

Dating in Archaeology

Contributed by Stephen Langfur

One effect of Roman domination was to change the nature of cities in the Holy Land. There seems to have been a general feeling of security, enough so that urban dwellers could descend from the crowded hilltops and build on the flat land below. For the same reason, they felt they could rely, for the first time, on water channeled from distant springs.

Before the Romans, however, a city needed a hill for defense, with a spring nearby. Certain proportions had to be right: the hill had to be small enough so that the population supplied by the spring would suffice to produce enough soldiers to defend a wall surrounding the hill. You needed enough good agricultural land to feed that population. (You also needed peasants in nearby villages to work the land: about ten for every aristocrat in the city.) If you wanted to engage in commerce, you had to be near a decent road.

Only certain hills fulfilled these requirements, and therefore people kept building on them. That is why we find layer after layer on some few hills, called tells, while others remained unsettled.

People usually built with mud brick on stone foundations. When destruction came, the walls would collapse, leaving a layer. In distinguishing a layer and its contents, archaeologists refer to it as a stratum. At Megiddo, for example, the American team counted twenty major strata.

Among the items that appear in a stratum are usually many fragments of pottery. Invented around 6000 BC, pottery fulfilled the function that plastic or metal containers do today. Digging through a tell (that is, through time) we find fragments showing different materials, styles and techniques. The decoration, in particular, enables deductions about the lives of the makers. T. B. L. Webster, *From Mycenae to Homer*, New York: Norton, 1964|Webster, for example, has demonstrated parallels between the Geometric vases of ancient Greece and the structure of Homeric epic.

It is an advantage for dating that pottery easily breaks: it does not usually get passed through the generations (though whole pots are often preserved in tombs). In digging down through a tell, therefore, we can distinguish layers with ceramic fragments that vary in the material, style and technique of their making. We can map out the sequence of layers, sketching the different types of pottery found in each. We can then go to another tell nearby, do the same, and we shall likely come up with a similar sequence. By comparing many tells in a specific region, we can gain an ever more precise idea of what kind of pottery came after what.

That is the principle, but of course things are never so simple. A city starts out on different levels. Stones are reused. People fill pits or dig new ones, disturbing the layers. New houses are built beside older walls. Some pots continue to be made or imported through several periods. In a word, the vicissitudes of life disturb the regular accumulation of layers. Nonetheless, as tell after tell is explored and recorded, knowledge of the sequence improves.

All that, however, gives at best a relative chronology: we know that a pot of type Y came after a pot of type X. We want, however, to be able to anchor the strata to absolute dates. We want to be able to say, for example, "Here is a stratum from the time when Solomon reigned."

How can we arrive at absolute dates? There are two major methods, each with its problems.

First, within the layers archaeologists sometimes find items with the names or symbols of Mesopotamian kings or Egyptian pharaohs. Such items may be statues, inscriptions or [There is a family of beetles called the Scarabaeidae, which includes June bugs and dung beetles. The ancient Egyptians regarded the latter as sacred, because of their behavior: they roll little dung balls, and this brought to mind a divinity rolling the sun each day across the sky. They sculpted them in stone and ceramic, using the result as a talisman or a seal, as on a ring. The base often contains hieroglyphics or images of gods, humans, animals and plants. Scarabs served both the living and the dead; when they are found, it is often in graves.](#) But these do tend to be handed down as heirlooms; we can hardly ever be sure that we have found them in the stratum of their origin. Often they appear in obvious secondary use, as part of a wall, for example.

If we knew for sure that a particular king or pharaoh ruled between 970 and 930 BC, and if we were to find many pottery fragments containing his name in a particular stratum, we could then assert that such fragments, along with any others found uniquely in the stratum with them, date from those years. On finding similar fragments in the stratum of another tell, even without the inscriptions, we could then say that this stratum too must be dated between 970 and 930 BC. In theory that works, but it just hasn't happened.

