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JERICHO AND THE CHRONOLOGY OF PALESTINE IN THE EARLY BRONZE AGE: A RADIOMETRIC RE-ASSESSMENT

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ABSTRACT. The absolute chronology of Early Bronze Age in the Levant has been the object of a major revision (Regev et al. 2012a), which implied an increase of at least two centuries in respect of traditional chronology. Such a shift back was based upon two sites (Tel Yarmouth, Megiddo) which were the backbone of the "reform," but actually do not offer complete sequences for the whole EBA. This was the weakest stone of the revision, together with a partial understanding of stratigraphy/contexts from where samples were taken. Tell es-Sultan/Jericho in Palestine was included in this study, as this prominent archaeological site provided well stratified ^{14}C dates for EBA. Its stratigraphy, established by Kathleen M. Kenyon in the 1950s, was reappraised by the Sapienza University of Rome–Palestinian MOTA-DACH joint Expedition (1997–2018). Published ^{14}C dates were reanalyzed along with new samples from carefully stratified and published archaeological contexts, measured by the CEDAD Laboratory (University of Salento, Lecce, Italy). They provided absolute dates connected with stratigraphy useful to double-check the proposed High Chronology. EBA stratigraphic periodization at Jericho suggests a more cautious approach and keeps a multi-based chronology more consistent with a comprehensive historical reconstruction of the Early Bronze Age in Syria-Palestine and Egypt.

KEYWORDS: absolute chronology, Early Bronze Age, Jericho, Levant, radiocarbon.

INTRODUCTION

The aim of this study is a complete reassessment and multiple recalibration of all available radiocarbon dates referable to the Early Bronze Age from Tell es-Sultan/ancient Jericho, one of the best-known and most widely published archaeological sites in the Levant. For this purpose, all available ^{14}C samples (Burleigh 1981, 1983; Weinstein 1984; Bruins and van der Plicht 1998, 2001; Lombardo et al. 1998; Lombardo and Piloto 2000) have been re-examined by checking their correct setting into the EBA sequence. This also allowed double checking of the new absolute chronology proposed for the Early Bronze Age in the Southern Levant, which included samples from Tell es-Sultan (Regev et al. 2012a, 2014: 258–262).

As Kathleen M. Kenyon demonstrated, stratigraphy is the basic tool for setting the chronology of a site like Tell es-Sultan, with an extraordinarily long occupational history, and the exact location of ^{14}C measured samples it is, thus, decisive to understand its chronological setting. For this reason, the precise location of ^{14}C dated samples from EBA layers at Jericho has been carefully verified, and new samples have been taken and measured from well-defined stratigraphic contexts useful to pinpoint the EBA sequence. Moreover, the archaeological contexts and nature of each sample have been carefully re-examined in order to better understand their chronological implications.

ARCHAEOLOGICAL CONTEXTS OF THE RADIOCARBON SAMPLES

Tell es-Sultan/Ancient Jericho: A Key Site for Bronze-Age Palestine

The site of Tell es-Sultan/ancient Jericho lies around 9 km north of the northern shore of the Dead Sea, 7 km west of the Jordan River, 250 m below sea level (Nigro 2013), at the foot of the Mount of Temptation (Jebel Quruntul) (Figure 1). It was one of most relevant human settlements in the ancient Near East from the Mesolithic/Epipaleolithic through the Neolithic, and one of the earliest

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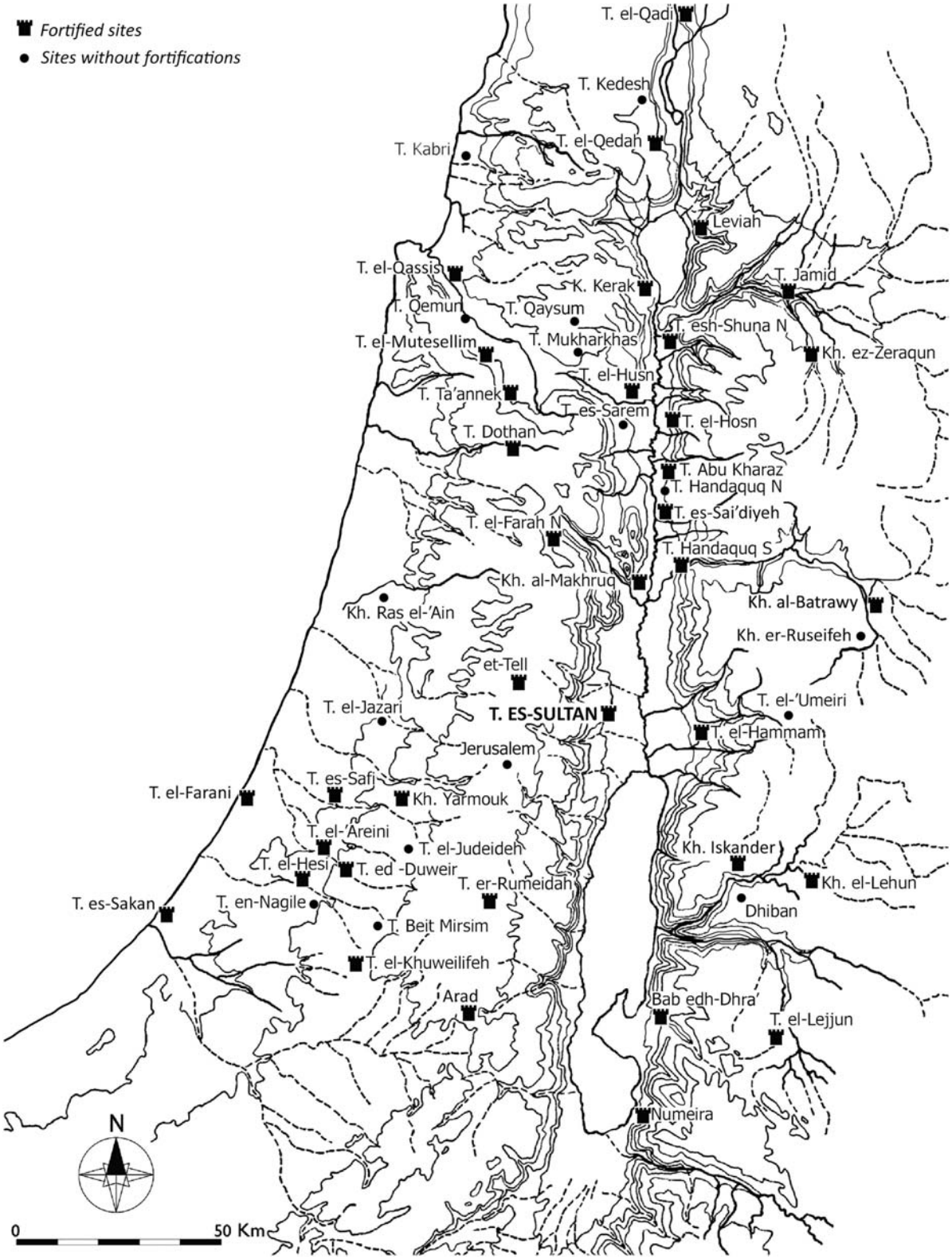

Figure 1 Map showing the location of Tell es-Sultan/ancient Jericho and the major EBA Southern Levantine sites.

to develop into a city at the beginning of the 3rd millennium BC, with a continuity in the occupational sequence from the Late Natufian (~10,500 BC) up to the Ottoman Period (1918 AD). The nearby Spring of 'Ain es-Sultan, which provided 4000–5000 liters of fresh water per minute, ensured life to the community over about 10 millennia (Nigro 2014a: figs. 1.1–1.2).

Tell es-Sultan has been the object of archaeological explorations since the beginning of the 20th century: the Austro-German Expedition between 1907 and 1909, directed by E. Sellin and C. Watzinger and fully published in 1913; the first British Expedition between 1930 and 1936, directed by J. Garstang (Garstang and Garstang 1948); the second British Expedition between 1952 and 1958, with a distinguished international team directed by Lady Kathleen M. Kenyon, published in five volumes (Kenyon 1960, 1965, 1981; Kenyon and Holland 1982, 1983). During Kenyon's excavations at Tell es-Sultan, the stratigraphic digging method became a standard and three major trenches were excavated on the western (Trench I), northern (Trench II), and southern (Trench III) flanks of the tell in order to vertically read the long occupational history of the site. Moreover, for the first time, radiocarbon dates were measured from samples taken from the site (Callaway and Weinstein 1977: 8, 10; Burleigh 1981, 1983). In 1997, the joint Italian-Palestinian Expedition resumed excavations at Tell es-Sultan, 40 years after Kenyon's last season, and during 13 seasons reappraised Kenyon's stratigraphy, which proved to be largely reliable, even though in some spots strata were missed and in other multiplied. New techniques and horizontal excavations have allowed a drastic increase of the information about the earliest city during the Bronze Age and to double-check contexts and sequences connected to samples recovered to be chronological anchor stones (Nigro 2016, 2017: 159–162).

New excavations documented the rise of the Early Bronze Age city (Nigro 2013: 3–5), its continuous development from the Early Bronze I rural village (Nigro 2005, 2008) to the EB II earliest fortified city, characterized by an impressive fortification system, the presence of public buildings and of extended domestic quarters in EB III (Nigro 2010a, 2010b), until its final dramatic destruction (Nigro 2016, 2017). Furthermore, the main contribution of the Italian-Palestinian Expedition was to put forward a comprehensive stratigraphy of the site, including data produced by all the previous expeditions (Marchetti and Nigro 1998, 2000; Nigro 2005, 2010a; Nigro and Taha 2009; Nigro et al. 2011: tab. 1). The Early Bronze Age has been divided into 4 periods, each sub-divided into two sub-periods on the basis of stratigraphy, architecture (major constructional phases of the city-walls and the palace) and associated material culture remains. These periods (Sultan IIIa-d) have been connected to the overall archaeological periodization of ancient Palestine of the EBA (EB I-IV), covering the time span 3500–2000 BC according to traditional chronology (Höflmayer 2017: 21–22). Periods Sultan IIIa-d have also been related to Egyptian chronology as summarized on Table 1.

Archaeological Contexts and Stratigraphic Sequence of ^{14}C Samples

A total of 45 ^{14}C dates have been determined from different types of samples (charcoals and short-lived charred materials) collected by the two last archaeological expeditions at Tell es-Sultan/ancient Jericho (Figure 2): the second British Expedition, and the still on-going Italian-Palestinian Expedition started in 1997. This study concerns 32 ^{14}C samples already published and 13 new ^{14}C samples collected during the last seasons of excavations (2014 and 2017). Seven samples previously considered reliable have been ruled out because of their scarce accountability [GL-24 (EB IA); BM-548, BM-549, GrA-223 (EB IIA); GrA-225, BM-1783R (EB IIB); BM-1781R (EB IIIB)].

Twenty-nine ^{14}C dates derived from samples collected at Jericho in the 1950s (Kenyon 1981; Kenyon and Holland 1983), and published in 1980s and 1990s (Burleigh 1981, 1983; Bowman et al. 1990; Bruins and van der Plicht 1998, 2001): 5 samples were collected in Tomb A94, 2 samples were collected in Trench II, and 22 samples were collected in Trench III (Figures 3–4). In this deep cut through the southern flank of the tell, all the four periods representing the Early Bronze Age were documented on both sections in clearly stratified layers (Kenyon 1981:

Table 1 Archaeological periodization of Tell es-Sultan/ancient Jericho in the Early Bronze Age, in relation to the Egyptian chronology, with a specific reference to the stratigraphic sequence of Trench III.

