NEAR EAST CHRONOLOGY: TOWARDS AN INTEGRATED ^{14}C TIME FOUNDATION

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ABSTRACT. Chronology is the backbone of all history, as the flow of time is identical in scholarly and scientific fields, even in the Near East. Radiocarbon dating can provide an essential and unifying chronological basis across disciplines, despite precision limitations. This issue presents exciting new ^{14}C developments in archaeological and environmental contexts, ranging from Proto-Neolithic cultures to historic earthquakes along the Dead Sea. Dark periods devoid of settlement in the deserts of the southern Levant seem to disappear with ^{14}C dating. Significant new findings collectively indicate the need for major chronological revisions in the 4th and 3rd millennia BCE in Egypt and the Levant. The implications for the 2nd millennium BCE are not yet established, but the use of ^{14}C dating in the Iron Age is finally beginning to focus on current controversies. The chronological way forward for Dynastic Egypt and the Levantine Bronze and Iron Ages is a multi-disciplinary approach based on detailed high-quality ^{14}C series as a unifying time foundation to anchor archaeological, textual, and astronomical data.

INTRODUCTION

The 17th International Radiocarbon Conference in 2000 was the first such major gathering held in Israel and the Near East since the invention of radiocarbon dating some 50 years before by Willard Frank Libby (1952). Ancient organic material from Egypt was used by Libby around 1950 to test his new method (Berger 1983) against the historical dates of the so-called Egyptian Calendar. It is, therefore, somewhat paradoxical that ^{14}C dating hardly played a role in scholarly chronological debates concerning Dynastic Egypt and the cultural periods known as the Bronze and Iron Ages in the Levant in the second half of the 20th century.

A pioneering evaluation study of ^{14}C dates in the southern Levant was made by Weinstein (1984), who at that time considered ^{14}C dating of limited value for the Early Bronze Age and later periods. He regarded archaeological and historic age assessments more precise than ^{14}C dating. That perception is, unfortunately, still widely prevalent today among archaeologists and Egyptologists, hampering independent chronological progress.

What somehow became overlooked is that precision and accuracy may be centuries apart! Distinguished scholars gave already very precise dates for Dynasties 1 and 2 in the first half of the 20th century: 3400–2980 BCE[1] (Breasted 1921) or 3407–2888 BCE (Weigall 1925). However, scholarly opinions became "younger" for Dynasties 1 and 2 during the second half of the 20th century and alternative precise dates were given: 3100–2686 (Hayes 1970) or 3000–2635 (Gutgesell 1984). This example illustrates that dates based on historical age assessment may be very precise but not necessarily accurate (Bruins and van der Plicht, this issue), as a shift in interpretation of essentially the same corpus of Egyptian texts "made" the above dynasties younger by two to four centuries.

EXPOSING CIRCULAR REASONING

Why is ^{14}C dating relevant in these periods for which a massive chronological building has already been erected on the basis of cultural remains, foreign synchronisms, and historical chronological

[1]Note: The more general notation BCE (Before Common Era) is often used in the Near East instead of BC (Before Christ), and likewise CE (Common Era) instead of AD (Anno Domini). Concerning the notification of calibrated radiocarbon dates, it was decided in 1986 during the business meeting of the 12th International Radiocarbon Conference in Trondheim, Norway to use *cal BC* and *cal AD* as technical terms by convention (Mook 1986). Hence, the notation "cal BCE" and "cal CE" for calibrated dates should preferably be avoided.

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data from Egypt and Mesopotamia? The answer is simple and potentially very disturbing: *circular reasoning*. For example, the age and time duration attributed to diagnostic pottery types or stone implements are often based on opinion rather than detailed and independent physical age measurements.

Time is *senso stricto* a physical dimension. Cultural classification should not be confused with dating, although stratified cultural objects do of course carry a sense of relative timing that may be more refined than individual calibrated ^{14}C dates. However, the primary pillars of chronology must be based on actual dates, not on cultural periodization (Bruins and Mook 1989). Some of the foundations of the conventional chronological building may be less secure than hitherto perceived. Quite a number of articles in this issue challenge and revise, on the basis of new ^{14}C dates, various aspects of "conventional" chronology and archaeological interpretation.

