by livestock. In the coastal areas face to the Atlantic Ocean, fish (cod and herring) played an important role as a protein-provider instead of livestock. In both of east and west of Eurasian con-

tinent, starch is provided mainly by crops. On the other hand, protein is provided by natural resources in the east, while it is provided by domesticated animal species elsewhere. These differences might bring about thought of nature.

Keywords: Starch, Protein, Eurasian continent, Diet package

New carpological analyses from Neolithic sites of North-eastern France, including records of “New Glume Wheat”

Nouvelles analyses carpologiques dans le N-E de la France, sur des sites du Néolithique, avec référence au blé de type “nouveau blé vêtu”

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Archeobotanical research on the Neolithic period of the North East of France is blooming, with new research focused on demography, social organization and cultural operation, with archaeobotanic data possibly acting as markers of different cultural groups. These data not only show the various stages of the opening and closing of the landscape, but also mirror demographic changes and their impact on agriculture and gathering activities.

This contribution present sites with a chronological sequence expanding from the early Neolithic to the Bell-Beaker culture ; Soultz Florival (Alsace) for a period starting at the early Neolithic Linearbandkeramik, Clairvaux (Jura) for the middle Neolithic, Ingenheim (Alsace) from the Neolithic recent, Pont-sur-Seine (Aube) dates to the recent Neolithic and Erstein (Alsace) to the end of the Neolithic period Bell-Beaker culture.

The archaeobotanic studies document, to the rank of the species, plants cultivated during the Neolithic period. The results obtained show an heterogeneity in the preservation modes of ecofacts in the structures studied; however, clues are provided on the societal choice of individuals in connection with their environment. The idea that the grain could have been adapted to different environments or to historical changes in the environment has to be demonstrated. The archaeobotanic history of these Neolithic communities, allows us to consider that choices were made by society as drivers of economic and social developments.

Deserving special mention is the recent discovery of New Glume wheat from the site of Pont-sur-Seine, France.

Keywords: Neolithic, France, North.East, New Glume Wheat

Crop diversity in the Dutch and German terps area

Diversité culturelle dans la zone des “terps”, allemande et néerlandaise

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Along the Wadden Sea coast of the Netherlands and Germany, numerous man-made living mounds known as terps,

testify of a time in which dikes were not there yet to provide permanent shelter for incidental flooding. In these times, between approximately 600 BC and 1200 AD, people were making their living on the open, unprotected salt marsh.

Both waterlogged and charred plant remains are generally found in substantial numbers in the terps, so a long and extensive archaeobotanical record is available. Amongst the taxa encountered are various crop plants, including barley as the dominant cereal (*Hordeum vulgare* subsp. *vulgare*), faba bean (*Vicia faba* var. *minor*) and flax (*Linum usitatissimum*). To many archaeologists, the fact that crop cultivation was possible at all, is already quite astonishing. An unfortunate side-effect of this astonishment is that little attention is paid so far to diversity in crop availability within the terps area, both chronologically and geographically.

In the Netherlands in particular, terp archaeology is very much alive, resulting in the founding of a research group devoted solely to the study of terps, the so-called Terp Research Group in 2012. Both from this group and in contract archaeology, excavations on various scales took place over the past years, and the work continues. Archaeobotany has a strong position within this research. Recent analyses show that a wider spectrum of crops was available and that difference in time and space do occur indeed.

The few overviews of crops in the Dutch and German terps area are not up to date, incomplete, generally restricted to the present national borders, and not published in a form easily available to an international audience. The complete dataset includes hundreds of samples from dozens of sites. This paper presents an overview of what is known so far, merging both recent and old' data, from the Netherlands as well as Germany.

Keywords: Salt marsh, Terps, Crop cultivation

Archaeobotanical data on farming practices during the Neolithic (2500 BC) to Early Historic (200 BC) in the Ganga Plain, India

Données archéobotaniques sur les pratiques agricoles du Néolithique (2500 BC) au début de la période historique (200 BC) dans la plaine du Gange, en Inde

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The Gangetic plain has a significant position in the history and archaeology of India. It has been the cradle of Indian civilization right from the terminal Pleistocene period. The Ganga plain was initially very rich in wild flora and fauna due to favourable climate, but has now to some extent been changed because of deforestation and excessive hunting and cutting of forest primarily due to pressure of human population. The changing climatic conditions during early and middle phases of Holocene in the area played a significant role in the evolution of cultures. The excavations and explorations conducted during the last four decades by Archaeological Survey of India, State Archaeology Departments and Departments of ancient Indian history of different Universities, have furnished a complete cultural sequence of the region-Epipalaeolithic, Mesolithic, Neolithic, Chalcolithic, Early Iron Age and Historical periods. Very few sites mostly, multi-cultural in nature have been excavated and attempted for multidisciplinary studies. Recent excavations have thrown new light on the early

farming cultures of the area. The study provides insight into a range of taxa exploited by early inhabitants of different cultural occupations spanning from about beginning of 3rd millennium BC to 2nd century BC and also for the change in plant use over time. The evidence denotes a highly developed state of arable agriculture, which requires foresightedness and planning. The principal cultivated cereals were *Oryza sativa*, *Hordeum vulgare*, *Triticum aestivum*, *Triticum sphaerococcum* followed by few African (*Eleusine coracana*, *Sorghum bicolor*) and indigenous (*Paspalum scrobiculatum*, *Panicum* sp.) millets. While there is continuity in the agricultural pattern in time and space however, certain changes do seem in diversification of plant use during Iron Age. The record of *Sesamum indicum*, *Brassica juncea*, *Carthamus tinctorius*, *Linum usitatissimum*, *Gossypium arboreum/herbaceum* and *Cannabis sativa* emphasize the importance of oiliferous crops and textile production. Finds of *Vitis vinifera*, *Vigna unguiculata*, *Luffa* sp., *Allium cepa*, *Nigella sativa*, *Murraya koenigii* and *Ziziphus mauritiana* along with *Phoenix dactylifera*, *Terminalia chebula*, *Terminalia bellerica*, *Emblica officinalis*, and *Crataeva* sp., suggest horticultural practices and highly advanced medicinal system was in vogue during 1st millennium BC. The weeds and wild taxa, belonging to cultivated fields, moist places, wasteland and ditches were also recorded as an admixture with these macroremains.

Keywords: Archaeobotany, Ganga Plain, Neolithic, Chalcolithic, Macroremains

Hunter-gatherer exploitation of wild plant foods during the Jomon period in Japan

Exploitation par les chasseurs-cueilleurs de plantes alimentaires sauvages au cours de la période Jomon au Japon

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Wild plant exploitation as starchy food was the fundamental part of prehistoric living even in the early agricultural ages. In so doing, processing technique of wild plants is the way to make plant tissue edible and is more vital than gathering or farming techniques. Along with examining local environment features, studies of artefacts and botanical remains can reconstruct "plant food cultures" efficiently. Especially use-wear and residue analyses have the potential of finding evidences of perishable materials that are usually poor-preserved in the archaeological record. These methods can also deliver minute testimonies of the practices of processing such materials and necessary technical know-how of past human populations. This study applied an interdisciplinary methodology combining use-wear and residue analyses for exploring plant processing activities in the Jomon period dating from 15,000-2500 cal BP. According to the current studies, Jomon people were not plain hunter-gatherers, and did use various plant resources around their settlements intensively since the early Jomon period starting at ca. 7000 cal BP. A series of questions on which I focus is how these people selected and processed wild plants for getting food sources over the long term. Examples come from habitation sites in northern, central, and southern parts of Japan, and these sites contained well-preserved macroscopic plant remains and many processing tools. The focus of this study is micro-plant remains that are extracted from grinding

stone tools and pottery vessels.

Macrobotanical remains show intensive processing of nuts and acorns. Microbotanical results confirm the stable existence of nut and acorn processing at study sites, and some evidences show that root plants were also processed/cooked by the same stone tools and pots. Based on these integrated results, macro and micro plant remains show intensive processing of nuts and acorns, that were conducted as the basic wild plant food production. Also starch residue patterns can reveal systematic use traces of grinding stones and pottery.

Keywords: Jomon period, Macro and micro plant remains, Processing and cooking methods, Starch granules, Wild plants

Morus alba: The history of the tree and Chinese, Sasanian and Byzantine silk production from palaeobotanical perspectives

Morus alba : Histoire de l'arbre et de l'artisanat de la soie chinoise, sassanide et byzantine, d'un point de vue archéobotanique

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Originating from China, *Morus alba* (white mulberry) is now distributed in warm-temperate and subtropical regions around the world. Such great success in spreading the species across the globe is undoubtedly the result of human attraction to silk, produced by monophagous caterpillar of silkworm *Bombyx mori*, feeding on *Morus alba*. The process of raw silk production consists of two agricultural technologies of white mulberry cultivation (moriculture) and silkworm rearing (sericulture). Starting in the Yellow River regions at ~2,300 – 2,000 B.C., silk production was kept secret, initially successfully. By AD 553-554 AD, under Emperor Justinian, the technology had definitely arrived in the Byzantine Empire, as reported by Procopius of Caesarea. Legend has it that a princess smuggled *Morus* seeds and silkworms out of China, concealing them in her hair, or monks hiding them in their walking sticks. However, the exact ways of distribution of moriculture and sericulture from China are unknown. This study presents a comparison of historical, palaeobotanical and palynological records, including recent finds that shed significant new light on the question.

Keywords: Moriculture, Sericulture, Sasanian Empire, Palaeobotany, Palynology

Bushman Rock Shelter: a Bonanza of Botanical Remains

L'abri sous roche Bushman : une mine d'or pour l'étude des restes botaniques

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Bushman Rock Shelter, Limpopo Province, is one of a handful of sites in southern Africa that preserves fruit and seed remains in Middle Stone Age (MSA) deposits. Excellent preservation of botanical remains is also present in the Later Stone Age (LSA) deposits. Archaeobotanical research at the site in the 1960s and 1970s indicated the abundant presence of marula (*Sclerocarya birrea*) in layers 25-28 (MSA) and in layers 1-8 (LSA). Significantly, an almost complete absence of marula was identified in layers 9-17. Marula is frost-sensitive and it was suggested that the clear absence of the taxon could be an environmental indicator, although social issues were not discounted. During renewed excavations at the site in 2015, marula remains were again recovered in MSA and LSA contexts and demonstrate the important contribution this taxon can make to the interpretation of the past at Bushman Rock Shelter, in terms of past vegetation and people's exploitation of the fruit. Recent ethnoarchaeological research in the area has indicated that this highly nutritious resource has many and varied uses that may leave distinct archaeological footprints.

Keywords: Marula, Bushman Rock Shelter, Middle and Later Stone Age, Ethnoarchaeology

“An Island of One's own”: Plant resources, resilience and population dynamics of the Aeolian Archipelago through Prehistory

“Une île à soi”. Ressources végétales, résilience et dynamique des populations dans l'archipel des îles éoliennes au cours de la Préhistoire

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The Aeolian archipelago is a group of 7 little volcanic islands located off the northern coast of Sicily, emerged about 2 millions of years ago. The archipelago is very rich and heterogenic in terms of geomorphology and biodiversity and there are extremely different biotopes, including several endemic plants. Analysing the delicate balance of human islanders communities during Prehistory (Vth-Ist millennium BC), dependent mainly on the environmental changes and the knowledge and use of the territory and its natural resources, it is possible to evaluate if the archipelago could be independent from the coast and self-sufficient. Plant macroremains from the archaeological sites are used to rebuild the paleoenvironmental framework and compare it with the cultural dynamics and the paleodemographic and socioeconomical data. The main aim of our research is to highlight the potential information of these plant macroremains in settlement contexts and to enhance the method for spatial analysis crossing all the available data. This approach will allow us to evaluate the paleoeconomical framework, in particular for the villages of Filo Braccio (Filicudi), Portella (Salina), Acropoli (Lipari) and contribute to investigate the possible network among the Aeolian islands from the beginning until the end of the Bronze Age (end of the IIIrd-end of the IIInd millennium BC). Cereals grains and wood charcoals were also selected and analyzed in

order to obtain $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ ratio, with two different techniques: by isotope ratio mass spectrometry (IRMS) and AMS (Accelerator Mass Spectrometry).

For the aim of the workshop, the specific features both of the insular and volcanic nature of these territories will be considered to analyse vegetation dynamics and its relation with human occupation, but also paleoeconomical issues and agricultural strategies. What features can be isolated as insular factors in vegetation? And in human dynamics? How did the andosols influenced plant growth? What kind of differences can be individuated in each island? Can we try and evaluate the paleodemographic impact and its influence on the use of resources? How does the ecosystem is balanced through its archipelagian environment? How much could these volcanic territories produce in terms of crops under different climatic conditions?

Keywords: Bronze Age, Aeolian archipelago, Island archaeobotany, Insular environment, Paleodemography

The Spread of Domesticated Plants along the Silk Road

La diffusion des espèces domestiques le long de la Route de la Soie

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The Great Silk Road was the largest commerce network of the ancient world; it linked the disparate ends of the vast Eurasian supercontinent and in doing so connected the imperial centers of East and southwest Asia. While organized trade, including military outposts and government taxation, along the Silk Road dates back to the Han dynasty (206 BC–AD 220), the exchange of goods, ideas, cultural practice, and genes, through the thousands of kilometers of desert and mountainous expanses comprising this region dates back to the third millennium BC. Over the past two millennia, the power struggle along the Silk Road has passed control back and forth between various nationalities and ethnic groups, including successive Chinese dynasties and Central Asian mobile peoples, such as the Xianbei and Xiongnu. This ebb and flow of cultures directly shaped the trajectory of human history in myriad ways, including by spreading agricultural practices and crop varieties.

Inner Asia is an anomaly in discourse surrounding social complexity; the early Iron Age (800–200 BC) is marked by a demographic transition, long believed to be fueled by increased pastoralism. Interestingly, one of the least studied parts of the world, in terms of early agriculture and its link to increasing social complexity, is also the region that saw the rise and fall of some of the world's greatest empires. The early Iron Age in Central Asia is also marked by large-scale exchange and globalization, increased craft specialization and social hierarchy, and, as recent data is showing, increased investment in agriculture. Over the past decade, with a new wave of archaeobotanical research in Central Asia, we are starting to piece together the role that farming played in the economy. Likewise, we can trace the introduction and spread of crops through the arable valleys and foothills of the Tien Shan, Dzungar, Pamir, and Kopet Dag Mountains. This new research is taking steps toward the construction of a novel economic model for Eurasia, and in doing so is reshaping the general understanding of so-

cial developments across the Old World. Likewise, by following the spread of specific crop varieties along the Silk Road, we can understand how they helped shape cuisines around the world. Archaeobotanically tracing the path that plants followed on their long journey across Central Asia, provides us with a map that lays out the early route these foods took to ultimately reach our dinner plates today.

Keywords: Silk Road, Central Asia, Agriculture, Crops, Exchange

Current status of ancient plant economy during Iron-Age and Early Historic period in Upper Ganga Plain

Etat actuel de l'économie végétale ancienne au cours de l'âge du Fer et de la période historique précoce dans la plaine du Gange supérieur

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In the recent past, many a sites of Iron Age and Early Historic times excavated in Upper Gangetic plain like Indorkhera in district Bulandshahr, Ahichhatra in district Bareilly, Sanchankot/Ramkot in district Unnao and Kampil in district Farrukhabad; have been investigated for palaeoethnobotanical finds, all in UP. A number of field-crop finds belonging to cereals, millets, pulses/legumes, oil-seed and fiber-yielding crops, have been recorded with their field associates through the morphological investigation of seed and fruit remains' samples from cultural horizon of pre-P.G.W., P.G.W., N.B.P.W. up to Early Historic Sunga and Kushana Periods (approx. 1500 B.C. to 300 A.D.). The studies have revealed well settled agriculture based subsistence economy of double cropping system of winter as well as summer crops, along with fruit remains of jujube and grape, etc. Use of herbal drug yielding plants like jambolan/jamun, emblic/amla, fig/gular and neem, etc. is also seen. The record of neem (*Azadirachta indica*) seed/fruit remains, a medicinally valuable tree taxa from Sunga-Kushana levels (200 B.C.-300 A.D.) at Naimisharanya (district Sitapur) is significant in archaeological lexicon of Ganga plain. Botanical remains such as fig at Ahichhatra and rudraksha of Himalayan origin at Indor-Khera, both of high religious value have also been recovered in the upper reaches of Ganga plain. The find of Custard apple recorded from Kushana phase (100-300 A.D.) at Sanchankot and Naimisharanya, are additional evidence to this pre-Columbian fruit in this region. There is record of minor crop (job's tear) from the ancient site Ahichhatra which apart from use as food, is also known to be used for ornamental purposes. The crop assemblage recorded include elements of Near-East, Central Asian, and indigenous origin. The weeds and wild taxa encountered in association with field-crop remains, reveal the pattern of field-crops, state of ancient agriculture fields and regional ecological conditions in ancient times.

The new advances in the recovery and analysis of plant remains during recent times have given higher yield of material evidence in comparison to past known ancient sites of Iron Age In this region, thus adding more information to our existing palaeoethnobotanical concepts.

It is also clear from the archaeological data that Chalcolithic communities of India were practicing skilled farming, which was adopted later by early iron using communities of the Ganga plains. The evidence suggest that the dwellers of the

Ganga plain, by and large, were towing the line of the earlier farming communities of the region.

Keywords: Archaeobotany, Ganga Plain, Neolithic, Chalcolithic, Macroremains

Layer formation processes in late Neolithic lakeshore sites

Les processus de formation des niveaux archéologiques dans les sites de bord de lacs de la fin du Néolithique

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As generally known, the understanding of taphonomy and formation processes of archaeological layers is crucial for their interpretation and forms a fundamental basis for further analyses (e.g. evaluation of FIBS or isotopes). Despite excellent preservation conditions, the taphonomy of wetland settlement layers at lakes in Central Europe ("pile dwellings", UNESCO world cultural heritage) is not well understood. In order to improve this situation, an SNF-funded project was started in 2014 by an interdisciplinary team at IPAS (project nr. CR30I2_149679/1). Aim is to identify natural and anthropogenic factors influencing the deposition and preservation of occupation layers using a multi-proxy approach (plant macroremains, pollen, micromorphology and archaeology). Some of the main questions are: can we jointly identify limnic and/or fluvial flooding and desiccation events? Can we make a statement about the seasonality in different micro-layers? Can we define groups of remains typical for a type of sediment? Are there "defined" assemblages in terms of functional groups? Another goal is to solve "old" methodological questions (presented separately in poster, by Steiner *et al.*). Within the project, we investigate two sites that were sampled in a completely different way (large-volume surface samples versus a dense network of profile-columns). In our contribution, we will present the results of one of those sites, the lakeshore settlement Zug-Riedmatt (Central Switzerland), which was occupied sometime between 3200 and 3100 cal BC and left behind a cultural deposit of up to 1.2 m thickness. Only a small part of this excellently preserved site has been excavated, but the recovery technique was detailed, allowing a separation into microlayers in 78 profile columns in the lab. Five profile sequences were chosen and analysed in close collaboration between the disciplines mentioned. All involved researchers simultaneously sampled the profiles, analysed the same layers and actively exchanged their results, experiences and ideas.

In a microarchaeological approach, we tried to disentangle the complex interactions of the different factors that may have formed the waterlogged organic layers. The first results show that often, different traces of activity were interwoven even on a microarchaeological level and are sometimes difficult to separate. Nevertheless, we could determine groups of remains

indicative for events which were perceived by all disciplines involved. These groups were tested by statistics and existing data from the literature. Final aim is to provide a sound basis for the interpretation of archaeological wetland sites in general.

Keywords: Taphonomy, Subfossil plant macroremains, Interdisciplinary sampling, Microarchaeology, Multiproxy approach

Crop Cultivation, Crop Processing and Consumption Preferences in Bronze Age South-Eastern Iberia (Prov. of Murcia and Almería)

Cultures, traitements des récoltes et préférences alimentaires dans le sud-est de l'Ibérie à l'âge du Bronze (Prov. de Murcie et d'Almería)

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Land-use management strategies of prehistoric agrarian societies do often differ considerably between regions and periods. In semi-arid south-eastern Spain, farming methods applied, mainly depend on the different landscapes and are primarily being influenced by the amount of precipitation and water availability. The importance of some domesticated crops in larger areas and their temporal shifts from Chalcolithic towards El Argar Bronze Age (Early and Middle BA in south-east Spain) and furthermore towards Late Bronze Age will be presented. A shift in cultivation preferences occurred: from free-threshing wheats and faba bean towards barley. In El Argar Bronze Age, the availability of free-threshing wheats probably depended on social status (Tira del Lienzo). While during the Chalcolithic period mainly wild olive was gathered in south-eastern Spain, and the use of several wild fruits and nuts (strawberry tree, stone pine, grape vine, myrtle, white crowberry, sloe) are reported from Zambujal and Alcalar in Portugal, in El Argar Bronze Age mastic fruit became an important gathered plant as indicated by pure storage finds from Tira del Lienzo and Monte Agudo. For the semi-arid south-east of Spain hulled barley (La Bastida and La Almoyola) was the dominant crop during El Argar Bronze Age, based on dryland farming. Less important cultivation of pulses and flax received additional water supply (probably seasonal flooding along the river beds) as isotopic analyses of seeds have suggested. There are hints of an overexploitation towards the end of the El Argar Bronze Age which seem to have led to social conflicts that brought El Argar society to an end. Late Bronze Age subsistence production became more diverse between regions with a broader spectrum of cultivated crops and subsistence strategies applied.

The analyses of archaeological contexts indicate different and changing societal organisations and hierarchical structures. They might have been strong factors for the choices of the applied subsistence strategies and for crop processing practices. Preferences in consumption and the formation of social groups sharing food are noticeable. In Chalcolithic context diversified subsistence production is detected; storage and consumption practices are dominated by collective principles. For El Argar society, specialised subsistence production with centralised storage practices and a new, highly efficient grinding technology are evident, while consumption of a greater amount of boiled food (soups, porridge, etc.) seems to have

been individualised. After ecological degradation and demographic collapse of El Argar culture, Late Bronze Age sees the beginning of a truly household centred economy.

Keywords: El Argar Bronze Age, South East Spain, Crop Choices, Societal Organisation, Subsistence Production

Crop husbandry and plant use in Central Anatolia: investigating chalcolithic “farmscapes” through a multi-stranded approach

Culture et utilisation des plantes en Anatolie centrale : Reconstruction du paysage agricole chalcolithique à travers une démarche pluri-disciplinaire

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Little is known about agricultural practices in central Anatolia between the 6th and 4th millennia cal BC. The Neolithic and the Bronze Age have claimed most attention, with limited focus on the intervening Chalcolithic period. However the transitional period between the emergence and establishment of agriculture and the development of urban centres, states and empires is crucial to understand the social and ecological roles of farming.

Using two cases studies from Central Anatolia, this presentation considers the techniques and strategies used by Chalcolithic farmers to cultivate crops. The evidence examined ranges from archaeobotanical analysis of crop remains and processing waste, through to stable isotope analysis of crop taxa. The methods used to cultivate crops and the modes by which they were processed, stored and consumed are explored in order to develop a nuanced view of farmscapes' during the Chalcolithic.

The case studies focus on the large early Chalcolithic site of Çatalhöyük West and the small late Chalcolithic site of Çamlıbel Tarlası. Macrobotanical remains demonstrate regional differences and the impact of site size and environmental conditions on crop choice and agricultural decision-making. Weed flora and crop stable isotope analysis shed light on distinctive management strategies for particular crops. The impact of environmental and social constraints appears to play an important role in shaping the agricultural landscape.

