RADIOCARBON, Vol 51, Nr 3, 2009, p 905–913 © 2009 by the Arizona Board of Regents on behalf of the University of Arizona

THE BEGINNING OF THE EARLY BRONZE AGE IN THE NORTH JORDAN VALLEY: NEW ^{14}C DETERMINATIONS FROM PELLA IN JORDAN

Stephen Bourke[1,2] • Ugo Zoppi[3] • John Meadows[4] • Quan Hua[5] • Samantha Gibbins[1]

ABSTRACT. This article reports on 10 new accelerator mass spectrometry (AMS) radiocarbon dates from early phases of the Early Bronze Age at the long-lived settlement of Pella (modern Tabaqat Fahl) in the north Jordan Valley. The new AMS dates fall between 3400 and 2800 cal BC, and support a recent suggestion that all Chalcolithic period occupation had ceased by 3800/3700 cal BC at the latest (Bourke et al. 2004b). Other recently published Early Bronze Age ^{14}C data strongly supports this revisionist scenario, suggesting that the earliest phase of the Early Bronze Age (EBA I) occupied much of the 4th millennium cal BC (3800/3700 to 3100/3000 cal BC). As this EB I period in the Jordan Valley is generally viewed as the key precursor phase in the development of urbanism (Joffe 1993), this revisionist chronology has potentially radical significance for understanding both the nature and speed of the move from village settlement towards a complex urban lifeway.

INTRODUCTION

The first (purely typological) studies on Early Bronze Age (EBA) assemblages in the Jordan Valley settled on the turn of the 4th/3rd millennium BC as marking the beginnings of the earliest Bronze Age culture (Albright 1932; Mallon 1932). It took some time before the initial stages of the Early Bronze Age (EB I) were codified (Wright 1937, 1958), with the appropriate chronocultural status in doubt for some time (de Vaux 1957; Hennessy 1967; de Miroschedji 1971).

Radiocarbon dating eventually provided a way out of typological dilemmas, but this took some time to come about. The first radiometric study to address the beginning of the EBA (Callaway and Weinstein 1977), moved its origins back into the last quarter of the 4th millennium BC, although to achieve this consensus, a number of apparently unreliable earlier dates had to be set aside (Callaway and Weinstein 1977:5). Mellaart challenged this attempt to harmonize historical and radiometric data sets, advocating a considerably higher commencement date for the EBA (Mellaart 1979:17–8). Weinstein took issue with Mellaart's analysis, but struggled to account for the growing body of unexpectedly high dates for the EBA (Weinstein 1980:22–4), suggesting that sample contamination or "old wood" issues might be to blame. Even so, in a more wide-ranging survey of Middle Eastern radiometric data, Weinstein placed the beginning of the EBA around the middle of 4th millennium BC (Weinstein 1984:306), considerably earlier than in previous formulations.

Following on from Weinstein's study, Gilead surveyed the radiometric database pertaining to the latest horizons of the preceding Chalcolithic period in the northern Negev, and concluded by advocating an end date for the Beersheban Chalcolithic early in the first quarter of the 4th millennium BC (Gilead 1993:87–9, 1994). This finding is consistent with more recent work in the south Jordan Valley, which advocated an end date for Ghassulian Chalcolithic occupation no later than 3800 cal BC (Bourke et al. 2001, 2004b; Bourke 2008). At the same time, new research on the radiometric chronology of the earliest EBA cultures of the coastal plain (Golani and Segal 2002; Golani 2004), and in southern Jordan (Görsdorf 2002; Kerner 2008), was turning up results that strongly support an early 4th millennium cal BC beginning for the EBA.

[1]Dept. of Archaeology, University of Sydney, Australia.
[2]Corresponding author. Email: stephen.bourke@arts.usyd.edu.au.
[3]Accium BioSciences, Inc., 550 17th Avenue, Suite 550, Seattle, Washington 98122, USA.
[4]Institute of Archaeology, University College London, United Kingdom.
[5]Australian Nuclear Science and Technology Organisation (ANSTO), PMB 1, Menai 2234, Australia.

Downloaded from https://www.cambridge.org/core. IP address: 54.161.116.225, on 21 Oct 2018 at 21:10:22, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms.
https://doi.org/10.1017/S003382220003397X

While most recent scholarship seems unwilling to countenance any form of occupational gap between the Chalcolithic and the Early Bronze Age cultures of the southern Levant in the first half of the 4th millennium BC, opinion seems split between advocacy of an attenuated Chalcolithic culture stretching throughout much of the first half of the 4th millennium BC (Joffe and Dessel 1995; Burton and Levy 2001; Braun 2001), or those who embrace an early 4th millennium BC transition to the EBA (Gilead 1994; Golani 2004). That such a scenario implies a much longer span for the EB I period than previously acknowledged would seem unavoidable (Braun 2001), although recent work on the later EBA sequences in the Jordan Valley (Fischer 2000; Bruins and van der Plicht 2001; Segal and Carmi 2004) and the southern coast (Anderson 2006) strongly implies that the dates for later EBA assemblages (EB II–III) may have to be revised upwards as well.