The excavation of material remains, their cultural interpretation, and their placement in time constitute three interrelated but different activities. It is obvious that age assessment or dating has a bearing on the interpretation of cultural remains. Whether certain Iron Age layers in Israel are 10th century or 9th century is currently hotly debated (Balter 2000), as it is perceived to affect archaeological interpretation and association concerning the Biblical period of the United Monarchy. ^{14}C dating, amazingly, did not form part of the debate, but this is finally beginning to change (Mazar and Carmi, this issue; Gilboa and Sharon, this issue). Quality control of ^{14}C dating and intercomparison of dating results between labs is always important, particularly in such fine-tuning as in the above case. Solomonic wisdom seems required to differentiate between the scientific potential and limitations of both archaeology and ^{14}C dating in relation to ancient Hebrew texts.

SYNCHRONIZATION BETWEEN HUMAN AND ENVIRONMENTAL HISTORY

Another crucial aspect in the use of ^{14}C dating is the synchronization between human and environmental history. The Near East is rather unique in terms of its combined archaeological, historical, and environmental attributes. Exotic rivers, in terms of outlandish origin and environmental setting, provide precious water from wetter regions into hyper-arid zones in Egypt and Mesopotamia. Large deserts meet with semi-arid to sub-humid Mediterranean zones in the Levant. Rainfall events transpire mainly during the cool winter months, as the first and latter rain occur during the adjoining autumn and spring. The influence of tropical, monsoonal, summer rains in the Near East is limited to Yemen, in the southern part of the Arabian Peninsula. The completely dry and hot summer in most of the Near East required resourcefulness in water management, also in antiquity. Drought was and is a natural hazard that should be taken very seriously in the region (Bruins, forthcoming).

The history of the environment in its various aspects is very relevant in relation to archaeological history. Extreme geological events also play a role, such as earthquakes (Ken-Tor et al. this issue; Bowman et al., this issue) and volcanic eruptions (Manning 1999). Natural hazards caused stress or even disaster in ancient societies. The synchronization of environmental history and archaeological history requires a uniform chronology in terms of methodology (Bruins 1994). Using only cultural or historical classifications as "proxies" for time in archaeological contexts, while dating environmental changes largely by ^{14}C may lead to a deceptive comparison between "time-apples" and "time-oranges". Differences of about two centuries have been found between ^{14}C dating and historical-archaeological age assessment of EB layers in Jericho, as related to Dynastic Egypt (Bruins and van der Plicht, this issue). Erroneous synchronization between archaeology and the environment may result from a mistaken methodology.

ADVANCES IN NEAR EAST CHRONOLOGY

This issue emphasizes the need to use ^{14}C dating as the universal yardstick to measure time in both archaeological and environmental contexts. As such the issue presents the latest ^{14}C developments in Near East chronology. The articles are largely organized in general chronological sequence, going from the distant past to more recent periods. The following article by van der Plicht and Bruins (this issue) concisely reviews the state of the art in ^{14}C dating in relation to its usage in the Near East during archaeo-historical periods. The authors call for widespread application of ^{14}C dating to build up a regional chronology based upon ^{14}C time, also in Dynastic Egypt and for the Levantine Bronze and Iron Ages. The update on methodology may remove some confusion about radiocarbon dating amongst current and potential users. Suggestions are made for necessary quality control in ^{14}C dating.

Late Pleistocene Near Lake Kinneret

Nadel et al. (this issue) report on new discoveries in the Sea of Galilee area, made possible as a result of the very low lake level during recent years. A large fisher-hunter-gatherer camp was dated by ^{14}C to 19,430 BP (average). The archaeological remains include quantities of excellently preserved organic remains. About 2 km south of the site eight *Salix* tree trunks were found, dated by ^{14}C to 16,100 BP. The authors suggest that the finds represent two separate episodes of deposition during low lake levels, followed by a rapid rise in the water level.

Holocene Chronology of the Dead Sea Area

Frumkin et al. (this issue) made an important attempt to compare different Holocene records from several sites along the Dead Sea, based on ^{14}C chrono-stratigraphy, including the paleoclimatic record of the Nahal Darga ephemeral stream valley. Investigation of former Dead Sea levels is complicated by possible tectonics and the rise of the Mount Sedom salt diapir. A relatively high level of the Holocene Dead Sea occurred around 3000 cal BC. The lake level fell sharply around 2500 cal BC, and later fluctuated close to early 20th century levels. The rise of Mount Sedom may be calculated in the range of 5 to 7 mm per year.