Keywords: Chalcolithic, Anatolia, Crop husbandry, Isotopes

Plant remains from Hasankeyf Höyük: a new PPNA settlement in the upper Tigris valley

Les restes végétaux de Hasankeyf Höyük : un nouveau site du PPNA dans la haute vallée du Tigre

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Hasankeyf Höyük is a sedentary village site on the upper Tigris and dated to the second half of the 10th millennium cal. BC. The site is more or less contemporary with other PPNA sites in this region: Hallan Çemi, Demirköy Höyük,

Körtik Tepe and Gusir Höyük. Interestingly, none of these sites show the sign of plant domestication when many other contemporary sites in West Asia demonstrate the evidence for cultivation of plants. Located in the bottom of the Tigris valley which is surrounded by steep slope covered with open forest which comprises deciduous oak, almond, pistachio and hackberry, etc., the natural environment around Hasankeyf Höyük is quite different from that of other sites on the upper Tigris.

Botanical remains were collected from 22 contexts inside structures and 9 contexts in open space. In total 52 samples were water floated and over 40 thousands charred remains have been identified. The most common taxa is almond (*Amygdalus* sp.), accounting for more than ten thousands shell fragments. Pistachio (*Pistacia* sp.) and hackberry (*Celtis* sp.) are also numerous. These three fruit tree species are today commonly seen in this region. Lentil (*Lens* sp.) is common and some pulses such as bitter vetch (*Vicia ervilia*) is also included. Cereal plants are virtually absent except for two examples of concentration of *Taeniatherum caput-medusae*. Many species of Boraginaceae are also seen. These plants were most probably exploited from nature and it seems likely that agriculture was yet to be known at Hasankeyf Höyük.

When compared with other contemporary sites on the upper Tigris, Cyperaceae and Polygonaceae are rich at Hallan Çemi and Graminae, Cruciferae and Chenopodiaceae are common at Körtik Tepe while both are rare at Hasankeyf Höyük. These three sites are not far from each other but their local vegetations are considerably different. Hasankeyf Höyük is located near a wood land on the bank of the Tigris while Hallan Çemi is located along a wetland and Körtik Tepe is in a fluvial plain at the confluence of two rivers.

It seems thus likely that their subsistence was tightly dependent on different types of wild plant resources available at their local natural environment. This is contrasted with the situations in other regions in West Asia, where initial cultivation was practiced and the local vegetation began to be encroached by domesticated plants.

Keywords: Tigris valley

Plant management on ancient Amazonia from an archaeobotanical approach

Approche archéobotanique de l'exploitation des plantes dans l'Amazonie ancienne

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ADEs are highly fertile soils found in association with archaeological sites all over the Amazonia that result from ancient societies' landscape management. We present preliminary results on the research of plant consumption on Amazonian Dark Earths (ADE) sites at Santarem region, Lower Amazon. To tackle questions concerning plant food production and the formation of ADEs at the region three sites are under investigation from an archaeobotanical approach: Serra do Maguari and Cedro on terra firme plateau and the riverine Porto de Santarem. Soil samples for phytolith and micro charcoal analyses were collected in test pits column soils and excavations on the sites. So far, palm phytoliths and phytoliths from another disturbance indicators plants were identified on

samples from Serra do Maguari.

Keywords: Amazonian Dark Earths, Tapajós, Plant management, Archaeobotany, Phytolith

Agricultural origins: Triticum “new” glume wheat type and the role of Anatolia

Aux origines de l'agriculture : Le blé de type “nouveau blé vêtu” et le rôle de l'Anatolie

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The most important questions related to the domestication of plants are those which concern the times and places of domestication, that is whether the species were domesticated all together or one at a time and at different times in different regions. Although these questions go back to last century's sixties and seventies, they are still debated, as they are linked to the theories on the origins, development and transmission of Neolithic cultures. Whereas it was previously assumed that “neolithization” had spread only from northern Levant (“Levantine primacy school”) recent research has demonstrated the key role of the Taurus region in the process. New researches in fact, indicate less restrictive areas of origin and confirm the existence of a center of agricultural development in southeastern Turkey, where the closest wild relatives of einkorn, emmer, barley, rye, chickpeas, and lentils still grow. Based on data provided by the DNA sequence, in particular, the primary importance of the Karacadağ (Taurus) region is emphasized.

This study fits in these debates with the aim to reconstruct the origin of hulled grains. Specifically, it examines some problematic aspects emerging when comparing experimental results with archaeobotanical data, such as:

1) Criteria for the identification of the so-called “*Triticum* new glume wheat type”, through biometric and morphological analysis on archaeobotanical samples from some Neolithic Anatolian sites such as Aşıklıhöyük (PPNB-Central Anatolia), Yumuktepe (PN-Cilicia) and Yenikapı (PN-Marmara), compared with experimental combustion of spike fragments of modern species.

2) Location of the area of potential origin of *Triticum* new glume wheat type, *T. monococcum* and *T. dicoccum* and other domesticated plants in order to define the role of the region of the Taurus in the process of domestication.

The results so far obtained confirm the existence of an important role played by the sites of the Karacadağ region in the emergence of production economy.

Keywords: Domestication, Anatolia, Neolithic, *Triticum* new glume wheat type, Karacadağ

Alcoholic drinks of prehistoric Greece: revisiting the evidence

Boissons alcoolisées en Grèce préhistorique : le réexamen des preuves

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Wine has been closely linked with ancient Greek civilisation, the cult of Dionysos and the symposium. As a diachronic element of Mediterranean religious, ritual, healing and culinary traditions, it has been the alcoholic drink par excellence, associated with prehistoric societies of the Aegean. Abundant artefactual evidence from the Bronze Age onwards, related to serving and drinking, has been associated with wine and this has been further supported by LBA Linear B texts which make clear references both to wine and Dionysos, its god. Yet, does this justify a projection of wine production and consumption to prehistoric communities of Greece? Do drinking sets, available already from the Neolithic, necessarily indicate wine as the liquid contained in them? This paper reviews the available archaeobotanical evidence for alcohol production, revisiting old data that may be providing alternative plant derived fermented liquids. The possibility that besides wine, beer was also known, produced and consumed by some at least prehistoric communities of the region is raised here based on old and more recent archaeobotanical finds from Greece.

Keywords: Wine, Beer, Neolithic, Bronze age, Iron age, Prehistoric Aegean

Onset of plant cultivation in Finland and Estonia

Les débuts de la mise en culture des plantes en Finlande et en Estonie

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In my ongoing PhD project, I conduct plant macrofossil analyses to study the onset and development of plant cultivation in mainland Finland, Åland and Estonia. Recently, the onset of plant cultivation has been discussed using palynological data. In mainland Finland, finds of *Hordeum*-type pollen date to ca. 4200 BC and *Fagopyrum* pollen date already to ca. 5300 and signs of small-scale sporadic cultivation is also found during the later stages of the Stone Age. In Estonia the first palynological signs of cultivation date to ca. 4000 BC and in Åland no palynological data regarding Stone Age cultivation has been yet found. These results have, however been questioned and debated lately.

These results showing of Early Neolithic cultivation are not in accordance with finds of plant remains. At the current stage the amount AMS-dated cereals is very limited. In Estonia and mainland Finland macrofossils indicate later dates for the onset of cultivation. In SW Finland AMS-dated cereals are found only during the end of the Stone Age / early Bronze Age (ca. 1800–1000 BC) and in Åland during the Pitted Ware period ca. 2800–2600 BC. A single barley impression has been found in Estonia from a Corded Ware vessel (2800–2300 BC).

Due to this gap in the material, I analyse and date new material from various Stone Age sites. So far the results have been promising. From a Pitted Ware site of Glamilders in Åland remains of barley and associated weeds have been found together with remains of collected plants. Material from a Corded Ware site of Narva-Jesuu 2b in Estonia have been analysed partly and has shown to contain many different collected plants. Material from a Corded Ware site, Tallbacka, in southern Finland is going to be analysed and presented. All these

analyses provide new insights on both the onset of cultivation, plant gathering and other types of plant use in northern Europe.

Keywords: Neolithic, Bronze Age, Diffusion/Trade, Finland, Estonia

Understanding the domestication of maize through ancient DNA

Appréhender la domestication du maïs grâce à l'ADN ancien

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Conventional archaeobotanical analyses of maize micro- and macrobotanical remains have shed light on many archaeological questions regarding the domestication of maize and its subsequent dispersal from Central Mexico. However, additional information can be gleaned from aDNA recovered from well-preserved archaeological samples, as demonstrated by the findings in this study. We present new genetic data from a range of archaeological maize remains from Mexico, the American Southwest, and Ozark Bluff Dweller rockshelter sites. Together, these data allow greater resolution on the genetic relationships between maize from different sites and time points, thereby giving new insights into the migration and diffusion routes used by past peoples. Furthermore, signatures of human selection on particular genes is shown to have occurred at different points in prehistory, enabling a more nuanced understanding of the domestication process of maize.

Keywords: aDNA, Domestication, Diffusion, Maize, Diet

Characterizing patterns of plant gathering and early cultivation at aceramic Neolithic Chogha Golan (Iran)

Déterminer les traits caractéristiques de la collecte et de l'agriculture émergente sur le site néolithique acérémique de Chogha Golan (Iran)

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The aceramic Neolithic site of Chogha Golan is located in the foothills of the Zagros Mountains in Iran and dates to between 11,700 and 9,600 cal. BP. Members of the Tübingen-Iranian Stone Age Research Project (TISARP) excavated the site in 2009 and 2010 and divided the stratigraphy into eleven archaeological horizons (AH). Whereas AH XI to III are characterized by a wide range of wild species, AH II and I (ca. 9,800 - 9,600 cal. B.P.) provided evidence for domesticated emmer wheat, although wild plants like *Aegilops* sp., *Hordeum spontaneum* and several small grained grasses remain dominant. Several legumes, including lentil and pea, add to the broad

spectrum of founder crops. This subsistence strategy is regarded as an early farming economy that developed on the basis of the local hunter-gatherers. The goals of this presentation are (1) to provide a spatial and functional insight into the archaeobotanical record of the upper horizons at Chogha Golan, (2) to compare this record with the lower horizons and (3) to investigate whether analogous patterns exist at contemporary sites in other regions of the Fertile Crescent.

Keywords: Aceramic Neolithic, Cultivation, Subsistence, Zagros Mountains

The where and when of barley domestication: new results

Quand et o a eu lieu la domestication de l'orge: nouvelles données sur la question

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Barley was domesticated about 10,000 years ago in the Fertile Crescent and became a founder crop of Neolithic agriculture. However, proto-weeds found in Ohalo II, a 23,000-year-old hunter-gatherers' sedentary camp on the shore of the Sea of Galilee, Israel, shows small-scale trial cultivation was much earlier than originally anticipated. Ohalo II's plant assemblage demonstrates extensive human gathering of over 140 plant species. Among these, 13 well-known current weeds were mixed with numerous seeds of wild emmer, wild barley, and wild oat. This provides the earliest evidence of a human-disturbed environment at least 11 millennia before the onset of agriculture that provided conditions ideal for "proto-weeds", a prerequisite for weed evolution. In addition, we will report the genome sequences of five 6,000-year-old barley grains, the oldest crop samples to be sequenced to date, from a cave in the Judean Desert, Israel. Comparison of the data to a diverse panel of present-day accessions of wild and domesticated barleys reveal the ancient barley to be most closely related to extant landraces from the Southern Levant, consistent with a proposed origin of domesticated barley in the Upper Jordan Valley. Our findings suggest that barley landraces grown over the past six millennia in present-day Israel have not experienced a major lineage turnover, despite evidence for gene flow between cultivated and sympatric wild populations since prehistoric times. We show the utility of ancient genomes from archaeobotanical remains in research into the origin, early domestication and subsequent migration of crop species.

Keywords: Barley domestication

New narratives on dispersal and diversification of rice cultures in East and South East Asia

Nouveaux récits sur la diffusion et la diversification des cultures du riz dans l'Asie de l'Est et du Sud-Est

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Different rice agricultural systems require varying degrees of human organisation and water management, indicating possible social and cultural changes. One of the larger aims of our

project has been to isolate and identify these developments in arable farming. I use phytoliths, to pinpoint changes in cultivation system from pre agriculture to complex irrigated paddies. The range of systems produce different sets of weed communities and in turn these produce diverse phytolith assemblages. The first method I used was to create ecological groups of phytoliths from a range of modern traditionally farmed fields and archaeological samples and apply multivariate analysis to these groups. Next I applied Madella's fixed versus sensitive model, which uses plant cells that are predisposed to take up silica (fixed) in contrast to those which are formed when there is increased water flow through the plant (sensitive), to infer wet versus dry farmed rice systems. Here I demonstrate how these methods can be applied through case studies from sites across the region while also considering their limitations.

Keywords: Rice, Weeds, Arable systems, Asia

The origins of agriculture in the eastern Fertile Crescent: new archaeobotanical evidence from recently excavated Neolithic sites in Iran and Iraq

Les origines de l'agriculture dans l'Est du Croissant Fertile : nouvelles données archéobotaniques venant de sites néolithiques récemment fouillés en Iran et Irak

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This paper focuses on the analysis of three new archaeobotanical datasets from recently excavated early farming sites in and around the Central Zagros region (www.czap.org). The charred plant assemblages studied span the Early Neolithic from Sheikh-e Abad (c.9800 – 7600 cal BC) in western Iran, to Bestansur an eighth millennium site (c.7600 cal BC) in north-east Iraq and Khaleseh (6000 – 5500 BC) in northwest Iran. Together these expand significantly upon the current body of archaeobotanical data available for the Neolithic period in the eastern Fertile Crescent, particularly its earlier phases, and provide us with the opportunity to test the validity of emerging paradigms that conceptualize plant domestication as a protracted and geographically diffuse process. Crucially these datasets address existing biases in the distribution of archaeobotanical evidence across Southwest Asia, which remains heavily weighted towards the western Fertile Crescent where the majority of archaeological investigations have been conducted in the past.

The results presented here provide evidence for the broad range of plant resources utilized in the eastern Fertile Crescent during the Early Neolithic and for the diversity in plant management strategies between sites, paralleling contemporary patterns observed in the western Fertile Crescent. Moreover, when integrated with other archaeobotanical datasets from the region, results are consistent with concepts of local crop trajectories and emphasize the need to further reassess the role that the eastern Fertile Crescent played in the domestication of plants and origins of agriculture in Southwest Asia.

Keywords: Neolithic, Agriculture, Domestication, Central Zagros

Early medieval agriculture in eastern France: are environmental conditions the important factors for crop choice and weed assemblages ?

Agriculture au haut Moyen Âge dans l'Est de la France : les conditions environnementales sont-elles les facteurs essentiels dans le choix des cultures et les assemblages de mauvaises herbes ?

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During the last 10 years several preventive excavations conducted by the Institut national des recherches archéologiques préventives (Inrap) allowed studying a rich archaeobotanical material from more than 20 early (Merovingian and Carolingian) to late medieval rural sites in eastern France (Lorraine and Champagne-Ardenne regions). In most cases the archaeobotanical studies had to focus on carbonized plant assemblages, dominated by cereals, pulses and associated weeds. The medieval settlers cultivated and consumed a wide range of cereals: naked wheat (bread wheat), hulled barley, cultivated oat, rye but also spelt and einkorn, which were only secondary cereals at most sites. These secondary cereals, both hulled wheat species, are well resisting to some environmental constraints like less fertile soils situated on gravel in the river valleys and less favourable climate conditions on higher altitude plateaus. The paper aims presenting and discussing environmental impact on crop choice of the medieval settlements.

Nevertheless, from ethnographic examples we know that some cereals may have also played a role during feasting and other culture or society driven activities. While most early medieval rural sites were focusing mainly on agricultural production, the excavation of the late medieval site of Chaillon (Meuse, Lorraine) gives evidence of a local medieval population mainly focusing on pottery production. The archaeobotanical results from this excavation are quite different compared to most of the early medieval sites. Are these differences in the cultivated and used crops due to a social differentiation of the medieval population or are they just a response of a local population of potters, who are not gaining their life mainly by agricultural activities ?

Keywords: France, Middle Ages, Cereals, Crop choice, Environmental factors

Bandkeramik in Bavaria

Le Rubané en Bavière

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The first settlers, earliest crops and domesticated animals in central Europe belong to the Neolithic cultural group. In the southern part of Germany, archaeobotanical investigations are correlated with pioneer work in the 1970s and 1980s at Schwanfeld, Enkingen and Mintraching in Bavaria, together with eight more sites in the area of the Linearbandkeramik culture. Current archaeobotanical investigations of several sites

in Bavaria are presented and can add a finer resolution in the regional and chronological development of crop cultivation. Schwanfeld is the most famous site of the Earliest Linearbandkeramik culture in Central-Western Europe, and had three crop plants: Emmer, Barley and Lentil.

The largest Linearbandkeramik site excavated in northern Bavaria is Stadel. More than 3000 features provide a settlement history from the oldest to the younger Linearbandkeramik. The archaeobotanical results of its oldest phase dated 5500 to 5200 BC can be compared with samples from the Middle Linearbandkeramik culture, after 5125 BC, with differences in the presence of domesticated plants. A very interesting discovery was a store of emmer together with grains probably of the "New Glume Wheat Type", representing *Triticum timopheevii*.

Settlements of the Linearbandkeramik usually are found on loess soils on lowlands. Nevertheless, excavations in the last years have found settlements on mountains in the southern part of Germany. Archaeobotanical results of this site, dated to the time of the second phase of Stadel, showed Emmer as a dominant crop, Einkorn and Lentil are present.

Not far from Eschlipp the Linearbandkeramik site of Buchbrunn starts a little bit later than Eschlipp and reaches the youngest Linearbandkeramik culture. Besides Emmer and Einkorn, breadwheat was identified. Barley is present only in the younger phases. Three more sites had species which were missing up to now in Bavaria: apple and acorn. Due to a growing contact to the Bavarian State Conservation Office (BLfD) we can look forward to an increasing cooperation in archaeobotany in Bavaria.

Keywords: Linearbandkeramik, Bavaria, Charred seeds and fruits

Barnyard-millet Farming Zone in Northeast Asia: Archaeobotanical evidence from Northeastern China

La zone de culture du millet japonais en Asie du Nord-Est : témoins archéobotaniques de Chine nord-orientale

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Northeastern China is described by Ancient Chinese literatures as a wild land, characterized by the subsistence of hunting/gathering. However, agriculture appeared in this region as early as the prehistoric time, based on new archaeological findings. In recent years, flotation works have been carried out in a number of archaeological sites which are located in Northeastern China. The sites are dated from Neolithic to historical periods, but most of them belong to the time of Liao/Jin Dynasties in Chinese history, i.e. AD 907-1234. A large number of soil samples were processed, and a tremendous amount of plant remains were recovered.

The majority of the plant remains are from crops, including foxtail millet (*Setaria italica*), broomcorn millet (*Panicum miliaceum*), barnyard millet (*Echinochloa esculenta*), soybean (*Glycine max*), adzuki bean (*Vigna angularis*), buckwheat (*Fagopyrum esculentum*), wheat (*Triticum aestivum*), barley (*Hordeum vulgare*), hemp seed (*Cannabis sativa*), oat (*Avena sativa*), perilla (*Perilla frutescens*), sorghum (*Sorghum vulgare*) and rice (*Oryza sativa*). The barnyard millet is the most significant finding, due to not only the abundance but also being the first found in China.

Based on a quantitative analysis, the two different farming systems were identified in Northeastern China during this historic period. One was distributed in the plain area, characterized by the dominant crops of foxtail millet, broomcorn millet and wheat. The other was distributed in the hilly areas, characterized by the dominant crops of foxtail millet, barnyard millet, buckwheat and barley. Considering the archaeobotanical data from northern Japan and Far East of Russia, I propose that an identical agricultural zone once existed in Northeast

Asia around 1000 years ago, with barnyard millet as a mark of unique crop. This agricultural zone was distributed in an area roughly between 40°-45° north latitude of northeastern Asia, specifically hilly areas of Northeast China, northwestern corner of Korea, southern part of Far East of Russia, and Hokkaido and northern part of Honshu of Japan.

Keywords: Northeastern China, Neolithic, Historical periods, Barnyard millet, Food plant complex

ABSTRACTS POSTERS

*Résumés des posters***Out of the shade: an archaeobotanical investigation of plant remains and wood charcoal from the “Dark Age” rural site of Dando Close, Wollaston, Northamptonshire***Sorti de l'ombre. Enquête archéobotanique sur les vestiges végétaux et les charbons de bois du site rural de Dando Close à Wollaston (Northamptonshire) aux “âges obscurs”*Stacey Adams¹¹ University of Nottingham – United Kingdom

Sixteen archaeobotanical samples were analysed for plant macro remains and wood charcoal from the Anglo-Saxon rural settlement of Dando Close, Wollaston, Northamptonshire. The inhabitants of the site practised a mixed cereal economy of oat and barley as a risk management strategy. Crop husbandry regimes did not change throughout the period with the exception of the introduction of free-threshing wheat from the Mid Saxon period (7 th – 9 th century AD) onwards. Wild plant food exploitation appears to have been avoided by the inhabitants of the site. The excellent preservation of the wood charcoal found that deciduous oak (*Quercus deciduous*) was the predominant species throughout the site and was employed for structural timber and firewood. The oak firewood was supplemented with lesser species including (*Sambucus* sp.), birch (*Betula* sp.) and hazel (*Corylus* sp.). Wood charcoal from the apple sub-family (Maloideae) was routinely cracked and may provide evidence for orchard cultivation of apple and/or pears near the site. The anthracological evidence suggests a wooded environment was exploited close to the settlement along with occasional driftwood of poplar/ willow (*Populus/Salix*). The results of the archaeobotanical investigation found that the inhabitants of the Anglo-Saxon Settlement at Dando Close were largely insular and focused on the domestic sphere. Wood collection, for timber and firewood, appears to have been the only activity in which interaction with the wild was exercised.

Keywords: Plant remains, Wood charcoal, Medieval Period**Using stable isotope analysis to reconstruct land management and storage systems in Apulian Bronze Age sites***Recours aux analyses d'isotopes stables pour restituer la gestion du paysage et les systèmes de stockage de sites de l'âge du Bronze dans la région des Pouilles*Giorgia Aprile¹, Cosimo D'Oronzo¹, Girolamo Fiorentino¹¹ Laboratory of Archaeobotany and Palaeoecology Dipartimento di Beni Culturali University of Salento – Italy

Thirty years of archeological research at Coppa Nevigata (Manfredonia-Foggia) showed transformations of the settlement from the Neolithic to the Iron Age. In particular, the site presents changes in defensive structures, the organization of space, the subsistence activities and exchanges during the

Bronze Age. The palaeoenvironmental study through a multi-proxy analyses (pollen, shell, ostracods, insects, charcoals, seeds, tephra) have shown a close relationship of the settlement with the lagoon environment and changes in vegetation cover. Archaeobotanical analyses conducted recently, highlight different species of crops (generally cereals, pulses and tree fruits) and different storing technique during the Bronze Age. The analysis of cereals caryopses, pulses and their spatial distribution has allowed to identify a few specific areas of the settlement devoted to storing (generally barley caryopses), which are characterized by the presence of a number of surface circular structures during the Middle Bronze Age. During the Late Bronze Age, in particular cereals appear mainly to have been stored in domestic spaces, as proved by the presence of a large amount of burned seeds at two huts, but you can assume collective storage areas near the defensive walls. The emergence of changes in storing technique is linked to social change, but probably to a greater specialization in agriculture techniques. To test this hypothesis, barley caryopses were selected and analyzed by volume extimation of single grain and $\delta^{13}C$ and $\delta^{15}N$ values. This approach is used to distinguish between grain from different harvesting sites (crop provenience) and to identify special agricultural practices (e.g. manuring or irrigation).