It is against this background of conflicting chronological scenarios for the birth and development of the Early Bronze Age in the Jordan Valley that recent work at Pella in Jordan is to be placed. Pella is a long-lived settlement of around 8 hectares, located in the eastern foothill zone of the north Jordan Valley (McNicoll et al. 1992), occupied for the greater part of the last 8000 yr (Bourke 1997). One aspect of recent work at Pella has focused on the development of a robust radiometric database for the prehistoric (Neolithic through Early Bronze Age) occupational sequences, sourced from short-life botanical samples.

A first report on the Neolithic and Chalcolithic radiometric data was published recently (Bourke et al. 2004a). The current article reports on 10 new short-life AMS dates drawn from a variety of contexts across the extensive Early Bronze Age horizons at Pella (Bourke et al. 1999; Bourke 2000; Gibbins 2001). They provide important new data bearing on both the nature and the timing of the transition from village to urban lifeways.

TECHNICAL DATA: PREPARATION AND PROCESSING

All samples presented in this study were ^{14}C dated at the AMS facility at ANSTO (Fink et al. 2004). To remove contamination, the standard AAA method (Mook and Streurman 1983) was employed. Pretreated samples were then converted to CO_2 by combustion at 900 °C for 5 hr in a sealed tube in the presence of precleaned CuO and Ag wires. Graphite targets were prepared by reducing CO_2 over iron catalyst (600 °C) in the presence of excess hydrogen. Finally, the graphite was loaded into an aluminium sample holder ready for the AMS measurement. The technical details of these methods are described in Hua et al. (2001).

The $^{14}C/^{13}C$ isotopic ratio was measured relative to the internationally accepted oxalic acid I (HOxI) standard material (Stuiver 1983). Corrections were then applied for the spectrometer background, for the contamination incorporated during the preparation of the graphite target, and for the isotopic fractionation. Using the corrected radioisotopic ratio, the conventional ^{14}C age was calculated and finally calibrated using the CALIB software (Stuiver and Reimer 1993) and the IntCal98 calibration curve (Stuiver et al. 1998).

THE NEW DATES AND THE SEQUENCE AT PELLA

Each of the 10 new samples (Table 1) consisted of short-lived plant remains, mostly cereal grain, but occasionally grass seeds or legumes. Each sample consists of between 3 and 5 individual elements. Samples are drawn from discrete concentrations of burnt or dark ashy material wherever possible, with bricky debris layers avoided. This strategy was adopted to cut down the likelihood of sampling residual materials. Archaeobotanical work at Pella (Bourke et al. 2003:373–8; Meadows 2005:143) and at Teleilat Ghassul (Meadows 2005:133; Bourke et al. 2007:67–72) demonstrates the persistence

Downloaded from https://www.cambridge.org/core. IP address: 54.161.116.225, on 21 Oct 2018 at 21:10:22, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms.
https://doi.org/10.1017/S003382220003397X

Table 1 Ten new AMS dates from Pella in Jordan.

ANSTO code	Material	Graphite mass (mg C)	$\delta^{13}C$ (‰) (PDB)	^{14}C age (BP)	1-σ calibrated age	Relative probability
OZD023	cereal grain	1.90	–23.2	4565 ± 65	3382–3084 BC	83%
OZG609	cereal grain	1.85	–23.7	5590 ± 40	4470–4349 BC	93%
	cereal grain	2.25	–23.4	3630 ± 40	2132–2079 BC	15%
					2055–1886 BC	85%
OZG612	cereal grain	0.66	–25.0	4480 ± 50	3300–3023 BC	100%
OZG613	cereal grain	2.29	–22.9	3470 ± 40	1884–1689 BC	100%
OZG875	grass seeds	2.02	–24.1	4730 ± 50	3640–3497 BC	64%
					3461–3376 BC	36%
OZG876	cereal grain	2.04	–25.8	4470 ± 50	3348–3015 BC	96%
OZG877	cereal grain	2.37	–22.3	4420 ± 50	3329–3219 BC	24%
					3123–2917 BC	72%
OZG878	cereal grain	1.09	–23.5	4120 ± 50	2873–2574 BC	100%
OZG879	legumes	1.33	–22.7	4290 ± 50	3027–2864 BC	89%

of spatial and temporal patterns in the incidence of plant remains, even in secondary contexts. This suggests that even if some of the dated materials were residual, they probably derived from nearby contexts, broadly contemporaneous with the contexts in which they were found. The coherence of the sequence of ^{14}C results from Tell Husn (see below) reinforces this belief (Figure 1).

