"Ecofacts" and relict plants from an archaeoological perspective

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Garden Archaeology
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A relatively new field within archaeology
First recorded garden excavation: Kirby Hall, England (1930s)

A lot has happened within the last 30 years

- Large excavation and restoration projects in the 1990s – increasing interest
  Great Britain, Germany, Holland, USA. (Ex. Privy Garden at Hampton Court)

- Scandinavian garden archaeology also started slowly in the 1990s, in the last 10 years a marked increase - interest, excavations and research
Two main types of source material knowledge about the past

"Historical" sources
writing, art, maps etc.
- The basic source material of historians.

"Material" sources
Physical remains, and material culture.
- The basic source material of archaeologists.

From *Capitulare de villis*, by Charlemagne, ca 795 AD.
*LXX. Volumus quod in horto omnes herbas habeant, id est lilium, rosas...*

1400-talsmanuskript ‘Roman de la Rose’ British museum.

Results of excavation
Pollen
Seeds and plant remains charred and uncharred
Living plants (f. ex. history in DNA, and relict plants)
Modern archaeology is the study of **Material culture**

- The physical (material) **aspects of a culture**
- Every thing made by or used by people

**Artefacts**—things made by people

"**Ecofacts**"—the word has been used for things created by nature, but used by humans, and affected by human activity.

F. ex. Burnt seeds from an archaeological context can tell us a lot, not only about human culture and food traditions, but also about cultivation and the environment.
The historical study of plants and cultivation need cooperation between many fields

- A lot is not written in historical records

- The further back we go the less documentary source material and the more important it becomes to find other sources of information.

- Other sources is even more important where the documentary source material is scarce
  - like here northern Europe.
Archaeological research: a combination of many methods

Of main importance in Garden Archaeology is for example:

• **Excavation**

• **Geophysics** – mainly “georadar”
  (Examines the physical properties of the ground. Mostly used for finding and studying hidden structures, and for planning excavations)

• **Archaeobotany** (& zooarchaeology)
  analysis of different kinds of ”ecofacts”
  – Plant macrofossil analysis (Seeds, parts of plants etc.)
  – Pollen analysis (palynology)
  – Wood analysis
  – **Zooarchaeology** (mainly analysis of remains of invertebrates – i.e. molluscs, parasites etc.)
Archaeological excavation and research: a combination of many methods

- **Soil chemistry and micro morphology**
  chemical and physical properties of the soil, f. ex. phosphate and humus content etc.

- **Landscape studies, air photography, analysis of “crop marks”** etc.
  Remains in the ground and vegetation f. ex. infrared photography (IR)
Example 1: Krapperup, Skåne (2009)

Engraving by G. Burman, 1680s.

Georadar

Map by Gustafsson 1855

Excavation
Example 2: Fossesholm, Norge (2009 & 2011)

Structure of a garden from late 1700s: paths, terraces, a manmade island with a small dug "moat" etc.
Example 3: Rosenlund, Jönköping

**Georadar** has shown the structure of a garden from the late 1700s. Limited excavation and archaeobotanical analysis planned for autumn 2012.

**Dam, paths, flower beds, planting pits, foundations of buildings (orangery?)** etc.
Ground-penetrating radar (GPR)

Flower beds (parterres) edged with limestone

Parallel paths

Planting pits

Stone foundations (orangery?)

Lars Winroth, Modern arkeologi.
Example 4: Roman Iron Age in Hyllie (0-400 AD).

An area with farms, about 150 meters apart, excavated in Hyllie (southern Sweden)

Traces of “gardening” in roman iron age Sweden?

Analysis of charred archaeobotanical remains farm 1b, 100–250 AD

Large amounts of gold-of-pleasure (Camelina sativa) and flax (Linum usitatissimum) in the kitchen and the eastern room.
Archaeology and Archaeobothany
Archaeology and Archaeobotany

Example: Macrofossil analysis

**Archaeobotany** works with the same time span as archaeologists
– *the time of people*

**Paleobotany** work with a much larger time span
– *the time of plant life*

Jens Heimdal, Riksantikvarieämbetet
There are many kinds of plant remains

Charred or in other ways preserved seeds, pollen and plant remains are important

but there are also for example

✔ Pieces of charred bred in f. ex. cremation graves (and other kinds of food, waste & fecal matter)
✔ Imprints in ceramic vessels and burnt clay (like wattle-and-daub walls)
✔ Crusts on the inside of ceramic vessels
✔ Charred plant remains in furnaces and metal slag

Dill (Anethum graveolens) preserved in wet, oxygen free conditions.

Common wheat (Triticum aestivum) preserved in charred condition.

Charred straw, seeds and wood can be found For example in the slag and remains of pit furnaces.
Many methods are used to analyse plant remains

For example:
✓ Plant macrofossil analysis
✓ Pollen analysis
✓ Wood anatomy & cell structure analysis
✓ Phytolith and starch analysis
✓ Chemical and biomolecular analysis

Each method has possibilities and limitations
No method can on its own give the entire picture

Seeds and fruits with hard shells are preserved better in water,
oil rich seeds often burn to easily and becomes to ruined to be identified,
in pollen diagrams species that are not wind pollinated more rarely show up
etc.