Keywords: Archaeobotanical methods, Bronze Age, Crops, Storage, Stable isotopes**Burnt building structures on the Bernstorff hill (Upper Bavaria, Germany) – an integrated research***Bâtiments incendiés à Bernstorff hill (Haute Bavière, Allemagne) – approche croisée*Vanessa Bähr¹, Barbara Eichhorn¹, Maren Gumnior², Astrid Röpke³¹ Institut für Archäologische Wissenschaften, Goethe-Universität, Frankfurt am Main – Germany² Institut für Physische Geographie, Goethe-Universität, Frankfurt am Main – Germany³ Institut für Ur- und Frühgeschichte, Universität zu Köln – Germany

The archaeological site Bernstorff hill (Upper Bavaria, Germany) comprises a vitrified Bronze Age and an Iron Age fortification as well as an early medieval refuge fort. In order to get a broader picture of the site and its Bronze and Iron Age burnt structures we applied micromorphology and phytolith analyses to investigate different burnt materials. Our investigations aim to distinguish between the composition of Bronze Age and Iron Age construction material by identifying different features of the construction (e.g. plaster, daub, floor) regarding sediment composition, treatment and possible tempering. The Bronze Age burnt structures are visually comparable. Thin section and phytolith analyses show that they are composed of the same source material and resemble the Bronze Age cultural layers as well as colluvial layers (reference soils). Most samples have high amounts of grass phytolith short cells in common. Concerning phytolith composi-

tions the wall material is comparatively uniform. Without definite evidence of intentional tempering, the phytoliths indicate open grassland vegetation shaped by men. Bilobate phytoliths attest the presence of wild and/or cultivated millets. Iron Age burnt building structures differ distinctly from the Bronze Age samples. Macroscopically, tempering is visible. Thin section and phytolith analyses confirm this observation. The building material has high amounts of inflorescence phytoliths (husks, mainly from the Triticeae tribe) often in cell sheets derived from threshing remains which were used as temper. According to micromorphological analyses the use of dung can be excluded. This is in contrast to the occupation layer containing mostly single inflorescence phytoliths.

Keywords: Micromorphology, Phytoliths analyses, Burnt structures

Growing grain for $\delta^{15}\text{N}$ values

Cultiver des grains pour obtenir des valeurs de $\delta^{15}\text{N}$

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Excavations of Bronze Age sites in the Netherlands reveal ancient fields with ard marks and their produce represented by charred grain. One of the questions regarding tilling practice is whether the fields were manured with animal dung. A now well-established method to tackle this question is to measure the $\delta^{15}\text{N}$ value of the charred crops. The Bronze Age grain reveals high $\delta^{15}\text{N}$ values, but before the conclusion can be reached that the fields were indeed manured with animal dung, $\delta^{15}\text{N}$ values of grain grown in the past on the same kinds of substrates without manuring need to be known. In order to obtain these baseline values emmer wheat and hulled barley, the most common Bronze Age crops, were grown on two of the substrates most appropriate for the Dutch situation. Big plastic tubs were filled with sandy clay or Pleistocene cover sand originating from localities that had not received any fertilizer during at least the last 50 years. These tubs were placed in the open air in a section of the Leiden Hortus Botanicus closed to the general public, on concrete tiles, and in a large cage to keep cats and birds out. They were sown with summer emmer and summer barley in the spring and the winter varieties of these crop plants in the autumn. The experiment lasted two years to avoid the impact of the influence of one especially bad or good summer or winter. The resulting grain was charred at the same temperature as the Bronze Age grain endured in the past, and the $\delta^{15}\text{N}$ values measured in the same lab with the same procedure (Centre for Isotope Research Groningen). The values were much lower than those of the prehistoric grain. Moreover, a difference in $\delta^{15}\text{N}$ values between the clay and the sand could be observed.

Keywords: Baseline $\delta^{15}\text{N}$, Experimental growing, Manuring

Plants and methods used for embalming in the Modern times in France: archaeobotanical results from the Jacobins' Convent at Rennes (France)

Plantes et méthodes de l'embaumement à la période moderne en France : résultats archéobotaniques du couvent des Jacobins à Rennes (France)

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From December 2011 to June 2013, a rescue excavation was conducted by Inrap (French National Institute for Preventive Archaeological Research) at the Jacobin convent in Rennes. Now dedicated to become the Rennes Métropole conference center, this edifice was built in 1369 after the War of the Breton Succession, as a consequence of the victory of John IV of Montfort, Duke of Brittany, over Charles of Blois. From the 15th to 17th centuries, this Dominican establishment became an important place for pilgrimages and inhumations. Approximately 800 graves were uncovered by the archaeologists, including five lead coffins dated back to the 17th century. Four of the coffins located in the church choir yielded relatively well-preserved skeletons. Some skulls and rib cages were sawed as an evidence of embalming, a common custom into elite social circles. Each coffin was accompanied by a heart-shaped lead reliquary containing an embalmed heart surrounded by textile and plant material. These reliquaries also presented inscriptions revealing the identity of the deceased. Such a discovery is unique in Brittany and very rare in France and in the whole Europe. It offers an exceptional occasion to carry on a comprehensive archaeobotanical investigation including pollen, seeds, and other macroremains and thus contribute to a better knowledge of embalming methods and *Materia Medica* in Modern Times.

Keywords: Mortuary practices, Archaeobotany, Modern Times, Prestigious burial

On the traces of food plants in archaeological sites of the Sultanate of Oman

Sur les traces de plantes alimentaires dans plusieurs sites archéologiques du Sultanat d'Oman

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The Italian Mission to Oman (IMTO, directed by Alessandra Avanzini, University of Pisa) is working in Southern and South-eastern Arabia since 1997. Excavation and research activities have been particularly focused on two archaeological sites: the pre-Islamic walled city of Sumhuram, located along the coasts of Dhofar, at the estuary of the Wadi Darbat, and the fortified Iron Age settlement of Salut, situated in a transitional area between the mountain region of the Al-Hajar and the interior arid plains, near Nizwa.

The widely different environmental contexts in which these sites are inserted are reflected in the dissimilarities in their

local food economies. In the arid interior plains of northern Oman, dates are still the main crop, whereas in the Monsoon-influenced southern region of Dhofar, agriculture is more varied with fruits such as bananas, coconuts and papayas and vegetables like tomatoes and cucumbers.

Textual information about the ancient diet and food economy of Southern Arabia comes from the Moroccan explorer Ibn Battuta, who visited Oman in the 14th century. In particular, he underlined that fishing was the main subsistence activity along the coasts and that the principal staple food in Dhofar was rice, which was imported from India.

The most ancient sedimentary sources from archaeobotanical researches have only furnished fragmentary information, mainly relative to the North and eastern coast of the country. Palm dates, *Ziziphus* stones, *Setaria* and *Sorghum* caryopses are the most common plant macro-remains, but the list of food plants has been extended by the study of micro-remains, for example pollen grains and starch grains.

At Salut pollen analysis attested the occurrence of palm grove and the cultivation of Cerealia and of *Sesamum*, a traditional crop the cultivation of which is now largely abandoned because insufficiently remunerative.

Cereal pollen also occurred along the stratigraphic sequences in the city of Sumhuram and was recorded in large amount in plastered rooms, suggesting that cereals were stored inside the city. Starch analysis demonstrated the presence of millet starch grains on the surface of a Pre-Islamic grindstone.

Unfortunately, the preservation of plant remains is not generally good in these contexts: at Salut, the sandy soil preserved a very low amount of pollen; the same is true in Dhofar, probably as a consequence of the repeated cycles of wet and dry episodes linked to the Tropical monsoon climate.

Keywords: Archaeobotany, Pollen analysis, Starch analysis, Diet

Charcoals and other archaeobotanical records of two Roman sites of Modena's area (N-Italy) in a multiproxy approach

Charbons et autres restes archéobotaniques de deux sites romains de la région de Modène (Italie septentrionale) dans une approche interdisciplinaire

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In the framework of the archaeobotanical research carried out in the area of Modena (Emilia Romagna, Northern Italy), new charcoal analyses from two Roman archaeological sites have been studied. The one named "ex Cinema Capitol" (MO-arch2) was brought to light in the current historical centre of Modena, and corresponds to a urban domus with walls, floors and foundation structures. The other is a complex archaeological site, and its study is in progress. Although it is still difficult to interpret the archaeology of this site, probably it was a domus or a votive area, located in the hill at 350 m a.s.l., near the important geological site called "Salse di Nirano", in the

village of Montegibbio. Charcoals from archaeological layers have been studied in order to improve the comprehension of the human-environment relationships (e.g., wood exploitation and timber selection) at the local scale. The study will provide further knowledge on palaeoecology of woody vegetation living in the areas close to the sites. In Mo-arch2, nearly all the remains have an excellent state of preservation and a relatively large size. The results suggest that the most of burnt wood were large including trunks or branches. The total charcoals are almost one thousand, with a strong dominance of *Fraxinus* and *Carpinus*, followed by *Acer*, *Ulmus*, *Quercus* (deciduous) and others. The record refers to the mixed broadleaved forest that grew in the area. In the second site, charcoals were again in a good state of preservation, *Acer*, *Carpinus* and *Fagus sylvatica* prevail. For both sites, pollen and seed-fruit analyses are available. The multiproxy study and the complementarity of different analyses improve the details of palaeoenvironmental and palaeoethnological reconstruction of this area.

Keywords: Anthracology, Archaeobotanical records, Roman Age, Modena, Plain/hill

Plant macro remains from the Antic city of Vani (Western Georgia, South Caucasus)

Macrorestes végétaux de la cité antique de Vani (Géorgie occidentale, sud du Caucase)

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Palaeobotanical studies of the antic city Vani have been in progress since 2007 within the frames of the Georgian-Swiss multidisciplinary Project. The goal of our investigation is to define the basic plant species that had decisive role in the nutrition of Colchic population in Antic and Hellenistic periods, the main question is if the results of our study can establish any signs of crisis that was observed on the base of archaeological investigations. According to archeologists in the second half of the III century BC was collapsed the united kingdom of Colchis, which was followed by occupation of Mithridates of Pontus in the end of II and beginning of the I centuries BC. Ca 64 plant species, representatives of 50 genera and 24 plant families were identified from 1056 L of sediment. The majority of carbonized plant remains from rubbish pit are result from frequently conducted, routine activities. Several hundred charred caryopses of millet with accompanied weeds mixed with burnt oak fragments were revealed in the storage pit (VI layer) burned in situ, were processed millet was stored most probably is the result of local fire. The analysis of carpological remains showed generally high botanical density across the deposits dated back by 6th-5th centuries BC and broad spectra of species represented. In assemblage free-threshing wheat was dominant. Fossilized remains of broomcorn and foxtail millets, grape wine, flax, pea and lentil with high number of weeds were identified.

Carpological complex of the material, obtained from the layers, dated back by the 3rd-1st centuries BC is mainly presented by broomcorn millet and Italian millet. Of wheat emmer and einkorn have been identified. The index of crop density is low. Single grains of barley and wild grape were detected. From the II-I cc BC the main wheat crop has been found to be emmer with very occasional grains of einkorn. Barley was presumably sown as another crop. Only one seed of flax was found as well. No evidence of crop legumes, wine grape and crop weeds at all. The remains of wild plant species of ruderal habitats are found in small amounts. Share of cereals in the carpological assemblage is reduced. These results are confirmed by comparing the ubiquities of different taxa. The described carpological spectrum points to the low economic activity and decline of farming. It is interesting to note that there are several changes through time period seen in the stratigraphic layers between the Antic and Late Hellenistic periods from the Vani settlement concerning plant husbandry and economy. Thus, our results partly corroborate the version proposed by archaeologists that the political events, taking place at the end of the 2nd century BC and beginning of the 1st century should have had an impact on life and economical activities of the population.

Keywords: Crop macro remains, Ethnobotany, Early Antic, Hellenistic

Vegetal offerings on Hellenistic age burials from Nokalakevi (Western Georgia, South Caucasus)

Offrandes végétales dans des inhumations d'époque hellénistique à Nokalakevi (Géorgie occidentale, sud du Caucase)

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This archaeobotanical study deals with carbonized fruits and seeds recovered from the Nokalakevi settlement, located in West the Georgia, on the edge of the Colchian plain, some 40km from the Black Sea. More than 130 samples were taken from Hellenistic cremation and inhumation burials and early Byzantine graves. Ninety species, belonging to 67 genera, were identified and recorded.

Most charred remains of wheat, millets, lentil, celtic bean, flax and hemp, nuts and fruits recovered from the Nokalakevi samples are of economic importance, widely used in Hellenistic period. They were probably intentionally selected for funerary rituals and should be interpreted as plant offerings. The recovery of grape, hazelnut and walnuts, berries, some unidentified fruit and shell fragments, indicates the consumption of fruit and nuts and that fruit may also have been offered whole as part of a funerary ritual. Small pieces of charred grape branches and pine needles might represent the remnants of fuel burned at the graveside. They may have been deliberately selected for their symbolic importance?

The seed assemblages associated with Hellenistic inhumation

burials are more rich than those associated with the cremations. The samples from the early Byzantine Christian period graves presented an atypical spectrum, with the near absence of pulses (only one item) and complete absence of broomcorn millet, grape and flax, however this might be for taphonomic reasons.

The most interesting finds are charred seeds of flax and hemp and textile fragments. The mineralized fragments of linen textile were revealed in both Hellenistic and early Byzantine burials and they may have been deposited in the graves as clothing, or the wrapped cerement of the decease. Ethnographic data suggests that, in west Georgia people used to dip the flax cerement in candle wax and roll it around the deceased before burial.

Within the archaeobotanical spectra there were revealed annual and perennial plant species associated with crop weeds, especially wheat and millets, such as several varieties of vetch, grass pea, mustard, bedstraw, rye-grass etc. Ruderals of disturbed habitats, such as broadleaf plantain, bird eye, spearwort, alkali bulrush, wood sorrel, ribwort plantain, sheep's sorrel, knotgrass, fat hen, speedwell etc, would have grown in the vicinity of the site, they were probably deposited in the grave unintentionally.

The remains of charred, processed meal were revealed, most likely millet porridge, possibly an element of funeral meals. Unidentified seed and fruit flesh remnants were also found, and require further investigation.

Keywords: Ritual archaeobotany, Grave goods, Hellenistic

Archaeobotanical evidence of food plants in Northern Italy during the Medieval and Renaissance periods

Témoins archéobotaniques de plantes alimentaires en Italie septentrionale aux périodes médiévale et moderne

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The aim of this study is to highlight carpological remains of food plants that have been found in about fifty archaeological sites of the Medieval and Renaissance Periods (7th – 16th century AD). All sites are located in Northern Italy. The deposits belonged to different contexts, especially waste disposal. A list of about 100 taxa of plants that can be used for food has been filled. It includes cereals (naked wheats, spelt, einkorn, emmer, barley, rye, broomcorn, foxtail millet, sorghum, oat), pulses (among which lentil, pea, chickpea, bitter vetch, faba bean,...), many fruits and nuts (grape, fig, peach, apricot, quince, sweet and sour cherry, plums, pear, apple, medlar, black mulberry, pomegranate, jujube, melon and watermelon, woodland strawberry, chestnut, walnut, hazelnut, almond, ...), vegetables and condiments (eg. beet, bottle gourd, carrot, chichory, lettuce, orache, purslane, rocket,...; anise, basil, dill, celery, coriander, fennel, mints, parsley, cultivated poppy, black pepper, ...) and plants for beverages, oils and food dyes. For a better interpretation of these data, written sources, such as the most ancient Italian "cookbooks",

have been checked for food plants. Such texts dated to a period between the 14th and the 17th century AD, and include Liber de coquina (various anonymous authors), Libro de arte coquinaria (the first collection of recipes "signed" - Maestro Martino), *De honesta voluptate et valetudine* (Platina), Libro novo nel quale s'insegna a far d'ogni sorte di vivande (Messisbugo), Opera. Dell' arte di cucinare (Scappi),...

Keywords: Seeds/fruits, Food plants, Recipe books, Medieval/Renaissance, Northern Italy

Early Neolithic farming economy in the Southern margins of the Massif Central (Southern France): a review of archaeobotanical data

Économie agricole au Néolithique ancien dans les marges méridionales du Massif Central (Sud de la France) : synthèse des données archéobotaniques

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Archaeobotanical research on early Neolithic sites in Southern France was quite active during the years 1970 and 1980, when excavations were carried out on many cave occupations. Unfortunately the potential for new studies decreased later on, when most of the archaeological activity focused on rescue excavations and open air settlements. Consequently the availability of early Neolithic archaeobotanical data is now rather poor compared to other regions of Western Europe. In the framework of the PROCOME ANR research program we have undertaken a systematic inventory of the available archaeobotanical information west of the Rhône river and south of the Massif Central mountains. In this poster we propose a critical review, highlighting the most recent achievements and important drawbacks of the dataset. About 30 sites which delivered any archaeobotanical information are registered. They only yielded charred botanical remains. The major part is represented by cave occupations and in many cases sampling and recovery techniques are not representative (coarse sieving prevails). The spatial distribution of the sites should be noticed as they cluster around the southeastern part of our area, close to the Mediterranean. Based on the available information we will discuss how agriculture established on the northwestern Mediterranean shore and how it spread to the hinterland. Previous research considered that the first agriculture in the area was based on naked cereals, wheat and barley; we will see how the recent studies fit into this model. Wild fruits are common in some of the sites. We will consider the nutritional role that they may have played in addition to cultivated plants. We will also investigate the possible evidence of field weeds and its implications regarding cultivation practices of the first farmers in the area.

Keywords: Agriculture diffusion, Naked cereals

Hunter gatherer archaeobotany of a mortuary context in Patagonia (Cueva Galpon, Argentina): artefactual, carpological, anthracological and other plant macroremains from ca. 3300 BP

Étude archéobotanique d'un contexte funéraire de chasseurs-cueilleurs en Patagonie (Cueva Galpón, Argentine) : artefacts, carpologie, anthracologie et autres macrorestes végétaux, 3300 BP

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This paper analyzes the archaeobotanical record (macroremains and manufactured items) of Cueva Galpón, a hunter gatherer site located in the Paileman hills (Río Negro Province, Argentina). The deposit is located in a cave of 50 m wide and 8 m average depth, in which three explorative transects were carried out and two sectors of 3m² each were excavated in artificial levels of 5 cm to 50 cm deep. The archaeological materials (mainly faunal and botanical) were recovered both manually and by fine sieving, and at least two mortuary contexts were identified. The first one presented charred human remains associated to materials chronologically near to the Spanish conquest of the territory. The second one give an age of 3314±51 and 3264±38 14C years BP. Results show that the latter was covered at the top by two layers of a mat whose warp was made from stems of *Piptochaetium* sp. (flechilla negra) and the weft from stems of Cyperaceae/Juncaceae. These structures were tied to sticks of *Larrea cuneifolia* (jarilla) by braids of leather or animal sinew. Numerous dispersed tufts of at least two grass species were also found which probably representing a kind of "bed" structure. Associated with this context a partially carbonized artifact made on *Chusquea* sp. (colihue cane), possibly an arrow shaft, was found. Nine fragments of different types of plant strings (lax and compact) were also recovered, together with a total of 1925 macroremains, both dry and charred. The assemblage shows a high diversity both taxonomical and anatomical (woody stems of different diameters, leaves, bark, fruits, inflorescences, rhizomes). The most abundant correspond to dry endocarps of *Condalia* sp. (piquillín) and *Prosopis* sp. (algarrobo), and aff. *Grindelia* sp. flowers, which suggest a spring/summer seasonal occupation. These materials represent at least three different anthropogenic sources: grass beds, fuel and food consumption, and except for *Chusquea* sp. of Andean-Patagonian origin, the genera identified correspond with the Monte province and to a lesser extent, to the Patagonian province, and are available near the site. The finding of a seaweed specimen links population that inhabited the site with the sea coast, distant 50 km. The analysis of archaeobotanical remains of Cueva Galpón do not only allowed to a better understanding of a kind of mortuary practices poorly known in Patagonia, but also defines the high mobility range of the hunter gatherer of the area, from the Andes Mountains to the Atlantic Ocean.

Keywords: Archaeobotany, Macroremains, Hunter gatherers, Mortuary context, Patagonia

Baking bread in the ancient Egypt, new discoveries from the site of Amheida-Dakhla Oasis

Faire du pain en Égypte ancienne, nouvelles découvertes dans le site de l'oasis d'Amheida-Dakhla

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Recent excavations in the site of Amheida brought to light, in area 4.I, a structure likely devoted to the production of bread datable to the II intermediate period c. 1700-1550 BC). Double bread moulds were found stuck on a wall of what is considered to be an oven for baking bread. The archaeobotanical assemblage is mostly made of cereals remains (80%) and a few weeds (12%). Among the cereals recovered, the majority are grains of hulled barley and a few of naked wheat. Residues of chaff and forks of hulled wheat were found, but no grain of such species. Chaff remains of hulled barley and naked wheat are also attested, but in lower percentage compared to the grains of the same species. The presence of chaff suggests that burnt hot straw was likely put in the bread moulds and used as base for the dough; it is possible that lately the bread moulds would be put on the wall of the baking oven to complete the cooking. Since no residues of burnt dough were recovered from the bread-moulds we do not have enough elements to differentiate between the species of cereals used for baking and those used for their straw. The fact that hulled wheat grains were not found might be an indication that this species was used solely for its straw, whereas hulled barley and, less likely naked wheat, could have been used for both purposes.

Keywords: Bread, Bakery, Archaeobotany, Second Intermediate Period

New evidence on the development of millet and rice economies in the Niger river basin: archaeobotanical results from Benin

Nouvelles données sur le développement de l'économie du millet et du riz dans le bassin fluvial du Niger : résultats archéobotaniques du Bénin

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The Niger river is second only to the Nile in length in Africa, and is host to dense populations of agriculturalists that supported in historical times states such as the kingdoms of Songhay and Mali. This is also the region to which the origins of the Niger-Congo language family, including its Bantu offshoot is attributed. Despite this archaeobotanical evidence for the development of agricultural systems based on both indigenous crops, like *Pennisetum glaucum*, *Vigna unguiculata* and *Oryza glaberrima*, and introduced crops, such as *Sorghum bicolor* and *Gossypium* sp. has remained limited. In particular

the role of multiple crop systems, that included both the wet (rice) and the dry (millets), has not been directly documented archaeobotanically. The present post presents new archaeobotanical results from 12 sites in Benin that suggest that the rise of larger populations and population centres, like the urban site of Birni Lafia, developed only once agriculture diversified beyond pearl millet cultivation to include multiple cereals, as well as cowpea, oil palm and cotton. Flotation results indicate that sites of the First Millennium BC were dominated by pearl millet evidence, which can be related to the earlier origins of this crop to the North in Mali. However by the early centuries AD, the additions of sorghum and rice correlate to increasing urbanism, a pattern revealed by our evidence from Benin and congruent with existing evidence from Mali. This highlights the role of agricultural diversification in promoting urbanisation and state formation.

Keywords: Africa, *Pennisetum*, *Sorghum*, *Oryza glaberrima*, Cotton, Urbanism

Taxonomic differentiation between *Triticum* species using multi-proxy methods: Application of pollen and chemical analyses on *T. monococcum*, *T. urartu* and “new type glume wheat” (*Triticum* cf. *timopheevii*)

*Différenciation taxinomique entre les espèces de *Triticum* par l'approche interdisciplinaire : analyses polliniques et chimiques de *T. monococcum*, *T. urartu* et du “new glume wheat” (*Triticum* cf. *timopheevii*)*

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Domesticated einkorn is mostly one grained, a two-grained einkorn-like form is identified in the archaeological contexts of Near Eastern and European Neolithic and Bronze Age sites, however its cultivation is not known in modern agriculture and the crop is not represented in modern crop germplasm. *T. urartu*, a diploid wheat species, is morphologically indistinguishable from *T. monococcum* but they constitute genetically separate species. Genetic studies show that the presence of *T. urartu* in the archaeological contexts, previously identified as einkorn, cannot be excluded. Identification of another wheat species, archaeologically named “new type glume wheat” (NGW) is based primarily on rachis morphology. For NGW, recently suggested taxonomic classification is “*Triticum* cf. *timopheevii*”. Identification of “new type glume wheat” grains is still problematic, due to preservational problems in comparison to other wheat species. Studies have shown that wheat species whose grains are morphologically inseparable can be distinguished from each other using pollen morphology. Evidence of *Triticum urartu* and *Triticum* cf. *timopheevii* in EBA K¹ull¹uoba's storage sample contexts are questioned using proxy methods based on gross morphological and pollen analyses, as well as biomarkers with FTIR and GC/MS.