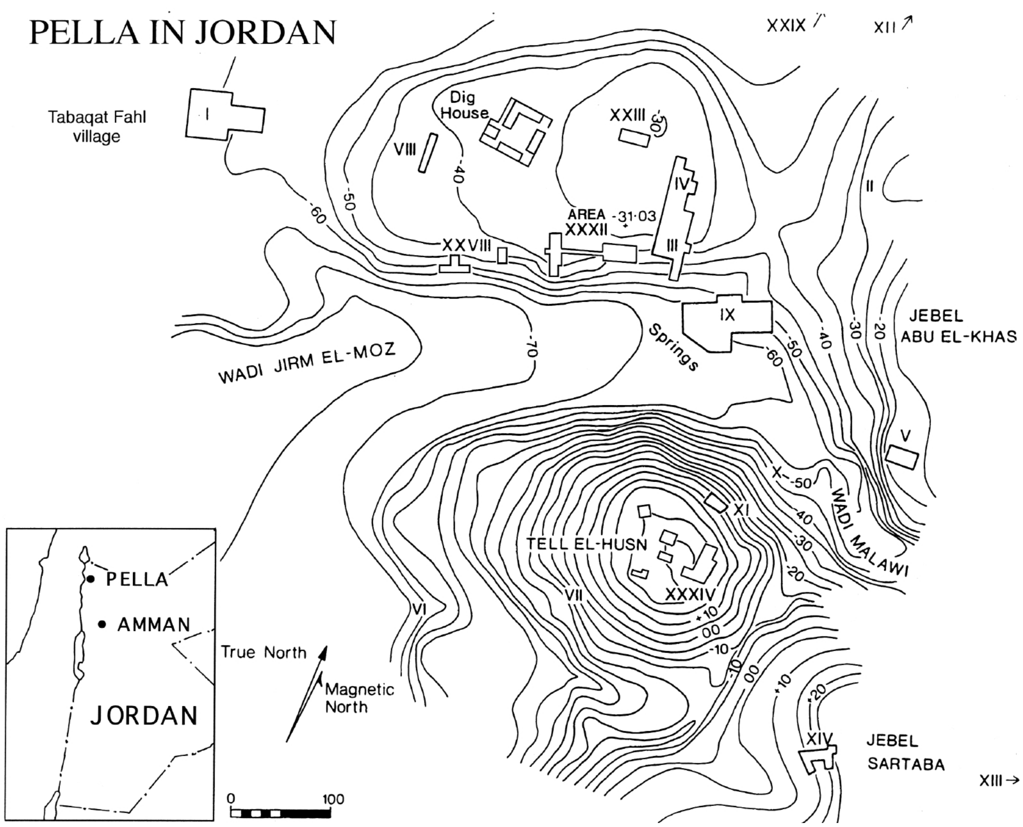

Figure 1 Map of Pella in Jordan, showing excavation areas mentioned in text

Downloaded from https://www.cambridge.org/core. IP address: 54.161.116.225, on 21 Oct 2018 at 21:10:22, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S003382220003397X

The 10 new determinations from Pella are drawn from 2 main locations (see Figure 1). Four samples come from the prehistoric excavation areas on the south side of Khirbet Fahl (areas XXVIII and XXXII), and aimed to bracket the Early Bronze Age strata between earlier and later horizons of occupation on the main settlement mound (Bourke 2000:233–4). One sample (OZG609) comes from the latest pre-Bronze Age Chalcolithic period occupational horizon, one (OZG612) from the main architectural stratum of the EB IB-II period settlement (Bourke 2000), and two (OZG611 and OZG613) are drawn from the first post-EBA (Middle Bronze Age I) strata. Six samples are drawn from various phases in the life of a massive fortified complex on the summit of nearby Tell Husn (Bourke et al. 1999; Gibbins 2001). Two samples (OZG875 and OZD023) come from strata of the earliest horizons of EBA occupation on the Husn summit, two fall within the middle phases (OZG 876–7), and two are drawn from the final horizons, one (OZG879) just before a fiery destruction of the complex, and one (OZG878) immediately afterwards, from what has been interpreted as a short-lived "squatter phase." Thereafter, the Husn summit was abandoned for nearly a thousand years (Table 2 and Figure 2).

Table 2 Archaeological contexts and phasing.

Site context	ANSTO code	Age BP	Calibrated age		Site phasing
XXXIIF 16.2	OZG609	5590 ± 40	4470–4349 BC	(93%)	Latest Chalcolithic (Khirbet Fahl)
XXXIVF 43.18	OZG875	4730 ± 50	3640–3497 BC	(64%)	Early Bronze IB (Husn)
			3461–3376 BC	(36%)	
XXXIVF 43.11	OZD023	4565 ± 65	3382–3084 BC	(83%)	Early Bronze IB (Husn)
XXVIIIA 39.6	OZG612	4480 ± 50	3300–3023 BC	(100%)	Early Bronze IB–II (Khirbet Fahl)
XXXIVF 43.3	OZG876	4470 ± 50	3348–3015 BC	(96%)	Early Bronze IB–II (Husn)
XXXIVF 42.21	OZG877	4420 ± 50	3329–3219 BC	(24%)	Early Bronze IB–II (Husn)
			3123–2917 BC	(72%)	
XXXIVE 105.2	OZG879	4290 ± 50	3027–2864 BC	(89%)	Early Bronze II (Husn)
XXXIVF 29.11	OZG878	4120 ± 50	2873–2574 BC	(100%)	Early Bronze II/III (Husn)
XXXIID 65.14	OZG611	3630 ± 40	2132–2079 BC	(15%)	Middle Bronze I
			2055–1886 BC	(85%)	
XXXIID 25.3	OZG613	3470 ± 40	1884–1689 BC	(100%)	Middle Bronze I