There are problems, besides, in determining when the kings and pharaohs lived. There is no sure chronological anchor until the 8th century BC in Assyria. The Assyrians "kept 'lim-mu' lists, which for each year state the name of the highest-ranking official in Assyria, sometimes together with an important event that took place at the same time. The limmu lists known run from 911 through 631 BC. The lists can be dated with the aid of the Canon of Ptolemaeus (second century AD), and coincide with dates from the Canon between 747 and 631 BC." [J. G. van der Land, "Pharaohs and the Bible: David Rohl's chronology untenable."](#)

This Canon lists Babylonian kings, but among them are some Assyrians who claimed authority over Babylon, for example, Sargon II. In a mathematical work, the Canon presents astronomical data, including solar and lunar eclipses, and connects them with particular kings. These data check out well against astronomical observations recorded on baked clay tablets found in Babylon.

According to one limmu list, a solar eclipse occurred in the tenth regnal year of the Assyrian king, Assurdan II, in the month of Sivan (May-June). Using the Canon of Ptolemaeus, scholars date that king's tenth year to 763 BC. On purely astronomical grounds, modern scientists have computed that there was in fact a solar eclipse on June 15, 763 BC. Thus we get an absolute date, a chronological anchor, for Assurdan II, and thanks to the detail of the limmu lists, we can extend our confidence to the kings after him, down to 631 BC. The Assyrians took the Egyptian city of Thebes in 664 BC, so from this time the firmness extends to Egypt as well. What is more, in the 6th century BC, coins began to circulate widely; these often contain data enabling researchers to determine the date of their minting.

But what about the period before 763 BC? Here archaeologists have largely depended on Egyptian chronology, which until recently was thought to be well established. In the last decade, however, challenges have arisen. The trouble is, one has to be an Egyptologist in order to decide between rival hypotheses, and being an Egyptologist does not leave time, apparently, for being anything else. If the conventional Egyptian chronology is off by a hundred years (some say as many as 250!), the list of pharaohs may slide with respect to the list of Biblical kings. At present both lists are afloat. The hope of getting absolute dates for strata (the hope of saying, for example, "Here was the city of Solomon's day") recedes.

For anyone who wants to take a dip in the recent debates on Egyptian chronology, here are a few Web sites for starters. Surfers beware! Strong undertow!

1. Centuries of Darkness by Peter James, IJ Thorpe, and others. [Another site.](#)

2. A Test of Time Home Page. The Official David Rohl Website.
3. J.G. van der Land, "Pharaohs and the Bible: David Rohl's chronology untenable"
4. P.G. van der Veen, "Is Rohl's chronology inaccurate?"
5. Jonathan Wade, Waste Of Time Home Page

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Radiocarbon dating

Is there then no hope for getting absolute dates? What about the Carbon-14 method?

This too has problems, but they can be solved, and then the pottery fragments will be all the more relevant for dating.

"Radiocarbon dating depends on a chain of natural events, some having taken place in deep space long ago. The sequence begins in various parts of the galaxy, where charged particles are accelerated to immense velocities, forming what are known as cosmic rays. A fraction of these particles eventually rain down on the earth and strike molecules of atmospheric gas, producing neutrons. Some of these neutrons in turn react with nitrogen," forming C-14, which combines with oxygen to form molecules of radioactive carbon dioxide. By the time this reaches the surface of the earth, "it has fully mixed with normal carbon dioxide and accounts for about one molecule in 10" (tips)R. E. Taylor, "Fifty Years of Radiocarbon Dating," American Scientist, January 2000|Taylor{/tips}).

Most of the radioactive carbon enters the oceans. But one or two percent goes into the terrestrial biosphere, because plants absorb carbon from the air during photosynthesis. The animals that feed on the plants get tagged as well with C-14. Living things maintain a C-14 content "about equal to the atmospheric concentration because the carbon atoms that undergo radioactive decay within their bodies are continually replaced. But once an organism dies and its metabolic processes cease, the amount of C-14 begins to diminish." A dead organism loses half its C-14 (relative to its non-radioactive carbon) through radioactive decay about every 5730 years.