Keywords: Morphology

European Late Neolithic population crash correlated with declines in agricultural productivity

Corrélation entre l'effondrement démographique en Europe au Néolithique final et le déclin de la productivité agricole

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The widely recognised increase in central and western European population densities after c. 4500 cal BC, more generally referred to as the Neolithic Demographic Transition, is attributed to a suite of advantageous effects of agriculture including the increased dietary availability of a greater complement of carbohydrate-rich plant foods (e.g., in Eurasia the grain crops such as cereals and pulses), reduced mobility, earlier onset of weaning and concomitant higher fertility. Recently, however, it has been demonstrated that there was a phase of particularly rapid growth beginning at c. 4000 cal BC after which population levels fluctuated for 500 years, then crashed at c. 3500 cal BC. Growth is then negligible before population densities begin to increase slowly in the early Bronze Age. This demographic instability has been characterised as resembling a boom and bust pattern and is recognisable across Neolithic Europe. Satisfactory explanations to account for the demographic crash after the initial growth of farming populations have proved elusive; however, on the basis of correlations with palaeoclimate proxies, in some regions of Europe (e.g., the northwest) increasingly cold and wet conditions are cited as the cause for the decline, or even abandonment, of cereal agriculture. The suggestion of a link between agricultural productivity and declines in population is compelling but has not been tested at the wider geographic scales from which population histories have been reconstructed. In this study we assess the relationships between population levels and agricultural productivity and we consider the possibility that a reduction in productivity can be attributed to decreasing soil fertility rather than diminished agricultural output from a smaller population base. We interpret the reductions in productivity as most likely driven by several centuries of intensive land use in the early Neolithic that led to a deterioration of soil fertility. In addition, we take into account evidence for worsening climate from c. 3500 cal BC and specifically increased rainfall that exacerbated the anthropogenic effects. Which of these two influences was the more significant is not at the present time resolvable but both are likely to have worked in tandem to produce noticeable declines in crop yields and a corresponding decrease in carrying capacity, leading to significant impact in population levels from c. 3500 cal BC onwards.

Keywords: Neolithic Europe, Agriculture, Productivity, Soil fertility

Trees and shrubs exploited in medieval Poland for the production of everyday use objects

Arbres et arbustes exploités en Pologne médiévale pour la production d'objets du quotidien

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The aim of the present study was to determine whether the choice of wood raw material for making agiven object was deliberate and justified by technological and exploitation wood qualities of different tree species or was it the result of accidental gathering of raw material from the nearest surroundings. A summary of taxonomic wood determinations is shown, which includes hundreds of medieval everyday use objects (e.g. scoops, turned and stave vessels, small buckets, spoons, plugs, pegs, bungs, dowels, construction elements, spades, torches, spindles, knife handles, clubs and net floats). The objects selected for analysis are functionally diverse and come from several strongholds on the territory of Poland (Szczecin, Wroclaw, Wolin, Dawidgródek and others). The wood of pine, oak, ash, and alder was more often used by medieval craftsmen. Pine was mostly used for making stave bowls and torches, oak wood for construction elements and clubs. Turned bowls were made mainly from ash, and alder was used for objects resistant to stay in the water for a long time. The connection of wood kinds with specific useful functions of objects allowed to conclude that raw materials were selected purposefully.

This work was supported by funds from the National Science Centre, Poland (grant No 2014/13/N/ST10/04881).

Keywords: Xylology, Useful wood, Technological and working wood qualities, Human impact on forest communities

The identity of the mysterious “new glume wheat” of early European agriculture

L'identité du mystérieux “nouveau blé vêtu” des premières agricultures européennes

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“New glume wheat”, NGW or new type of glume wheat is unidentified, extinct today *Triticum* species, formerly classified as aberrant or slender emmer. Its close relationship to modern tetraploid *Timopheevii* wheats has been proposed with respect to spikelet bases and the grains. In prehistoric times NGW could have been a widespread crop with archaeological records ranging from Anatolia to Western Germany, from various cultures from the Early Neolithic to the Iron Age. Domesticated *T. timopheevii* is not a common species; being restricted to localized regions of Georgia. The aim of the project is to establish the identity of the NGW to distinguish if archaeological tetraploid NGW is related to *Timopheevii* wheat (*Triticum timopheevii* subsp. *timopheevii* and *T.t. araraticum*, AuAuGG) or to emmer (*Triticum turgidum* subsp. *dicoccum*, AuAuBB). Archaeobotanical study is not sufficient in diagnosing definite taxonomic identification of the NGW. However, there are unambiguous differences at the molecular level: *T. timopheevii* possesses the G and Au genomes; whereas emmers genomic composition is B and Au. The specific objective of the project is therefore to use ancient DNA (aDNA) sequencing to determine if the NGW contains a B or G genome. Plant material consists of 41 *T. timopheevii* ssp. *timopheevii* accessions, 12 *T. timopheevii* ssp. *araraticum* and charred NGW grains from Assiros Toumba, Greece. We will de novo sequence variable regions of at least 50kb of the G genome in

order to identify diagnostic polymorphisms, apply target enrichment and then sequence targeted aDNA from charred cereal grains. Prevalence of major plasmon haplotypes can also determine *Triticum* species so we will confirm species identity via chloroplast and mitochondrial marker identification.

Keywords: New Glume Wheat, Timopheevii wheat, domestication, genome, sequencing

***Arrhenatherum elatius* var. *bulbosum* and funerary practices: the study of carbonized plant remains from a gallo-roman cremation at Compertrix “Saint-Pierre” (Champagne-Ardenne, France)**

Arrhenatherum elatius var. *bulbosum* et pratiques funéraires : étude de restes végétaux carbonisés d’un bûcher gallo-romain à Compertrix “Saint-Pierre” (Champagne-Ardenne, France)

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The importance of plants used during funeral rites is difficult to identify. Nevertheless, archaeobotany enables us to study this question when plant remains survive through carbonization. Excavations carried out by the Institut National des Recherches Archéologiques Préventives (Inrap) in 2012 allowed study of the site of Compertrix (51) “Saint Pierre”, which contains archaeological features dating from the Mesolithic to Antiquity.

A stone funerary monument, dated to the 1st century AD, was situated within the excavated area. Remains of a funerary pyre were deposited at the base of the monument around AD 250-275. Later the ensemble was covered by colluvial deposits. This poster presents and discusses the identified plant species and attempts to interpret their use in funerary rituals during Roman times.

2,438 carbonized macro-remains have been recorded. They allow us to investigate the funeral ritual in detail. The burial gifts and offerings were composed of seeds and bread, cake or cereal porridge. Five cereals, one pulse and 31 associated weeds were identified. Exceptional amounts of charred roots, stems and tubers of the grass species *Arrhenatherum elatius* ssp. *bulbosum* were recovered. The assemblage of carbonized plant remains deriving from this deposit contains 933 roots fragments, 625 tubers and 419 stem fragments of this grass species. This remarkable quantity of remains raises the questions regarding its use and ritual importance. We suggest that the grass *Arrhenatherum* was used to make a “bed” for the body of the deceased prior to the lighting of the funeral pyre. The archaeobotanical analysis of the site of Compertrix (51) “Saint Pierre” allowed study of botanical remains which reveal information concerning funerary ritual during Gallo-Roman times. The results from this study are quite different compared to those from other Gallo-roman cemeteries in Champagne-Ardenne, where the remains of *Arrhenatherum elatius* ssp. *bulbosum* are rare or absent.

Keywords: France, Antiquity, Cremation grave, Funerary ritual, *Arrhenatherum elatius* var. *bulbosum*, Poaceae, Tubers

North Bohemian sandstone rockshelters: an attempt at reconstructing past landscapes and human impact using plant macroremains

Abris sous roche en grès de Bohème septentrionale : tentative de restitution des paysages passés et de l’impact anthropique par le recours aux macrorestes végétaux

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Archaeological excavations at North Bohemian sandstone rockshelters in the area called Bohemian Paradise offered well-stratified sandy sediments dated since the Mesolithic to the recent period. These were recently systematically sampled for plant macroremains, charcoal, faunal and malacofaunal remains and small artefacts. The contribution deals particularly with the plant macroremain assemblages showing unusual uniformity throughout the whole profiles and attempts to reconstruct past landscape and possible plant use in the specific area under study.

Keywords: Bohemian Paradise, Rockshelters, Mesolithic, Plant macroremains

The plant economy of the Northern European Bronze Age: More than just Emmer and Barley

Economie végétale à l’âge du Bronze en Europe septentrionale : davantage que de l’amidonier et de l’orge

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Opposed to previous, more local investigations, summarizing all available data concerning the plant economy of the Northern European Bronze Age has shown that it constitutes a time of innovation and continuous change. In addition to the omnipresent Emmer (*Triticum dicoccum*) and Barley (*Hordeum vulgare*) this period is marked by the emergence of new cultivars with spelt (*Triticum spelta*) in the transition to the Early Bronze Age and broomcorn millet (*Panicum miliaceum*) in the Middle Bronze Age. Furthermore it was possible to observe the establishment of oat (*Avena sativa*) at the last stages of the Bronze Age, that reached its maximum in the following Iron Age. Also the cultivation of different pulses with pea (*Pisum sativum*), lentil (*Lens culinaris*) and horse bean (*Vicia faba*) as well as different oil plants with flax (*Linum usitatissimum*) and, as a new development in the Late Bronze Age, gold-of-pleasure (*Camelina sativa*) could be verified. A comparison between the cereal spectra from several regions in Northern Germany and Scandinavia revealed differences and similarities that allowed the reconstruction of multiple possible contact zones and various influences from adjacent cultures. It was confirmed that Northern Germany and especially Schleswig-Holstein served as an important link for trading over land and by water between the southern areas and Scandinavia as well

as the North Sea and the Baltic Sea. The diversity of crop plants in the Late Bronze Age, which is comparable to the southern regions, displays the increased trade and therefore stronger influence from beyond the Northern European Bronze Age, which resulted in an accelerated assimilation of innovations and new technologies.

Keywords: Economy, Northern European Bronze Age

Chasing Chinese Millet using Replica-SEM Method

Recherche du millet chinois par le recours à la méthode Replica-SEM

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Many macrobotanical remains of Chinese millet from pre-5000 BC Neolithic sites in Europe were younger than the contexts with recent direct radiocarbon dating. Hence, the timing of appearance of Chinese millet around Eurasia, and the sequence of the Trans-Eurasian exchange are still unclear. Also, there are huge blank of macrobotanical dataset between North China, presumed a place of origin and West Europe. Because of the limitation of macrobotanical evidence, impressions on pottery are still the basis of archaeobotanical research in many areas of Eurasia, but the identification of those impressions are skeptical, and difficult to evaluate equally with macrobotanical remains using strategic flotation, and rigorously scientific identification of seeds are requested.

To resolve the subject, the author would like to propose Replica-SEM Method as an effective and complementary procedure to recover seeds, especially for small grains like Chinese millet. From impressions on potsherd, positive replicas are copied with silicone rubber resin, and those replicas are observed using scanning electron microscopy (SEM). Those replicas are able to observe ca. 500 or more than 500 magnifications because of the high transcription of clay for pottery making. Therefore, the way of identification is possible on both of the seed size and shape, and the surface texture of seed that has much reliable entities. Charred seeds are sometimes deformed by carbonization, but impressions are keeping fresh condition, observable for the taxonomically detailed surface texture, morphologically identifiable, before carbonization. The small voids as casts are informative unexpectedly. From our dataset of Chinese millet during Jomon-Yayoi transition period in Japan, most of all seeds identified from replicas are observed as floret with lemma and palea, same to replicas from South Korea and Primorye district in Russia, therefore, the identification criteria is not only general shape and size of grain and the embryo pit, but also the morphological comparison of lemma and palea to modern species.

Unfortunately, for the discussion of quantitative analysis, the studies concerning the formation process of impression must be improved, but the presence of seed impression on pottery with certain identification is a significant evidence to understand the timing of appearance of domesticated cereals. To fill gaps in the record of Chinese millet, particularly over large areas of central Eurasia, Replica-SEM Method must be an effective and practical procedure.

Keywords: Replica, SEM Method, Impression, *Panicum miliaceum*, *Setaria italica*, Trans-Eurasian exchange

Exploring variations in crop storage and discard practices across Neolithic sites in Serbia

Explorer la variabilité des pratiques de stockage des récoltes et de gestion des déchets dans les sites néolithiques de Serbie

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A number of Late Neolithic Vinča culture settlements (c. 5400-4650/4550 cal BC) has been registered and investigated in the territory of Serbia. Plant remains (seed/fruit/chaff) have been collected only at a fraction of them and just a handful of sites included some form of archaeobotanical sampling (as opposed to hand-collection of visible charred remains). The differences in field- and laboratory methods inevitably limit the potential for comparisons between the sampled and non-sampled sites. By comparing the like-with-like, however, it is still possible to draw some valid inferences and conclusions about certain aspects of plant use at these sites. Here we focus on three specific types of archaeological contexts present at the majority of the analysed sites: in situ burnt crop storage deposits; deposits from, or directly associated with, fire installations; and crop-rich deposits in rubbish pits. Our aim is to explore the nature of crop storage and discard of crop processing by-products over the period and across a wider region. The paper presents and cross-compares the botanical content of these deposits and uses the observations to discuss differences and similarities between the sites in the choice of stored/consumed crops and in the disposal of crop processing by-products. Implications for, and relevance to, other known aspects of life at the sites are briefly discussed.

Keywords: Neolithic, Vinča culture, Crop storage, Rubbish pits

Multidisciplinary analysis of wild cereals from the Holocene archaeological site of Takarkori (Central Sahara)

Analyses interdisciplinaires de céréales sauvages du site archéologique holocène de Takarkori (Sahara central)

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The long-time exploitation of wild cereals by hunter-gatherers is confirmed by the study of pollen and macroremains recovered from archaeological sites of central Sahara. These plants were prevalent among those selected and transported to shelters and caves. Spikelets, florets and grains of Panicoideae are the most abundant plant remains found in the Takarkori rock shelter, and were analysed by means of morphological and molecular (ancient DNA) approaches. The archaeological excavation by the Italian-Libyan Archaeological Mission in the Acacus and Messak (Sapienza University of

Rome – directed by S. di Lernia) exposed a surface of ca. 140 m². The 1.6 m thick deposit includes stone structures, fireplaces, plant accumulations, dung layers and a burial area. Layers were deposited first during hunter-gatherers' occupation and later by pastoral groups. Chronology ranged from ca. 10,200 to 4,600 cal yr BP and was based on stratigraphy, radiocarbon dates, and archaeological materials. Systematic morphobiometrical analysis was carried out on 1,450 spikelets selected as representative of different cultural contexts. The records of *Panicum*, *Echinochloa* and *Sorghum* showed homogeneous typology and uniform size in each genus. This could be associated with the action of collection of those cereals by the humans who lived at Takarkori. aDNA was extracted testing different protocols and then it was studied by the DNA barcoding technique. For plants did not exist still a universal DNA barcode, however the Consortium for the Barcoding of Life identifies a major core-barcode consisting of portions of plastid regions (rbcL, matK, trnH-psbA and trnL), to be used together in a multilocus approach. A primer set for each barcode was created and Polymerase Chain Reaction was run. The amplified regions were sequenced and using both these new results and the previous obtained on the same material by Olmi and colleagues (2011: Morphological and Genetic Analyses of Early Mid-Holocene Wild Cereals from the Takarkori Rockshelter (Central Sahara, Libya): First Results and Prospects. Windows on the African Past: Contemporary Approaches to African Archaeobotany, Reports in African Archaeology), a preliminary sequence analysis was run looking for taxonomic identification and phylogenetic relationship of the studied species.

Keywords: Wild cereals, Archaeobotany, DNA, Barcoding, Takarkori rock shelter

Reconstructing the Agricultural System of the Byzantine Negev

Restituer le système agricole du Negev byzantin

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In the long human history of the Negev desert, agricultural settlement during the Byzantine period (4th-6th centuries C.E.) was of unprecedented scope and intensity. However, at the end of this period and in the ensuing Islamic era, this system declined and collapsed. Although the Byzantine Negev has been previously studied and excavated, the economic relationship between its agricultural and settlement systems has not yet been properly researched.

Our archaeobotanical analysis of several relevant archaeological sites seeks to reconstruct the natural and agricultural landscape of the ancient Byzantine Negev. This will make it possible to answer several important research questions related to the agriculture and economics of this settlement system: To what extent did runoff agriculture meet the needs of Negev residents? To what degree do historical accounts, such as the Nitzana papyri, reflect local subsistence agriculture versus a trade economy? How did the Byzantines support an estimated population of 30,000 in the northwest Negev? What agricul-

tural techniques did they employ? What brought about the eventual collapse of the system and how could it have been prevented?

In this lecture, we will discuss the project aims and provide first impressions from the excavation of the first two sites – Halutza (Elusa) and Shivta (Soboda). We will describe their plant assemblages and our preliminary reconstruction of the local and imported food plants.

Keywords: Byzantine period, Negev

The CUISINE project: an innovative approach for the study of culinary practices in past societies

Le projet CUISINE : une approche innovante pour l'étude des pratiques culinaires des sociétés anciennes

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This poster will present the theoretical and methodological background of the CUISINE project, which aims at developing an innovative methodology for the study of culinary practices (cuisine) in past societies. By analysing a society's diet and cuisine we can explore, for instance, cultural development expressed through growing complexity in parallel with the development of more complex social and technological structures. This project will explore culinary practices in past societies through the integrated analysis of phytoliths, starch grains and lipids from cooking pottery. In order to interpret the archaeological record, extensive plant reference collections and several experiments will be developed as part of the project. At the same time, the methods developed during the experimentation phase will be tested and validated on two archaeological case studies in the Aegean, an area that has historically been (and still is) a crossroad for people and food-stuffs: the Neolithic site of Stavroupoli (Greek Macedonia, ca. 5600-5000 cal. BC) and the Bronze Age site of Knossos-Gypsades (Minoan Crete, ca. 3650-1100 cal. BC). The development of these integrated analyses on Neolithic and Bronze Age settlements will allow for the study of the emergence of new social practices and cultural identities linked to the origins of food production and the development of complex, urban societies.

Keywords: Archaeology, Microbotanical remains, Lipid analysis, Pottery, Cuisine

The plant macroremains from PPNB Tell Labwe (Lebanon)

Macrorestes végétaux du site PPNB de Tell Labwe (Liban)

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Tell Labwe constitutes the oldest Neolithic settlement in the Beqaa Valley (Lebanon). This site was excavated by D. Kirkbride in 1966 and revealed a sequence dated from the Late PPNB to the Pottery Neolithic. In 2011, a Lebanese-Spanish team carried out a fieldwork season in order to complete the data obtained previously by D. Kirkbride. The work focused on a 47 m length and 4 m high section of the tell, and excavations focused on the western sector. The C14 analyses showed that the foundation of the Neolithic village dates back to 8100 +/- 40 BP, whilst the last occupation phase was dated to 7640 +/- 40 BP. In this paper, we present the final results of wood charcoal and non-woody plant macroremain analyses. The results highlight the presence of oak-woodland and woodland-steppe trees in the immediate vicinity of the site, although mountain resources were also exploited as suggested by the presence of cedar. The analyses also suggest the cultivation of different crops, from which lentils seem to have been regularly consumed. Tell Labwe represents so far one of the few archaeological sites that have provided data in order to understand past vegetation and plant-based subsistence during the Neolithic in Lebanon.

Keywords: Neolithic, Founder crops, Wood charcoal, Cultivation

The influence of landscape and climate on the food economy of medieval towns: case studies from southwest Germany

Influence des paysages et du climat sur l'économie alimentaire de villes médiévales : études de cas en Allemagne du sud-ouest

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The influence of climate and environmental conditions on all aspects of life is unequivocal. To what extent these factors affected the food producing economy of medieval towns and how the people coped with them remains questioned. It can be assumed that environmental factors as well as climate directly affected the food production and the availability of certain goods. At the same time shortages or crop failures could be compensated to a certain extent through trading activities. These questions will be addressed in an interdisciplinary case study from Southwest Germany. The main focus will be the analysis of botanical macroremains from medieval Constance, Esslingen and Isny to gather first hand evidence for food production and consumption. Off-site pollen analysis from archives in the vicinity of Isny and Constance should evidence environmental changes in the wider surroundings. Complementary archaeobotanical sources as well as other published data on geology and soil and historical sources will be taken into consideration. The aim of this study is to gain new insights into the handling of environmental or climatic circumstances in the Medieval of Southwest Germany. The poster will present first results of an ongoing dissertation project.

Keywords: Urban archaeobotany, Europe, Middle Ages, Landscapes, Food/Diet

The late republican military camp located on the Petrisberg (Trier, Rhineland-Palatinate, Southwest Germany) from an archaeobotanical point of view (macroremains)

Le camp militaire du Bas-Empire à Petrisberg (Trier, Rhénanie-Palatinat, Allemagne du sud-ouest) du point de vue archéobotanique (macrorestes)

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The described archaeobotany studies are part of studies performed on roman find spots located in Rhineland-Palatinate and Saarland in Southwest Germany. The roman camp on the Petrisberg was constructed in the late republic and was located an important passage between Rhone and Rhine. Being the first camp from the 30 before Christ, it represents the historical important time frame between Caesar and Emperor Augustus with the earliest military establishments along the Rhine. Covering this time interval the Petrisberg represents a key finding spot for the field of archaeobotany. Following questions arise: What happened archaeobotanically while the roman troops was stationed on the Petrisberg around 30 before Christ? What was the main source for nutrition and are there differences to the late Iron Age distinguishable? Did this occupation time have a remaining influence? This poster presentation summarizes the available results and outlines answers to these questions.

Keywords: Roman periode, Late republican military camp, Food supply, Southwest Germany

Not gone with the fire - Charred cereal food remains from Billendorf Culture burials at Niederkaina (Lkr. Bautzen, Saxony) (750-500 cal BC)

Pas partis en fumée - Restes alimentaires de céréales carbonisées dans des inhumations de la culture de Billendorf à Niederkaina (Lkr. Bautzen, Saxe) (750-500 cal av. J.-C.)

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The Niederkaina Schafberg near Bautzen (Saxony) consists of more than 2000 graves dating from the Neolithic to early Iron Age, and is therefore one of the biggest burial grounds in central Europe. During excavations in 1948-1971, conducted by the Landesamt für Archäologie Sachsen, several thousand samples of charred food remains were recovered in graves of the Billendorf Culture (750-500 cal BC). Some were still in pottery vessels, others were scattered between the packing of pottery in the grave. Macrobotanical investigations combined with scanning electron microscopy revealed different kinds of foods, all made of processed cereals. Frequently found are leavened (buns) and unleavened bread (flat bread) made from

mostly emmer wheat (*Triticum dicoccon*). Emmer wheat was also detected as main ingredient of elongated cylindrical objects we called "noodles". Cooking experiments showed that these noodles were rolled between the palms of the hands and been cooked immediately in boiling water. Different kinds of cereal gruel were also found. On the one hand, emmer gruel was prepared and wrapped up in leaves for consumption. On the other hand, millet gruel (*Panicum miliaceum*), mostly made from still hulled millet, was also very common in the graves. Opium poppy (*Papaver somniferum*) was used as a flavour and could have also been an important plant in the burial ritual. As the flour used for bread, noodles and gruel was of good quality, and therefore contained neither weeds nor chaff remains, cereal processing was intensive and included threshing, dehusking, winnowing and sieving. The investigations gave us insight into the elaborate food preparation of a variety of foods during the Lusatian Culture with cooking, baking, addition of leaven or ingredients like opium poppy to improve the flavour, as well as the modeling of different shaped cereal food (different kinds of bread, buns, "noodle", stuffed leaves). The high quality of the cereal products found in Niederkaina showed that these food offerings most probably corresponded with daily food. But as equivalent material is missing from settlement sites we are not able to determine if some food offerings, e.g. the "noodles", were exclusively made for the burial ritual. At the same time, food and the associated set of pottery were important for indicating the social status of the dead within the ancient society. This was shown in Niederkaina as not all dead adults and only some children were cremated with a large set of pottery containing food on the funeral pyre.