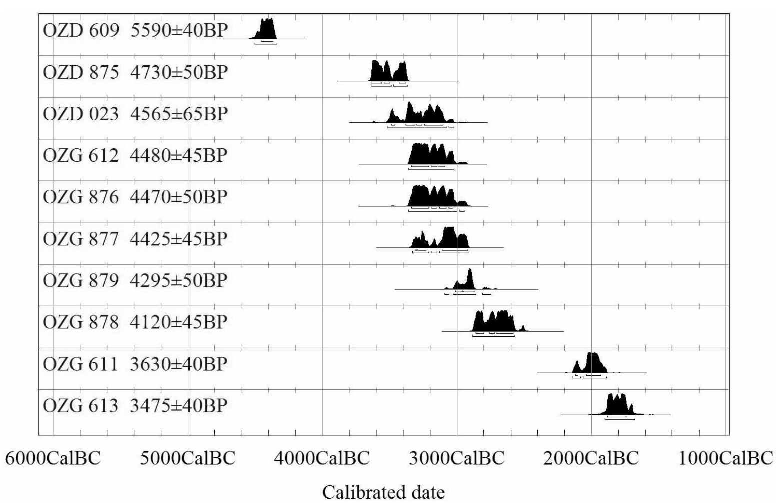

Figure 2 Plot of calibrated ages (atmospheric data from Reimer et al. 2004; OxCal v. 3.10, Bronk Ramsey 1995, 2001).

Downloaded from https://www.cambridge.org/core. IP address: 54.161.116.225, on 21 Oct 2018 at 21:10:22, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S003382220003397X

The 4 dates from Khirbet Fahl bracket the potential chronological range of Early Bronze Age (EBA) occupation on the main mound. The Chalcolithic period sample (OZG609) comes from an occupation deposit immediately below the first Early Bronze Age layer. Consistent with this, it records the latest Chalcolithic occupation on the main mound (Bourke et al. 2004a:122–3). In so doing, it suggests a gap of approximately 800/1000 yr (about 4200–3400 cal BC), separating Chalcolithic and Early Bronze Age occupational horizons. One sample (OZG612) dates the main phase of EBA architecture present in Area XXVIII (Bourke 2000:234). Two samples (OZG611 and OZG613) are drawn from earliest Middle Bronze Age (MBA) deposits, which seal all EBA occupation in the area. The first (OZG611) comes from a debris/fill layer overlying the latest EBA occupation, and the second (OZG613) from a small pit cut into this last EBA occupation (Bourke et al. 2003:337–8). Together, they suggest an MBA presence from around 1900 cal BC, implying another gap in the settlement sequence of around 800/1000 yr separating latest EBA from earliest MBA occupation, with the latest EBA on the main mound dated on ceramic grounds (in the absence of radiometric data from terminal EBA layers) to around 2900/2800 BC (Bourke 2000:252).

The 6 dates from the massively fortified EBA structures on Tell Husn (Bourke et al. 1999; Gibbins 2001) sample the full occupational lifespan of the complex. The 2 earliest dates (OZD023 and OZG875) derive from building fill layers associated with the construction of a massive rectangular rubble and stone terrace located on the northeastern corner of the Husn summit. The first (OZD023) date calibrates at least potentially earlier, and could theoretically contain derived material. However, as both OZD023 and the later assay (OZG875) are sourced to broadly contemporaneous fill layers, it seems probable that they both record activity commencing around 3400/3300 cal BC. Both constructional fills contain exclusively Early Bronze Age IB ceramics.

Two dates (OZG876–877) derive from sequential occupational fill deposits in an enclosed courtyard located in the northeast corner of the complex. These courtyard fills are associated with early occupational horizons in the Husn complex. They contain ceramics that are transitional Early Bronze Age IB/Early Bronze II in date. The radiometric data would place this transitional assemblage around 3200/3100 cal BC.

Further into the life of the complex, 1 date (OZG879) is taken from an occupational fill layer within the gatehouse complex located on the southeastern corner of the summit. Archaeological assemblages are now exclusively Early Bronze Age II in makeup, and document late activity within the complex, perhaps from around 3000/2900 cal BC.