Egypt chronology	Southern Levant periodization	Tell es-Sultan periods	Trench III stratigraphic sequence	^{14}C samples from Jericho
Pre-Dynastic	EB IA 3500-3200	Sultan IIIa1	Stage XI.phases xxxvi/xxxix Stage XII.phasex 1 Stage XIII.phases xli/xlii	GL-24; BM-1775R; BM-1774R; BM-1328; BM-1329; GrN-18540; GrN-18541
0 Dynasty 00 Dynasty	EB IB 3200-3000	Sultan IIIa2	Stage XIV.phases xliii/xlv Stage XV.phases xlvi/lix	GrN-18545; GrN-18546; LTL17372A; LTL17373A
I Dynasty	EB IIA 3000-2850	Sultan IIIb1	Stage XVI.phases lx/lxvii	BM-548; BM-549; GrA-222; GrA-223 rep. 1; GrA-6315 rep. 2; GrA-6332 rep. 3; BM-1779R; BM-1778R; LTL17369A; LTL17370A; LTL17371A
II Dynasty	EB IIB 2850-2700	Sultan IIIb2	Stage XVII.phases lxviii/lxxi	BM-1780N; BM-550; BM-552; BM-551; GrA-224; GrA-225; BM-1783R
III Dynasty IV Dynasty	EB IIIA 2700-2500	Sultan IIIc1	Stage XVIII.phases lxxii/lxxv	LTL17381A; LTL17382A; LTL17383A; LTL14952A; LTL14953A; LTL14954A; LTL14955A; LTL14956A; BM-553
V Dynasty	EB IIIB 2500-2300	Sultan IIIc2	Stage XIX.phases lxxvi/lxxvii	Rome-1177; Rome-1178; BM-554; BM-1781R; Jericho 1
VI Dynasty	EB IVA 2300-2200	Sultan IIId1	—	—
First Intermediate VII-X Dynasties	EB IVB 2200-2000	Sultan IIId2	Stage XX.phases lxxviii/lxxx Stage XXI.phase lxxxi	BM-1782R; BM-1784R

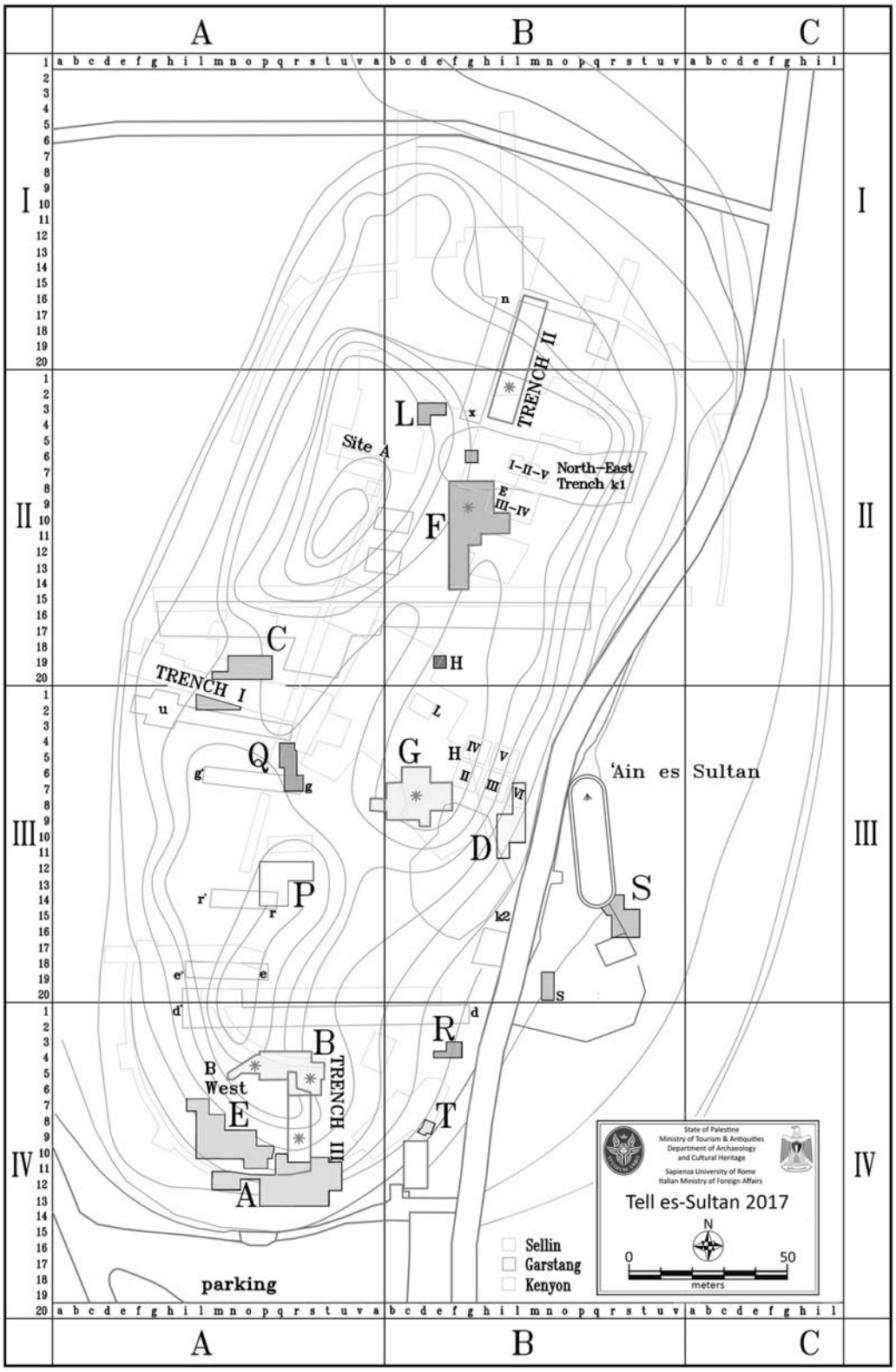

Figure 2 Map of Tell es-Sultan/ancient Jericho showing the excavated areas. The stars (asterisks) indicate the areas from which ^{14}C samples were collected.

193–215, pls. 273–274), firmly connected to the overall stratigraphy of the site (Nigro 2016: table 1). ^{14}C samples from Trench III have been double-checked with a careful micro-stratigraphic re-examination and re-excavation of the trench sections during the last (2017) excavation season.

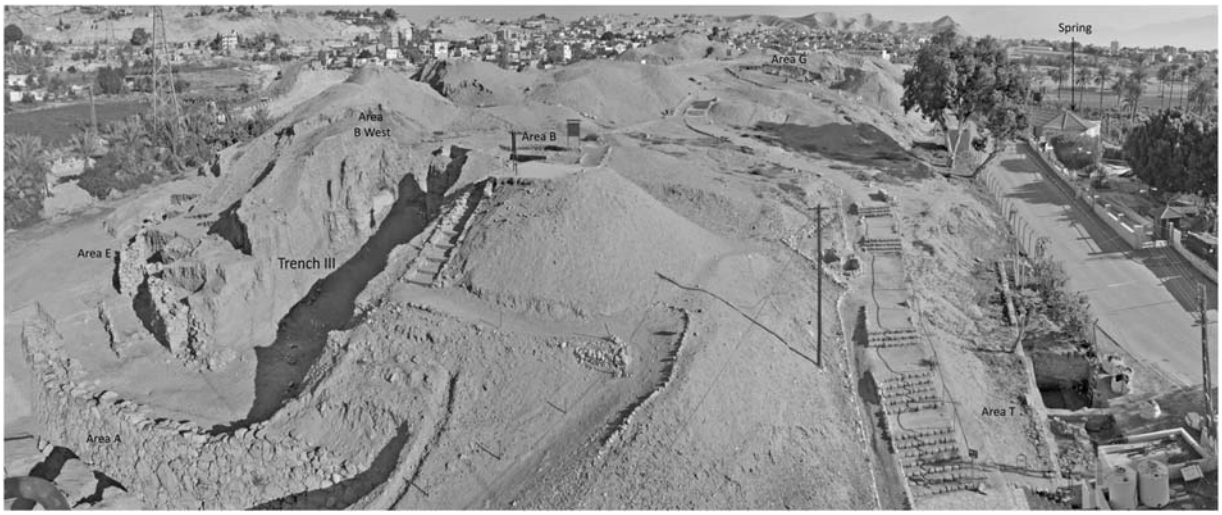

Figure 3 General view of the southern flank of Tell es-Sultan/ancient Jericho and the deep cut of Trench III, from south.

This analysis allowed us to correct stratigraphic errors and to reassessing the stratigraphic distribution of some of the samples.

Three ^{14}C samples were collected in Areas B and F during the first two seasons of excavations (1997–1998) of the Italian-Palestinian Expedition (Marchetti and Nigro 1998, 2000; Lombardo et al. 1998; Lombardo and Piloto 2000).

To these already published dates, 13 ^{14}C samples were added by the recent seasons of the Italian-Palestinian Expedition. Five samples were collected in 2014 season in Area G, and further eight samples of charcoals and short-lived organic materials were collected in different areas of the site during the 2017 season: Areas B and B-West, Area F and Trench III.

In this study, ^{14}C samples have been listed according to their archaeological context, set into a carefully verified and documented stratigraphy. The distribution of the available dates across strata, with the exception of 5 EB IA dates from a single tomb in the necropolis (Tomb A94, Kenyon 1960: 16–40), is the following: 2 dates are from a Sultan IIIa1/EB IA context; 4 dates are from Sultan IIIa2/EB IB contexts; 18 dates are from Sultan IIIb/EB II archaeological layers, namely 11 from Sultan IIIb1/EB IIA contexts, and 7 from Sultan IIIb2/EB IIB layers; 14 samples originate from Sultan IIIc/EB III strata, namely 9 from Sultan IIIc1/EB IIIA contexts, and 5 from Sultan IIIc2/EB IIIB layers. Finally, 2 more dates are available from Sultan IIId2/EB IVB archaeological deposits.

All dated samples are set in the stratigraphic sequence of Tell es-Sultan/ancient Jericho as illustrated in Figures 4 and 5, Tables 1–8, and discussed in detail in the following paragraphs.

METHOD OF ANALYSIS

The published ^{14}C dates have been reanalyzed and calibrated with the IntCal13 calibration curve (Reimer et al. 2013), using both OxCal program version 4.3.1 (Bronk Ramsey 2009a) and CALIB program version 7.04 (Stuiver et al. 2018). All date ranges are given with various relative probabilities due to the wiggles in the calibration curve at that time (ca. 3rd millennium BC).

The ^{14}C samples collected during the 2014–2017 seasons of excavations were measured by accelerator mass spectrometry (AMS) at the Centre for Dating and Diagnostics (CEDAD) of

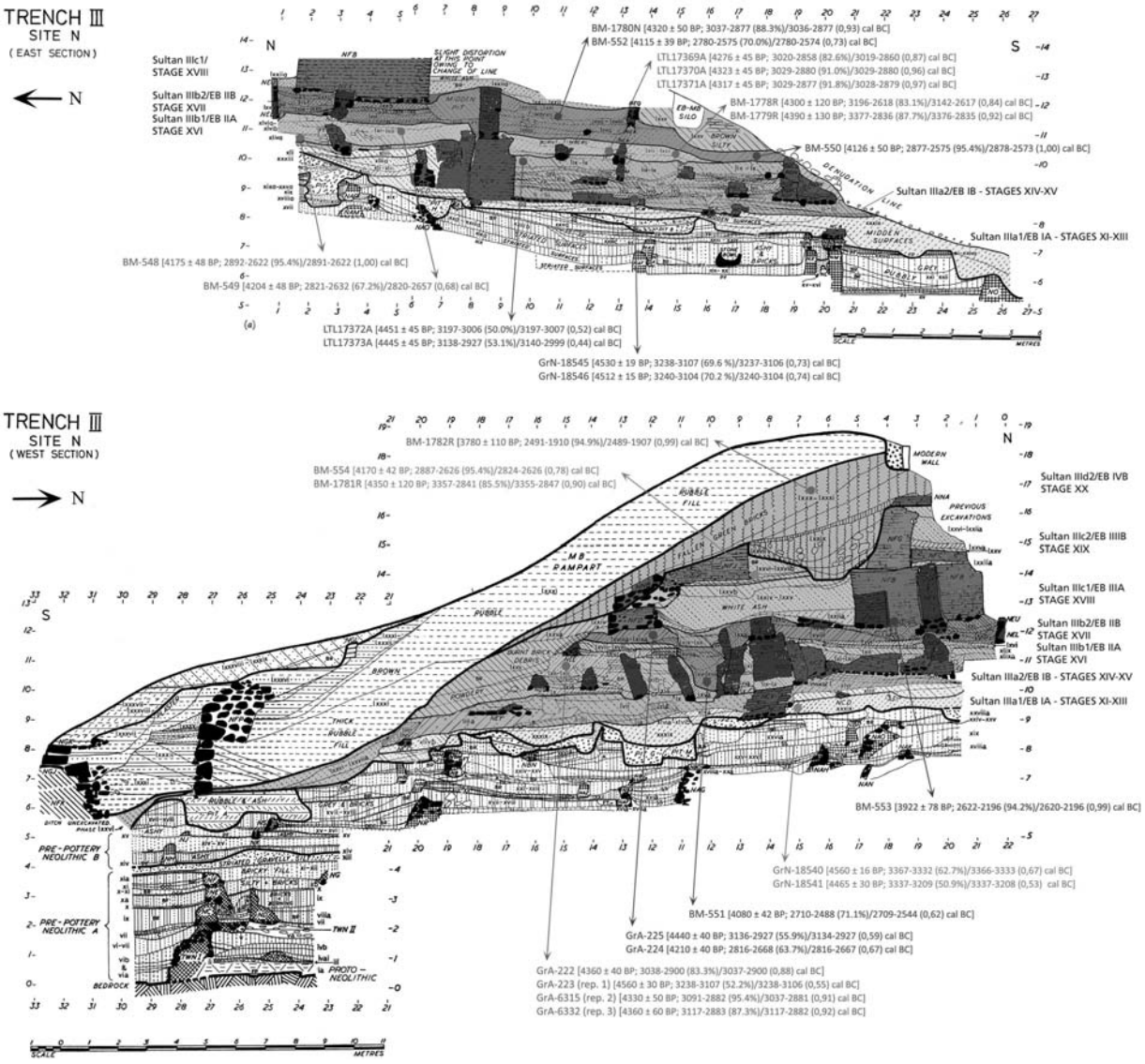

Figure 4 East and West Sections of Kenyon's Trench III with the stratigraphic distribution of ^{14}C samples discussed in this paper.