Dating the Inventions of Agriculture, Livestock Raising, and Pottery Production

It was in the Near East that human beings inaugurated an entirely new interaction with the environment, which was truly revolutionary. Following a few million years of food gathering and hunting by hominids and more recent human species, a radical change occurred rather suddenly and inexplicably. Humans in the Near East started to domesticate plants and animals in order to produce food in an actively managed way. The annual cycle of sowing and harvesting of food crops, as well as the annual cycle of pastoralism for milk and meat production had begun. Farmers and herders interacted with the environment in a new manner, affecting the landscape, the vegetation, and the soils.

The question may be asked why agriculture did not develop earlier, after previous Ice Ages, climatic changes, environmental pressures and opportunities, if it is an obvious and logical development for *Homo sapiens* society. Material remains may not be able to provide the answer to this question, though interesting non-environmental suggestions are made in an important book by Cauvin (2002), reviewed by Bar-Yosef (2001) and others. Even within the frame of *Homo sapiens sapiens*, it is interesting to note that agriculture never developed in Australia, where hunting and gathering persisted among the local Aborigine population until European colonization in the 17th century.

The actual beginning of agriculture and livestock raising in the world apparently took place in the Near East just before or during the Neolithic period, depending somewhat on definition and interpretation. Aurenche et al. (this issue) carried out a unique collective approach to date the first distinct agricultural cultures with ^{14}C to the period between 8300 and 8000 cal BC. The beginning of agriculture and livestock raising is truly revolutionary, as it enabled human cultures to increase the carrying capacity of the land, which gradually enabled development of a larger population with social specialization and the rise of civilization. Indeed, the first appearance of ceramics has been dated by ^{14}C to about 7000 cal BC (Aurenche et al. this issue), i.e. about a millennium after the onset of agriculture. Finally, the authors dated to about 6000 cal BC the emergence of Mesopotamian cultures that later became responsible for the beginning of the urban revolution.

Continuous Habitation in the Southern Levant Deserts: 6000–2000 cal BC

Avner and Carmi (this issue) analyzed ^{14}C dating of desert settlements in the Southern Levant from the Late Neolithic through the Early Bronze Age (6th–3rd millennia BCE). They show that perceived dark periods without settlement in the traditional chronology and archaeological interpretation largely disappear, if the chronology is based on ^{14}C dating. This is a very important discovery. Avner and Carmi (this issue) state: "The time factor was usually based on archaeological estimates rather than comprehensive physical dating." For example the perceived age and time-duration of "hole-mouth" pottery sherds and tabular flint scrapers became a source of circular reasoning to "date" sites and their "duration".

The Chalcolithic Period

Bourke et al. (this issue) present important new accelerator mass spectrometry (AMS) dates from Teleilat Ghassul in Jordan. They conclude that the earliest occupation at Ghassul postdates the Neolithic, while significant occupation at Ghassul had ended by the time of the Beersheban Chalcolithic. "These possibilities have revolutionary significance for our understanding of the development of Chalcolithic culture in the southern Levant" (Bourke et al., this issue).

Burton and Levy (this issue) discuss the sequence and timing of Chalcolithic socio-economic change in relation to new technologies, such as metallurgy, groundstone, agro-technology, and the elaboration of social institutions. They evaluate available ^{14}C dates but consider the radiometric database still too coarse-grained to resolve sequences of social, political, and economic formations.

Aardsma (this issue) obtained new ^{14}C dates on a reed mat found with the famous Chalcolithic treasure of copper objects in the Judean desert (Bar-Ardon 1980). The latter mat was initially dated by ^{14}C in the 1960s to about 3500 cal BC. The new AMS dates from the University of Arizona ^{14}C lab are about 800 years older. Aardsma (this issue) calibrated the new dates to the range 4500–4200 cal BC, while 4300 ± 50 cal BC is given as his best estimate. The results emphasize that ^{14}C dates measured during the first decades after the invention of the method cannot always be trusted (Bruins and van der Plicht 1998). Modern high-quality dating is required.

Predynastic, Early Dynastic Egypt, and the Early Bronze Age in the Levant

Savage (this issue) is developing a very detailed ^{14}C-based chronology of Predynastic ceramics in Egypt. One of his important conclusions states the following: "the Nagada II a/b to Nagada II b/c transition may occur earlier than previously estimated, which impacts the dating of the Early Bronze Age in the Southern Levant". The methodological implications of the excellent research by Savage are obvious: detailed ^{14}C dating of ceramic complexes, wherever possible, is highly recommended for other archaeological periods, such as the Bronze and Iron Ages in the Levant.