EB II occupational strata are sealed by a thick layer of destruction debris, associated with quantities of burnt mudbrick and stone. Immediately above these layers, in shallow, much-disturbed deposits suggestive of an ephemeral short-term re-occupation (often characterized as a “squatter phase” in much regional literature), a single date (OZG878) documents occupation which could potentially date anywhere between 2900–2600 cal BC. However, given the immediate post-destruction stratigraphic context, the transitional Early Bronze Age II/Early Bronze Age III makeup of the ceramic assemblage (Bourke 2000), and the absence of even a single sherd of the Khirbet Kerak ceramic characteristic of mature Early Bronze Age III assemblages (Philip and Millard 2000), it seems probable that this ephemeral “squatter phase” dates from around 2900/2800 cal BC.

DISCUSSION

The earliest Early Bronze Age cultural assemblages at Pella belong to the EB IB period in ceramic terms (Bourke 2000:252). This assemblage probably begins around 3400/3300 cal BC. This is in keeping with radiometrically constrained EB IB assemblages from nearby Tell Abu Kharaz (Fischer

Downloaded from https://www.cambridge.org/core. IP address: 54.161.116.225, on 21 Oct 2018 at 21:10:22, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S003382220003397X

2000:222–5), dovetailing with the closely dated earlier (EB IA) assemblages from Tell esh-Shuna North (Bronk Ramsey et al. 2002:82–4). Shuna excavators suggest that the EB IA period begins there no later than 3700/3600 cal BC (Philip 2008:166–8), consistent with revisionist dating schemes, which posit an early 4th millennium cal BC date for the beginning of the EBA (Golani and Segal 2002:136–40). Of more general significance, the Shuna, Pella, and Abu Kharaz radiometric results support cultural formulations that view the north Jordan Valley as a key center of early EBA urbanization (Joffe 1993:73–6; Paz 2002:254–5).

The transition between Early Bronze Age IB and Early Bronze Age II cultural assemblages at Pella would seem to have occurred around 3200/3100 cal BC. This is perhaps a century earlier than traditional ceramic-based overviews favor (Stager 1992:40), and as this transition is tied to the rise of dynastic civilization in Egypt, it is a datum of some significance. However, the Pella data are consistent with a large group of EB II ^{14}C dates from nearby Tell Abu Kharaz (Fischer 2000:223–8), which include exported Egyptian materials dating from this transitional period. They are also consistent with new radiometric assays from EB II Jericho (Bruins and van der Plicht 2001). All favor raising the date of the EB IB/II transition.

Perhaps more telling, these Levantine findings are also consistent with new assays drawn from the Egyptian Late Predynastic/Early Dynastic Royal cemetery at Abydos (Görsdorf et al. 1998:642–5). These also favor an upward revision to the EB IB/II transition date. Although these new Egyptian dates are not without their critics (Joffe 2000:113, n. 4; Hendrickx 2006:90–2), constant appeals to a theoretical "old wood" effect in a Royal necropolis would seem somewhat strained, as even Weinstein (2003:643) has come to acknowledge.

The end of EB II occupation at Pella seems to be associated with a site-wide destruction of some severity. Cultural assemblage analysis suggests that this EB II assemblage at Pella is to be dated towards the end of the EB II period in general (Bourke 2000:252), as isolated ceramic elements that look forward to later EB III assemblages support this reconstruction. This would imply an end date for the EB II period in general somewhere between 2900/2800 cal BC. The Pella scenario is paralleled with closely similar archaeological circumstances (a site-wide destruction perhaps earthquake-related, ending all EB II occupation) and like radiometric data sets at nearby Tell Abu Kharaz (Fischer 2000:224; Philip and Millard 2000:282–3) and at Tell es-Saidiyeh (Tubb 1998:41–8; Philip and Millard 2000:283–4), further to the south in the east Jordan Valley.

Culturally, the beginning of the EB III period is generally correlated with the rise of the Egyptian Old Kingdom, and set at around 2700 BC (Stager 1992; Philip 2008). However, associating the rise of Dynasty 3 in Egypt with the beginning of the EB III period has always been tentative, with insufficient exports in either direction to knit the cultural assemblages together securely (Philip and Millard 2000:281). Placing the start date of the EB III period at around 2800 cal BC, perhaps a century earlier than traditionally posited, is consistent with EB III assays from Tell esh-Shuna (Philip and Millard 2000:284) and Tell es-Saidiyeh (Ambers and Bowman 1998:430).

This revised south Levantine chronology serves to bring the later EBA chronologies of the northern and southern Levant into sequence (Philip and Millard 2000:287–8). Where previously it was necessary to posit a 100–200 yr time-lag between production in the northern Levant and export to the south of distinctive ceramic types such as Khirbet Kerak ware, with the revised chronology proposed above in place, such a forced scenario is no longer required (Philip 1999:50–1). Finally, it is of some interest to note that recent radiometric studies on Dynasty 3 assemblages at Saqqara and Dashur are consistent with an upward revision to Old Kingdom chronology of around 100 yr

Downloaded from https://www.cambridge.org/core. IP address: 54.161.116.225, on 21 Oct 2018 at 21:10:22, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms.
https://doi.org/10.1017/S003382220003397X

(Bonani et al. 2001:1303), so the link between Levantine EB III and the beginning of the Old Kingdom may well be sustainable after all.