the University of Salento in Lecce, Italy. To clean the samples and rid them of any possible contaminants, a preliminary chemical protocol was adopted at the CEDAD chemical laboratories (D'Elia et al. 2004). Macroscopic contaminants were removed after observation with an optical microscope. The standard AAA (acid-alkali-acid) protocol was then used to remove any source of contamination. The purified sample material was sealed under vacuum together with CuO in sealed quartz tubes and then combusted at 900°C for 8 hr in a muffle oven in order to extract CO_2, which was then reduced to solid graphite at 600°C by using H_2 as reducing agent and iron powder as catalyst. The quantity of graphite extracted from the samples was sufficient for accurate experimental determination of age. The ^{14}C concentrations (expressed as $^{14}C/^{12}C$ ratio) in the extracted graphite were measured by comparing the ^{12}C and ^{13}C ion beam currents, and the ^{14}C counts measured with those obtained from standard samples of C6 (sucrose), supplied by the IAEA (International Atomic Energy Agency). All ^{14}C ages have been corrected for isotope fractionation by using the measurement of the $\delta^{13}C$ values carried out directly with the AMS system, and corrected for sample processing and machine background (Stuiver and Polach 1977; Calcagnile et al. 2005). Finally, samples of known concentration of oxalic acid, supplied by

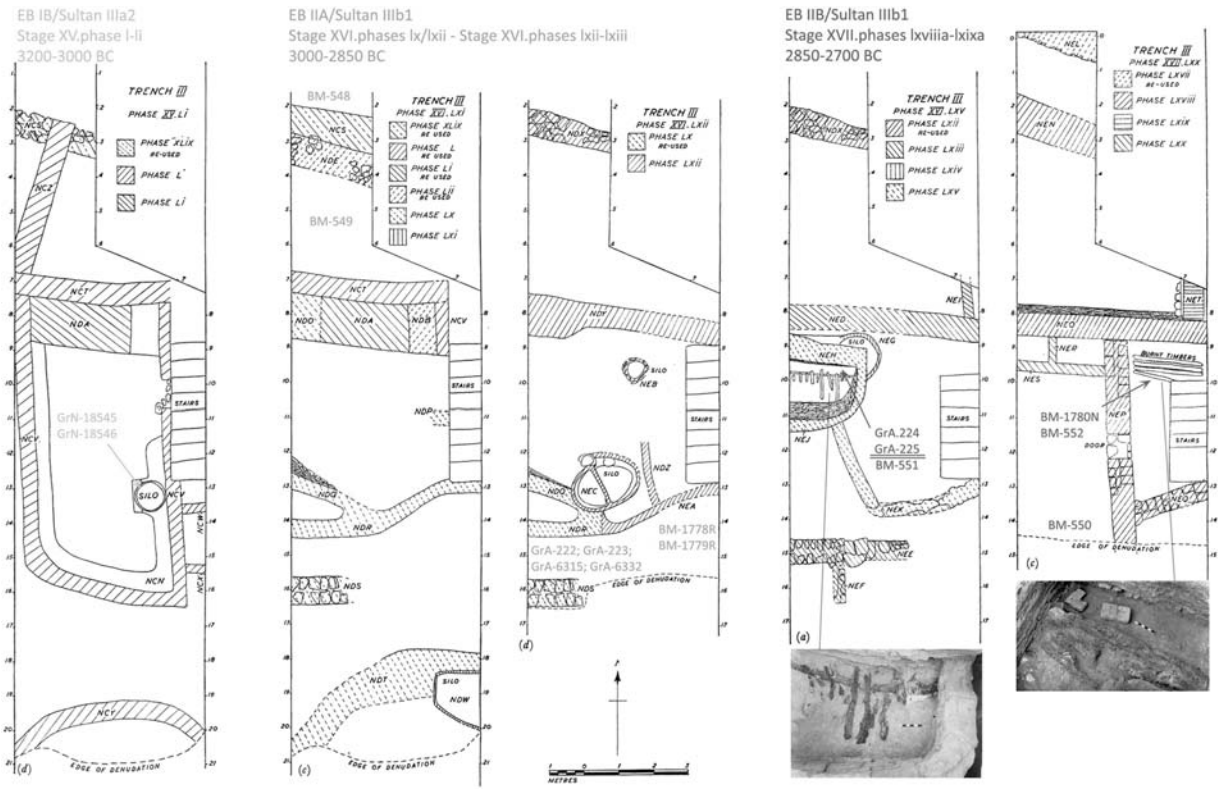

Figure 5 Stratigraphic distribution of samples collected during Kenyon's excavations in Trench III from layers dated to Sultan IIIa2/EB IB and Sultan IIIb1-2/EB IIA-B (after Kenyon 1981: pls. 265d, 267c-d, 268a, c).

NIST (National Institute of Standards and Technology), were used as modern carbon standard to check the results. Conventional radiocarbon ages were then calculated by using the radioactive decay law of ^{14}C. All ^{14}C ages are expressed in conventional ^{14}C yr BP relative to AD 1950, in accordance with the international convention (Stuiver and Polach 1977). Conventional radiocarbon ages, as for those already published (see above for the references), were calibrated using the IntCal13 calibration curve and both OxCal v. 4.3.1 and CALIB v. 7.04 programs.

Samples and related data (archaeological contexts, type of materials, ^{14}C ages, and calibrated time ranges corresponding to 95.4 percent probability levels) are presented below in tables separated for each period (from Early Bronze IA to Early Bronze IVB) and always listed in a strictly stratigraphic order.

RESULTS AND DISCUSSION: SETTING SULTAN PERIODS IN ABSOLUTE CHRONOLOGY

Early Bronze IA (Period Sultan IIIa1, 3500–3200 BC)

EB IA (Period Sultan IIIa1) at Jericho is represented by five radiocarbon dates from charcoal samples collected in the cremation pile uncovered by Kenyon in Tomb A94; two more samples were collected from silo NDV in Trench III (Table 2).

Tomb A94 is one of the earliest tombs in the Jericho Necropolis, discovered in Area A at the northern edge of the tell (Kenyon 1960: 16–40). It consisted of a large roughly circular chamber with a central pillar used for supporting the roof and contained multiple secondary burials with long bones piled in the center and skulls aligned along its walls, according to a typical EB IA burial custom (Kenyon 1957: 96-99). Five ^{14}C samples (GL-24, BM-1328, BM-1329, BM-1774R, BM-1775R) were

Table 2 Sultan IIIa1/EB IA ^{14}C dates from Tomb A94 in the Necropolis of Tell es-Sultan/ancient Jericho and from the Tell itself (Trench III).

Lab code	Sample material	Area	Context	^{14}C age (BP)	OxCal 4.3.1 (±2σ yr BC)	CALIB 7.04 (±2σ yr BC)
BM-1775R	Charcoal	Necropolis	Tomb A94 (Kenyon 1960: 16–40)	4710 ± 110	**3707–3309 (87.1%)**	**3705–3309 (0.91)**
					3297–3284 (0.5%)	3298–3283 (0.01)
					3276–3265 (0.4%)	3276–3265 (0.00)
					3240–3105 (7.4%)	3240–3105 (0.08)
BM-1774R	Charcoal	Necropolis		4600 ± 110	**3636–3022** (95.4%	**3635–3022 (1.00)**
BM-1328	Charcoal	Necropolis		4570 ± 50	3501–3431 (13.3%)	3499–3433 (0.13)
					3380–3261 (36.5%)	3379–3261 (0.38)
					3256–3097 (45.6%)	**3253–3098 (0.49)**
BM-1329	Charcoal	Necropolis		4500 ± 60	**3369–3011 (95.0%)**	**3368–3011 (0.993)**
					2977–2971 (0.3%)	2977–2969 (0.004)
					2948–2945 (0.2%)	2949–2944 (0.003)
GrN-18540	Charred grains	Trench III	Stage XIII.phase xlii Silo NDV (Kenyon 1981: pl. 265a)	4560 ± 16	**3367–3332 (62.7%)**	**3366–3333 (0.67)**
					3214–3187 (18.6%)	3212–3188 (0.19)
					3156–3128 (14.2%)	3155–3130 (0.14)
GrN-18541	Charred grains	Trench III		4465 ± 30	**3337–3209 (50.9%)**	**3337–3208 (0.53)**
					3194–3149 (12.1%)	3194–3148 (0.13)
					3141–3078 (19.5%)	3142–3078 (0.20)
					3072–3024 (12.8%)	3073–3024 (0.14)

collected in the cremation pile of long bones in the center of the tomb.[1] BM-dates from Tomb A94 belonged to two different series of charcoal samples measured in 1977–1978 (BM-1328 and BM-1329) and in 1981 (BM-1774 and BM-1775) in the British Museum ^{14}C Laboratory (Burleigh 1981: 502; 1983: 762). Some years later a careful re-examination of all the radiocarbon measurements from samples processed in the British Museum ^{14}C Laboratory from 1980 and 1984 revealed a systematic error, as a result of which these dates were roughly 200–300 yr too young (Bowman et al. 1990: 59–60; van der Plicht and Bruins 2001). Some samples could be dated again, including some charcoals from Jericho (revised dates are signalled by letters N or R added to the samples code name: Bowman et al. 1990: 62, 74, table 2a). The new ^{14}C dates however showed a larger range of uncertainty (higher that ± 100), with calibrated age ranges from 400 up to 600 yr (see BM-1774R and BM-1775R). These ^{14}C determinations may show how samples even from sealed archaeological contexts can nonetheless result in strong uncertainties. Nevertheless, these samples provide dates which can be used as *termini post quos* for the beginning of EB IA/Sultan IIIa1 period.

Two samples of short-lived materials taken from silo NDV in Trench III provided the only available dates from the tell for Sultan IIIa1/EB IA. The installation was plotted by Kenyon in the plan of Stage XVI, however it actually belonged to Stage XIII.phase xlii (Kenyon 1981: pl. 265a), underneath wall NCJ visible in the West Section of the Trench (Figure 4). The two samples (GrN-18540 and GrN-18541), measured in the 1990s in Groningen University ^{14}C Laboratory (Bruins and van der Plicht 1998: 627; 2001: 1327–1328), consist of charred grains: namely, GrN-18540 of wheat (Bruins and van der Plicht 1998: 627; 2001: 1327), while GrN-18541 of Emmer (*Triticum dicoccum*) (Hopf 1983: 595, sample SA 1030). GrN-18540 was dated to 4560 ± 16 BP, while GrN-18541 was dated to 4465 ± 30 BP; the calibrated ranges are between ca. 3370 and 3210 BC, pointing to an advanced phase of Sultan IIIa1/EB IA.

Samples from Tomb A94 came from charcoals which possibly produced an old-wood effect or belonged to items placed in the tomb over a long timeframe; calibrated ranges of these samples all cover a long time span, from ca. 3700 and 3000 BC, which however overlap the conventional chronology of Sultan IIIa/EB I (ca. 3500–3000 BC). In contrast, short-lived samples collected from EB IA contexts from the tell, provide calibrated dates with narrower ranges of uncertainty, which cover a time span apparently corresponding to that of conventional chronology for Sultan IIIa1/EB IA: ca. 3500–3200 BC.

Early Bronze IB (Period Sultan IIIa2, 3200–3050/3000 BC)

The mature Proto-Urban stage (Sultan IIIa2/EB IB), immediately preceding the rise of the city, that witnessed intense contacts with Egypt (Sala 2012: 281–284), is of crucial importance in the history of the site during the Early Bronze Age (Nigro 2008). Its chronology can be framed by four dates from samples collected in Trench III (Figures 4–5, Table 3).

Sultan IIIa2/EB IB in Trench III comprises 2 stages, XIV and XV (Kenyon 1981: 195–202; Nigro 2005: 118, tab. 2). Two samples of charred seeds of unsorted cereal grains (GrN-18545 and GrN-18546) were collected into a brick-lined silo of an apsidal building (NCT + NCV) erected in

[1]Sample GL-24 gave a clearly higher date in respect of its context (Callaway and Weinstein 1977: 5; Burleigh 1983: 764; Weimstein 1984: 306). The sample was processed in 1953, when radiocarbon dating was still in an early phase of development, so the ^{14}C age, 5210 ± 110 BP, and the calibrated date, 4270–3782 (92.5%) cal BC OxCal and/or 4269–3780 (0.97) cal BC CALIB, are too early for the EB IA period. Tomb A94 was not yet in use before this period as confirmed by its funerary assemblage (Kenyon 1960: 25), and this is also confirmed by sample BM-1329 a remeasurement of the same charcoal sample which clearly gave a different date as shown in Table 2 (Burleigh 1981: 501; 1983: 764). In any case, the charcoal may also derive from an item (a tray or something else) deposited into the tomb from another earlier provenience (e.g. something used to carry the remains of the ancestors to the tomb, when the community settled the site).

