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EXPERTS PREDICT WHAT’S NEXT FOR BIBLICAL ARCHAEOLOGY
RESURRECTING BOTANICAL REMAINS

Utilizing new scientific methodologies, Dafna Langgut anticipates plants will be the lynchpin in defining how ancient humans interacted with their environment within the context of a Biblical archaeological site, the recovery of botanical remains are enormously helpful in addressing questions related to plant usage for the human diet, fodder, fuel, construction and tool or utensil making. Assuming that most of the plants were brought to a site from nearby, not only the natural environment in which people lived can be reconstructed based on the botanical remains, but also the human impact on vegetation following agricultural practices, grazing activities, deforestation, soil erosion and land degradation.

The field of archaeobotany is currently progressing significantly, and this will probably continue in the future. The integration of traditional analysis of archaeobotanical methods during excavations is increasing rapidly (seeds and fruit remains, charcoal and wood remains, palynology, phytolith analysis), as well as the involvement of new tools in the field (analysis of chemical residues, ancient plant DNA studies).

Progress in the field of archaeobotany is also linked to recent developments in other fields of archaeology (e.g., dating methods, geoarchaeology). A special issue is the application of carbon 14 dating of short-lived plant remains in order to illuminate issues of Biblical archaeology when pottery dating is not precise enough. In archaeology overall, there is a trend to try to better understand daily life, and plant remains of various types store critical information that cannot be accessed by other remains. For instance, weeds found mixed with grain illuminate agricultural, seasonal and geographical issues. Pests found in grain can illuminate issues of storage and seasonality of destruction. Identification of foreign plants within the archaeobotanical assemblages is used to trace long-distance trade relationships and cultural and political influences.

Traditional archaeobotany primarily consists of studying macrobotanical remains—wood, seeds and fruit remains—which under Levantine conditions are usually preserved only in their charred form. One of the main benefits of this is that they can be seen by the naked eye. Additionally, by filling just half a bucket of excavated sediments with water (floating), a firsthand evaluation on the occurrence of macrobotanical remains emerges. Since studies of macrobotanical remains are the most common, the next stage would be to collect all the detailed (but scattered) information that was acquired during the past decades and create a regional database. This may shed new light on important topics, such as ethnic identity, changing agricultural and technological practices, and a more detailed understanding of paleoenvironments. The establishment of such a database requires the sharing of data among different scholars and therefore demands good collaboration.

A detailed wood-anatomical atlas of Levantine trees and shrubs that provides the full descriptions of all relevant anatomical variations, including both light and Scanning Electron Microscope (SEM) pictures of various plant parts with thin branches and all stages of bark development, is certainly needed. Since sometimes there are difficulties recognizing seeds based on their morphology and because of the changes caused by taphonomy, more advanced identification methods are recommended, such as microtomography technology which enables 2D and 3D simulation to a scale of microns.

More developments are also expected from the use of macrobotanical remains in stable isotope analysis. Several atoms common in plants (hydrogen, carbon, nitrogen, oxygen) have either stable or radioactive isotopes that may provide information about the ecological conditions under which the plants grew (e.g., amount of precipitation or practices such as irrigation).

In the case of microbotanical remains, while palynology has already been in use for
many decades, other botanical methods have been more recently integrated into the fieldwork, such as the identification of phytoliths, organic residue analysis and study of ancient DNA. During the last several decades, palynology has made a sustained contribution to the understanding of occupation sites, both in terms of the wider vegetational and environmental contexts and in determining patterns of plant usage within sites.

Conventional pollen-analytical investigations, which are usually based on sediment cores extracted from anaerobic environments (e.g., swamps, lakes), will still play a key role within the discipline. Possible future developments within the field of environmental palynology are advances in climatological modeling and simulation of vegetation as suggested for the region, and the incorporation of the Levantine datasets into large pollen datasets, such as the European Pollen Database and Neotoma. Palynologists increasingly must be adept at or able to join forces with statisticians and modelers. Unfortunately, it still does not seem feasible that in the near future, automated pollen counting will be able to replace human identification due to the problematic state of preservation of the fossil pollen grains.

Future advances in carbon 14 dating may allow more frequent use of pollen dating; pollen assemblages from secure archaeological contexts will be helpful with the establishment of a site’s chronology. In the coming decades, pollen genetics based on the expected progress in the ability to clone fossil DNA of individual pollen grains may help resolve resolving debates and uncertainties, and reveal new research horizons.

Phytoliths, Greek for “plant stones,” are microscopic, three-dimensional silica infillings of cavities within and between the cells of certain plants. Since these are inorganic particles, unlike other botanical remains, they can be well preserved within the archaeological record when other plant remains decayed. Phytoliths help in identifying ancient human food, fodder, agriculture, identification of areas within houses or sites used for specific plant or animal-related activities, the use of fuel and identifying taphonomic processes. Although significant effort has been given to answering fundamental questions regarding production, taxonomy and preservation in the region during the historical periods, these issues have not been satisfactorily explored, and additional detailed investigations will be required.