CONCLUSION

The 10 new dates reported above outline the broad chronological phases of the Early Bronze Age I–II period horizons on the main mound of Pella (Khirbet Fahl), and on the nearby fortified hilltop (Tell Husn). Taken together, they suggest these EBA IB through transitional EB II/III strata at Pella date between 3400–2800 cal BC (Figure 2). These dates add further weight to recent suggestions that the EBA I period occupied much of the 4th millennium cal BC (Segal et al. 1998; Segal and Carmi 2004:139–40; Golani 2004:46–7). It further supports recent work placing the transition between the EBA IB and II periods around 3200/3100 cal BC (Bruins and van der Plicht 2001), and that between the EB II and EB III periods between 2900/2800 cal BC (Philip 2008:167), in both cases perhaps a hundred years earlier than previously formulated.

ACKNOWLEDGMENTS

The 10 new AMS dates were processed under AINSE Grant 04/002. The authors would like to thank AINSE for these grants, and all members of the AMS dating facility at ANSTO (Lucas Heights, Sydney) for their assistance in the preparation of the new dates.

REFERENCES

Albright W. 1932. The Chalcolithic Age in Palestine. *Bulletin of the American Schools of Oriental Research* 48:10–3.

Ambers J, Bowman S. 1998. Radiocarbon measurements from the British Museum: Datelist XXIV. *Archaeometry* 40:413–35.

Anderson R. 2006. Southern Palestinian chronology: two radiocarbon dates for the Early Bronze Age at Tell el-Hesi (Israel). *Radiocarbon* 48(1):101–7.

Bonani G, Haas H, Hawass Z, Lehner M, Nakhla S, Nolan J, Wenke R, Wölfli W. 2001. Radiocarbon dates of Old and Middle Kingdom monuments in Egypt. *Radiocarbon* 43(3):1297–320.

Bourke S. 1997. Pre-Classical Pella in Jordan: a conspectus of ten years' work (1985–1995). *Palestine Exploration Quarterly* 129:94–115.

Bourke S. 2000. Pella in the Early Bronze Age. In: Philip G, Baird D, editors. *Ceramics and Change in the Early Bronze Age Southern Levant*. Sheffield: Sheffield Academic Press. p 233–54.

Bourke S. 2008. The Chalcolithic period. In: Adams R, editor. *Jordan: An Archaeological Reader*. London: Equinox. p 109–60.

Bourke S, Sparks R, Mairs L. 1999. Bronze Age occupation on Tell Husn (Pella): report on the University of Sydney's 1994/95 field seasons. *Mediterranean Archaeology* 12:51–66.

Bourke S, Lawson E, Lovell J, Hua Q, Zoppi U, Barbetti M. 2001. The chronology of the Ghassulian Chalcolithic period in the southern Levant: new ^{14}C determinations from Teleilat Ghassul, Jordan. *Radiocarbon* 43(3):1217–22.

Bourke S, Sparks R, McLaren B, Sowada K, Mairs L, Meadows J, Hikade T, Reade W. 2003. Preliminary report on the University of Sydney's eighteenth and nineteenth seasons of excavations at Pella (Tabaqat Fahl) in 1996/97. *Annual of the Department of Antiquities Jordan* 47:335–88.

Bourke S, Lawson E, Zoppi U, Hua Q. 2004a. The chronology of the Late Neolithic and Early Chalcolithic periods in the north Jordan Valley: new ^{14}C determinations from Pella in Jordan. In: Higham T, Bronk Ramsey C, Owen C, editors. *Radiocarbon and Archaeology. Proceedings of the 4th Symposium, Oxford 2002*. Oxford: Oxford University School of Archaeology, Monograph 62. p 119–25.

Bourke S, Zoppi U, Meadows J, Hua Q, Gibbins S. 2004b. The end of the Chalcolithic period in the south Jordan Valley: new ^{14}C determinations from Teleilat Ghassul, Jordan. *Radiocarbon* 46(1):315–23.

Bourke S, Lovell J, Seaton P, Sparks R, Mairs L, Meadows J. 2007. Preliminary report on a fourth season of renewed excavations at Teleilat Ghassul by the University of Sydney, 1999. *Annual of the Department of Antiquities Jordan* 51:35–80.

Braun E. 2001. Proto, Early Dynastic Egypt and Early Bronze I–II of the Southern Levant: some uneasy ^{14}C correlations. *Radiocarbon* 43(3):1279–96.

Bronk Ramsey C. 1995. Radiocarbon calibration and analysis of stratigraphy: the OxCal program. *Radiocarbon* 37(2):425–30.