Table 3 Sultan IIIa2/EB IB ^{14}C dates from Tell es-Sultan/ancient Jericho (samples listed according to their stratigraphy = top is a lower/older stratum in the dig).

Lab code	Sample code	Sample material	Area	Context	^{14}C age (BP)	OxCal 4.3.1 (±2σ yr BC)	CALIB 7.04 (±2σ yr BC)
GrN-18545	—	Charred grains	Trench III	Stage XV.phase l (Kenyon 1981: 198-199; Nigro 2005: 118)	4530 ± 19	3359–3315 (23.5%)	3358–3314 (0.25)
						3294–3288 (0.9%)	3293–3288 (0.01)
						3274–3266 (1.5%)	3274–3266 (0.01)
						3238–3107 (69.6%)	**3237–3106 (0.73)**
GrN-18546	—	Charred grains	Trench III		4512 ± 15	3348–3308 (16.7%)	3347–3308 (0.17)
						3302–3282 (4.7%)	3301–3282 (0.05)
						3276–3264 (3.8%)	3276–3265 (0.04)
						3240–3104 (70.2%)	**3240–3104 (0.74)**
LTL17372A	TS.17.TrIII. PR.5	Charcoal	Trench III	Stage XV.phase lix-Stage XVI.phase lx End of EB IB (Kenyon 1981: 203)	4451 ± 45	3339–3204 (38.7%)	3339–3204 (0.41)
						3197–3006 (50.0%)	**3197–3007 (0.52)**
						2986–2932 (6.7%)	2987–2932 (0.07)
LTL17373A	TS.17.TrIII. PR.6	Charcoal	Trench III		4445 ± 45	3337–3208 (35.6%)	3337–3209 (0.37)
						3194–3149 (8.9%)	3194–3149 (0.09)
						3141–3000 (41.4%)	**3140–2999 (0.44)**
						2994–2929 (9.5%)	2994–2928 (0.10)

Stage XV.phase l (Kenyon 1981: 198–199, pls. 119a-b, 265c-d, 266, 267a-b; Nigro 2005: 118). The apsidal building was completely destroyed in Stage XV.phase li-lii (Kenyon 1981: 199), and the two samples provided ^{14}C determinations for this event. In the recent revaluation of EBA in Southern Levant (Regev et al. 2012a: 537, table 1, fig. 7), Stage XIV.phase xliva and Stage XV. phase li-lii, and consequently the radiocarbon dates related to them, were erroneously attributed to the EB II or even to the EB III, thus resulting in a groundless raising of absolute chronology for these periods. According to a correct interpretation of the stratigraphy of Trench III, Stages XIV-XV correspond to Sultan IIIa2/EB IB. The two samples were measured in the 1990s in Groningen University ^{14}C Laboratory: GrN-18545 was dated to 4530 ± 19 BP; GrN-18546 was dated to 4512 ± 15 BP (Bruins and van der Plicht 1998: 626; 2001: 1325–1326). The calibrated ^{14}C age ranges are between 3240 and 3104 BC. On the basis of the stratigraphy, such ^{14}C determinations can be referred to a central phase of Sultan IIIa2/EB IB.

A further measurement on samples from contexts associated to Sultan IIIa2/EB IB has been conducted in the 2017 season of excavations. Two charcoal samples, LTL17372A and LTL17373A, were collected in Trench III from destruction layers marking the end of Sultan IIIa2/ EB IB village (Stage XV.phase lix-Stage XVI.phase lx: Kenyon 1981: 202; Nigro 2014b: 70), and measured by CEDAD Laboratory (Figure 6). LTL17372A was dated to 4451 ± 45 BP, LTL17373A was dated to 4445 ± 45 BP. The calibrated ranges of the two samples are between ca. 3190 and 3000 BC. These dates fit with the archaeological dating at about 3150–3000 BC for the final phase of Sultan IIIa2/EB IB, and the end of the period between 3050 and 3000 BC.

Early Bronze IIA (Period Sultan IIIb1, 3050/3000–2850 BC)

Eleven dates come from samples collected in stratified layers of Trench III (Figures 4–5, Table 4) dating to the initial urban phase of Sultan IIIb1/EB IIA, when the impressive mud-brick city walls of Jericho were erected.

Figure 6 Northern edge of Trench III East Section during the 2017 season of excavations, with highlighted the spots from where EB IB samples (LTL17372A and LTL17373A) and EB IIA sample (LTL17369A) were collected.

Sultan IIIb/EB II in Trench III comprises 2 stages (XVI, XV) distinguished by Kenyon (1981: 204–209), corresponding to the two main EB II sub-periods (Sultan IIIb1-2/EB IIA-B) identified by the Italian-Palestinian Expedition in Areas F and G (Nigro 2010a: tab. 1.1). The earliest one, Sultan IIIb1/EB IIA (= Stage XVI.phases lx/lxvii, Kenyon 1981: 202–206; Nigro 2010a: 105), was erroneously considered the final phase of EB II (Bruins and van der Plicht 1998: 627; 2001: 1328–1329) and even attributed to EB III (Regev et al. 2012a: 537, table 1, fig. 7). This mistake, originating from a lack of knowledge of stratigraphy and associated finds, resulted in an incorrect dating of both EB II and EB III. As a correct interpretation of stratigraphy and finds (e.g. Nigro 2010a: 110, pls. LI:4-5, 9-10, LII: 3, 8, LIII: 4-5, 11 LIV: 1-2) suggests, Stage XVI definitely marks the beginning of EB II and not its end. In this period, new domestic structures were built on the southern terraced slope of the tell. ^{14}C samples collected from Stage XVI layers (Table 4) and the descending chronological indications are discussed below.

Sultan IIIb1/EB IIA is represented by six dates from samples collected in destruction layers associated to a seismic shock occurring during the EB IIA (Stage XVI.phase lxii-lxiii). Two high-precision series of dates were made on such samples in the British Museum and Groningen laboratories. Charcoal samples were examined in London (BM-dates), while short-lived samples of charred seeds of weeds in Groningen (GrA-dates). BM-1778R and BM-1779R, redated in 1990s (Bowman et al. 1990: 74, table 2a), were collected on the southern terrace (Kenyon and Holland 1983: xxxvii), as shown in the East Section (Figure 4), which however gave a large range of uncertainty like as the other BM-samples redated in the 1990s (see Table 2). The four remaining ^{14}C dates (GrA-222, GrA-223 rep. 1, GrA-6315 rep. 2, GrA-6332 rep. 3) were obtained from charred seeds of weeds (Hopf 1983: 595–596, SA-739).[2] GrA-222, GrA-6315 rep. 2, GrA-6332 rep. 3 gave very similar dates (Table 4), consistent with the ^{14}C ages of BM-1778R and BM-1779R, from the same context.[3] These three dates from short-lived samples were averaged (Bruins and van der Plicht 2001: 1328), and the resulting calibrated date is 3025–2902 (93.9%) cal BC.

In the 2017 season, three charcoal samples were collected from the East and West Sections of Trench III (Figure 6), and then measured by CEDAD Laboratory (LTL17369A, LTL17370A and LTL17371A). These samples come from a destruction layer of the end of Sultan IIIb1/EB IIA (Stage XVI.phase lxvii). LTL17370A was dated to 4323 ± 45 BP, LTL17371A to 4317 ± 45 BP, LTL17369A to 4276 ± 45 BP; the calibrated ranges for these samples are between 3029 and

[2]GrA-223 rep. 1 gave a very different date from the others of the same series: 4560 ± 30 BP, calibrated as 3238-3107 (52.2%) cal BC OxCal and/or 3238–3106 (0.55) cal BC CALIB (Table 4), an age similar to those of Sultan IIIa2/EB IB samples (Table 3). It has to be rejected as outcome of two additional measurements (GrA-6315 rep. 2 and GrA-6332 rep. 3) of the same sample (Bruins and van der Plicht 1998: 623).

[3]Two more charcoal samples, BM-548 and BM-549, previously erroneously associated to EB IB layers due to stratigraphic misinterpretations, actually proved to belong to Stage XVI. A careful re-examination of the stratigraphy of Trench III (Kenyon and Holland 1983: xxxv–xxxvi), matched with the analysis of pottery and other ^{14}C dates, revealed that all main walls (NCS, NDE, NCT and NCV, NDP, NDR, NDT, NDW) were kept in use from the EB IB (Stage XV. phase l) up to the EB IIA (Stage XVI.phase lxi). Consequently, walls and levels recognisable in the East Section to the north of Walls NCS and NCT belong to Sultan IIIb1/EB IIA (Kenyon and Holland 1983: xxxv). Following this stratigraphic re-evaluation, BM-548, collected from a layer north of Wall NCS, is associated to a latest phase of use of the structure, roughly at the beginning of Stage XVI.phase lxi. Likewise, BM-549 is related not yet to the destruction of Stage XV.phase li-lii but rather to the destruction of Stage XVI.phase lxi-lxii. The two samples were measured in 1971 in the British Museum ^{14}C Laboratory (Burleigh 1981: 502), gave similar dates: BM-548 was dated to 4175 ± 48 BP [2892–2622 (95.4%) cal BC OxCal, 2891–2622 (1.00) cal BC CALIB], BM-549 was dated to 4204 ± 48 BP [2821–2632 (67.2%) cal BC OxCal, 2820-2657 (0.68) cal BC CALIB]. These determinations are not consistent with the other dates, being younger than samples associated with overlying Sultan IIIb1/EB IIA strata. This might depend on protocols for samples preparation used at that time, or are connected to a unidentified repair of the overlaying city-walls that occurred in the following EB IIB. In any case they have been ruled out from the final determination of this period chronology.

Table 4 Sultan IIIb1/EB IIA ^{14}C dates from Tell es-Sultan/ancient Jericho (samples listed according to their stratigraphy = top is a lower stratum in the dig).

Lab code	Sample code	Sample material	Area	Context	^{14}C age (BP)	OxCal 4.3.1 (±2σ yr BC)	CALIB 7.04 (±2σ yr BC)
GrA-222*	—	Charred seeds of weeds	Trench III	Stage XVI.phase lxii-lxiii Earthquake at the end of phase lxii (Kenyon 1981: 204–205)	4360 ± 40	3090–3044 (12.1%) **3038–2900 (83.3%)**	3090–3045 (0.12) **3037–2900 (0.88)**
GrA-6332* (rep. 3)	—		Trench III		4360 ± 60	3324–3234 (7.5%) 3173–3162 (0.7%) **3117–2883 (87.3%)**	3323–3234 (0.07) 3172–3162 (0.01) **3117–2882 (0.92)**
GrA-6315* (rep. 2)	—		Trench III		4330 ± 50	**3091–2882 (95.4%)**	3090–3044 (0.09) **3037–2881 (0.91)**
BM-1779R	—	Charcoal	Trench III		4390 ± 130	3497–3458 (1.4%) **3377–2836 (87.7%)** 2816–2670 (6.3%)	3495–3462 (0.01) **3376–2835 (0.92)** 2817–2665 (0.07) 2643–2640 (0.00)
BM-1778R	—	Charcoal	Trench III		4300 ± 120	3339–3206 (11.2%) **3196–2618 (83.1%)** 2609–2584 (1.1%)	3337–3208 (0.11) 3194–3148 (0.03) **3142–2617 (0.84)** 2610–2582 (0.02)
LTL17370A	TS.17.TrIII.PR.2	Charcoal	Trench III	Stage XVI.phase lxvii Major destruction at the end of EB IIA (Kenyon 1981: 207)	4323 ± 45	3086–3061 (4.4%) **3029–2880 (91.0%)**	3086–3062 (0.04) **3029–2880 (0.96)**
LTL17371A	TS.17.TrIII.PR.4	Charcoal	Trench III		4317 ± 45	3085–3062 (3.6%) **3029–2877 (91.8%)**	3085–3064 (0.03) **3028–2879 (0.97)**
LTL17369A	TS.17.TrIII.PR.1	Charcoal	Trench III		4276 ± 45	**3020–2858 (82.6%)** 2809–2752 (10.8%) 2721–2702 (2.0%)	**3019–2860 (0.87)** 2808–2755 (0.11) 2720–2704 (0.02)

*Measurements of the same sample.

2858 BC. These dates are quite consistent with those obtained from the other samples from Stage. XVI.

Calibrated dates from reliable samples collected in Sultan IIIb1/EB IIA contexts fall within the range of conventional archaeological chronology pointing to a date for Sultan IIIb1/EB IIA period between ca. 3050/3000 and 2850 BC.

Two more dates should be added to the Sultan IIIb1/EB IIA determinations. Samples collected in 2017 season from charred wooden beams inserted into the Sultan IIIc/EB III fortification walls in Area B (LTL17382A) and Area B-West (LTL17381A) gave dates consistent with the chronology of Sultan IIIb1/EB IIA (Table 6). These dates could confirm the hypothesis that the EB III city-walls were built incorporating the pre-existing Sultan IIIb/EB II defensive line not only on the northern and western sides of the tell (Nigro 2010a: 12–19, 22–34), but also on the southern side, where the EB II city-wall has never been clearly identified (Nigro 2010a: 21).