Which method to use depends on the questions asked

For example if you study introduction history you need to use methods
that can identify species (mainly macrofossil analysis)
Plant macrofossil analysis

Preservation
Extraordinary conditions – natural process of decay has somehow “stopped”

Charred remains
• Seeds, fruits and other plant parts (like stems and husks) can keep their shape if charred at the right temperature. If not crushed they remain indefinitely.
• Charred remains are found f.ex. in post holes of houses, in conditions where all other organic matter is gone.

Subfossil remains
For decay water, oxygen and the right temperature is necessary. Take away one and you may get the right conditions for good preservation.

✓ Water – in very dry conditions, like the tombs of the pharaohs, even things like rose flowers (Rosa x richardii) can survived
✓ Oxygen – in wet conditions (like wells, bogs) and some layers that are especially dense and airless (like medieval town layers) there is so little oxygen that decay can stop or slow down.
✓ Temperature – in frozen conditions, like the “kurgan” graves of Siberia buried in the tundra permafrost, decay can also stop or slow down.
Plant macrofossil analysis

Identification
- The identification is done by microscope and comparison with reference material.
- It needs to be done by a botanist with experience in old species and varieties (before the 1800s and modern plant breeding), because they often look different than modern ones.

Marigold (*Calendula officinalis*) and Coriander (*Coriandrum sativum*)

Kv. Diplomaten, Jönköping 2007. 1600s. Identification and photo Jens Heimdal

Dill (*Anethum graveolens*)

Lund, Sweden. 900-1000s. Identification and photo Jens Heimdal

One way of finding reference material is thorough old seed collections. This one is from Nordiska museet, Stockholm.
Pollen analysis

Identification
• The identification is done by microscope and **comparison with reference material**.

Limitations
• Often only genus can be identified, not species...
• Plants that are **wind-pollinated** can easily be found in pollen analysis. Largely **self-pollinated** plants, like flax (*Linum* sp.) and peas (*Pisum* sp.) are usually not found.

Well, c.200-0 AD. Bottom layer where pollen samples were taken (5) is considered to be deposited during the time the well was in use. To the right the first part of the pollen diagram for the same well.
Other methods to analyse plant remains

Wood anatomy and cell structure

• Preserved pieces of wood (charred or uncharred) can be identified through analysis of the anatomy of the wood and how the cells are structured (usually to species level).

• Other plants can be identified the same way (at least family, sometimes species) by looking at the cells and how they are structured. The method can be used for example on crushed seeds, and stomach contents (“bog bodies” and Ötzi)

Phytolith analysis

• Phytoliths are silica bodies produced by plants (especially grasses). Soluble silica is absorbed from ground water and deposited in & around the cellular walls. The result is opal phytoliths with distinct shapes.

DNA

• Sometimes plant remains contain enough preserved DNA to make analysis possible. New methods to analyse degraded DNA is under development.

• This method is especially interesting since it could make it to examine genetic variation even within species.
The history is told by the archaeological context

To understand and to date the remains identified archaeobotany and archaeology need to work together
The way samples to be analysed are collected is of crucial importance

✔ To be able to say that a **plant species where** in a certain place at a certain time you have to find **identifiable remains in a layer that can be dated with accuracy** to this period.

✔ **To say that it was cultivated** (not for example collected in the wild or imported from abroad) **is ofcourse even more difficult...**
Dating of botanical remains

$^{14}$C – carbon dating of the remains themselves

Both charred and uncharred biological remains can normally be dated well this way (precision usually +/- 50-100 years). Contamination and too small samples can be a problem.

Cereal grains are often used to date layers in archaeology today, Since generally analysis of short-lived remains give more high-precision $^{14}$C dates.

The problem is that the method is expensive, and usually only a few samples are budgeted for each excavation.

Results are usually presented in the form of an OxCal diagram.
Dating of botanical remains

Dating through association to a specific context

This is by far the most common way of dating contexts and finds.

A layer is usually dated through a combination of different methods, often for example an analysis of finds (like pottery), together with the relationship to other layers at the site, and scientific methods (like $^{14}$C and dendro-chronology).

To be sure the dating is accurate you need to examine how the dating has been done.

Usually the excavation report gives a detailed account of this.

The pollen examined from this well was dated to c.200-0 AD since the layer (5) was dated to this period. The dating was in this case mainly based on an examination of how the layers in the well had been deposited, comparison with other wells and features within the site, pottery found in different layers of the well, and $^{14}$C dates of wood (unidentified) from layer 5 and charcoal (unidentified) from layer 1.
Arkeologi och arkeobotanik – växtmaterial som kunskapskälla: att analysera och tolka de fysiska lämningarna efter människor mat och aktiviteter.

Växter och växtlämningar inom de arkeologiska vetenskaperna: källor till odlingens, trädgårdarnas och kulturlandskapets historia av Anna Andréasson, Inger Larsson, Kjell Lundquist & Boel Persson
LTJ-fakultetens faktablad 2010:19.