Bronk Ramsey C. 2001. Development of the radiocarbon calibration program. *Radiocarbon* 43(2A):355–63.

Bronk Ramsey C, Higham T, Owen D, Pike A, Hedges R.

Downloaded from https://www.cambridge.org/core. IP address: 54.161.116.225, on 21 Oct 2018 at 21:10:22, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S003382220003397X

2002. Radiocarbon dates from the Oxford AMS system: Datelist 31. *Archaeometry* 44(3):1–149.

Bruins H, van der Plicht J. 2001. Radiocarbon challenges archaeo-historical time frameworks in the Near East: the Early Bronze Age of Jericho in relation to Egypt. *Radiocarbon* 43(3):1321–32.

Burton M, Levy T. 2001. The Chalcolithic radiocarbon record and its use in southern Levantine archaeology. *Radiocarbon* 43(3):1223–46.

Callaway J, Weinstein J. 1977. Radiocarbon dating of Palestine in the Early Bronze Age. *Bulletin of the American Schools of Oriental Research* 205:1–16.

de Miroschedji P. 1971. *L'epoque Pre-Urbaine en Palestine*. Paris: Gabalda & Co.

de Vaux R. 1957. Les fouilles de Tell el-Far'ah près Naplouse. Sixième campagne, rapport préliminaire. *Revue Biblique* 64:552–80.

Fink D, Hotchkis M, Hua Q, Jacobsen G, Smith A, Zoppi U, Child D, Mifsud C, van der Gaast H, Williams A, Williams M. 2004. The ANTARES AMS Facility at ANSTO. *Nuclear Instruments and Methods in Physics Research B* 223–224:109–15.

Fischer P. 2000. The Early Bronze Age at Tell Abu el-Kharaz, Jordan Valley: a study of pottery typology and provenance, radiocarbon dates, and synchronization of Palestine and Egypt during Dynasties 0–2. In: Philip G, Baird D, editors. *Ceramics and Change in the Early Bronze Age Southern Levant*. Sheffield: Sheffield Academic Press. p 201–32.

Gibbins S. 2001. Early Bronze Age fortifications on Tell Husn (Pella). In: Walmsley AG, editor. *Australians Excavating Ancient Jordan: Fifty Years of Archaeological Exploration*. Sydney: Research Institute for Humanities and Social Sciences. p 89–94.

Gilead I. 1993. Sociopolitical organization in the northern Negev at the end of the Chalcolithic period. In: Biran A, Avitam J, editors. *Population, Production and Power (Jerusalem June 1990)*. Jerusalem: Israel Exploration Society. p 82–97.

Gilead I. 1994. The history of the Chalcolithic settlement in the Nahal Beer Sheva area: the radiocarbon aspect. *Bulletin of the American Schools of Oriental Research* 296:1–13.

Görsdorf J. 2002. New ^{14}C datings of prehistoric settlements in the south of Jordan. *Orient Archäologie* 5: 333–9.

Görsdorf J, Dreyer G, Hartung U. 1998. New ^{14}C dating of the archaic royal necropolis Umm al-Qaab at Abydos. *Radiocarbon* 40(2):641–7.

Golani A. 2004. Salvage excavations at the Early Bronze Age site of Ashkelon, Afridar-Area E. *'Atiqot* 45:9–63.

Golani A, Segal D. 2002. Redefining the onset of the Early Bronze Age in southern Canaan: new evidence of ^{14}C dating from Ashkelon Afridar. In: van den Brink E, Yannai E, editors. *In Quest of Ancient Settlements and Landscapes*. Tel Aviv: Ramot Publishing. p 135–54.

Hendrickx S. 2006. Predynastic-Early Dynastic chronology. In: Hornung E, Krauss R, Warburton D, editors. *Ancient Egyptian Chronology*. Leiden: Brill. p 55–93.

Hennessy J. 1967. *The Foreign Relations of Palestine during the Early Bronze Age*. London: Quartich.

Hua Q, Jacobsen G, Zoppi U, Lawson E, Williams A, Smith A, McGann M. 2001. Progress in radiocarbon target preparation at the ANTARES AMS Centre. *Radiocarbon* 43(1):275–82.

Joffe A. 1993. *Settlement and Society in Early Bronze Age I and II Southern Levant*. Sheffield: Sheffield Academic Press.

Joffe A. 2000. Egypt and Syro-Mesopotamia in the 4th millennium: implications of the new chronology. *Current Anthropology* 41(1):113–23.

Joffe A, Dessel J-P. 1995. Redefining chronology and terminology for the Chalcolithic of the southern Levant. *Current Anthropology* 36:507–18.

Kerner S. 2008. The transition from the Late Chalcolithic to the Early Bronze Age in the southern Levant. In: Kühne H, Czichon R, Kreppner F, editors. *Proceedings of the 4th International Congress on the Archaeology of the Ancient Near East. Volume 2. Social and Cultural Transformations*. Wiesbaden: Harrassowitz. p 155–66.