Keywords: Early Iron Age, Food, Noodles and bread, Ritual archaeobotany, Saxony

Archaeobotanical analysis of finds from the Kostolac and Kosihy/Čaka (Makó) culture site in Komárno, SW-Slovakia: another record of the "new glume wheat"

Analyses archéobotaniques de vestiges de la culture Kostolac et Kosihy/Čaka (Mak) du site de Komárno (SO-Slovaquie) : une nouvelle découverte de "new glume wheat"

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Poster presentation represents an overview of results from author's (V. Dvorská Plháčková) diploma thesis, focused on the Kostolac culture occupancy of Slovak Republic territory. The most important part of work was processing various archaeological, especially ceramic and archaeobotanical finds, coming from site in Komárno-Old Fortress (dist. Komárno, SW-Slovakia). The site was archaeologically excavated in 2009 by Slovak Archaeological and Historical Institute in Bratislava and it is the second settlement site of Kostolac culture known from territory of Slovakia. Moreover, processing of ceramic finds led to detection of material set that came from archaeological sections, and it can be dated back to the Kosihy/Čaka (Makó) culture. The divergence of assemblages set is also sup-

ported by the analysis of archaeobotanical material, which is described in detail. Besides larger amount of *Triticum monococcum* grains and chaff, during taxonomic identification of finds, we were able to identify also several grains and chaff of the "new glume wheat". This contribution represents a part of the project VEGA 1/0787/16 "Bratislava in the middle of the 4th millennium calBC. Settlements in the Baden culture. (Bratislava v polovici 4. tisícročia calBC. Obraz osídlenia v období badenskej kultúry)".

Keywords: Central Europe, Eneolithic, Kostolac culture, Kosihy/Čaka (Makó) culture, New glume wheat

Archaeobotanical material from Komjatice in the context of the middle La Tène lowland settlements from South-West Slovakia

Matériel archéobotanique de Komjatice (Slovaquie du sud-ouest) dans le contexte des établissements de plaine de La Tène moyenne

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The village Komjatice is situated in the SW Slovakia in the district of Nové Zámky, in the territory of the Nitra Region, between the cities of Nitra and Šurany. During several rescue excavations (between 1977 - 1979 excavations by the lead of A. Točík) a part of the La Tène settlement was explored in the site Kazova jama. From this period there have been found at all six semi-grounded huts and one cultural pit. Material from this site has been completely analysed and published as a catalogue only recently. The dating of the settlement to the LTC1 has been also corrected through the recent processing. Except the archaeological material (pottery, stone artefacts, metal and glass finds) there has been preserved only one smaller sample of soil, which was taken from the hut XI. The sample has been hand-floated in water in order to obtain the botanical material. It contained relatively a high amount of cereals. Despite of the quite high material fragmentation, we were able to classified 175 cereal grains and 57 cereal weeds. From the cereal types there were species such as wheats (*Triticum monococum* and *Triticum spelta*), rye (*Secale cereale*), millet (*Panicum miliaceum*), oats (*Avena sativa*) and barley (*Hordeum vulgare-vulgare*). The results of the botanical analyse of mentioned sample along with analyse of the botanical macro-remains imprints on the clay daubs have certainly a great importance in the field of archeobotany. Primarily in the comparison with other excavated lowland settlement from same period from SW Slovakia.

Keywords: Archaeobotany, La Tène, Settlements, SW Slovakia

The agricultural economy of Tell Mohammed Àrab in northern Iraq

Economie agricole de Tell Mohammed Àrab en Irak du nord

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The archaeological site of Tell Mohammed Arab was situated on the western bank of the Tigris river in Northern Iraq before being flooded by the waters of the Eski-Mosul dam. The site was occupied intermittently for over 2000 years from the Late Chalcolithic-Late Bronze Age, and during this period the region saw considerable changes in terms of socio-economic complexity with a shift from small-scale village rural settlements through to large city-scale urban centres. Accompanying these changes in settlement pattern are shifts in the economic basis of the economy from a relatively egalitarian system based on self-sustaining subsistence farming to a large-scale state-controlled system capable of producing sufficient surpluses to maintain a large population not directly involved in food production.

This study investigates charred plant remains, of crops and wild plants from Tell Mohammed Arab, from the Late Uruk – Ninevite V and Middle Assyrian periods. The earlier occupation covers the transition to urbanisation while the latter occurs during a period of centralised state economy. As such the archaeobotanical remains allow us to explore changes in agricultural economy and practices carried out in the rain-fed region of Iraq in relation to the ecological indicators of crop growing conditions revealed by functional analysis of the crop weed floras through time.

Keywords: Archaeobotany, Agriculture, Northern Mesopotamia, Bronze Age

Drilling wood for fire: discoveries and studies of the fire making apparatuses in the Yanghai cemeteries of ancient Turpan of China

Forer le bois pour le feu : découvertes et études des structures de chauffe des cimetières Yanghai de l'antique cité de Tourfan en Chine

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A fire drilling tool was an article of daily use by our ancestor. Under the principle of using local material, they selected many natural resources, especially plants growing in or around their habitation. If efficiency was a priority, our forefather should have chosen specific wood for making a fire drilling tool. Due to poor environmental conditions, fire drilling tools have rarely been preserved in sites on Mainland China, and none of these have been investigated xylotomically. The Turpan District in Xinjiang, China, however, is characterized by year-round drought, which provides us with well-preserved plant remains for studying our ancestors' awareness and usage of local plants. This paper aims to identify the fragments of fire drilling tools unearthed in the Yanghai Tombs, Turpan Area. The fire drilling apparatuses were identified to be of *Picea*, *Salix*, *Populus*, etc. These are then compared with fire drilling devices discovered overseas and those of contemporary indigenous peoples at home and abroad, investigating the intrinsic differences and similarities.

Keywords: Fire drill, Wood anatomy, Subeixi culture

Food or fodder – Plant macroremains from Lipnik site 5

Alimentation ou fourrage – Restes végétaux du site 5 de Lipnik

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Lipnik is located within a loess plateau called the Rzeszów Upland (Podgórze Rzeszowskie), close to a border with the higher elevated, hilly area, which belongs already to the Carpathian Foothills (Dynów Foothill). The archaeological site number 5 in Lipnik occupies a vast promontory, surrounded from S, E and N by deep stream valleys. Total estimated area of the Bronze Age settlement complex in Lipnik is as large as 3.4 square kilometers. Excavations carried out in 1998-2005 encompassed an area of almost 0.4 hectare and resulted in the discovery of more than 500 structures originating from the long time span between the Middle Bronze Age (MBA, ca 1600 BC) and Early Iron Age (EIA, ca 400 BC).

Feature number 302 located in the NE part of excavated area belongs to the group of the smallest trapeze-shaped pits at the site in question. The pit had a quite simple structure of the fill. Flat bottom (130 cm under the modern ground surface) was covered partially with a thin clay layer, which in turn was covered with a layer of dark soil, up to 20 cm thick and saturated by numerous small daub pieces and charcoal. The last one occurred in some larger concentrations, containing macroscopically visible plant remains, including acorns. A few of them provided radiocarbon date (3015±35, 2σ 1390-1120 BC). The pit belongs to the Trzciniec culture of the MBA.

The plant material from pit 302 was charred and generally preserved in a very good condition. Among plant remains about 70 taxa were documented and fragmented acorn kernels predominated in volume. The rest of plant remnants included cereals, dominated by common millet *Panicum miliaceum*, as well as weeds and ruderals. A unique character of this assemblages is the presence of about 20 plants typical of grasslands and pastures (small seeded Poaceae including *Phleum pretense*, *Plantago lanceolata*, *Medicago lupulina*, *Prunella vulgaris*, *Coronilla varia*, *Trifolium* sp. and others). Among woody plants, 16 taxa were found. Interestingly, they were mainly represented by twigs (*Carpinus betulus*, *Corylus avellana*, *Fraxinus excelsior*), bast (*Tilia* sp.) and tree buds.

Acorns were probably used as a source of food as they were found in a storage pit together with other edible plants. However, the abundance of grassland taxa as well as remains of young twigs and several vegetative parts could suggest the use of the pit as a storage for fodder as well. Also, those remains could be part of a pit construction, or some other kind of insulation. We could also conclude some mixed economic strategy of the pit owner in the past.

Keywords: Acorns, Fodder, Crop remains, MBA settlement, Trzciniec culture, SE Poland

Exploring intra-settlement use of space in Late Bronze Age Greece: preliminary observations on the archaeobotanical visibility of storage and disposal strategies during the late 2nd millennium BC in the Aegean

Comprendre l'usage de l'espace intra-site en Grèce à l'âge du Bronze final : premières observations sur les témoins archéobotaniques des stratégies de stockage et de rejet la fin du second millénaire avant notre ère en zone égéenne.

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Here we use archaeobotanical data from the Late Bronze Age (1700-1050 BC) layers of four settlements located across the north-south axis of mainland Greece, in order to explore intra-settlement use of space as regards to crop storage and refuse disposal. Preservation and recovery methods are well known in the literature as being amongst the crucial taphonomic factors forming archaeobotanical assemblages that need to be taken into account before data synthesis in broad level discussions and generalized statements. This presentation examines two factors affecting the composition, quantity and quality of the archaeobotanical assemblages considered in our investigation: destruction by fire and sampling strategy.

Preliminary results are based on the ongoing study of ca. 2170 samples collected either systematically (Thessaloniki Toumba, Mitrou and Ayios Vassileios) or based on judgment sampling (Kynos), and in certain cases from in situ preserved fire destruction layers (Kynos, Mitrou, Ayios Vassileios). The samples represent a variety of indoor and outdoor contexts such as floors, pits, postholes, clay- and stone-made constructions, pithoi and other vessels, hearths and burnt lenses, rubbish pits, fill and street deposits. Our preliminary analysis shows that both factors greatly affect, among others, sample composition and therefore the degree to which storage patterns and refuse disposal can be seen and reconstructed archaeobotanically. Sites where preservation is by burnt destruction episodes reveal direct storage evidence and allow for a discussion on storage organization, as is the case for Kynos, Mitrou and Ayios Vasileios where crops were found either still contained in storage vessels or spilled over the floor surface. Refuse deposits are very well represented at sites sampled systematically, allowing a thorough study of their spatial distribution and management practices. For example at Thessaloniki Toumba waste was not related to any specifically defined intra-settlement area, being accumulated both in outdoor areas as well as in contexts within the buildings. Where sampling is systematic, archaeobotanical composition and contextual analysis also provide direct or indirect evidence for storage along with the preliminary insights on refuse management within the settlement space. At Toumba storage, though not seen as in situ preserved concentrations, is suggested by small more or less pure grain concentrations in secondary deposits such as hearth contents.

Completion of analysis of each data-set will allow for a reconstruction of storage and/or refuse disposal strategies at the settlements under study, thus providing a methodologically sound basis for a comparative diachronic investigation of intra-settlement use of space during the late 2nd millennium BC, when major sociopolitical changes occur in the Aegean encompassing both the rise and fall of palatial centres in the Mycenaean southern and central Greece, as well as the emer-

gence and establishment of loose hierarchical networks in the North.

Keywords: Storage, Disposal, Taphonomic factors, Late Bronze Age, Aegean

Evidence of pollen and plant macro-remains from the sediments of suburban area of medieval Tartu (Estonia)

Vestiges de pollens et de macrorestes végétaux dans le sédiment de la zone suburbaine médiévale de Tartu (Estonie)

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During the last 20 years, several rescue excavations took place in the suburban area of medieval Tartu (Estonia). Although the exact data concerning the formation of southern settlement outside the town wall is not available, it is rather likely that the suburban settlement was developing by the fourth quarter of the 13th century at the latest. The first pollen and plant macrofossil analyses from the area were carried out in connection with archaeological rescue excavations in 1990 – 1994. The year 2014 gave us an opportunity to get new material from remote southern settlement area of the town. Several soil samples were taken both times from natural and archaeological layers (13th - 17th centuries) to reconstruct the local environment before and during medieval and early modern habitation of the area to compare two sites. Long-term landscape changes are documented by pollen diagram indicating a transformation of the landscape type from natural to urban one. A list comparing and summarizing the pollen and macrofossil taxa is given to see how the plant communities are recorded in the results of different methods.

Keywords: Medieval suburban area, Archaeobotany, Early modern time

Wet rice/dry rice. Identifying rice cultivation systems in South Asia

Riziculture irriguée/riziculture sèche. Identifier les systèmes de mise en culture du riz en Asie du Sud

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Domestic rice agriculture spread across the Indian Subcontinent into South India and Sri Lanka c.500BC. The spread of rice into these dry regions is largely supposed to have relied on irrigation, as suggested by early historical data. However, new archaeobotanical evidence from Kodumanal, Perur (Tamil Nadu) and Mantai (Sri Lanka), dated to c.400 BC-800 AD, suggests otherwise. Macrobotanical and phytolith evidence from six sites across India and Sri Lanka have been analysed in order to examine the type of rice cultivation system employed at each site. This suggests that early rice agriculture in South India and Sri Lanka was not supported by irrigated paddy fields but may instead have relied upon seasonal rain-

fall. This poster also presents new data from Tokwa (c.1600-931 BC) (Uttar Pradesh), Golbai Sasan and Gopalpur (c.1500-910 BC) (Odisha), which provide a framework from which to understand the broad history of the evolution of rice cultivation systems within the subcontinent.

Keywords: South Asia, Phytoliths, Irrigation, Rice

Archaeobotanical evidence from Dikili Tash, French sector

Témoins archéobotaniques à Dikili Tash, secteur français

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Dikili Tash is a multiperiod tell site situated in the south-east part of the Drama plain in eastern Macedonia, northern Greece, near the ancient city of Philippi. Systematic research carried out in the last fifty years has brought into light, among others, extensive habitational remains of the Late Neolithic period (ca. 5500-4200 B.C.). This presentation concerns the charred plant remains from sector V, on the southern slope of the tell, excavated by the French team during the 1986-2001 Dikili Tash Research Programme, which were retrieved by flotation of soil samples. At least four main successive levels representing the early stages of the period (Dikili Tash phase I ca. 5500-4800 B.C.) have been unearthed in this sector and also two partially preserved levels of the early parts of the following phase (II) have been found in the same area. The archaeobotanical material derives from these habitation areas, which represent interior of houses and also an outdoor space and contained food-storing and foodprocessing facilities, such as ovens, platforms, hearths, clay bins, ceramic vessels. A variety of species were identified, with emphasis to cereal and pulses. Glume wheats, dominant in the Neolithic and Bronze Age, are represented mostly by grains. Barley is also encountered in the samples. Among glume wheats, emmer holds a dominant position and einkorn is also present. Pulses are strongly represented by lentils, while bitter vetch and grass pea are also present but in lower proportions. Grapes and figs are also found, but not in great quantities. The study of the archaeobotanical material from the French sector of Dikili Tash provides the opportunity to investigate everyday life activities in relation to plants (dietary habits, storage, agricultural activities).

Keywords: Neolithic

Final report on the analysis of charred plant remains from the Late Neolithic and Bronze Age riverside site of Longas Elatis in western Macedonia, northern Greece

Rapport final de l'analyse des restes végétaux carbonisés du site riverain de Longas Elatis (Macédonie occidentale, Grèce du nord), au Néolithique final et à l'âge du Bronze

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This poster presents the final results of analysis of charred plant remains from the Late Neolithic and Bronze Age riverside settlement of Longas Elatis in western Macedonia, northern Greece. The site is located in the low right bank of Aliakmon, the longest river entirely within Greek borders (297 km up to the point where it flows into the Thermaic Gulf) and particularly in the lower sloping terraces of adjacent hills. In the valleys and plains of the Aliakmon a number of important settlements, such as Longas, grew up as long ago as prehistoric times and went on to develop into important cities by the beginning of the historical era. A large amount of archaeobotanical remains has been revealed during the rescue excavations 2009-2012 at the site dated to Late Neolithic and Bronze Age, adding significantly to the few known material from investigated sites in western Macedonia. The samples derive from various archaeological contexts such as pits, stone structures, ditches and burning areas. Plant remains are mainly represented by a variety of cereal and pulse species such as einkorn (*Triticum monococcum*), emmer (*Triticum dicoccum*), spelta (*Triticum spelta*), barley (*Hordeum vulgare*), grass pea (*Lathyrus sativus*), lentils (*Lens* sp.) and bitter vetch (*Vicia ervilia*). Among fruits, grape pips are the most common find along with the presence of a few pressed grapes. Seeds of weed species are represented in lower proportions. The archaeobotanical remains of Longas Elatis contributed to our knowledge about the various aspects of human activity in relation to plants, giving wealth information about the aspects of the socioeconomic sphere of everyday life, such as use of space, agricultural practice, storage of plants and food habits in Late Neolithic and Bronze Age western Macedonia.

Keywords: Northern Greece, Western Macedonia, Neolithic, Bronze Age, Food habits

ArboDat – a time saving working tool for the archiving and the scientific evaluation of archaeobotanical data

ArboDat – un outil "gain de temps" pour l'archivage et l'évaluation scientifique des données archéobotaniques

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Over the 14 years of its history the database program ArboDat© has proven as a reliable and constantly improved tool for the archiving and the scientific evaluation of archaeobotanical data. ArboDat 2013 Update 2015 - German and English version - is based on Microsoft Access. One of the key features of ArboDat are the preprogrammed interactive evaluation tools, which offer the possibility to quantify, group and sort archaeobotanical results for any combination of parameters involved. To facilitate work additional tools are provided. Two examples: TaxaMerge offers the possibility of merging two taxa lists of different length by appending the columns while merging the taxa into one row. TaxaTransfer facilitates the data import of archaeobotanical results from Excel taxa lists into the data tables of ArboDat. Recently, the creation of an English version has substantially promoted the spread of ArboDat amongst European archaeobotanists. All details

of the program and its use are provided by the English and the German manuals. Modern archaeobotanical investigations are aimed to answer biological and historical questions within the whole distribution area of the archaeological cultures, beyond political borders. As a consequence, a supraregional data exchange is required, comparing in detail and with high resolution standardised data from different archaeobotanical laboratories. A central basis for such a project are the primary data being recorded with comparable determinations, calculation methods and terms. Therefore, one important benefit of a database program is the standardised data archiving. Compared with centralised projects ArboDat combines both, the flexible data management within each single working and the possibility to integrate and exchange the data within a national or centralised system as well. Demonstration of and support on all ArboDat features and the additional tools will be offered during the IWGP conference.

Keywords: Archaeobotanical database program, ArboDat 2013 Update 2015, Microsoft Access, Data evaluation

The subsistence strategies of the early medieval hillfort in Mikulčice

Stratégies de subsistance à la motte altomédiévale fortifiée de Mikulčice

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This paper is designed to evaluate plant's macro-remains acquired from the archaeological deposits from the Mikulčice and Kopčany. The results of the evaluation of plant's material will contribute to the debate concerning the organization of agriculture, the subsistence of the Early Middle Age society and economic relations of the central settlements with the villages in the hinterland. The plant seeds from 9th to 11th century AD, extracted from 16 different locations of the settlement complex (acropolis, ward, extramural settlement and background) were here analyzed. From 2005 until 2013 the archaeobotanical research managed to collect 946 samples, out of which 26,995 macro-remains with the help of extracting techniques. In addition to the coke plant seeds there are numerous macro-remains documented as mineralized, but also water-preserved. The plant material was tested by series of different multidimensional statistical analysis, Taphonomic, economic and ecological methods. Multidimensional statistical analysis indicates the relationship of the samples of plant species in the context of sites, conservation, dating and their own contexts. The results of these analysis were used in the consecutive evaluations. Taphonomic analysis were primarily aimed at determining the origin of the samples in terms of post-harvest processing of crops. Based on these analysis it is clear that the sample is only representative, and the final waste products from a crop processing. From the economic point of view, by using two approaches, the subsistence strategy in the Mikulčice-Kopčany residential complex can be characterized as commercial. In the second approach, which evaluates the society from the political and socio-cultural point of view, we can assume a strongly centralized managed society. Confrontation of these arguments in trans-regional context demonstrates the legitimacy of this hypothesis. Through the analysis of ecological factors, it was possible to predict the location and

the nature of the extracted natural resources (fields, meadows and forest). Comparison of ecological claims, early-medieval wild species with the current botanical taxa that can be found on the hill-fort, demonstrates that situating the fields, forests and meadows in the Morava river floodplain. This presented study provides the evidence from a different perspective, than the traditional archeologically focused studies.

Keywords: Archaeobotany, Mikulčice Kopčany, Taphonomy, Paleo-economy, Ecology

Use of plants during the Middle and Late Neolithic in Polgár area (north-eastern Hungary)

Utilisation des plantes durant le Néolithique moyen et final dans la région de Polgár (Hongrie du nord-est)

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The area of Polgár located near the Tisza River was an important occupational centre during the Neolithic period. The first agrarian communities came to this north-eastern region of the Great Hungarian Plain in the second part of the Vth millennium cal BC with the appearance of the Eastern Linear Pottery Culture (Alföld Linearbandkeramik), which in the Hungarian relative chronology corresponds to the Middle Neolithic. However, the highest density of the occupation is associated with the Late Neolithic Tisza-Herpály-Csöszhalom complex developed during the first half of the Vth millennium cal BC. The current study is based on new archaeobotanical materials found in three archaeological sites dated to the Middle Neolithic (Polgár-Piócási-dlő) and Late Neolithic (Polgár-Csöszhalom and Polgár-Bosnyak-domb) from which charred plant macro-remains were recovered. Also, plant imprints in daub and pottery were analyzed. Among the cultivated plants, emmer wheat *Triticum dicoccon* was the most represented cereal species, while einkorn *T. monococcum* and barley *Hordeum vulgare* were not frequently found. Emmer wheat was also added to clay used for constructions, as documented i.e. by an imprint of its spike. Interestingly, it was observed that the way in which plants were used as temper in clay changed during the Late Neolithic since in the youngest phases of this period their amounts decreased. The same tendency, but starting from the Middle Neolithic, was also observed in the pottery indicating a significant technological change. Wild herbaceous plants were represented by field, ruderal, and meadow taxa of which different species of *Chenopodium*, *Polygonum* and *Setaria* were predominant. Charcoal assemblages evidenced gathering of wood from oak-dominated forests, especially from wooded steppe and floodplain areas.

Keywords: Neolithic, Crop husbandry, Daub, Anthracology, Hungary

Over 100 years of archaeobotanical analysis at a Late Iron Age and Roman town: methodologies, results and future prospects at Silchester

Plus de 100 ans d'analyses archéobotaniques dans une ville de la fin de l'âge du Fer et de la période romaine : méthodologies, résultats et perspectives à Silchester

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Silchester is the site of a Late Iron Age oppidum and Roman civitas capital in central-southern Britain and is highly significant for several reasons. First, its modern location as a green-field site means the archaeological layers are well preserved and accessible. Second, its complex history as a royal oppidum, client king capital and centre of Roman administration makes it a significant site for understanding social and economic changes in the Late Iron Age and Roman period. Third, the high intensity of research at Silchester over the last century includes significant archaeobotanical investigation. This poster will explore the methodologies used, the key results for food, farming and the environment, and future prospects for investigating the agricultural basis of the settlement. The earliest archaeobotanical study of Silchester was undertaken by Clement Reid and Arthur Lyell, as part of the large-scale excavations within the walled Roman town, 1899-1909. This study was the benchmark for Roman archaeobotanical studies for much of the twentieth century, but the accuracy of the finds has previously not been known. The archive of plant remains analysed in this early study has recently been re-examined, verifying many of the significant introduced plant foods and wild plants published at the beginning of the twentieth century. Much more detailed archaeobotanical work has been ongoing as part of the recently completed *Insula IX Town Life* project excavations, in one small area of the town. Charred, mineralised and waterlogged plant remains have been studied from the earliest Late Iron Age occupation (c. 40 BC) through to the latest Roman occupation (c. AD 400/450). These have shed light on the arable farming practices undertaken in the earliest phases of the town, the import of new plants in the Late Iron Age, the broadening of diet through the first century AD and changes in settlement vegetation throughout the town. Despite the intensive bulk sampling undertaken within the town, identifying the location and farming regimes under which cereals, pulses and oil crops were cultivated in the surrounding area requires intensive study of the surrounding landscape. This poster will introduce the Silchester Environs project, which is undertaking small-scale excavation of Iron Age sites within the hinterland of Silchester. The preliminary archaeobotanical results will be summarised, and the future direction of establishing the agricultural basis of Silchester explored.