As the organic residue field emerges from its preparadigmatic phase and the organic residue revolution gathers pace, the way is open for challenging many long-held archaeological hypotheses and offering new perspectives on the study of past human activity. This may influence how pottery is treated during excavations. Pottery vessels are a good example of archaeological finds on which residue analysis can be performed. By applying appropriate separation (chromatographic) and identification (mass spectrometric) techniques, the preserved, and altered, biomolecular components of such plant-origin residues can be revealed.

In just three decades, the study of ancient DNA has gone from a scientific curiosity to an extremely powerful method for reconstructing past biological, anthropogenic, agricultural and ecological phenomena. The information derived from such studies is a rich source for questions regarding species identification, origin and spread of cultivated plants, monitoring the state of domestication and issues of ancient trade. The critical technique for studying ancient DNA is called Polymerase Chain
Reaction (PCR) in which minute amounts of DNA are multiplied many times in a test tube. This method is, however, very sensitive to modern contaminations, and strict lab procedures and controls are required to conduct reliable ancient DNA studies.

Ancient DNA studies of archaeological plant remains from the Biblical periods in the Levant have received very little attention; most attention has been given to the domestication of plants and related issues. Currently the main problem concerning ancient plant DNA in Southern Levantine sites is the gradual degradation with time and its quick destruction during burning and charring. The ability to screen archaeological samples in which the DNA is not fully degraded without passing a large number of samples is needed, as well as continuing work on understanding the preservation of DNA in different types of plant material—stems, glumes, leaves, lignified fruits or from wood.

In cases where the morphology of archaeobotanical remains is not very distinctive, ancient DNA can shed light on species identification by using species-specific genomic regions. Additionally, the evaluation of trade versus local agricultural diversity can be illuminated by ancient DNA studies. Conducting ancient plant DNA studies in archaeological sites more frequently and integrating new technologies, such as real-time PCR or other new sequencing techniques, will impact the field of ancient plant genetics, similarly to ancient DNA research in animals.

Chronology and its refinement continue to be critical issues in the archaeology of the region. In Biblical Levantine sites, relative dating is achieved mainly by typology of pottery, while carbon 14 dating is commonly used for absolute chronology. Accurate absolute chronology for the historical periods of the region would make it possible to link changes in material culture to important issues, such as trade, the dissemination of knowledge and the impact of climate on historical processes. To achieve this, a detailed chronology is needed for individual sites and on a regional scale with a resolution that can differentiate events within a century. The preferable materials for high-precision radiocarbon dating are short-lived macrobotanical remains (e.g., charred seeds and olive pits) as well as collagen from bones, in clear association with the relevant archaeological context. Among these remains, clusters of seeds provide the most efficacious carbon 14 samples. Comparison of short-lived samples with typical wood charcoal samples shows a mild old-wood effect that accounted for differences of up to 50 years in the chronological models.

In the near future, greater attention must be paid to the associations between samples and the archaeological contexts from which the carbon 14 samples originate. In ongoing excavations, microarchaeological methods can be useful in determining which associations are strong or even absolute. The major limitation on applying this approach is the fact that carbon 14 measurements are currently constrained to dating short-lived samples, mainly macrobotanical remains. Thus an immediate goal of radiocarbon research is to develop the ability to date also short-lived microbotanical materials, such as organic material occluded in siliceous plant phytoliths, wood ash, and possibly also organic residues preserved in pottery vessels.

Due to the scarcity of timber remains in the Biblical Southern Levant, this field does not seem to have as good a potential as it does in most parts of Europe. Yet the best candidate to provide some tree-ring-based dating in the Southern Levant is Cedrus libani (cedar of Lebanon). There are several reasons for this: (1) the tree forms well-defined annual growth-rings; (2) it can be long-lived; (3) it was used all over the region for millennia; and (4) there are probably thousands of finds in the Levant and in Egypt that may allow the construction of a millennia-long chronology, including the Biblical periods. A broad international effort may enable us to overcome this complicated task. Then Cedrus libani timber, even when charred, can be dated.

A broad systematic study of the morphology and chemistry of starch grains in the rich wild and domesticated flora is needed to establish a database that will allow progress in this area. The accumulation of new data together with the unforeseen methodological developments within the coming years and decades will probably shed more light on issues that are currently under scholarly debates. The traditional archaeobotanical methods are likely to expand to include innovative new approaches, such as studying ancient DNA and biomarkers. A deeper collaboration among botanists, archaeobotanists and archaeologists is essential in order to exploit the full potential in this variable field.