Early Bronze IIB (Period Sultan IIIb2, 2850–2700/2650 BC)

The late phase of Early Bronze II (Sultan IIIb2/EB IIB) is illustrated by seven dates from samples collected during Kenyon's excavations (Table 5). One sample (BM-1783R) came from Trench II and belonged to Stage XVIII.[4] Six dates were obtained from samples collected in Trench III and associated to Stage XVII (Figures 4–5). Stage XVII was erroneously considered an early phase of the following EB III period (Bruins and van der Plicht 1998: 627; 2001: 1329; Regev et al. 2012a: 537, table 1, fig. 7), again with an unjustified raising of its absolute chronology. In Trench III, Sultan IIIb2/EB IIB is represented by a rectangular house (NEP + NEQ), built on the southern terrace, which remained in use during the whole Stage XVII (Kenyon 1981: 207, pl. 268c, 269a; Nigro 2010a: 106). Once again, two high-precision series of measurements were made on samples of charcoals (BM-550, BM-551, BM-552 and BM-1780N), and of short-lived organic materials (GrA-224 and GrA-225), all of them associated to the same stratigraphic phase (Stage XVII.phases lxviiia-lxixa), and collected in well stratified layers, as the finding spot is clearly buried under the earliest Sultan IIIc/EB III massive mudbrick city-walls (Nigro 2010a: fig. 4.49).

BM-1780N and BM-552 were charcoals sampled from burnt timbers excavated in the eastern room of the domestic unit, south of Wall NEO (Kenyon 1981: pl. 268c) (Figures 4–5). These samples gave two quite different ^{14}C ages (Bruins and van der Plicht 1998: 625): BM-1780N was dated to 4320 ± 50 BP, the calibrated date is 3037–2877 (88.3%) cal BC OxCal and/or 3036–2877 (93%) cal BC CALIB; BM-552 was dated to 4115 ± 39 BP, calibrated date is 2780–2575 (70.0%) cal BC OxCal and/or 2780–2574 (73%) cal BC CALIB. However, it seems possible that the charcoals sampled for the ^{14}C determinations belonged to timbers from trees cut in chronologically successive circumstances and then resulting in different dates. BM-1780N can be used as a *terminus post quem* in relation to the beginning of Sultan IIIb2/EB IIB.

GrA-224 and GrA-225 represent two different measurements made on a sample of charred onion bulbs (*Allium* sp.; Hopf 1983; SA-704, Jp.N. 5.30), from layers associated to Stage XVII.

[4]Sultan IIIb/EB II is represented in Trench II by 3 stages: Stage XVI.phases liii/lvi and Stage XVII.phases lvii/lvii-lviii belong to Sultan IIIb1/EB IIA; Stage XVIII.phases lviii/lxiii belongs to Sultan IIIb2/EB IIB (Kenyon 1981: 149–153; Nigro 2010a: 75–96). BM-1783R was collected from layers related to the use of the domestic quarter extending on the northern slope of the site during the EB IIB. When the sample was re-measured (Bowman et al. 1990: table 2a), it covered an extremely long time range: 4170 ± 130 BP, calibrated date is 3099–2431 (93.9%) cal BC OxCal and/or 3096–2428 (0,98) cal BC CALIB. Nonetheless, if one focuses on the center of such time range, the calibrated date is 2897–2629 BC.

Table 5 Sultan IIIb2/EB IIB ^{14}C dates from Tell es-Sultan/ancient Jericho (samples listed according to their stratigraphy = top is a lower stratum in the dig).

Lab code	Sample material	Area	Context	^{14}C age (BP)	OxCal 4.3.1 (±2σ yr BC)	CALIB 7.04 (±2σ yr BC)
BM-550	Charcoal	Trench III	Stage XVII.phase lxviiia Burnt timbers in the eastern room (Kenyon 1981, 207, pl. 268c; Nigro 2010a: 106)	4126 ± 50	**2877–2575 (95.4%)**	**2878–2573 (1.00)**
BM-552	Charcoal	Trench III		4115 ± 39	2872–2799 (24.6%) 2793–2787 (0.8%) **2780–2575 (70.0%)**	2871–2799 (0.26) 2793–2786 (0.01) **2780–2574 (0.73)**
BM-1780N	Charcoal	Trench III		4320 ± 50	3090–3044 (7.1%) **3037–2877 (88.3%)**	3090–3046 (0.07) **3036–2877 (0.93)**
GrA-224*	Charred onion bulbs	Trench III	Stage XVII.phase lxviiia-lxixa Occupation layers in western room and layers sagged into silo NEH-NEJ (Kenyon 1981: 207)	4210 ± 40	2905–2836 (31.7%) **2816–2668 (63.7%)**	2904–2835 (0.33) **2816–2667 (0.67)**
BM-551	Charcoal	Trench III		4080 ± 42	2864–2806 (16.7%) 2760–2717 (7.7%) **2710–2488 (71.1%)**	2863–2806 (0.18) 2759–2717 (0.08) **2709–2544 (0.62)** 2541–2488 (0.12)

*Two measurements of the same sample.

phase lxviiia-lxixa. According to Kenyon these layers "were accumulated in the western room ... [of the domestic unit] ... sagged into the fill of the silo NEH-NEJ" (Kenyon 1981: 207). A possible stratigraphic error occurred here. A pit existed from where BM-551 was taken as it is clearly visible in West Section (Figure 4). It was therefore erroneously attributed to Stage XVI. phase lxv-lxvi, while it should be associated to the later Stage XVII.phase lxviiia-lxixa (Table 5). BM-551, in facts, produced a date younger than samples GrA-224 and GrA-225, collected from layers at a higher elevation, but stratigraphically older (Figure 5). GrA-224 and BM-551 gave two quite similar ^{14}C ages, this would suggest to rule out GrA-225.[5]

Calibrated dates of samples from Sultan IIIb2/EB IIB contexts range between ca. 2870 and 2600 BC. Such radiocarbon determinations approximately fit with the archaeological-historical periodization for Sultan IIIb2/EB IIB ranging between ca. 2850 and 2650 BC.

A further date should be added to the Sultan IIIb2/EB IIB determinations. BM-554, collected during Kenyon's excavations in Trench III, was sampled from a charcoal inserted in the mud-brick superstructure of the Sultan IIIc2/EB IIIB fortification walls and associated to the final destruction at the end of EB IIIB (Table 7). However, this gave a date consistent with the chronology of the other Sultan IIIb1/EB IIB samples, and should belong to building materials employed in the earliest Sultan IIIb/EB II defensive line then reused in the later Sultan IIIc/EB III reconstructions of the fortification walls.

Sultan IIIb2/EB IIB ended with a severe destruction due to a terrible earthquake (Nigro 2014b: 72), which completely destroyed the city (Stage XVII.phase lxxi-Stage XVIII.phase lxxii), and was followed by a clearly different phase characterized by the erection of the EB III double city-walls (Kenyon 1981: 207–209, pls. 268c, 269; Nigro 2010a: 106–110). This stratigraphic *caesura* is neatly distinguishable all over the tell and can be dated, on the grounds of the above mentioned radiocarbon determinations, at about 2700/2650 BC.

Early Bronze IIIA (Period Sultan IIIc1, 2700/2650–2500 BC)

The absolute chronology of Sultan IIIc1/EB IIIA at Jericho is based on nine dates from samples collected in different areas of the site. One sample (BM-553) was collected during Kenyon's excavations in Trench III (Figure 4). A further eight samples were collected during the Italian-Palestinian excavations (2014-2017) in the areas where the remains of the EB IIIA city were brought to light: Area B (LTL17382A); Area B-West (LTL17381A); Area F (LTL17383A); Area G (LTL14952A, LTL14953A, LTL14954A, LTL14955A, LTL14956A) (Figure 2, Table 6).

Three samples (BM-553, LTL17381A, LTL17382A) originate from layers associated to the beginning of Sultan IIIc1/EB IIIA, and related to the erection of the first EB III fortifications.

Period Sultan IIIc1-2/EB IIIA-B in Trench III comprises 2 different stages (XVIII and XIX). Stage XVIII belongs to Sultan IIIc1/EB IIIA; in this stage Town Walls NFB and NFD, respectively the Inner and Outer City-Wall of the double fortification system, were erected (Kenyon 1981: 209–212, pl. 269b; Nigro 2006a: 361–375, tab. 2). BM-553 was collected from burnt timbers incorporated into Town Wall NFB (Stage XVIII.phase lxxii). It was dated to 3922 ± 78 BP, calibrated date is 2622–2196 (94.2%) cal BC OxCal and/or 2620–2196 (99%) cal BC CALIB. This sample, although burnt at the end of EB IIIB, and thus collected in a later

[5]GrA-224 and GrA-225 gave two different ^{14}C ages: GrA-225 was dated to 4440 ± 40 BP, while GrA-224 was dated to 4210 ± 40 BP. Both dates could be reliable (Waterbolk 1990: 148), but the first one is consistent with BM-551 (4080 ± 42 BP).

stage, due to the old-wood effect (meaning that it was cut well before being burnt, presumably when it was set into the structure as architectural element), would suggest a date around 2620 BC. This date may be considered approximately that of the reconstruction of the city-wall where the sample was found, that is the beginning of Sultan IIIc1/EB IIIA.

LTL17382A and LTL17381A were collected by the Italia-Palestinian Expedition in 2017 season respectively in Area B and Area B-West (Figure 7), where a stretch of the southwestern corner of the Sultan IIIc1-2/EB IIIA-B double city-walls was brought to light (Nigro 1998a: 32–46; 1998b: 89–91; Nigro and Taha 2009: 738–739, figs. 14–15; Nigro et al. 2011: 580–581).

Stratigraphy in Area B, as reconstructed by the Italian-Palestinian Expedition, comprises 5 phases (Activities 5-1): Activities from 5 to 3 are connected to Sultan IIIc/EB III, Activity 2 represents the Middle Bronze Age, while Activity 1 corresponds to modern disturbance and excavation activities. At the beginning of EB IIIA, the double city-wall fortification system was built (Nigro 1998a: 36–39, fig. 1.10; 2006a: 361–373): it consisted of a Main Inner City-Wall (Wall 2, prosecution of Kenyon's Wall NFB) and an Outer City-Wall (Wall 56, Kenyon's Wall NFD), with a blind room in between filled up with crushed and pulverized limestone. A gate (South Gate L.1800), discovered in the 2010 season, was opened through the Main Inner City-Wall during the EB IIIA (Nigro et al. 2011: 580–581, figs. 10–11; 2016: 9), and this was obliterated at the end of the period after a dramatic collapse due to a fierce fire (Nigro 2014b: 75). LTL17382A was collected from the carbonized collapsed beam of Palestinian tamarisk (*Tamarix* sp.) used as lintel of the gate and found collapsed inside the passageway.

Stratigraphy in Area B-West comprises 5 phases (Activity 5-1), from the earliest EB III strata (Activities 5-4) to the latest Middle Bronze (Activity 3) and modern strata (Activities 2-1). Activity 5/Operation 5c belongs to Sultan IIIc1/EB IIIA (Nigro 1998b: 84), and is represented by the erection of the Main Inner City-Wall (Wall 2, like in the nearby Area B) and Outer City-Wall (Wall 56). After the EB IIIA destruction (Activity 5/Operation 5b), the double city-walls were completely reconstructed in the successive Sultan IIIc2/EB IIIB (Activity 5/Operation 5a): the Main Inner City-Wall was refurbished (Wall 1, prosecution of Kenyon's Wall NFG), and the Outer City-Wall (Wall 51, prosecution of Kenyon's Wall NFJ) was rebuilt and moved inwards (Nigro 1998b: 85, 90–91). LTL17381A was collected during the 2017 season from charred beams inserted at the bottom of Sultan IIIc1/EB IIIA Inner City-Wall (W.2) to ensure air circulation and structural linkage to the massive mud-brick superstructure upon its stone foundation (Figure 8).

LTL17382A and LTL17381A gave dates older than their recovery contexts. More specifically, LTL17382A was dated to 4421 ± 45 BP, calibrated as 3127-2916 (69.3%) cal BC OxCal and/or 3126-2916 (73%) cal BC CALIB; LTL17381A was dated to 4376 ± 45 BP, calibrated as 3105–2894 (93.1%) cal BC OxCal and/or 3105–2895 (96%) cal BC CALIB. Both dates overlap a time range respectively from ca. 3120–2900 BC and ca. 3100–2890 BC, the same as for the EB IB-EB II samples (see Tables 3–5). However, the tamarisk wood beam of the gate (Area B) and the wooden beams inserted in the superstructure of the city-wall (Area B-West) might have been cut and set into the wall when it was first erected in Sultan IIIb1/EB IIA (the ^{14}C date obtained thus refers to this time), to be subsequently reused when the fortifications were rebuilt in Sultan IIIc1/EB IIIA, and finally burned when the city fortifications were set on fire at the end of Sultan IIIc2/EB IIIB.