Braun (this issue) analyzed a significant number of recent ^{14}C determinations from his own excavations and several other sites in the region concerning Proto-Dynastic and Early Dynastic Egypt and Early Bronze Age I and II. The ^{14}C results from EB-I suggest that the period is older than conventionally considered. However, Braun (this issue) feels, understandably, very uneasy about the implications for conventional time-correlations with Egypt. He states: “The logical outcome of an acceptance of these new dates puts such a strain on chronological correlations between the ^{14}C data and the archaeological record, that the entire system would no longer be tenable if they were accepted” (Braun, this issue).

Bonani et al. (this issue) present a very important list of new ^{14}C dates from the Old and the Middle Kingdoms in Egypt. The authors collected and dated a few hundred organic samples from monuments. Although they refrain from making definite conclusions, most dating results clearly confirm the trend found in various articles in this issue that conventional historical and archaeological age assessments for Predynastic and Early Dynastic Egypt appear too young by a significant margin. In an earlier publication of initial results from Egyptian Old Kingdom monuments (Haas et al. 1987), using a different calibration approach, an average difference of about 300 years was mentioned.

Bruins and van der Plicht (this issue) show in a detailed case that high-quality stratified ^{14}C dates from EB Jericho are older by up to a few hundred years than conventional archaeo-historical time frameworks, related to Dynastic Egypt. These results seem to confirm the data obtained by Haas et al. (1987) and Bonani et al. (this issue). The authors conclude: “Egyptian chronology should not be regarded as ultimately fixed. Egyptologists in the first half of the 20th century gave much older dates for the earlier Dynasties. The new ^{14}C evidence is overwhelmingly in favor of an older Early Bronze Age and older dates for Dynasties 1–6” (Bruins and van der Plicht, this issue).

The Iron Age Controversy

What’s in a date (Van Strydonck et al. 2000)? Well, the suggestion by Finkelstein (1996, 1998) to lower the Iron Age I and II by some 50–100 years has caused a great controversy, because it is perceived to affect the credibility of the Biblical period of the United Monarchy through archaeological association or rather dissociation (Balter 2000). It also has repercussions for chronological relationships with other areas in the Near East and Eastern Mediterranean region. The viewpoint of Finkelstein has been opposed by Mazar (1997), Ben-Tor and Ben-Ami (1998) and Ben-Tor (2000).

Can ^{14}C dating help to find a solution in this controversy? Two articles in this volume bring ^{14}C finally into the debate. Mazar and Carmi (this issue) discuss 32 new ^{14}C dates in Iron Age I and II contexts from Tel Beth Shean and Tel Rehov in northern Israel. The latter site produced one of the best Iron Age IIa stratigraphic sequences in Israel. The ^{14}C results from both Tel Rehov Stratum V and Beth Shean Stratum S1 are so far ambiguous in the sense that they may allow for a 10th or a 9th century date. Ongoing high-quality ^{14}C dating of these stratified ceramic sequences may give more conclusive results.

Gilboa and Sharon (this issue) present 22 ^{14}C dates from a detailed Iron I–IIa stratigraphic/ceramic sequence at Tel Dor, on Israel’s Mediterranean coast. The site has also strong Phoenician and other links through a variegated sequence of ceramics. The majority of ^{14}C dates obtained so far are up to a century lower than those established by conventional ceramic chronology, apparently supporting the lower chronology proposed by Finkelstein. However, the authors caution that more sites need to be dated by ^{14}C before major conclusions can be drawn. Gilboa and Sharon (this issue) emphasize that a possible “low” chronology of the Levantine Iron Age can no longer be ignored but must be tested further.

The Southern Part of the Near East: the Republic of Yemen

Görsdorf and Vogt (this issue) present many new ^{14}C dates from the Bronze and Iron Age cultures in Yemen, in the southwestern part of the Arabian Peninsula. ^{14}C dates are very important in the study of the Sabir culture and to correlate its developments with other parts of the Near East on the basis of chronology. The monumental mudbrick architecture is an interesting aspect of the above culture. The dates are from Ma'layba and Sabir, which is the largest archaeological site. The results provide a significant chronological basis for architectural and ceramic developments during the 2nd and 1st millennia BCE.