Keywords: Oppida, Roman towns, Silchester, Agriculture

Multidisciplinary studies in squash (*C. maxima*) domestication through experimental, physiological and archaeobotanical approaches

*Études multidisciplinaires de la domestication de la courge (*C. maxima*) : approches expérimentale, physiologique et archéobotanique*

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Plant domestication is a complex process in which natural and cultural factors play important roles delimiting evolutionary pathways of plants under cultivation. In order to deal and understand the changes generated during this process multidisciplinary research groups are required providing different approaches, mostly when a full picture of a taxa domestication history is to be assessed. In this presentation we expose advances in the study of *C. maxima* domestication through archaeobotanical, physiological and statistical analysis. An experimental plant field was established and crosses conducted between domesticated (*C. maxima* ssp. *maxima*) and the spontaneous/wild form (*C. maxima* ssp. *andreana*), advancing F1 and F2 generations. All the genotypes obtained were subjected to analysis. Physiological studies allowed us to characterize dormancy in all these genotypes setting the crucial role of the testa for the restoration of seed growth. Morphological and anatomical analyses of seeds, pericarps, peduncles and testas were conducted in order to reconstruct size and shape evolution under domestication and its linkage with physiological changes. All these analysis were then applied to archaeobotanical remains recovered from Southern Peru and North West Argentina archaeological sites ranging from 3000 BP up to the Spanish Conquest. Results suggest the presence of hybrid forms, mainly in the earlier sites, but also present in the latter ones. As it was expected, despite some trends, a linear evolutionary pathway was not found, diversity and multiple crossing seems to have been a constant through squash cultivation over time.

Keywords: Domestication, *Cucurbita maxima*, Cultivation, South America

Tracking the spread of oat in Atlantic Europe

Sur la piste de l'avoine en Europe atlantique

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Oat (*Avena* spp.) is a crop that can be grown in relatively challenging environmental conditions across Atlantic Europe. The popularity of oat has risen significantly in recent years because of new insights into its health benefits. What can archaeology tell us about early oat cultivation? When did oat start to be grown in Atlantic Europe, what foods were created, and did oat play a role in the creation of social identity? This paper will address these questions through examination

of archaeobotanical and related evidence for the cultivation and consumption of oat.

Keywords: Oat, Atlantic, Europe, Domestication, Food

Some morphological changes in seeds and fruit before preservation

Changements morphologiques dans les semences et les fruits avant conservation

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Plant remains are a significant source for reconstructing human activities and environments in archaeological sites. Usually, a higher number of plants identified to species level improves the chances for accurate reconstructions. Therefore, seeds and fruits are the most valuable remains since they provide the most detailed plant assemblage. When identifying a taxon, one has first to determine that the fossil is similar to its extant specimens. In addition, the finding has to be compared with all closely related taxa having similar seeds that might be expected to appear in the site on the basis of their current habitat and distribution area. As preservation of the remnant is higher, the ability to identify to the species level is greater. Waterlogging and desiccation are two antithetical ways of seed preservation. While waterlogged plant remains usually suffer degradation of soft tissues and compression, desiccated plant remains are generally well preserved. Desiccation is considered as the best state of preservation as desiccated plant remains show only minor morphological changes. However, some seeds or fruits contain dry soft tissues that can erode without leaving traces. As a result, remnants that appear to be complete may be somewhat or totally different from their original plant elements. They therefore will not be identified to the species level or will be designated as unidentified. Examples of these metamorphoses are the desiccated remains of *Erodium hirtum* and *Plantago ovata*, as well as the waterlogged remains of *Lycopus europaeus* and *Foeniculum vulgare*. In order to achieve reliable and meaningful identification, archaeobotanists should be aware of the metamorphoses of seeds and fruits and take them into consideration when identifying remnants. Consequently, when modern computerised 2- as well as 3-dimensional seed atlases are constructed, the metamorphosed remnants should be included in these atlases.

Keywords: Seeds identification, Metamorphosis, Desiccation, Waterlogged

A review of archaeobotanical research in Sudan with reference to palaeoenvironment and palaeoeconomy

Synthèse des recherches archéobotaniques au Soudan en lien avec le paléoenvironnement et la paléoeconomie

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This paper tries to provide review of archaeobotanical researches in Sudan focusing on the works which have been carried out in prehistoric and historical sites in different regions of Sudan. Different methods were adopted by different missions including the morphological identified of macro carbonized plants remains using microscopes, carpology, pollen grain analysis, positive casts and ancient plant drawings identifications ...etc. The obtained results of all these studies improve our knowledge to reconstruct the palaeoenvironmental, to know the plants cultivation and production history, palaeoeconomy and subsistence patterns in ancient Sudanese civilization. On other hand the review will reveal the archaeobotanical fields which not yet have been covered.

Keywords: Archaeobotanical, Methods, Africa, Sudan, Positive cast

The archaeobotanical remains of the ermita de Santa Potenciana site (Jaen, Spain). First results

Les vestiges archéobotaniques du site de l'ermitage de Santa Potenciana (Jaen, Espagne). Premiers résultats.

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Ermita de Santa Potenciana is an archaeological site situated in Villanueva de la Reina in the countryside of northern Guadalquivir River, Jaen province (Andalucía, Spain). Excavations directed by Antonia González and Juan Nicás Perales have revealed well preserved occupation layers from Roman to Medieval Periods (I-XVII AD). Archaeobotanical analyses in this site are part of an Argentinian-Spanish international research project entitled "The research of traditional crops in the Guadalquivir River and its application to restore of historical sites". The objective is to reconstruct of the ancient local landscape as well as to investigate the economy, especially agricultural activities, of this settlement. The archaeobotanical assemblages analysed only referred to Roman Period and their first results are presented here. Carbonized seeds and fruits from hearth structures, storage and refuse contexts were recovered using fine-sieving methods and were scanned under microscope at 20–400x in laboratory. Taxa included fruit-trees, cereals and pulses. The fruit-trees recovered are *Olea europea* (olive), *Vitis vinifera* (grape), *Prunus dulcis* (almond) and *Prunus domestica* (plum). The cereals are mainly *Triticum aestivum/durum* (bead/hard wheat) and *Hordeum vulgare* (hulled barley). Pulses are represented by *Lathyrus sativum* (almorta), *Lens culinaris* (lentil), *Pisum sativum* (peas) and *Vicia* spp. Different types of consumption of these plants were identified, such as for food or fuel. Archaeobotanical data for this period show, at Ermita de Santa Potenciana, a landscape strongly influenced by human action, most of it in relation to agricultural and/or husbandry practices.

Keywords: Macroremains, Roman period, Agriculture, Jaén

The origin of Bíle Karpaty meadows from the pedoanthracological perspective

L'origine des prairies de Bíle Karpaty à partir de l'analyse pédoanthracologique

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Vegetation is an inherently dynamic system of more or less intensively interacting plant populations. The recent vegetation of Central Europe is a heterogeneous mixture of plant communities of different age, depending not only on site conditions, but also on the history of vegetation development. The mesic meadows vegetation is usually interpreted as cultural relicts, i.e. vegetation types shaped by human management practices that used to be more common in the past and that have been abandoned. In this study we focus on the origin of the species rich meadows on mesic sites in the Bílé Karpaty Mts. The herb-rich meadows of Bílé Karpaty are among the most valuable territories, with the highest species diversity in the Europe. The meadows communities include mostly extensively managed species-rich mesic, dry-mesic and wet-mesic grasslands on base-rich to moderately rich but nutrient-poor to moderately rich soils (Cirsio-Brachypodium, and mesotrophic variants of Arrhenatherion). We have tried to reveal an origin of the meadows using the pedoanthracological approach. Seven soil profiles have been exposed along the altitude gradient (280-970m asl). The pedoanthracological analysis of the charcoal assemblage has provided an impression of the composition of the arboreal vegetation at the time of a meadows creation and has been supplemented by radiocarbon dating. The result of anthracological analysis and radiocarbon dating has been correlated with the altitude gradient. Our results show the presence of the human impact during the mesolithic, neolithic and early medieval period in relation to the altitude position of meadows. The charcoal records reconstructed the vegetation with a high abundance of *Quercus* sp. in the uplands and *Fraxinus excelsior*, *Acer* sp. in the highland territory.

Keywords: Charcoal, Origin of meadows, Long term human impact, Altitude gradient, Pedoanthracology

Crop storage and problems with pests at Late Neolithic settlement of Selevac, Serbia

Stockage des récoltes et problèmes de ravageurs sur le site néolithique final de Selevac, Serbie

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Selevac is a Late Neolithic settlement (Vinča culture, c. 5400-4650/4550 cal BC) located in the Lower Morava Valley, Central Serbia. During test excavations of the site in the 1970s, burnt crop storage deposits were discovered; remains of five possible storage containers were found, but only three that

contained recognisable cereal remains were sampled. Previous archeobotanical analysis of one of the storage samples was carried out by Maria Hopf (1974) while other samples were stored in the local museum (in Smederevska Palanka). These samples recently became available for the analysis. In this paper, results of the detailed analysis of three storage containers from Selevac are presented, with the reference to the original field documentation which has not been fully published. The results are used to discuss: (1) crop cultivation and storage practices in the Late Neolithic of the Central Balkans; (2) previously offered interpretations of the Selevac storage context, which differ in terms of storage construction (above ground granaries/pits) and purpose (storage containers/ovens for cereal grain parching); (3) possible problems with pests and crop losses, for at least one of the storages was infested with wheat weevil.

Keywords: Neolithic, Vinča culture, Storage, Einkorn, Wheat weevil

The development of agricultural resources in the Southern Levant from the Bronze to the Iron Ages

Le développement des ressources agricoles dans le sud du Levant de l'âge du Bronze à l'âge du Fer

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The agricultural developments in the Bronze and Iron Age Levant (3600 – 332 BC) have so far not been comprehensively investigated. A new project – “The land flowing with milk and honey”. Development and significance of agrarian resources in Bronze and Iron Age Palestine – which is part of the Collaborative Research Centre “Resource Cultures” at the University of Tübingen will try to fill this gap. The focus of this project lies on the development of the cultivation of crop through time. It is characterized by the combination of different scientific approaches namely the archaeobotanical, the archaeological, the iconographical and the philological method.

Since the Southern Levant is situated in a semiarid region climatic changes could have had dramatic effects on agriculture. For the Bronze Age variations in climatic conditions are still discussed intensively. Furthermore the Southern Levant experienced many cultural processes, such as the phenomenon of Urbanization and De-Urbanization or the suzerainty of the Egyptians over Canaan just to name a few. Available sources from climatology and ethnography will be investigated to reveal possible environmental and cultural impacts on changes observed in the archaeobotanical record.

The main aim of this contribution is to analyze all relevant archaeobotanical data that have been published until now, compiled in an archaeobotanical database (ADEMNES). Furthermore the project will include unpublished material from recent archaeological excavations (Tel Burna, Jaffa, Tel Farah, Qubur Walaydah, and Tell Burak). Statistical analyses will be used to illustrate developments and changes in the crop assemblages.

Keywords: Southern Levant, Bronze Age, Iron Age, Archaeobotani-

cal database, Statistical analyses

Earliest evidence of grape domestication in the western mediterranean basin

La plus ancienne preuve de domestication de la vigne dans le Bassin méditerranéen occidental

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A recent discovery of waterlogged grape pips, recovered into three wells dating from the Middle and Late Bronze Age (ca. 1350–1150 BC) in the archaeological site of Sa Osa (Cabras-Oristano, Sardinia), allowed to investigate the domestication process of *V. vinifera* and verify the possibility that primitive cultivars might have existed in Sardinia, during the Bronze Age. A morphological comparison of archaeological seeds and modern wild and cultivated Sardinian grapes pips was performed to determine the similarities among them. Modern seed materials were collected from 13 wild populations (*V. sylvestris*) and 37 traditional cultivars (*V. vinifera*) grown in Central-West and South Sardinia. In addition, two Italian and French cultivars and 25 wild plants, grown by the Agricultural Research Agency of Sardinia (AGRIS) for five years through propagation by cuttings, were also sampled. Digital images were acquired using a flatbed scanner and then processed and analysed with the image analysis software KS-400 (Carl Zeiss Vision, Germany), applying a macro specially developed for the wild seeds characterization. A total of 98 morphometric features were measured on 98,338 grape pips. The recorded data were statistically analysed, applying the stepwise Linear Discriminant Analysis method (LDA), to compare the modern cultivars with the archaeological seeds, which were considered as unidentified specimens. The results showed that the archaeological seeds from the Middle Bronze Age have intermediate morphological traits between modern wild and cultivated grape pips of Sardinia. In contrast, the analyses performed on the archaeological seeds from the Late Bronze Age showed a high degree of similarity with the modern cultivars. These results provide the first evidence of primitive cultivated *V. vinifera* in Sardinia during the Late Bronze Age (1286–1115 cal BC, 2 σ). This evidence may support the hypothesis that Sardinia could have been a secondary domestication centre of the grapevine, due to the presence of ancient cultivars that still exhibit the phenotypic characteristics of wild grapes.

Keywords: Archaeological seeds, Domestication process, Image Analysis, Nuragic society, Seed morphology, Sardinia

Integrating macro- and micro-archaeobotanical proxies to activity area analysis of semi-subterranean buildings. An Early Iron Age (EIA – Hallstatt culture) case study from the Carpathian Basin

Intégrer les macros et micro-restes archéobotaniques aux analyses des aires d'activités de bâtiments semi-souterrains.

Un cas d'étude du premier âge du Fer (EIA – culture de Hallstatt) dans le bassin des Carpates

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The everyday life of past human societies are assessed not only through the diverse material heritage they leave behind, but also through the more ephemeral but critical evidence provided by anthropogenic sediments. Such sediments are formed at activity surfaces, places where sediment formation occurs due to the impact of human activity. In this sense activity area is defined as a specific part of human occupation within settlements and features where a well-defined activity was performed in the past (e.g. places of food preparation, crop processing or metallurgy). The cultural differences in domestic space use, and the development of household activities, are encoded both in the material remains and in the anthropogenic sediments. However, since anthropogenic sediments are the most abundant finds at archaeological sites, they provide a vast array of possibilities for integrated multi-proxy studies. Research projects in the past that addressed questions related to activity area analysis applied the tools of various disciplines (e.g. ethnography, geoarchaeology, archaeobotany). These gave important insights in their own right. The separate use of different scientific components within activity area analysis support the archaeological interpretation of these features, but the combined analysis of the data significantly increase our knowledge in this field. To achieve this aim our methodology links the tools of archaeology, soil science, geochemistry and archaeobotany into an inter- and multidisciplinary approach by integrating sampling methods suitable to carry out activity area analysis, and by bringing together the analytical results of geoarchaeological and micro-archaeobotanical methods supported by GIS technology based models. In this sense the present contribution deals with the scientific results of each applied discipline, but also undertakes an attempt to demonstrate the use of GIS technology in the data integration and data assessment of activity area studies.

Keywords: Phytoliths, Integrated archaeobotany, Geochemistry, Geoarchaeology, Early Iron Age

The first archaeobotanical evidence of *Lagenaria siceraria* from the territory of Hungary

*Première découverte archéobotanique de *Lagenaria siceraria* en Hongrie*

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Bottle gourd (*Lagenaria siceraria* (Molina) Standl.) is accepted as typical New World' cultivated economic plant. Currently, two subspecies are known: *L. siceraria* ((Molina) Standl.) subsp. *siceraria* has an African origin, whilst subsp. *asiatica* is recognized to be originating from Asian territories. It only seldom appears in European archaeological context, however finds from the Roman period sporadically appear. A Late Middle Age (14th-15th cent.) settlement part was excavated near the town of Pócspetri (SE Hungary) and one of the refuse pits contained waterlogged remains of several dozen dicot leaves and small sized branches (e.g. *Populus* sp.). In addition an entire dog skeleton and an app. 10 cm by 7 cm bottle gourd pericarp fragment was found in a well-preserved pot. This fortunate recovery accounts for the first evidence of bottle gourd in the archaeobotanical record of Hungary. Due to its favourable preservation not only its precise histological analysis could have been undertaken, but ancient DNA (aDNA) extraction, PCR amplification and sequencing was used to more closely identify its possible origin and taxonomic relations. Different diagnostic phytolith morphotypes of the archaeobotanical rind find were matched to modern reference phytolith assemblages. The diversification of plant exploitation in the Late Middle Ages is supposed to be in correlation with migrations through the Carpathian Basin. Moreover, trading and the import of agricultural and agro-technical knowledge led to the step-by-step intensification of crop production and of horticulture and viticulture. This latter is extremely important if we would like to place bottle gourd in the Carpathian Basin in an economical context, since the species is a regular additional plant of smaller wine yards. Since bottle gourd was not detected in this geographical region so far, it is hard to find any parallels, however it fits well to the vegetable production of introduced species of the Late Middle Ages. Though the aDNA analysis linked the find to the Asian subspecies it cannot be adjudged whether it was grown locally, imported through trading from the east or from the west.

Keywords: Bottle gourd, Phytolith analysis, Integrated archaeobotany, DNA, Late Middle Age (14th, 15th cent.)

From weed to wheat: a diachronic approximation to crop production and food consumption in the Santa Maria valley (Argentinean Northwest)

De la mauvaise herbe au blé : approche diachronique des productions agraires et des pratiques alimentaires dans la vallée de la Santa María (nord-ouest de l'Argentine)

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In this presentation we bring together knowledge concerning crop production and food consumption in the Santa María Valley, Argentinean Northwest, in a time span ranging from the first Millennium of the Era up to the first centuries after the Spanish Conquest. Plant production is evaluated together with the postharvest system through the analysis of plant macroremains obtained in four archaeological sites (Rincon Chico 1, Rincon Chico 15, Soria 2, El Colorado). As a result of our research we suggest changes through time considering the predominance of weeds in the earliest of the archaeological sites, maize in those corresponding to the Late Period (1000-500 BP) and wheat in the latter one. Bringing together archaeobotanical analysis with other archaeological studies developed in these archaeological sites, we reflect on the possibility of evaluate changes in crop assemblages, processing and food consumption from a diachronic perspective considering the continuities, breaks and overlaps in the valley 's history.

Keywords: Argentinean Northwest, Weeds, Wheat, Production

La Monédière (Bessan, France) : archaeological fruit and seed remains

La Monédière (Bessan, France) : vestiges archéologiques de fruits et de semences

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The oppidum of La Monédière (Bessan) is a major site of coastal Languedoc (southern France), situated near Agde. It was founded during the first half of the 6th century BC and abandoned at the end of the 5th century BC. Recent rescue excavations conducted by Chronoterre Archéology in 2014 has allowed identifying new occupation levels dated to the 2nd-1st centuries BC and 1st century AD. Abundant Mediterranean elements (for instance, Greeks, Etruscan, Punic and Iberian) are attested. It seems that the inhabitants of La Monédière have left the site when the Adge's colony was founded. La Monédière is an important site for understanding the exchanges between a Greek colony and the indigenous hinterland. The work presented here concerns the first Iron Age levels. At this moment, La Monédière was fortified and the inner habitat consisted of large rectangular houses (made of stone and adobe) for the older phase and of curvilinear houses for the 5th century phase. Several domestic structures (hearths, pits...), as well as an unusual and massive pit (a cistern?) containing abundant ceramics and bones (remains of a symposium?), have been attested and sampled. The analysis of the seed and fruit remains of La Monédière, all charred provides new data about plant consumption and crop productions. Cereals (mainly barley, emmer and naked wheat) and pulses are the most abundant taxa, but we can also find some fruits such as grapes. We will discuss the economic role of these species in the regional and chronological context of the site and we will try to characterise the agricultural practices through the wild taxa.

Keywords: First Iron age, Southern France, Seed and fruit remains, Plant consumption, Exchanges

Archaeobotany at Khirsara (2600-2000 BC), a Harappan site in Kachchh, Gujarat, India

Archéobotanique à Khirsara (2600-2000 av. J.-C.), un site harappéen à Kachchh dans le Gujarat (Inde)

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We present archaeobotanical data obtained from excavations at Khirsara, a Mature Harappan (2600-2000 BC) outpost in Kachchh, Gujarat. The incidentally carbonized grains and seeds of *Hordeum vulgare* (barley), *Triticum* sp. (wheat), *Eleusine coracana* (ragi millet), *Pennisetum glaucum* (pearl millet), *Sorghum bicolor* (bajra millet), *Panicum miliaceum* (proso millet), *Setaria italica* (Italian millet), *Pisum arvense* (field pea), *Lathyrus sativus* (grass pea), *Cicer arietinum* (chick pea), *Vigna radiata* (green gram), *Macrotyloma uniflorum* (horse gram), *Sesamum indicum* (sesame), *Linum usitatissimum* (linseed) and *Gossypium* sp. (cotton) indicates agriculture based on double-cropping, although barley is dominant in the assemblage. In addition, there is evidence for gathered grains/fruits of *Setaria* sp. and *Ziziphus*. Further, a number of weeds and other wild taxa have turned up as an admixture in the crop assemblage, which throws considerable light on the vegetation cover around the settlement area. Some species occurring in the cultivated fields, may be taken as dependable evidence of crop and weed association.

Keywords: Archaeobotany, Macroremains, Indus civilization, Gujarat, India

Plants offerings from the antique sanctuary of Labranda

Offrandes végétales du sanctuaire antique de Labranda

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The ancient city Labranda, is a holy area of Zeus Labraundos, is in ancient Karia (South-western Anatolia), 14 km to the north-east of Mylasa city to which it is affiliated. The most ancient findings belong to the year 600 BC. The area that was used as holy area in the 6th and the 5th centuries and then as temple terrace consisted of a single, small, artificial terrace. A war took place in the holy area in 497 BC and Karia army has been defeated by the Persian army with its alliances. The 4th century BC is the most important period for the temple. The botanical remains were collected from different context. The main species recorded are: *Pinus pinea*, *Vitis vinifera*, *Juglans regia*, *Ficus carica*, *Prunus* sp., *Lens culinaris*, *Triticum aestivum/durum*, *Hordeum vulgare*, fragments of charred bread. The use of plants in variety of rituals is common practice in the Antiquity. Numerous archaeobotanical remains from different archeological sites presented evidences that some plants were particularly introduced to the religious rituals. The goal of the present study is to identify specific plants and food that was

subject of ritual practices in Labranda sanctuary. The study also will discuss similarities and differences between different plant remains in the archaeological context and will identify which plants were used as a ritual food. The study is based on a comparative archaeobotanical analysis of several sanctuaries in the territory of Bulgaria as well as in Turkey and gives a clear indication of certain similarities and differences between those regions, which will be discussed as well.