Sultan IIIc1/EB IIIA is also represented by six samples collected in Areas F and G. Their stratigraphic location and the associated EB IIIA material culture is known (including Khirbet Kerak Ware, Nigro 2009: 72–74).

Table 6 Sultan IIIc1/EB IIIA ^{14}C dates from Tell es-Sultan/ancient Jericho (samples listed according to their stratigraphy = top is a lower stratum in the dig).

Lab code	Sample code	Sample material	Area	Context	^{14}C age (BP)	OxCal 4.3.1 (±2σ yr BC)	CALIB 7.04 (±2σ yr BC)
LTL17382A*	TS.17.B.PR.27	Charcoal	Area B	City-gate L.1800 Beginning of EB IIIA (Nigro et al. 2011: 580)	4421 ± 45	3330–3214 (22.2%) 3185–3155 (3.8%) **3127–2916 (69.3%)**	3330–3215 (0.23) 3185–3156 (0.04) **3126–2916 (0.73)**
LTL17381A*	TS.17.Bw.PR.24	Charcoal	Area B-West	Erection of Wall W.2 (Nigro 1998b: 81-94)	4376 ± 45	3264–3240 (2.3%) **3105–2894 (93.1%)**	3308–3302 (0.01) 3282–3279 (0.01) 3264–3240 (0.02) **3105–2895 (0.96)**
BM-553	—	Charcoal	Trench III	Stage XVIII.phase lxxii Erection of Town Wall NFB (Kenyon 1981: 209)	3922 ± 78	**2622–2196 (94.2%)** 2171–2147 (1.2%)	**2620–2196 (0.99)** 2170–2147 (0.01)
LTL17383A	TS.17.F.PR.30	Charcoal	Area F	F.1290 EB IIIA occupation	4154 ± 45	**2881–2618 (95.4%)**	**2882–2619 (0.98)** 2607–2599 (0.01) 2593–2587 (0.01)
LTL14955A	TS.14.G.PR.26	Charcoal	Area G	EB IIIA Palace G reconstruction	4113 ± 45	**2873–2572 (94.8%)** 2510–2506 (0.6%)	**2872–2572 (0.99)** 2511–2505 (0.01)
LTL14953A	TS.14.G.PR.22	Charcoal	Area G		4080 ± 40	2863–2807 (16.6%) 2759–2717 (7.2%) **2708–2547 (60.3%)** 2540–2489 (11.3%)	2862–2807 (0.17) 2758–2718 (0.07) **2706–2548 (0.63)** 2539–2489 (0.13)
LTL14956A	TS.14.G.PR.32	Charcoal	Area G		4076 ± 40	2861–2808 (15.4%) 2756–2719 (6.1%) **2705–2488 (73.9%)**	2860–2808 (0.16) 2755–2720 (0.06) **2704–2542 (0.64)** 2541–2488 (0.14)
LTL14954A	TS.14.G.PR.23	Charcoal	Area G		4035 ± 40	2836–2816 (3.7%) **2671–2468 (91.7%)**	2835–2816 (0.04) **2668–2469 (0.96)**
LTL14952A	TS.14.G.PR.20	Charcoal	Area G		4009 ± 40	2831–2821 (0.8%) **2631–2461 (94.6%)**	2831–2821 (0.01) **2631–2460 (0.99)**

*Dates older in respect of the archaeological context and other datings from the same stratigraphic setting.

Figure 7 General view of Areas B and B-West, with Sultan IIIc2/EB IIIB Building B1 (to the left), the EB IIIA-B double city-walls (to the right), from north.

Area F was opened on the northern plateau of the site, where a large portion of the Sultan IIIb-c/EB II-III domestic quarter (Figure 9), extending to the west and to the east of a major street running northeast, was brought to light (Nigro 2000a: 15–51; 2006b: 10–17; Nigro and Taha 2009: 740–741, fig. 17).[6] Stratigraphy of Area F comprises 6 phases (Activities 6-1): Activities from 6 to 3 cover the Early Bronze Age, respectively EB II, EB IIIA-B and EB IV, while the latest two activities represent the Middle Bronze Age (Activity 2) and the modern frequentation (Activity 1). Sultan IIIc1/EB IIIA houses, extensively excavated by the Italian-Palestinian Expedition (Nigro 2000b: 16-17), revealed a long stratigraphic sequence (Activity 5/Operations 5e-a) which ended with a destruction (Activity 5/Operation 5a). Two samples (LTL17383A, LTL17384A) were collected during the 2017 season in the layer of use (F.1290) of a house dated to Sultan IIIc1/EB IIIA. LTL17383A was dated to 4154 ± 45 BP, while unfortunately it was not possible to date a short-lived sample (olive stone) from the same context (LTL17384A).

Area G is located on the eastern flank of the Spring Hill, where a Sultan IIIb-c/EB II-III complex building, called Palace G, was brought to light and carefully investigated by the Italian-Palestinian Expedition (Figure 10). Upon the EB Palace scanty remains of the Sultan IIId1/EB IVA camp site (Nigro 2003: 130–131) were uncovered, drastically obliterated by the

[6]This northern domestic quarter, excavated by all of the four expeditions (Sellin and Watzinger 1913: 36–38, fig. 17, pls. I–II; Garstang et al. 1935; 1936; Kenyon 1981: 309–338), is located on prominent strata of the Neolithic settlement, and shows the development of the site from the earliest village with circular huts in EB I (~3300–3000 BC; Nigro 2005; 2008) to the planned urban center with the dwellings arranged on both sides of a main street in EB II-III (~3000–2350 BC; Nigro 2000b: 15–120; 2006b: 5–6, 10-17; 2010a: 75–96).

Figure 8 Tell es-Sultan/Jericho, Area B-West: location of sample LTL17381A collected from a carbonized wooden beam set across the Main Inner City-Wall (W.2) just upon its stone foundation, from northwest.

structures of the Middle Bronze II Palace, the so-called Hyksos Palace (Nigro et al. 2011: 585-586). Palace G was erected on three terraces at the beginning of Sultan IIIb/EB II, reconstructed during Sultan IIIc1/EB IIIA, and destroyed at the end of Sultan IIIc2/EB IIIB by a fierce fire (Marchetti 2003: 300–303, fig. 4; Nigro 2006b: 20–22, figs. 29–32; 2014b: 77–79; 2016: 10, figs. 8–9; 2017: 159–161, 164–165; Nigro et al. 2011: 586–592). The thick destruction layers inside the rooms of the palace yielded a wealthy EB IIIB ceramic assemblage, and special finds such as ceremonial vessels, seal impressions, metal weapons (Nigro et al. 2011: figs. 18–21).

Five ^{14}C samples (LTL14952A, LTL14953A, LTL14954A, LTL14955A, LTL14956A), collected in the 2014 season (Figure 11), belonged to charred beams of a wooden installation (B.1238) excavated in Room L.1224 and associated to the Sultan IIIc1/EB IIIA reconstruction of the Palace. LTL14955A, LTL14953A, LTL14956A, LTL14954A, and LTL14952A dated respectively to 4113 ± 45 BP, 4080 ± 40 BP, 4076 ± 40 BP, 4035 ± 40 BP, and 4009 ± 40 BP. Although found in the same context, these charcoals resulted in different dates, corroborating the interpretation that they belonged to timbers from trees cut in a chronologically successive sequence (Table 6).

Calibrated dates from samples collected in Areas F and G in Sultan IIIc1/EB IIIA strata range between ca. 2880 and 2460 BC, which approximately overlap with the conventional archaeological dating ~2700–2500 BC for this period.

Figure 9 Tell es-Sultan/Jericho, Area F: general view of the EB II-III domestic quarter excavated on the northern plateau, from northwest.

Figure 10 Tell es-Sultan/Jericho, Area G: general view of Sultan IIIc/EB III Palace G, from east.

Figure 11 Sampling of charcoals in Palace G, Room L.1224 (Sultan IIIc1/EB IIIA), during the 2014 season of excavations.

Early Bronze IIIB (Period Sultan IIIc2, 2500–2300 BC)

EB IIIB (Period Sultan IIIc2) at Jericho is illustrated by five radiocarbon dates based on samples collected in different areas of the site. Two samples (BM-554, BM-1781R) were collected in Trench III (Figure 4); two samples (Rome-1177, Rome-1178) were collected in Area F and one sample (Jericho 1) in Area B by the Italian-Palestinian Expedition at the end of 1990s (Table 7).

Rome-1177 and Rome-1178 (Lombardo and Piloto 2000) were associated to Sultan IIIc2/EB IIIB (Activity 4) according to the stratigraphic sequence of Area F. They originate from a filling which sealed the Sultan IIIc1/EB IIIA destruction layers, which yielded diagnostic EB IIIA pottery fragments (Nigro 2000b: 29–31, figs. 1:32–38), among which some Khirbet Kerak Ware fragments (Nigro 2000b: 29, fig. 1:39; 2009: 72–74, figs. 7–8). Rome-1177 was dated to 3890 ± 60 BP, while Rome-1178 was dated to 3875 ± 60 BP: the corresponding calibrated dates

Table 7 Sultan IIIc2/EB IIIB ^{14}C dates from Tell es-Sultan/ancient Jericho (samples listed according to their stratigraphy = top is a lower stratum in the dig).

Lab code	Sample material	Area	Context	^{14}C age (BP)	OxCal 4.3.1 (±2σ yr BC)	CALIB 7.04 (±2σ yr BC)
Rome-1178	Charcoal	Area F	Activity 4	3890 ± 60	2564–2533 (2.6%)	2563–2533 (0.02)
					2495–2200 (92.6%)	**2494–2199 (0.97)**
					2158–2155 (0.2%)	2158–2154 (0.01)
Rome-1177	Charcoal	Area F		3875 ± 60	2547–2540 (0.4%)	2547–2540 (0.01)
					2489–2196 (93.0%)	**2489–2195 (0.97)**
					2171–2147 (2.0%)	2172–2146 (0.02)
BM-554*°	Charcoal	Trench III	Stage XIX.phase lxxvi-lxxviia EB IIIB destruction (Kenyon 1981: 213)	4170 ± 42	**2887–2626 (95.4%)**	2887–2828 (0.22)
						2824–2626 (0.78)
Jericho 1	Charcoal	Area B	Activity 4c Building B1 destruction (Nigro 1998a: 26)	4000 ± 60	2851–2813 (3.5%)	2849–2813 (0.03)
					2742–2730 (0.6%)	2740–2731 (0.01)
					2694–2337 (90.6%)	2693–2687 (0.01)
					2323–2308 (0.7%)	**2680–2336 (0.95)**
						2323–2307 (0.01)

*Dates older in respect of the archaeological context and other datings from the same stratigraphic setting.
°Two measurements of the same sample.

range between 2495 and 2195 BC, which overlap the time span ~2500–2300 BC archaeologically established for Sultan IIIc2/EB IIIB.

BM-554 and BM-1781R were found in the destruction layers which marked the end of Sultan IIIc2/EB IIIB, when the fortified city of Jericho was completely destroyed probably by an enemy attack (Kenyon 1981: 213; Nigro 2014b: 77–80, figs. 20–23; 2017: 164–166). Sultan IIIc2/EB IIIB in Trench III corresponds to Stage XIX, when the fortification system was completely rebuilt for the last time (Kenyon 1981: 212–213, pl. 270a; Nigro 2014b: 75–77) after the destruction occurred at the end of Sultan IIIc1/EB IIIA (Kenyon 1981: 212, pl. 124b). BM-554 and BM-1781R were obtained from the same sample of charcoal and associated to Stage XIX.phase lxxvi-lxxviia, namely the end of Sultan IIIc2/EB IIIB (Kenyon and Holland 1983: xxxviii).[7] BM-554 was dated to 4170 ± 42 BP, calibrated date is 2887–2626 (95.4%) cal BC using OxCal and/or 2824–2626 (78%) cal BC using CALIB. This date is older than its recovery context, namely the EB IIIB destruction layers, but is consistent with the other dates of Sultan IIIb2/EB IIB. As already noted for charcoal samples taken from the fortification walls (e.g. LTL17381A and LTL17382A), building materials (wooden posts and timbers) of the earliest Sultan IIIb/EB II defensive line may have been reused when the city-walls were rebuilt during Sultan IIIc/EB III, remaining embedded in the mud-brick superstructure until the final destruction of the EB IIIB city.