In their second article, Görsdorf and Vogt (this issue) focus on Ma'rib, the most famous archaeological site of Yemen. It had the largest irrigation system in the world based on rainwater-floodwater harvesting from an ephemeral river (wadi) situated in a desert area. Ma'rib became the capital of Saba and the economical and cultural center of South Arabia in the 8th century BCE. The Almaqah Temple of Bar'an was investigated in detail, showing four building phases, as it was used from the 9th century BCE to the 4th century CE. The ^{14}C dates from the temple provide important new information of Sabaean chronology in general and the history of Mar'ib in particular. Irrigation agriculture in the area continued until the final destruction of the Mar'ib Great Dam around 600 CE.

Historic Earthquakes in the Dead Sea Area

Major geological events such as earthquakes may have a devastating effect on the human environment. Ken-Tor et al. (this issue) have admirably investigated the record of Late Holocene earthquakes in lake-facies sediments of the Dead Sea through the stratigraphic study of "seismite" layers. In this article they evaluate the degree of chronological precision that can be obtained from calibrated ^{14}C dating in order to link seismite layers with historic records of earthquakes in the region. The authors showed that it is feasible to refine the calibrated age ranges through stratigraphic information and historical dates of earthquakes. They evaluate the age of the vegetation debris in the layers, used for dating, in relation to the age of the sedimentation layer and the time of the earthquake.

Bowman et al. (this issue) investigated along the Dead Sea exposed sections in various fan deltas that show abruptly changing facies of alluvial fan, beach, and shallow lacustrine environments. Soft sediment seismites of the load-structure type were studied, which are different in character and show a limited lateral extent compared to the lacustrine mixed layer seismites studied by Ken-Tor et al. (this issue). The potential of load-structures as seismic-chronological benchmarks in landscape analysis through ^{14}C dating is demonstrated by Bowman et al. (this issue). The authors were able to correlate for the first time load structure and mixed layer seismites in different spatial locations through ^{14}C dating, through comparison with the key stratigraphic section of Ken-Tor et al. (this issue).

CONCLUSIONS

Chronology is the backbone of all history, whether human or environmental, enabling juxtaposition and synchronic interpretation. The Near East has witnessed some unique developments in human history, which have taken place in dramatic settings of drylands and desert environments. ^{14}C dating is the most widely applicable physical method to measure time with the same yardstick in a variety of contexts during the Late Pleistocene and Holocene, including historical periods. Thus, it can provide an essential and integrative chronological basis across disciplines, notwithstanding precision limitations of calibrated age ranges.

This issue presents many new ^{14}C dates and important chronological evaluations concerning the Late Pleistocene Lake Galilee and the Holocene Dead Sea, a regional examination of Proto-

Neolithic and Neolithic cultures in the Near East with the beginning of agriculture, livestock raising and the invention of ceramics, the erasing of dark periods in the habitation of deserts in the southern Levant, exciting new chronological developments in the Chalcolithic period, in Predynastic and Dynastic Egypt, in the Levantine Bronze and Iron ages, in ancient Yemen, as well as the dating of earthquake layers along the Dead Sea.

Collective evidence in this issue clearly indicates that major chronological revisions seem required for the 4th and 3rd millennium BCE, as proto-historical, predynastic, and early dynastic periods, EB I and EB II are considerably older according to ^{14}C in comparison to archaeo-historical age assessments. This may also have some repercussions for the 2nd millennium BCE, but detailed stratified series of high-quality ^{14}C dates from Egypt and the Levant are so far largely absent for this period. Concerning the Levantine Iron Age, the use of ^{14}C dating to investigate current chronological controversies is finally taking off. More results from different Iron Age sites are required before definite conclusions can be made.

A precise chronological framework based on ancient texts is not necessarily accurate, as there is a principal difference between precision and accuracy. ^{14}C dating can provide an independent basis to anchor detailed but floating historical chronologies to absolute time. Astronomical events recorded in ancient texts are very important but may have multiple time windows. ^{14}C dating may help to decide which window is the correct one.

The chronological way forward for Dynastic Egypt and the Levantine Bronze and Iron Ages is first and foremost the establishment of detailed high-quality ^{14}C series as a unifying time foundation, integrated with detailed stratified archaeological series and with historical chronologies based on ancient texts, possibly linked to astronomical time windows.

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