Keywords: Sanctuary, Ritual food, Labranda

Archaeobotanical research in Classe (Ravenna, Italy)

Recherche archéobotanique à Classe (Ravenna, Italie)

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The archaeobotanical research carried out in ancient ports can provide key information on the plant landscape of the area, and also on climate, the food customs and the commercial traffic. In Italy, in the last fifteen years, archaeobotanical studies were conducted in some of the most important ports of the Roman period, located along the Tyrrhenian coast such as Rome, Pisa, Naples. The site of Classe is the most important port of the Adriatic between the 1st and 7th century AD. It represents the first study of port contexts in this part of the Mediterranean sea. The archaeological surveys discovered a well connected to a horizontal duct containing a large quantity of archaeological material dating from the 2nd to 7th century AD. There is a significant amount of organic remains preserved by waterlogging in the sediments of the duct. The research on this water structure has revealed a rather rich carpological list (176 taxa), considering the exceptionality of the site of Classe. The site shows a high plant biodiversity, perhaps evidence of the simultaneous presence of different habitats. The more data obtained are those related to the relationships between plants and man. There are several evidences of fruit trees/shrubs, especially olives, and peach, melon, mulberry and the earliest remains of the jujube tree for the Northern Italy. Moreover, condiments and vegetables are represented by, e.g., coriander, rue and bottle gourd. Among crops useful for the craft, there are madder, hemp and flax, although for the latter plant the possible use as food may be also hypothesised. Of interest are the records of cypress, that are known to have been probably introduced in the Etruscan period, and then spread by the Romans. Concerning wooden elements, about 300 records belonging to 27 taxa represent almost all manufactured goods. They prevalently were made by elm (e.g. for tools), boxwood (e.g. for spindle whorls), oak and fir (e.g. for *tabulae ceratae*).

Keywords: Port, Roman Age, Seeds/fruits, Wooden objects, Northern Italy

Archaeobotanical remains and funerary rituals from the Agro Mutinense necropolis (1st-4th century AD)

Vestiges archéobotaniques et rituels funéraires de la nécropole d' Agro Mutinense (Ier-IVe s. ap. J.-C.)

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The research aims to study the archaeological and archaeobotanical remains from the *agro mutinense* necropolis of Mutina, dated from the 1st to the 4th century AD. The purpose is to make a wider and complete framework of the deepen aspects concerning the after-death rituals, as inferred from graves contexts. The research focuses on the foodstuffs and offers that were common during the Roman Age, the way of thinking they represent and the symbolism related to death in juxtaposition with life. How did they change in relation to individual, social and economic aspects? During Roman times, ritual offerings were widespread in graves, especially in three principal ceremonies: the libation, the funeral meal and the gift to the dead. Indeed, in these sites, the records of raw, cooked or burnt food in funerary contexts depends on human practices: different kind of objects and products can potentially provide more information about the deads, their beliefs and customs.

The Novi Sad Park (urban site) and Marzaglia (rural site) are two sites providing hundreds graves, both of the cremation and inhumations type. The analysis of this necropolis shows that fruit records are the most common (grapes, dates, figs, peaches, walnuts, pinenuts, hazelnuts). Also cereals and pulses, among which is the fava bean, are important. In addition to traditional methods, such as sieving and flotation, new advanced technologies helped to study offerings presence. For this reason, in order to visualize the internal structure of the burned archaeological samples using a non invasive technique, a CT-scan has been used in 3D reconstructions obtained from the archaeological samples. Archaeobotanical records have been compared with modern samples burned in anoxic conditions at 500 °C for 2 hours. In order to investigate the temperature of burning adept in ancient practices, archaeological samples were analysed using a SAXS approach (200-900 °C).

Keywords: Funerary banquet, Mutina, Roman Age, CT, scan/SAXS, Burned samples

Agriculture and wood management in Islamic Extremadura (Spain)

Agriculture et gestion du bois en Estrémadure islamique (Espagne)

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Started in 2009, the multidisciplinary project in the archaeological settlement of Albalat (Extremadura, Spain) aims to document the small fortified Islamic establishment, mentioned by the textual sources from the second half of the 10th century. Located on a terrace dominating one of the fords that cross the Tagus river, the site became for the Christian troops a

strategic objective, leading to the siege and the systematic destruction of the city in the mid- 12th century. Covering a total area of more than 1000 m², the excavation has revealed various types of contexts organized along streets: domestic spaces (kitchens, ovens, storage and patios), craft spaces (forge), as well as a hammām installed at the foot of the wall of the city. Archaeobotanical material, extracted from about 150 samples, comprises charred and mineralized seeds/fruits as well as charcoals in varying degrees of abundance. From the analysis of the carpological samples, 19 cultivated/gathered taxa were found: 7 cereals, 1 pulse, 1 technical/oil plants and 10 fruits, and approximately an additional 20 weeds/wild plants. *Triticum aestivum/turgidum*, *Hordeum vulgare*, *Secale cereale* and *Panicum miliaceum* were the principal crops, produced in local fields. The numerous cereal chaff and straw remains discovered suggest their use as fodder or litter in the biggest houses of the city. The pulses, less common than cereals, are mainly represented by *Vicia cf. sativa*. The most frequent fruits are *Ficus carica* and *Quercus spec.*, although a large diversity of cultivated/gathered species was used (*Castanea sativa*, *Morus alba/nigra*, *Olea europea*, *Malus/Pyrus*, *Prunus avium/cerasus*, *Prunus persica*, *Prunus dulcis*, *Vitis vinifera*.), taxa also present for some of them among the charred wood of the deposits. *Linum usitatissimum* is also commonly found. The exploitation of dry, rich soils is suggested by the discovery of several nitrophilous taxa (*Lolium temulentum*, *Agrostemma githago*, *Solanum nigrum*). In the meantime, charcoals testify of the exploitation of various habitats for timber and firewood, such as the oak forest (*Quercus ilex/coccifera*), the riparian woods (*Alnus sp.*, *Fraxinus sp.*, *Ulmus sp.*) and orchards (different types of Rosaceae –Prunus and Pomoideae-, *Vitis vinifera*, *Olea*). The preferential use of Pine wood in several contexts must also be discussed. This study allows for the first time to shed light on the plant species exploited and on their uses by the Islamic populations of this area, at the edge of al-Andalus.

Keywords: Archaeobotany, Islamic Spain, al Andalus, Middle Ages, Extremadura

The agriculture in Northern Italy during the Iron Age: a review

L'agriculture en Italie du nord durant l'âge du Fer : une synthèse

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In this review we analyse published archaeobotanical data, with particular regard to the analysis of plant macro-remains, in more than 30 settlements, sanctuaries and cemeteries in Northern Italy, carefully evaluating the archaeological contexts, the quality of the sampling and the analytical procedures employed. In order to better understand the botanical data, detailed consideration of the archaeological contexts of their discovery is necessary. The analysis of excavation data is necessary not only to date the finds, but also in order to precisely understand the origin and temporal dynamics of the spread and cultivation of each different species. In fact differ-

ent archaeological cultures are present in different territories in Northern Italy during the Iron Age (Veneti, Golasecca culture, Reti, Camuni). Then there are the Etruscan colonisation from south, the Celtic colonisation from north and lastly the Roman "colonisation" of the territory. Compared to the Bronze Age, in Northern Italy we see the introduction of new species (especially of fruit), the increased production of legumes and the development of new agricultural techniques, such as crop rotation and the use of more effective tools. These changes are reflected in a surplus of production and in the use of more complex storage systems. This process seems to be the prelude to the development of agriculture in Roman times, which cannot therefore be described as the simple agricultural colonization.

Keywords: Iron Age, Northern Italy, Agriculture, Fruit Farming

Wet preservation in a semi-arid environment – well features from the Bronze Age Sintashta settlement Kamennyi Ambar (Russia) as multidisciplinary archives

Conservation humide en environnement semi-aride – vestiges de puits du site de l'âge du Bronze de Sintashta (Kamennyi Ambar, Russia) comme archives multidisciplinaires

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Water is one of the key factors for people when choosing a place to stay – this issue becomes still more important for herdsmen who are responsible to supply their stock. That is why the Transural penneplain with its gently rolling landscape intersected by perennial streams with fertile meadows was so attractive for the Sintashta people. Additionally, they and other Bronze Age cultures in the Eurasian steppe belt built wells within their settlements – many of them – one or even more for each living unit. These features are multidisciplinary archives and thus important elements in understanding the way people were organizing their subsistence and day-to-day live. Drilling cores taken before excavation conserve the otherwise lost stratigraphy which enhances our knowledge about the occupation in the settlement by analysis of the (very diversified) filling history, about the craft standard concerning digging and construction technology and maybe its development through time. The cores are a source of stratified short-lived plant material to build up a detailed chronology. The wet preservation of waterlogged organic material allows to study wooden artefacts in general and to get information about the choice and availability of construction wood. In the well features plant remains are preserved which otherwise would be lost in steppe sediments. Therefore, at Kamennyi Ambar we have the possibility to compare both wet and charred plant remains one site which results in a more detailed knowledge about the vegetation composition and about plant choice and use by the Sintashta pastoralists. As also pollen and spores are preserved archaeobotanical analyses can be brought together.

Keywords: Archaeobotany, Multidisciplinary archives, Wells, Steppe, Sintashta culture, Bronze Age

Markers of agriculture at archaeological sites of the Russian Far East: coherence of the results of carpological, pollen and phytolith analyses

Marqueurs agricoles des sites archéologiques du grand Est russe : cohérence des résultats des analyses carpologiques, palynologiques et de phytolithes

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We unveil new materials of carpological, pollen and phytolith analyses of cultural layers in archaeological sites of Priamurye and Primorye (south of the Russian Far East) where population practiced agriculture since the Neolithic age. We have applied various methods to conduct a joint research of the samples from the Neolithic and medieval settlements at the Osinovo Lake and multilayered site of Risovaya-4. The research is focused on evaluating the feasibility and efficiency of three paleobotanical approaches in search for the proofs of ancient farming in cultural layers. We have also emphasized the problems of identifying the pollen and phytoliths of millet species, which lay in the basis of the ancient agriculture in this region. It has been established that under these conditions a carpological method has become the most efficient in searching for the remains of cultivated plants: it revealed a representative set of seeds of cultivated plants in the deposits of two out of the three sites researched. The method has brought new data confirming the composition of cultivated plants in the Medieval Western Priamurye. A cultural layer of the Middle Neolithic Period (Risovaya-4) contained the seeds of two species of cultivated millet and the pollen similar to *Setaria italica*. The assumption about existing middle-Neolithic agriculture in Primorye needs a more reliable confirmation. The sediments of all three sites contained occasional microremains, which are morphologically similar to the phytoliths of cultivated plants; however, they were not sufficient for identifying a plant species. Simultaneous sampling for pollen and phytolith analysis has proven low-efficient; the preservation of grasses pollen in soil deposits has turned out critically unfavorable thus explaining the inconsistency of test results. However, pollen and phytolith data have supplemented to the carpological results and confirmed the assumption about incorrectly-identified age of the carbonized grains at the Neolithic settlement of Osinovo Lake. Abundance of forests around the sites in that period, lack of extensive deforestation, as well as lack of segetal weeds prove that the fields either did not occupy major areas or were localized away from the settlements.

Keywords: Millet agriculture, Russian Far East

Middle Ages *Cucumis melo* L.: molecular and morphological characterization

Cucumis melo L. au Moyen Âge : caractérisation moléculaire et morphologique

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In 2007, during an archaeological excavation in the city centre of Sassari (Italy), a well dated to between 1330 to 1360 AD was discovered. The fill of this context yielded a huge assemblage of ceramics, zoological and plant remains. Among the 117 plant taxa identified, a consistent presence of *Cucumis melo* L. seeds was recorded. Their exceptional state of preservation allowed the application of specific analyses for molecular and morphological characterization. Sets of 179 accessions of melon landraces from Europe, Asia and Africa, included Sardinian traditional cultivars, were selected for molecular and morphological comparison to the archaeological seeds. Genotyping was performed using 211 polymorphic SNPs and the genotyping technology iPLEX Gold MassARRAY Sequenom. A total of 96 morphometric parameters, acquired by an automatic image analysis system, were specifically designed to evaluate seeds size and shape. Results from the molecular and morphological analyses showed some affinity between the archaeological seeds and domesticated melons. The closest accessions to the archaeological seeds were both sweet types, as Cantaloupe and Winter melon, and non-sweet ones, as snake melon and Chate, coming from Central Asia, Near East, North Africa and Europe. Data also showed a high variability in seed shape as well as in genetic admixture, probably due to the coexistence of various melon types, which might suggest that in Sardinia, during Middle Ages, phenotypes were still not fixed and different types of melons were already cultivated. These typologies likely included sweet and non-sweet forms, making these fruits still distant to the current ones. This is in agreement to the previous idea that the spread of sugary melons may occurred only later as a consequence of independent introductions between the late Medieval and Renaissance periods.

Keywords: Melon, Ancient DNA, Morphological analysis, Archaeobotany

Archaeobotany of the Bronze Age in the region of South Bohemia (Czech Republic)

Archéobotanique de l'âge du Bronze dans la région de la Bohême du sud (République tchèque)

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The aim of our contribution is to notify of current macroremains analysis of the Bronze Age cultural sediments in the region of South Bohemia (Czech Republic). Macroremains analysis represents in our research another source of interpretation of archaeological features infill and cultural layers and it makes possible to reconstruct palaeoeconomy of settlement areas (e.g. housing, economy, burial rite, etc.). Sampling for macro-remains analyses has been systematically applied since 2005. Recently we have several hundreds of analyzed samples and tens of thousands of individual determinations. Samples were dated based on artefact typology or by AMS radiocarbon dating within the interval of 1800 – 800 BC. The main topic of this contribution is the first conclusion of the utility plants structure in the region of South Bohemia and methodology of sampling of prehistorical features and layers. It can be concluded that the number of species of utility plants was constantly rinsing during the Bronze Age. The structure of utility plants is connected with the cultural contacts among the European societies.

Keywords: Plant macroremains, South Bohemia, Bronze Age

Economic and social insights from C- and N- isotopes of rich cereal finds

Éclairage économique et social à partir des isotopes C- et N- de riches assemblages céréaliers

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Isotope analyses on cereal caryopses evolve over the last few years to a powerful tool in reconstructing hydrological growing conditions and identification of possible manuring practices. Comparing the results from different areas and time periods we identified further profits of N- and C-isotope analyses in archaeological contexts as well as possible pitfalls in their interpretation. Very rich cereal finds in the Early Bronze Age tell settlement Fidvár near Vráble at the northern margin of the Carpathian Basin (SW-Slovakia) offered the opportunity to compare yields from separate fields ripened under different humidity conditions and manure intensity. Comparisons between households of the central and the peripheral part of the settlement may here allow identifying social differences expressed in field qualities. The latter might be also connected with the absolute duration of field cultivation as well as field distances from the settlement. In northern Germany, we compared isotope values of different cereal species along a profile from the dwelling mounds (Wurten) at the North Sea coast into the river marshes of the hinterland, representing a steep gradient in salt concentration in soils from high salinity stress to freshwater conditions. Along the salinity gradient, the C-isotope values vary accordingly from apparent high at the coast to normal low values in the hinterland. Regarding the reduction of yields under salty conditions expressed in high $\delta^{13}C$ values, the yields per m² at the coast must have been about 25% less than in fields with fresh water conditions. All measured cereal samples (barley, wheat, rye) from Germany and Slovakia show mean $\delta^{15}N$ -values between 3,5

- 8,5, except one. With about 10,5 a rye sample from one of the dwelling mounds exhibit an extraordinary high content of the ¹⁵N-isotope. This high value may point to the use of well decayed farmyard manure. Thick layers of such dung were found during the archaeological excavations in the barns on top of the dwelling mounds and in the mound sediments as well. But to better understand the values, analyses of rye cultivated under different manure practices have been started. The gradient study from Northern Germany suggests a significant positive auto-correlation between C- and N-isotope values. This needs further investigations and has to be taken into consideration when using these isotopes as palaeoecological proxies.

Keywords: Tells, Carpathian Basin, Dwelling mounds (Wurten), North Sea coast, Harvest yield

Medieval cultural plants in the Russian Far East – results of the seed analysis at Bohai State sites (698-926 AD)

Plantes médiévales culturelles dans le grand Est Russe – résultats des analyses carpologiques des sites de l'état de Bohai (698-926 ap. J.-C.)

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The results obtained by the quantitative analysis of seeds from sites occupied during the Bohai State (698-926 AD) and post-Bohai periods (10th century AD) in the Primorye region of the Russian Far East allows us to reconstruct the archaeobotanical spectra and identify the main agricultural plants. Three fortified towns and two other settlements dated to the 8th-10th centuries are concerned by our study. The seeds of cultivated plants are largely predominant in all contexts. Between 8 and 12 crop species are recognised according to the sites: *Abutilon theophrasti*, *Cannabis sativa*, *Echinochloa utilis*, *Fagopyrum esculentum*, *Glycine max*, *Hordeum vulgare*, *H. vulgare var. nudum*, *Panicum miliaceum*, *Perilla* sp., *Pisum sativum*, *Setaria italica*, *Triticum aestivum* and *Vigna angularis*. Among these, foxtail and barnyard (Japanese) millets largely predominate, attaining at least 50-60 % on all sites. The archaeobotanical spectra from the different sites show many similarities but also minor variations. The town settlement of Koksharovka-1 stands out in particular with nearly 90 % of the seed assemblages represented by foxtail millet. This particular situation may be the result of food preferences or other cultural specificities of this urban population.

Keywords: Primorye, Middle Ages, Seed analysis, Archaeobotanical spectra

The study of biodiversity as a new method of interpretation of an archaeobotanical data

L'étude de la biodiversité comme nouvelle méthode pour interpréter les données archéobotaniques

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Just as on the basis of modern floristic data, also archaeobotanical ones could be a source of knowledge about biodiversity. Biodiversity studies of anthropogenic flora of the present human settlements shows a direct link between the number of plant species with the number of human population. It is proved that the larger human population is connected with greater diversity of flora of examined settlement. The aim of this poster is to present the results of biodiversity studies which were made on the basis of macroremains analysis. The processed data were gained from large medieval urban sites from Poland, for which it is possible to connect archaeobotanical data with demographic ones (known from historic sources). These studies will provide a reference point for interpreting data from smaller medieval sites located in Central-Eastern Europe. Thanks to this comparison it will be possible to determine the hypothetical number of people which probably lived in e.g. medieval small town or village, on the basis of plant macroremains analysis. If it is impossible to compare gained archaeobotanical results with data from reference sites (e.g. in case of lack of historic data), it is possible to analyze the biological diversity of archaeophytes and apophytes. A relatively large number of first ones describes the level of community development – the higher it is, the more archaeophytes should be in the fossil flora. With a relatively large number of apophytes conclusions should be different – the settlement was small or/and underdeveloped. Methods presented above certainly do not exhaust the possibilities offered by biodiversity analysis. They represent only the basis for the development of a new tool in the interpretation of the archaeobotanical data.

Keywords: Biodiversity

Berries from Belgium: archaeobotanical finds of redcurrant, blackcurrant and gooseberry

Baies de Belgique : découvertes archéobotaniques de groseilles, cassis et groseilles à maquereau

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Recently medieval and post-medieval carpological data from Belgium were collected in an ArboDat© database. The dataset obtained shows a diversification of fruit species during the late medieval period, which can be related to the development of horticulture. Blackcurrant (*Ribes nigrum*), redcurrant (*Ribes rubrum*) and gooseberry (*Ribes uva-crispa*) belong to this new fruit species group occurrence. In the Low Countries *Ribes* sp. pollen and macrobotanical remains dating to the Atlantic period were recently recorded, suggesting that at least some species are autochthonous. However, it is striking that the earliest records after prehistoric times date to the medieval period. In Northwestern Europe archaeobotanical finds become more frequent from the end of the medieval period and the beginning of the early modern period onwards. Likewise, the oldest historical sources date to the 15th and 16th centuries. This poster gives an overview of the Belgian archaeobotanical records of *Ribes* species. We will discuss the species status and use during the late medieval and post medieval period in Belgium based on archaeobotanical finds and information from iconographical and written sources.

Keywords: Europe, Middle Ages, Horticulture, Diffusion, Trade

Methodological studies in waterlogged sediments

Études méthodologiques de sédiments en contextes imbibés

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Despite excellent preservation conditions, the taphonomy of wetland settlement layers at lakes in Central Europe (“pile dwellings”, UNESCO world cultural heritage) is not well understood. In order to improve this situation, an SNF-funded project was started by an interdisciplinary team at IPAS (project nr. CR30I2_149679/1). Aim of this project is to identify natural and anthropogenic factors influencing the deposition and preservation of occupation layers, among them also post-excavational factors like methodology. Several factors which could influence the outcome of archaeobotanical analyses were tested. In this poster, we will shortly present our research about the four factors sieving, subsampling, volume measurement and the semi-quantitative recording of preservation parameters. The consistency of the wash-over sieving process done by different operators was looked at, revealing that there were some systematic differences present in the large fraction of the tested samples due to the techniques of the sievers. However, with counting guidelines and detailed instructions, it is no disadvantage to have different sievers in one project. The subsampling process was also looked at in detail. Due to the clumpy distribution of remains in waterlogged sediments, square subsampling (sampling of sediment from two grids of a sample) was less suitable than systematic grid subsampling (sampling of a portion out of every grid of a sample). We could also determine what amount of remains had to be counted in order to have a good representation of a waterlogged sample in terms of proportions and diversity. Different volume measurement techniques (classical before and after freezing and displacement) were compared and a systematic difference was found. However, with the use of a proportionality factor of 1.5, the different techniques can easily be compared. The description of preservation parameters in wetland settlements was often done, but rarely evaluated in a systematic way. Indicators for presence or absence of processes of erosion and corrosion were defined and a methodology for their efficient recording was developed and used for the reconstruction of the taphonomic history of layers. Methodology can have a large impact on archaeobotanical data and should therefore always be disclosed at a detailed level. Our research will help to standardise some common methods used in the archaeobotanical analysis of waterlogged sediments, and thus hopefully eliminate a potential source of error.

Keywords: Methodology, Wash-over sieving, Subsampling, Volume measurement, Preservation parameters

Food strategies and supplies: inferring crop provenience from carbon and nitrogen stable isotopes analysis

Stratégies alimentaires et approvisionnement : déterminer l'origine des cultures par l'analyse des isotopes stables du carbone et de l'azote

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In this work we try to assess the possibility of using carbon and nitrogen stable isotopes as markers of crop provenience. Studies and long-term experiments carried out in the last decades show significant relationships between the growing-site conditions and the isotope signature in cereals: edaphic features and water availability influence N and C ratio in plant remains. Based on this assumption, in order to reconstruct past trades, the incidence of foreign supply on local production and verifying the presence of clusters of cereals referring to different harvesting areas, samples of caryopses from two archaeological sites were selected and subjected to quantitative analysis of stable isotopes. The measure of carbon and nitrogen ratio was also extended to charred wood remains of wild local vegetation considered marker of local pattern. The first site is an insular Early-Bronze Age settlement, Filo Braccio, located in Filicudi in the Aeolian archipelago, where were found some huts and a multifunctional open area which was probably assigned to the processing of cereals (threshing and roasting). The Aeolian Islands represent a privileged point of view for biological and human dynamics and trades in Central Mediterranean area. The other site considered is the site of Egnazia, in the Apulian region. This is a long life city, occupied from the Bronze age to the Middle Ages; our study focused on the period between II cent. BC to XIII cent. AD. Egnazia is located in a region particularly suitable for crop growing thanks to its geomorphological features. Furthermore, its coastal location also projected the city towards maritime trades. This approach shows how the analysed kernels could refer to statistically distinct groups, then grown in different areas, some of which are probably not of local production.

Keywords: Stable isotopes, Food-Stuff provenience, Early Bronze Age, Roman Period, Southern Italy

Plant exploitation at Agrigento (Sicily, Italy): first results from the Hellenistic-Roman quarter and the midden layers over the temple of Isis

Exploitation végétale à Agrigente (Sicile, Italie) : premiers résultats du quartier hellénistique-romain et des niveaux de fumier près du temple d'Isis

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The aim of this work is to investigate the relationships between humans and the environment over the Roman Period and the Late Antiquity at Agrigento (south-western Sicily). During the last archeological excavation in the Valle dei Templi' digging was supported by sampling strategies of the sediment and systematic archaeobotanical analyses were carried out. Sampling involved functional and chronological distinct contexts of the Insulae I and IV of the Hellenistic-Roman Quarter, for example some ash lenses from the cubicu-

lum (II-III cent. AD), a most recent burial (VI-VII cent. AD) and the filling of a pit with thermally altered walls (Late Antiquity). Other archaeobotanical analyses were also performed in the area of the Temple of Isis where wide dumping layers, dated to IV-V cent. A.D., have been recovered. Although preliminary, data allow to advance some assumptions. Charcoals highlight the exploitation of distinct habitats (maquis, woodland) and the use of specific taxa as fuel, likely selected because of their calorific value. Economy was mainly oriented towards the cultivation of cereals and pulses but fruit trees were also an important food source. At present archaeobotanical data allow to fill, partially, an information gap that characterizes Sicily in the period between the first century. B.C. and the tenth century. A.D., providing informations about the main catchment areas of plant resources and defining land use and main crops.