Sultan IIIc2/EB IIIB in Area B was associated with the reconstruction of the Main Inner City-Wall (Wall 1, prosecution of Kenyon's Wall NFG), which was repaired in various spots (Nigro 1998a: 36) incorporating the blocked South Gate (Nigro 1998a: 36; Nigro et al. 2011: 581). In the

[7]BM-1781R, which was a new measurement of sample BM-1781 originally processed by the British Museum ^{14}C Laboratory in 1981, is unfortunately unreliable (Bowman et al. 1990: table 2a): it was dated to 4350 ± 110 BP, and the calibrated date is 3357–2841 (86.9%) cal BC OxCal and/or 3355–2847 (0.90) cal BC CALIB.

same phase, Building B1 was erected against the inner side of the fortification wall (Nigro 1998a: 24–25; 2000a: 122). Building B1 was completely destroyed at the end of Sultan IIIc2/EB IIIB (Activity 4/Operations 4c-a), as it is shown by its walls ruinously collapsed and by the thick destruction layers which filled up all the rooms (the same event is also visible in cracks and subsided sections of the nearby city-walls; Nigro 1998a: 25–26; 2000a: 122–123). Sample Jericho 1 was retrieved in the destruction layer which filled up Room L.39 (filling L.39c) when Building B1 was set on fire (Lombardo et al. 1998: 242). Jericho 1 was a charcoal from a timber set in the ceilings of the building, and may thus be referred to the Building B1 construction at the beginning of Sultan IIIc2/EB IIIB (Nigro 1998a: 41). It was dated to 4000 ± 60 BP, and the calibrated date is 2694–2337 (90.6%) cal BC OxCal and/or 2680–2336 (95%) cal BC CALIB. This sample, thus, would provide a chronological indication which coincides with archaeologically established conventional dates for Sultan IIIc2/EB IIIB between ca. 2650 and 2300 BC. However, further short-lived samples are still needed to provide a reliable date of the destruction of the Early Bronze Age city at the end of Sultan IIIc2/EB IIIB, which ranges from 2350 to 2250 BC.

Early Bronze IVA-B (Period Sultan IIId1-2, 2300–2000/1950 BC)

There are no Sultan IIId1/EB IVA samples available from the tell, where this phase was identified in relatively restricted areas (Nigro 2003: 132).

The overlying Sultan IIId2/EB IVB is represented only by two charcoal samples collected during Kenyon's excavations in stratified layers from Trench II and Trench III, associated to the latest EB IV occupation.

In Trench III, the latest Sultan IIId/EB IV occupation is illustrated by Stage XX and Stage XXI (Kenyon 1981: 213–215, pl. 273). BM-1782R was retrieved in layers associated to Stage XX.phase lxxxa, and related to a ditch, suggesting the existence of a village on the top of the mound, with dwellings spread to the north and to the south of the ditch (Kenyon 1981: 214; Nigro 2003: 129).

The same stratigraphic phase in Trench II corresponds to Stage XXI.phase lxviii (Kenyon 1981: 166–167; Nigro 2003: 128), that includes houses built on top of the northern EB IIIB Outer City-Wall in the latest phase of the period (Sultan IIId2/EB IVB). The post-urban rural village was destroyed by an earthquake at the end of EB IVB (Kenyon 1981: 167; Nigro 2003: 131–133). BM-1784R was collected from the collapse layer (Stage XXI.phase lxviii-Stage XXII. phase lxixa) marking the end of the EB IVB settlement at Jericho.

The two samples provided very similar dates (Table 8): BM-1784R was dated to 3840 ± 110 BP, BM-1782R was dated to 3780 ± 110 BP. The calibrated dates overlap a time range between 2580 and 1907 BC. With a view to collecting further samples from EB IV contexts, these measurements suggest for the final phase of occupation of the Sultan IIId2/EB IVB village a latest date around 2000/1950 BC.

CONCLUSIONS

Re-examination of ^{14}C dates available for Tell es-Sultan/ancient Jericho in the EBA (summarized in the multiple plot, Figure 12) has shown that archaeological periods (Table 9) and chronological divisions based on stratigraphic analysis and material culture sequences and associations can be matched with dates provided by ^{14}C determinations. Whether the two systems keep their independence avoiding circular reasoning, the reassessed radiocarbon dates in relation to careful verified stratigraphic location of samples (e.g. from the beginning, mid or end) for each period may allow a more precise setting of archaeological periods and even highlight excavation or interpretive misunderstandings.

Table 8 Sultan IIId2/EB IVB ^{14}C dates from Tell es-Sultan/ancient Jericho (samples listed according to their stratigraphy = top is a lower stratum in the dig).

Lab code	Sample material	Area	Context	^{14}C age (BP)	OxCal 4.3.1 (±2σ yr BC)	CALIB 7.0.4 (±2σ yr BC)
BM-1784R	Charcoal	Trench II	Stage XXI. phase lxviii-Stage XXII. phase lxixa End of EB IVB (Kenyon 1981: 167)	3840 ± 110	**2580–1966 (95.4%)**	**2578–1972 (1.00)**
BM-1782R	Charcoal	Trench III	Stage XX. phase lxxxa Latest EB IVB occupation (Kenyon 1981: 214)	3780 ± 110	2551–2537 (0.5%) **2491–1910 (94.9%)**	2547–2540 (0.01) **2489–1907 (0.99)**

At Jericho, archaeologists clearly marked in stratigraphy the inner subdivisions of each period, even though this is not always reflected in an obvious manner by material culture. These sub-periods have been tentatively dated thanks to available radiocarbon dates anchored to strata as shown in Table 9 thanks to Bayesian tools.[8]

This absolute chronology of Tell es-Sultan/Jericho in the EBA contradicts the recently-proposed Levantine High Chronology (Regev et al. 2012a, 2012b, 2014; Höflmayer et al. 2014; Falconer and Fall 2016; Regev 2017). The latter, as far as Jericho is concerned, was based on some major misunderstandings of Kenyon's stratigraphy—and in a complete oblivion of what was more precisely established by the Italian-Palestinian Expedition. Henceforth, the results of the present study suggest maintaining the already-established chronological relationships between Jericho and Palestine with Pre- and Early Dynastic Egypt.

Moreover, this study has made clear once again how many perils are concealed in the use of ^{14}C to date stratigraphies and related archaeological chronologies. Different types of samples have different kinds of relationships with stratigraphy—with a special mention to the old-wood factor which can quite often occur in a site with monumental defensive structures built up and destroyed many times. Moreover, errors can also occur during samples chemical treatment before measurement, as some cases in the British Museum and Oxford Laboratories (and following re-measurements) have shown (Bowman et al. 1990; Waterbolk 1990; van der Plicht and Bruins 2001: 1162).

[8]The analysis of the whole set of ^{14}C ages was also performed by using the advanced Bayesian tools available in OxCal Ver. 4.3. A Model was then generated in which all the samples were grouped in different Phases divided by boundaries and forming a Sequence named Tell-es-Sultan. The identification of possible outliers was carried out by using the dedicated routines available in OxCal and by following Bronk Ramsey (2009b). In a first run of the model all the samples were considered as potential "outliers". In this way three dates were identified as outliers with a posterior probability threshold of 5%: BM1775R, LTL17381A and LTL17382A. The model was then re-run by highlighting these dates as "outlying" data. The obtained results are shown in Figure 12, where calibrated ages were rounded by 10 and ranges merged. Overall the very good single statistical agreement indexes and the overall value of the model Amodel = 137 indicate the robustness of the analysis. The model was then used to estimate the boundaries of each phase as summarised in the last column of Table 9.

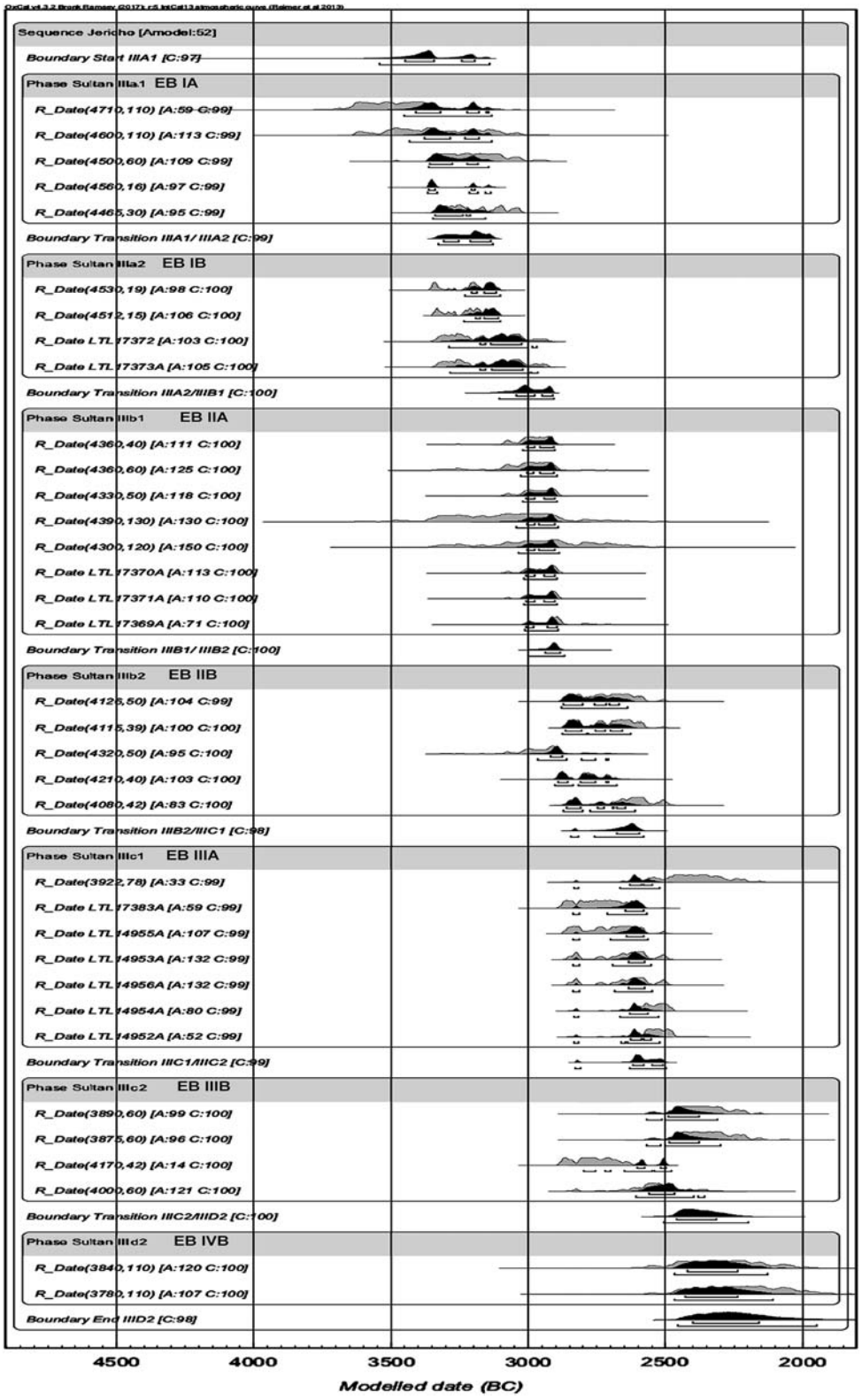

Figure 12 Multiple plot of Jericho Early Bronze Age ^{14}C dates (OxCal v. 4.3.1).

In any case, the most dangerous and hazardous challenge has been that brought about by an indirect knowledge of stratigraphy, as the chronological implications of a sample mostly rely on its stratigraphic exact location and understanding. For this reason, plans, sections and photos,

Table 9 Archaeological periodization of Tell es-Sultan/ancient Jericho and the radiometric reassessed chronology.

Egypt chronology	Tell es-Sultan Jericho Periodization	Archaeological period	Archaeological chronology	^{14}C samples from Jericho (stratigraphic order)	Radiometric reassessed chronology	Radiometric reassessed chronology (Bayesian)
Pre-Dynastic	Sultan IIIa1	Early Bronze IA	3500–3200	BM-1775R; BM-1774R; BM-1328; BM-1329; GrN-18540; GrN-18541	**3500–3200**	3350 (100)–3220 (60)
0Dynasty 00Dynasty	Sultan IIIa2	Early Bronze IB	3200–3000	GrN-18545;GrN-18546 LTL17372A; LTL17373A	**3200–3050/3000**	3220 (60)–3000 (60)
I Dynasty	Sultan IIIb1	Early Bronze IIA	3000–2850	GrA-222; GrA-6315 rep. 2; GrA-6332 rep. 3; BM-1779R; BM-1778R; LTL17369A; LTL17370A; LTL17371A; LTL17381A; LTL17382A	**3050/3000–2850**	3000 (60)–2900 (30)
II Dynasty	Sultan IIIb2	Early Bronze IIB	2850–2700	BM-1780N; BM-550; BM-552; GrA-224; BM-551;BM-554	**2850–2700/2650**	2900 (30)–2700 (70)
III Dynasty IV Dynasty	Sultan IIIc1	Early Bronze IIIA	2700–2500	LTL17383A; LTL14952A; LTL14953A; LTL14954A; LTL14955A; LTL14956A; BM-553	**2700/2650–2500**	2700 (70)–2510 (50)
V Dynasty	Sultan IIIc2	Early Bronze IIIB	2500–2300	Rome-1177; Rome-1178; Jericho 1	**2500–2300**	2510 (50)–2290 (70)
VI Dynasty	Sultan IIId1	Early Bronze IVA	2300–2200	—	**2300–2200**	2290 (70)–2200 (90)
First Intermediate VII-X Dynasties	Sultan IIId2	Early Bronze IVB	2200–2000	BM-1782R; BM-1784R	**2200–2000/1950**	2300 (90)–2090 (130)

when available, of samples in situ are mostly needed and have been included in this study. In many cases, ^{14}C determinations helped in better understanding stratigraphy.