Mallon A. 1932. La civilisation du 3eme millenaire dans la Vallee du Jourdain: les fouilles de Teleilat Ghassul. *Syria* 13:333–44.

McNicoll A, Edwards P, Hanbury-Tenison J, Hennessy J, Potts T, Smith R, Walmsley A, Watson P. 1992. *Pella in Jordan 2*. Sydney: Mediterranean Archaeology Supplement 2.

Meadows J. 2005. Early farmers and their environment: archaeobotanical research at Neolithic and Chalcolithic sites in Jordan [unpublished PhD dissertation]. Melbourne: La Trobe University.

Mellaart J. 1979. Egyptian and Near Eastern chronology: a dilemma? *Antiquity* 53:6–19.

Mook W, Streurman H. 1983. Physical and chemical aspects of radiocarbon dating. In: Mook W, Waterbolk H, editors. Proceedings of the First International Symposium on ^{14}C and Archaeology. *PACT* 8:31–55.

Paz Y. 2002. Fortified settlements of the EB IB and the emergence of the first urban system. *Tel Aviv* 29:238–61.

Philip G. 1999. Complexity and diversity in the southern Levant during the third millennium BC: the evidence of Khirbet Kerak ware. *Journal of Mediterranean Archaeology* 12(1):26–57.

Philip G. 2008. The Early Bronze Age I–III. In: Adams R, editor. *Jordan: An Archaeological Reader*. London: Equinox. p 161–226.

Philip G, Millard A. 2000. Khirbet Kerak ware in the Levant: the implications of radiocarbon chronology and spatial distribution. In: Marro C, Hauptmann H, editors. *Chronologies des pays du Caucase et de l'Euphrate aux IVe-IIIe Millenaires*. Paris: Institut Francais d'Etudes Anatoliennes d'Istanbul. p 279–96.

Downloaded from https://www.cambridge.org/core. IP address: 54.161.116.225, on 21 Oct 2018 at 21:10:22, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms.
https://doi.org/10.1017/S003382220003397X

Reimer PJ, Baillie MGL, Bard E, Bayliss A, Beck JW, Bertrand CJH, Blackwell PG, Buck CE, Burr GS, Cutler KB, Damon PE, Edwards RL, Fairbanks RG, Friedrich M, Guilderson TP, Hogg AG, Hughen KA, Kromer B, McCormac G, Manning S, Bronk Ramsey C, Reimer RW, Remmele S, Southon JR, Stuiver M, Talamo S, Taylor FW, van der Plicht J, Weyhenmeyer CE. 2004. IntCal04 terrestrial radiocarbon age calibration, 0–26 cal kyr BP. *Radiocarbon* 46(3):1029–58.

Segal D, Carmi I. 2004. Rehovot radiocarbon date list VI. *'Atiqot* 48:129–41.

Segal D, Carmi I, Gal Z, Smithline H, Shalev D. 1998. Dating a Chalcolithic burial cave in Peqi'in, Upper Galilee, Israel. *Radiocarbon* 40(2):707–12.

Stager L. 1992. The periodization of Palestine from the Neolithic through Early Bronze times. In: Ehrich R, editor. *Chronologies in Old World Archaeology.* 3rd edition. Chicago: Oriental Institute of the University of Chicago. p 22–60.

Stuiver M. 1983. Business meeting. *Radiocarbon* 25(2): 793–5.

Stuiver M, Reimer P. 1993. Extended ^{14}C database and revised CALIB 3.0 ^{14}C calibration program. *Radiocarbon* 35(1):215–30.

Stuiver M, Reimer P, Bard E, Beck J, Burr G, Hughen K, Kromer B, McCormac G, van der Plicht J, Spurk M. 1998. IntCal98 radiocarbon age calibration, 24,000–0 cal BP. *Radiocarbon* 40(3):1041–83.

Tubb J. 1998. *Canaanites*. London: British Museum Press.

Weinstein J. 1980. Palestinian radiocarbon dating: a reply to James Mellaart. *Antiquity* 54:21–4.

Weinstein J. 1984. Radiocarbon dating in the southern Levant. *Radiocarbon* 26(2):297–366.

Weinstein J. 2003. A new set of radiocarbon dates from the Town Site. In: Rast W, Schaub T, editors. *Bab edh-Dhra': Excavations at the Town Site (1975–1981). Part 1. Text*. Winona Lake: Eisenbrauns. p 638–48.

Wright G. 1937. *The Pottery of Palestine from the Earliest Times to the End of the Early Bronze Age*. New Haven: American Schools of Oriental Research.

Wright G. 1958. The problem of the transition between the Chalcolithic and Bronze Ages. *Eretz Israel* 5:37–45.

Downloaded from https://www.cambridge.org/core. IP address: 54.161.116.225, on 21 Oct 2018 at 21:10:22, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms.
https://doi.org/10.1017/S003382220003397X