Suppose, then, that we find the charred remains of wood in a layer of a tell. If we can measure the proportion of C-14 to its other carbon isotopes, then compare this to the concentration in a recently living thing, we should be able to determine when the tree died. For example, if the wood has only half the concentration of C-14 that a living tree has, then it must be about 5730 years old.

A scientist named Willard F. Libby grasped this principle and, in 1949, managed to determine the concentration of C-14 in dead organic matter by measuring the rate of radioactive decay. From the late 1970s, scientists learned to detect concentrations of the isotope directly by sorting out masses through spectrometry in an accelerator (cyclotron). This reduced the amount of organic material needed from grams to milligrams. It also reduced measurement-time from days to minutes. Tests on ancient wood had been problematic for dating a stratum, since wood may continue in use for thousands of years. Using the cyclotron, scientists could determine the C-14 in small amounts of organic materials that would not have been passed down, such as charred grain.

Yet C-14 tests did not always yield results corresponding to known historical dates. Soon it was realized that the amount of C-14 in the atmosphere had not been constant throughout the ages. Scientists found, however, a method of coping with this fact:

"For some species of trees growing in some climatic conditions, visually recognizable rings form annually with a climatically determined width pattern. This width pattern allows cross dating between trees felled in different periods (the pattern shown by the inner part of a recent tree can be matched with that shown by the outer part of a tree that was felled earlier.) In this way a master chronology can be established for a region..." (Eric M. Meyers, Editor, *The Oxford Encyclopedia of Archaeology in the Near East*, American Schools of Oriental Research, 1997) ("Dating Techniques").

Such dendrochronology can be used directly to date pieces of wood found at a site. But more to our purpose, one can also measure the radiocarbon age of the wood in a tree trunk and check this against the number of rings. Using California giant sequoia and bristlecone pine, as well as European oaks, researchers have been able to document the amount of "offset" between "C-14 time" and "real time" for the past 11,800 years. On this basis they have been able to calibrate the radiocarbon method, calculating true age by adding or subtracting the appropriate offset.

"(I)nvestigators now have a good handle on the 'wiggles' in the calibration for the last twelve millennia. These variations are well documented, yet they cause considerable problems because they introduce built-in uncertainties in dating: Calendar ages can often be expressed only as broad ranges," even when the C-14 concentrations are known precisely (R. E. Taylor, op. cit.). Researchers express the range by adding a plus/minus figure: for example, 1468 \pm 75 BC. This does not mean that the date necessarily lies within those ranges. The 75 years constitute what is called a "standard deviation" or "sigma." When a date is so given, it means that the tested item has a 66% probability of lying between 1468 + 75 BC and 1468 - 75 BC. It has a 95% probability of lying within the limits of two standard deviations, i.e., between 1468 + 150 BC and 1468 - 150 BC. It has a 99.5% probability of lying within three.

Calibration curves vary by region, and we do not yet have them for the Eastern Mediterranean. Scientists can trace the tree rings here from the present back to 362 AD. What's more, a Cornell University team has established a 1503-year 'floating sequence' of rings for Bronze and Iron Age Anatolia, but this has yet to be connected to modern sequences in order to supply absolute dates. Until that happens, no C-14 results for the Middle East will be definitive. Once the Cornell work is completed, we should be able to date strata within the limits of probability mentioned above, and the pottery distinctive for a stratum so dated can then be used to date strata elsewhere, even when no organic material is found. The accumulation of data, along with further techniques, should solve the problem of absolute dating.

Given all the difficulties of Egyptian chronology and those of carbon dating, we may wonder how archaeologists in the Holy Land have been able to arrive at dates such as those given in this Website for periods before 763 BC. The answer is that they have assumed they were on firm ground with Egyptian chronology. Because Egyptology is vast and complex,

they have not been able to check that chronology for themselves. "The dependence on Egyptian chronology is so strong that any change in the latter necessitates a parallel shift concerning Palestine" (Amihai Mazar, *Archaeology of the Land of the Bible: 10,000 - 586 B.C.E.*, New York: Doubleday, 1990|Mazar, p. 29.) Once the regional tree-ring sequence is all hooked up, there may be some rewriting to do, this Website being no exception.