Keywords: Urban archaeobotany, Plant exploitation, Roman period, Agrigento, Sicily

Plant remains from the neolithic site of Kleitos, Northern Greece

Restes végétaux du site néolithique de Kleitos, Grèce du nord

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The aim of this presentation is the study of plant charred remains, in an attempt to reconstruct past human activity and to shed light on crop processing practices, production, consumption and discarding strategies at the Neolithic site of Kleitos. Kleitos is situated near the city of Kozani, in Northern Greece. During the excavation of the settlement which started in 2006 and lasted until 2010 an attempt was made to collect soil samples from all the excavated units. The sampling strategy thus employed was close to total sampling, sampling of almost all excavated features. Samples studied here are dated to Late and Final Neolithic age and correspond to various habitation phases excavated. The analysis of charred plant remains so far revealed that subsistence in the site was based on cereals, pulses, plants growing in the wild and crop processing activities. Glume wheats, are represented by grains, glume bases and spikelet forks. The most common glume wheats are: "new type" glume wheat, emmer and einkorn. Barley (*Hordeum vulgare*) is also present in the samples represented by grain corresponding to both the 'naked' and 'hulled' varieties. The most common pulses are lentil (*Lens culinaris*), bitter vetch (*Vicia ervilia*) and grass pea (*Lathyrus sativus*). Weed species are rarely represented as well as fruits and nuts. Some of the samples are mixed and represent the remains of household activities though there is an indication of cereal and pulse storage in some cases. The study of samples derived from the site allows a better insight into the Neolithic exploitation, dietary practices and agricultural economy at the site and the wider area of western Macedonia.

Keywords: Northern Greece, Kleitos, Neolithic, Plant remains

Seed size and genetic variation was shifted with changing political and social conditions in Japan

Rapport entre l'évolution de la taille des graines, celle des variations génétiques, et les changements politiques et sociaux au Japon

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To understand how agricultural crop variation was changed during with transition of social and political condition, we compared transitions of seed size and genetic variation between 77 populations of rice remains (5942 seeds) and 40 populations of melon seed remains (3990 seeds) for 2000-years periods including modern period. The rice remains populations showed wide variation in seed length and width, which showed correlation to one another and normal distribution within population ($p > 0.05$). The seed length variation derived from length differentiation in populations among and within sites and within population, with statistical significant analysis ($p < 0.01$). Seed length variation narrowed in populations after 600 CE, and length slightly increased toward 1500 CE. Genetic variation of rice remains narrowed toward the Sengoku Periods based on the genotyping by chloroplast and nuclear genome markers. In melon seed remains, length variation decreased from 1 CE to 250 CE, though largeness of seed size recognized around the period. Then variation more decreased toward 1600 CE, around which genetic variation also decreased in the populations of Okayama Prefecture. The archaeological and historical facts indicated that the shift regarding scale and level in agricultural management seemed to occur by powerful clans and occupational groups around 250 CE to 600 CE. They introduced culture and goods such as Buddhism, utilization of horse and iron wear to wide areas in Japan. Agricultural crops may be promoted to change through the introductions. After the Heian Periods, agricultural development and improvement of crop variety are promoted for tax payment by local governance, especially for food security in the Sengoku Period of warring provinces, causing to decrease seed and genetic variation in rice and melon.

Keywords: Agriculture, Archaeobotany, Archeology, *Oryza sativa*, Selection

Archaeobotanical evidence of economic plants in Mediterranean France during Roman times

Vestiges archéobotaniques de plantes économiques en France méditerranéenne durant la période romaine

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The Roman period is characterized by an intensification of the trade of vegetal goods and the long-distance diffusion of diverse food plants (as coriander, pine kernels, peach, melon). It is also during this period that archaeobotanical

studies and archaeological data show an intensive cultivation of grapevines, fig and olive trees in the Roman Empire. In Mediterranean France, the chronology of these changes is still under scrutiny due to the uneven distribution of information, most particularly concerning the Provence region. Archaeological excavations suggest regional specializations; the production of olive oil seems to be locally important in Provence while wine producing is repeatedly attested in the Languedoc. This archaeobotanical synthesis assembles published data and new results. Recent and ongoing analysis of waterlogged contexts (for example: harbour dumps and wells) allows us to register a wider spectrum of economic plants (both cultivated and wild) and to draw a new appraisal on economical plants during this period. It provides new insights on consumption, plant processing and local cultivation, especially for condiments, fruits such as grapevine, olive, walnut, umbrella pine, and exotic goods acquired from trade. The diversity of contexts studied (urban, rural, funerary, ritual etc.) makes it sometimes possible to assess the social, cultural and symbolic status of plants and their uses. We notice that the presence of imported exotic foods highlights particular uses (funeral symbolism and high social distinction) linked to the status of site.

Keywords: Antiquity, Southern France, Diffusion, Trade, Economic plants

Identification of *Prunus domestica* L. endocarps from a Phoenician-Punic context (5th - 2nd century BC) by image analysis

Identification d'endocarpes de Prunus domestica L. en contexte phénico-punique (Ve s.-IIe s. av. J.-C.) par l'analyse d'images

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During the archaeological excavation in the Phoenician-Punic settlement of Santa Giusta (Oristano, Sardinia), dated to the 5th - 2nd century BC, several *Prunus* spp. endocarps were recovered. The exceptional state of preservation of the waterlogged remains allowed us to perform morphological and morphometric analysis by computer vision. Digital images, were acquired with a flatbed scanner and processed and analysed using the open source image analysis software ImageJ v. 1.49. The morphometric parameters were obtained through a specific plugin able to measure 26 morphometric features and 80 Elliptic Fourier Descriptors (EFDs). Applying the stepwise Linear Discriminant Analysis (LDA), a morphological comparison among the archaeological endocarps of *Prunus* and the modern one collected in Sardinia was performed. These analyses allowed to identify 53 and 11 endocarps of *Prunus spinosa* and *Prunus domestica*, respectively. The results showed that the archaeological endocarps of *P. spinosa* have morphometric similarities in the 92.5% of the cases with *P. spinosa* that at present grow near the Phoenician-Punic settlement of Santa Giusta. In addition, the archaeological endocarps identified as *P. domestica* showed similarity with the modern variety of

plum so-called Sanguigna di Bosa actually cultivated in the village of Bosa (Oristano). In this case, the correct classification has been 81.8%. These results, as far as we know, provide the first evidence of *P. domestica* in Sardinia during the Phoenician-Punic period. Moreover, these archaeological remains represents the early evidence of *P. domestica* in the Western Mediterranean Basin.

Keywords: Archaeological fruit stones, Archaeobotany, Endocarp image analysis, *Prunus spinosa*, *Prunus domestica*, Sardinia

Correct identification of archaeological grape seeds by computer vision: support for archaeobotanical study

Identification exacte de pépins de raisins archéologiques par ordinateur : aide à l'analyse archéobotanique

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The identification of archaeological charred grape seeds is a difficult task due to the alteration of the morphological seeds shape. In archaeobotanical studies, the correct discrimination between *Vitis vinifera* subsp. *sylvestris* and *Vitis vinifera* subsp. *vinifera* grape seeds is very important to understand the history and origin of the domesticated grapevine. In this work, different carbonisation experiments were carried out using a hearth to reproduce the same burning conditions occurring in archaeological contexts. In addition, several carbonisation trials on modern wild and cultivated grape seeds were performed using a muffle furnace. In order to implement morphological comparison with archaeological materials, modern grape seed samples were treated applying seven different temperatures of carbonisation, ranging between 180 and 340 C for 120 min. Analysing the grape seed size and shape by computer vision techniques, and applying the stepwise Linear Discriminant Analysis (LDA) method, it was possible to discriminate between the wild from and the cultivated charred grape seeds. An overall correct classification of 93.3% was achieved. Applying the same statistical procedure to compare modern charred with archaeological grape seeds, found in Sardinia and dating back to the Early Bronze Age (2017–1751 2σ cal. BC), the 75.0% of the cases have been identified as wild grape. The proposed method proved to be an useful and effective tool for the identification of charred grape seeds found in archaeological sites. Moreover, it may be considered valid support for advances in the knowledge and comprehension of viticulture adoption and the grape domestication process. The same methodology may also be successful when applied to other plant remains, providing important information about the history of domesticated plants.

Keywords: Carbonisation experiment, Grape seeds identification, Image analysis, Seed remains, *Vitis vinifera*

Traditional wheat cultivation: the case of east Anatolia

Culture traditionnelle de blé : le cas de l'Anatolie orientale

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The study analyzes the activities of wheat cultivation currently carried out by some rural communities in South-eastern Anatolia. The region is included in the northern part of the so-called Fertile Crescent, which played a crucial role in the domestication of wheat, *Triticum monococcum* and *Triticum dicoccum* in particular, about 11,000 years ago. The ethnobotanical work was carried out between November 2013 and July 2015 in the rural areas of the cities of Diyarbakir, Mardin, Şirnak and Elazığ. In all these locations, the different phases of grain cultivation, except for soil preparation and sowing, were documented. Information about technical cultivation details and planting periods was collected through interviews carried out during the field work. A partial conservation of traditional harvesting and storing practices was observed in the villagers "modern" living, with elements similar to those found in the Neolithic communities, which would also explain the use of the same techniques. In the cultivation of wheat there was no technical difference, in spite of the multi-ethnic composition of the region. The existence of continuous exchanges of different seed varieties even at a long distance was demonstrated, and this might have allowed the transmission of cultivation techniques. The dynamics of this trade seems to involve specialized mobile farmers. Another interesting result of our studies is that the labour division between men and women is directly connected to how agriculture is done: with modern or traditional techniques.

Keywords: Ethnobotany, Wheat, Anatolia, Agricultural techniques

Cereals as food and medicine in ancient Greece: integrating archaeobotanical and textual evidence

Les céréales comme nourriture et médicament dans la Grèce ancienne : témoins archéobotaniques et textuels

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Cereals have had a long tradition of use in Greece since pre-historic times, after the onset of agriculture in the region in the 7th millennium B.C. During the course of time the archaeobotanical record reveals regional preferences in certain cereal species as well as temporal changes occurring through evolving contact networks and changing socioeconomic organisation. This poster examines this 'longue durée' of cereal consumption in Greece, from prehistoric times to the present, integrating for the historical periods the available written texts. Problems concerning interpretation of terms used in ancient texts are highlighted as well as changing perceptions of the properties and ways of transforming cereals into food depending on time period, context of consumption and region. The insights gained from the investigation of ancient texts provide a unique opportunity to inspire our approaches of prehistoric plant remains for which no textual evidence is available. Our integrated approach, attempted for the first time, combined

with a wide temporal framework, offers exciting insights into cereal consumption in Greece over a period of 7000 years. This research has been the result of the project *The Seeds of Demetra*, supported by Thrace Flour Mills.

Keywords: Wheat, Barley, Ancient Greek texts, Cereal food, Medicinal uses

Preserving *Pyrus amygdaliformis* for later consumption: archaeobotanical and ethnographic observations approach

*Conserver *Pyrus amygdaliformis* pour une consommation différée : observations archéobotaniques et ethnographiques*

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Recent finds of *Pyrus amygdaliformis* from sites in South-eastern Europe have stimulated a review of published ethnographic literature as well as ethnographic work conducted in October 2015 at the village of Kosmati, in Grevena, northern Greece. Our ethnographic observations have revealed a wealth of information as regards alternative ways of preserving a nowadays ignored wild plant food resource. Besides drying ripe wild pears, we record in detail the preparation of wild pear syrup similar to the preparation of epséma/sapa/petimezi/pekmez (wine syrup). Our ethnographic observations widen the range of potential foodstuffs prepared by wild plant food resources in prehistoric times.

Keywords: *Pyrus amygdaliformis*

The dynamics of olive cultivation in the context of Greek colonisation: an archaeobotanical investigation integrating old and new archaeobotanical evidence

Les dynamiques de la culture de l'olivier dans le contexte de la colonisation grecque : enquête intégrant des données archéobotaniques anciennes et nouvelles

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Olive and olive oil constitute important elements of pre-historic communities of the Eastern Mediterranean and the Aegean as, together with cereals and wine, they form the 'Mediterranean triad'. An essential element of the Mediterranean polyculture, olive cultivation is considered as a decisive factor towards the emergence of Bronze Age elites either by a need for redistribution due to its ability to thrive in less fertile soils or by labour demands and ties to the cultivated land due to its late return in produce. Although adequate archaeobotanical evidence is available from the south of Greece, suggesting the exploitation of the plant since the 4th millennium B.C., little attention has been given to its absence from the archaeobotanical record of the north of the country. This paper brings together new evidence from a large number of sites

from the north Aegean that contribute towards an understanding of the processes that led to the introduction of oleiculture in the north. Olive oil, an important product already, circulating in the Aegean in the Bronze Age, is a rare, imported commodity for northern Greek communities. In our presentation we explore old and new archaeobotanical evidence from the Aegean, combining olive stones, pollen and charcoal. We argue that Greek colonisation is responsible for the introduction of the olive in the north and we explore its uses and the socioeconomic processes that introduced a new tree species leading to its subsequent establishment in the northern Greek coastal landscape.

Keywords: *Olea europea*, Greek colonisation, North Aegean, Olive oil, Olive cultivation

The significance of vegetable offerings in Roman cremation burials in Switzerland: an introduction

La signification des offrandes végétales dans les tombes à incinération en Suisse : une introduction

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The archaeobotanical record of Roman cremation burials in Switzerland has grown considerably in recent years. The majority of these studies have been undertaken on behalf of the Cantonal archaeological services, and were mainly to complement the evaluation of individual excavations with archaeobotanical results. These studies are generally carried out on a very tight budget and do not permit wider comparison, contextualization, or further research. Within the scope of this project, it is our aim to 1) collect all available archaeobotanical data from Roman cremation burials in Switzerland using the internationally-used database ArboDat; 2) include the analysis of new burial sites and 3) evaluate the collected data using exploratory statistical methods assessing whether chronological and/or geographical trends exist, and if a connection between the proven range of plants and the age, gender and the status of the deceased exists. It is thereby aimed to contribute to a deeper understanding of the Roman period burial rites north of the Alps and to develop an indispensable basis for the project-related research.

Keywords: Roman, Cremation, Vegetable offerings, Switzerland, Plant macro remains

The development and spread of Early Neolithic crop agriculture in the western Balkans

Le développement et la diffusion de l'agriculture au Néolithique ancien dans l'ouest des Balkans

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At the start of the 6th millennium BC farmers began to spread throughout the western Balkans (Montenegro, Croatia, Bosnia and Herzegovina and Serbia). Impressed Ware (IW) groups

moved along the Adriatic coast whilst Starčevo-Körös-Criş (SKC) communities advanced inland up to the Carpathian Basin. Despite the fact that the western Balkans is a major corridor into Europe, the Neolithic economy of the region remains poorly understood. Previous studies have highlighted the significant reduction in crop species between Bulgaria and Greece (13 and 11 crops respectively) and those cultivated in the Former Yugoslavia (seven crops). However, the reasons for the selection of certain crops over others, and associated cultivation techniques, remain elusive due to limited evidence. This poster presents initial results from the analyses of newly gathered archaeobotanical data from Early Neolithic sites (6000-5500 BC) in the western Balkans. This dataset illustrates how the crop package was not as reduced as previously thought and how various selective pressures, such as cultural choice and ecology, may have influenced the selection of crops. The coastal and inland routes of Neolithisation are compared, showing that cultural differences between the two strands are not only evident in their ceramic traditions but also in their agricultural practices. Placing these results into the comparative framework of contemporaneous surrounding sites in Italy, Bulgaria, Greece, Macedonia, Romania and Hungary highlights larger scale patterns and trends. The latter illustrates how agricultural practices along the two main routes of Neolithisation influenced those in both central Europe and along the Mediterranean. Adjustments and modifications to crop packages and farming practices, whose origins lie in the Near East, are explored, nesting the western Balkans into its broader geographical context. The newly gathered data therefore enables a more robust understanding of how crop agriculture developed and grew, ultimately propelling the spread of the Neolithic.

Keywords: Western Balkans, Early Neolithic, Crop agriculture, Routes of Neolithisation

Woodland use in past environments. A methodological approach on wood management

Exploitation des boisements dans les environnements anciens. Une approche méthodologique de la gestion du bois

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It is beyond doubt that people used woodlands in the past. In Northwest European archaeology it is often presumed that people did not only exploit woodland but also actively managed it, perhaps already from the Mesolithic onwards, to improve the availability and quality of resources including wood. Such assumptions are also raised when archaeological assemblages yield large quantities of long branches with a uniform diameter or branches of the same age. Since woodland management has a large impact on the landscape, requires cultural organization and has implications for ownership, the question rose whether the assumptions are correct and whether it is possible to recognize woodland management in assemblages of archaeological waterlogged wood.

A model was developed that describes the relationship between the age and diameter of both managed and unmanaged trees, characteristics that are relatively easy to investigate. It

assumes that managed trees tend to produce long, straight branches (managed spurts) in a short time and that branches of unmanaged trees grow slower and thus are older when they reach the same diameter. Woodland management and diameter selection are explicitly separated from each other. The model was tested with data of managed and unmanaged modern-day trees of *Salix*, *Fraxinus*, and *Alnus*, the dominant branch wood at archaeological sites in the Netherlands. Examples of clearly managed and unmanaged modern-day trees support the model. New research, focusing on variation in growth conditions, larger diameters and also including *Corylus*, an important taxon in archaeological assemblages from Denmark, revealed some anomalies in the model. The fast growth of long, straight branches also occurs naturally in *Corylus* and *Salix* bushes, and in trees that have fallen over in a storm (natural spurts). In addition, fast growth may occur in unmanaged trees growing under extremely favorable circumstances. Moreover, the good growing conditions of newly managed trees diminish through time, which results in similarity with the unmanaged diameter/age ratio. These factors lead to an adjustment of the model. The results have been compared with data from archaeological wood assemblages to investigate the evidence for woodland management in the past. This comparison shows that the interpretation of archaeological wood assemblages by age/diameter analysis is possible, provided that a sound methodology and careful interpretation are applied. There is a need for further research on modern-day trees and for larger systematically collected archaeological datasets.

Keywords: Archaeobotanical methods, Woodland management, Landscape, Models, Experimental archaeobotany

Four proxies reconstruct the human-environment relationships and climate at Arslantepe (Turkey) between the Chalcolithic and the Bronze Age

Quatre proxis restituent la relation Homme-Environnement et le climat à Arslantepe (Turquie) entre le Chalcolithique et l'âge du Bronze

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This study deals with past and current archaeobotanical research on plant micro- and macroremains recovered at the site of Arslantepe, Malatya (Turkey). The settlement mound of Arslantepe can be considered an outstanding case-study for palaeoenvironmental and palaeoclimatic reconstruction in the Near East. A large amount of charred plant material (seeds, fruits and wood) has been collected from building contexts dated from the Late Chalcolithic 1-2 (4250-3900 BC) to the Early Bronze Age III (2500-2000 BC). Detailed studies are already available on these remains, allowing insights on agricultural practise, wood choice and technology of the different populations along this long period of time. Moreover, the stable carbon isotope analysis has been successfully used in outlining the past climate changes. Unpublished pollen data are now available and used to improve past landscape and land use reconstructions obtained through macroremain analyses. This integration of data on seeds/fruits, charcoals, isotopes and pollen was carried out on the same archaeological contexts.

The long occupation of the site is an added value because the interpretation of all the proxies can be done between coeval structures or along more than 2000 years. Wood and seed/fruit remains strongly reveal human selection and transportation of plant sources into the site. Pollen grains show the presence of wild and cultivated species around the settlement, although the main factor for pollen accumulation is represented by human activities. Stable carbon isotope content from plant tissues provides information on water availability during plant's life and independent information on the vegetation history and local palaeoclimatic features. The isotopic trend evidences some changes in water availability along the time and the comparison with modern values shows present day higher aridity. The multiproxy approach will be soon enriched by the nitrogen isotope analyses that will supply data on the nutrient status of ancient soil and reveal manuring practices.

Keywords: Eastern Anatolia, Palynology, Wood, Seeds/fruits, Stable carbon isotope analysis

A model for the collection and harvesting of wild and domesticated crops in the Borada Highlands of southwestern Ethiopia

Un modèle pour la collecte et la récolte des denrées végétales sauvages et domestiquées sur les hauts plateaux Borada du sud-ouest de l'Éthiopie

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This poster reports on ethnobotanical research with Gamo enset farmers in the Borada highlands of southwestern Ethiopia, highlighting observations on the ecology of indigenous and adopted crops, particularly the vertical zonation of fields that characterises Gamo traditional agronomic systems. The Gamo are known as "enset (*Ensete ventricosum* (Welw.) Cheesman) farmers" but they also grow a range of other vegetative crops such as "koltso" (*Arisaema schimperianum* Schott) and cereals of African and Near Eastern Origins. A model is presented that has potential archaeobotanical applications.

Keywords: Gamo, Borada highlands, *Arisaema schimperianum*, *Ensete ventricosum*

Crop processing and storage of surpluses – The importance of cereals in Bronze Age and Iron Age settlements in the Lower Rhine Basin (North Rhine Westphalia, Germany)

Traitement des récoltes et stockage des surplus – L'importance des céréales dans les sites des âges du Bronze et du Fer en basse plaine du Rhin (Westphalie Rhin nord, Allemagne)

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The Lower Rhine Basin (North Rhine Westphalia, Germany) belongs to the most fertile landscapes in Western Europe and was therefore used for agriculture since the early Neolithic.

Because of the lignite mining and the resulting extensive excavations, the Lower Rhine Basin is also one of the best archaeologically studied regions in central Europe. In numerous sites soil samples were collected for archaeobotanical investigations regularly from the Rhineland Regional Office for the Preservation and Care of Field Monuments (Rheinisches Amt für Bodendenkmalpflege). As part of a PhD (Title "Archäobotanische Untersuchungen zur Landwirtschaft und Ernährung während der Bronze- und Eisenzeit in der Niederrheinischen Bucht") carbonized plant remains from 66 Bronze Age and Iron Age settlements were analyzed. This period, which lasted from 2000 to 50 B.C., can be subdivided into five chronological groups. Within the study various aspects were examined: The changes in the crop spectra over the last two millennia B.C., the soil conditions of the agricultural areas, the determination of weed assemblages, the intensity of tillage and harvesting methods as well as the investigation of crop processing. One focus was based on multivariate statistics. In this way it was possible to differentiate sample types (crop processing by-products vs. products) of mixed samples with remains of

various crops. The results added new aspects to the debate on agricultural development in the study area. The analysis for crop processing suggests that the four earlier periods (older Bronze Age to middle Iron Age [2000–250 B.C.]) differ considerably from the late Iron Age: In the early stages by-products are most frequent, the late Iron Age, however, is dominated by cleaned products. This can be explained by an intensification of cereal cultivation along with an increased storage of cleaned products in the late Iron Age. Obviously, this shift is related to the settlement development. For the early Bronze Age to the middle Iron Age only individual self-sufficient farmsteads (with a very wide range of different crops) are documented. In the late Iron Age than a settlement differentiation (with increased cereal production) has taken place, where in addition to the individual farmsteads larger, village-like settlements existed, which apparently played an important role in the storage of harvest surpluses.

Keywords: Lower Rhine Basin, Bronze Age, Iron Age, Crop processing

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