Even though the result of this study, as summarized above in Table 9, are considered soundly reliable, as they stem from a multi-based approach to chronology and are the outcome of a pluriannual work at Tell es-Sultan, a further collection of precisely located samples and measurements is needed to double-check our preliminary time indications with new evidence, which may also be verified by means of further Bayesian interpretive models.

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REFERENCES

Bowman SGE, Amber JC, Leese MN. 1990. Re-evaluation of British Museum ^{14}C dates issued between 1980 and 1984. *Radiocarbon* 32(1): 59–79.

Bronk Ramsey C. 2009a. Bayesian analysis of radiocarbon dates. *Radiocarbon* 51(1): 337–60.

Bronk Ramsey C. 2009b. Dealing with outliers and offsets in radiocarbon dating. *Radiocarbon* 51(3): 1023–45.

Bruins HJ, van der Plicht J. 1998. Early Bronze Jericho: high-precision ^{14}C dates of the short-lived palaeobotanic remains. *Radiocarbon* 40(2): 621–28.

Bruins HJ, 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.

Burleigh R. 1981. Appendix C. Radiocarbon dates. In: Kenyon KM. *Excavations at Jericho. Volume Three. The Architecture and Stratigraphy of the Tell*. London: The British School of Archaeology in Jerusalem. p. 501–04.

Burleigh R. 1983. Appendix D. Additional radiocarbon dates for Jericho (with an assessment of all the dates obtained). In: Kenyon KM, Holland TA. *Excavations at Jericho. Volume Five. The Pottery Phases of the Tell and Others Finds*. London: The British School of Archaeology in Jerusalem. p. 760–65.

Calcagnile L, Quarta G, D'Elia M. 2005. High-resolution accelerator-based mass spectrometry: precision, accuracy and background. *Appl Radiat Isotopes* 62(4): 623–29.

Callaway JA, Weinstein JA. 1977. Radiocarbon Dating of Palestine in the Early Bronze Age. *B Am Sch Oriental Re* 225: 1–16.

D'Elia ML, Calcagnile L, Quarta G, Sanapo C, Laudisa M, Toma U, Rizzo A. 2004. Sample preparation and blank values at the AMS Radiocarbon Facility of the University of Lecce. *Nuclear Instruments and Methods in Physics Research B* 223–224: 278–83.

Falconer SE, Fall PL. 2016. A radiocarbon sequence from Tell Abu en-Ni'aj, Jordan and its implications for Early Bronze IV chronology in the Southern Levant. *Radiocarbon* 58(3): 615–47.

Garstang J, Droop JP, Crowfoot J. 1935. Jericho: city and necropolis (fifth report). *Liverpool Annals of Archaeology and Anthropology* 22: 143–84.

Garstang J, Ben-Dor I, Fitzgerald FM. 1936. Jericho: city and necropolis (report for the sixth and concluding season, 1936). *Liverpool Annals of Archaeology and Anthropology* 23: 67–100.

Garstang J, Garstang JBE. 1948. *The Story of Jericho*. London: Marshall, Morgan & Scott.

Höflmayer F. 2017. A radiocarbon chronology for the Middle Bronze Age Southern Levant. *Journal of Ancient Egyptian Interconnections* 13: 20–33.

Höflmayer F, Dee MW, Genz H, Riehl S. 2014. Radiocarbon evidence for the Early Bronze Age Levant: Tell Fadous-Kfarabida (Lebanon) and the end of the Early Bronze III period. *Radiocarbon* 56(2): 529–42.

Hopf M. 1983. Appendix B. Jericho plant remains. In: Kenyon KM, Holland TA. *Excavations at Jericho. Volume Five. The Pottery Phases of the Tell and Others Finds*. London: The British School of Archaeology in Jerusalem. p 576–621.

Kenyon KM. 1957. *Digging up Jericho*. London: Ernest Benn Limited.

Kenyon KM. 1960. *Excavations at Jericho. Volume One. The Tombs excavated in 1952–1954*. London: The British School of Archaeology in Jerusalem.

Kenyon KM. 1965. *Excavations at Jericho. Volume Two. The Tombs excavated in 1955–1958*. London: The British School of Archaeology in Jerusalem.

Kenyon KM. 1981. *Excavations at Jericho. Volume Three. The Architecture and Stratigraphy of the Tell*. London: The British School of Archaeology in Jerusalem.

Kenyon KM, Holland TA. 1982. *Excavations at Jericho. Volume Four. The Pottery Type Series and Other Finds*. London: The British School of Archaeology in Jerusalem.

Kenyon KM, Holland TA. 1983. *Excavations at Jericho. Volume Five. The Pottery Phases of the Tell and Other Finds*. London: The British School of Archaeology in Jerusalem.

Lombardo M, Piloto A. 2000. New radiocarbon dates and assessment of all dates obtained for the Early and Middle Bronze Ages in Jericho. In: Marchetti N, Nigro L, editors. *Excavations at Jericho, 1998. Preliminary Report on the Second Season of Excavations and Surveys at Tell es-Sultan, Palestine* (Quaderni di Gerico 2). Rome: Università degli Studi di Roma «La Sapienza». p 329–32.

Lombardo M, Piloto A, Calderoni C. 1998. Datazione tramite radiocarbonio di un frammento di travetto ligneo carbonizzato dell'Edificio B1. In: Marchetti N, Nigro L, editors. *Scavi a Gerico, 1997. Relazione preliminare sulla prima campagna di scavi e prospezioni archeologiche a Tell es-Sultan, Palestina* (Quaderni di Gerico 1). Roma: Università degli Studi di Roma «La Sapienza». p. 241–43.

Marchetti N. 2003. A century of excavations on the Spring Hill at Tell es-Sultan, ancient Jericho: a reconstruction of its stratigraphy. In: Bietak M, editor. *The Synchronisation of Civilisations in the Eastern Mediterranean in the Second Millennium B. C. II, Proceedings of the SCIEM2000 – Euro-Conference, Haindorf2nd of May–7th of May 2001* (Contributions to the Chronology of the Eastern Mediterranean IV). Wien: Verlag der Österreichischen Akademie der Wissenschaften. p. 295–321.

Marchetti N, Nigro L, editors. 1998. *Scavi a Gerico, 1997. Relazione preliminare sulla prima campagna di scavi e prospezioni archeologiche a Tell es-Sultan, Palestina* (Quaderni di Gerico 1). Roma: Università degli Studi di Roma «La Sapienza».

Marchetti N, Nigro L, editors. 2000. *Excavations at Jericho, 1998. Preliminary Report on the Second Season of Excavations and Surveys at Tell es-Sultan, Palestine* (Quaderni di Gerico 2). Rome: Università degli Studi di Roma «La Sapienza».

Nigro L. 1998a. L'Area B. La cinta di mura interna e l'Edificio B1. In: Marchetti N, Nigro L, editors. *Scavi a Gerico, 1997. Relazione preliminare sulla prima campagna di scavi e prospezioni archeologiche a Tell es-Sultan, Palestina* (Quaderni di Gerico 1). Roma: Università di Roma «La Sapienza». p. 23–80.

Nigro L. 1998b. L'Area B Ovest. La doppia cinta di fortificazione del Bronzo Antico III. In: Marchetti N, Nigro L, editors. *Scavi a Gerico, 1997. Relazione preliminare sulla prima campagna di scavi e prospezioni archeologiche a Tell es-Sultan, Palestina* (Quaderni di Gerico 1). Roma: Università di Roma «La Sapienza». p 81–94.

Nigro L. 2000a. Architecture and stratigraphy of Building B1. In: Marchetti N, Nigro L, editors. *Excavations at Jericho, 1998. Preliminary Report on the Second Season of Excavations and Surveys at Tell es-Sultan, Palestine* (Quaderni di Gerico 2). Rome: Università di Roma «La Sapienza». p 121–63.

Nigro L. 2000b. Area F. An Early Bronze IIIA residential quarter. In: Marchetti N, Nigro L, editors. *Excavations at Jericho, 1998. Preliminary Report on the Second Season of Excavations and Surveys at Tell es-Sultan, Palestine* (Quaderni di Gerico 2). Rome: Università di Roma «La Sapienza». p. 15–120.

Nigro L. 2003. Tell es-Sultan in the Early Bronze Age IV (2300-2000 BC). Settlement *vs* necropolis - A stratigraphic periodization. *Contributi e Materiali di Archeologia Orientale* IX: 121–58.

Nigro L. 2005. *Tell es-Sultan/Gerico alle soglie della prima urbanizzazione: il villaggio e la necropoli del Bronzo Antico I(3300-3000 a.C.)* (Rome «La Sapienza» Studies on the Archaeology of Palestine & Transjordan 01). Roma: «La Sapienza» Expedition to Palestine & Jordan.

Nigro L. 2006a. Sulle mura di Gerico. Le fortificazioni di Tell es-Sultan come indicatori della nascita e dello sviluppo della prima città di Gerico nel III millennio a.C. In: Baffi F, Dolce R, Mazzoni S, Pinnock F, editors. *Ina kibrāt erbetti. Studi di archeologia orientale dedicati a Paolo Matthiae*. Rome: «La Sapienza» Università di Roma. p 349–75.

Nigro L. 2006b. Results of the Italian-Palestinian Expedition to Tell es-Sultan: at the dawn of urbanization in Palestine. In: Nigro L, Taha H, editors. *Tell es-Sultan/Jericho in the Context of the Jordan Valley: Site Management, Conservation and Sustainable Development, Proceedings of the International Workshop (Ariha*

2005) (Rome «La Sapienza» Studies on the Archaeology of Palestine & Transjordan 02). Rome: «La Sapienza» Expedition to Palestine & Jordan. p 1–40.

Nigro L. 2008. Tell es-Sultan/Jericho from village to town: a reassessment of the Early Bronze Age I settlement and necropolis. In: Córdoba JM, Molist M, Pérez MC, Rubio I, Martìnez S, editors. *Proceedings of the 5th International Congress on the Archaeology of the Ancient Near East (5-8 April 2006)*, Volume II. Madrid: Universidad Autónoma of Madrid. p 645–2.

Nigro L. 2009. Khirbet Kerak Ware at Jericho and the EB III change in Palestine. In: Petit L, Kaptijn E, editors. *A Timeless Vale. Archaeological and related essays on the Jordan Valley in honor of Gerrit van der Kooij on the occasion of his sixty-fifth birthday* (Archaeological Studies Leiden University 19). Leiden: Leiden University Press. p 69–83.

Nigro L. 2010a. *Tell es-Sultan/Jericho in the Early Bronze Age II (3000-2700 BC): the rise of an early Palestinian city. A synthesis of the results of four archaeological expeditions* (Rome «La Sapienza» Studies on the Archaeology of Palestine & Transjordan05). Rome: «La Sapienza» Expedition to Palestine & Jordan.

Nigro L. 2010b. Tell es-Sultan/Jericho and the origins of urbanization in the Lower Jordan Valley: results of recent archaeological researches. In: Matthaie P, Pinnock F, Nigro L, Marchetti N, editors. *Proceedings of the 6th International Congress of the Archaeology of the Ancient Near East. 5 May – 10 May 2008, "Sapienza", Università di Roma*, Volume II. Wiesbaden: Harrassowitz. p 459–81.

Nigro L. 2013. Jericho. In: Master DM, editor. *The Oxford Encyclopedia of the Bible and Archaeology*, Volume II. Oxford: Oxford University Press. p 1–8.

Nigro L. 2014a. Aside the spring: Tell es-Sultan/ancient Jericho: the tale of an early city and water control in ancient Palestine. In: Tvedt T, Oestigaard T, editors. *A History of Water. Series III. Volume 1: Water and Urbanization*. London: I.B. Tauris. p 25–51.

Nigro L. 2014b. The archaeology of collapse and resilience: Tell es-Sultan/ancient Jericho as a case study. In: Nigro L, editor. *Overcoming Catastrophes. Essays on disastrous agents characterization and resilience strategies in pre-classical Southern Levant* (Rome «La Sapienza» Studies on the Archaeology of Palestine and Transjordan, 11), Rome: Rome «La Sapienza» Expedition to Palestine & Jordan. p 55–85.

Nigro L. 2016. Tell es-Sultan 2015. A pilot project for archaeology in Palestine. *Near East Archaeol* 79 (1): 4–17.

Nigro L. 2017. The end of the Early Bronze Age in the Southern Levant. Urban crisis and collapse seen from two 3rd Millennium BC-cities: Tell es-Sultan/Jericho and Khirbet al-Batrawy. In: Cunninghm T, Driessen J, editors. *Crisis to Collapse. The Archaeology of Social Breakdown* (AEGIS 11). Louvain: UCL Presses Universitaires de Louvain. p 149–72.

Nigro L, Sala M, Taha H, Yassine J. 2011. The Early Bronze Age palace and fortifications at Tell es-Sultan/Jericho. The 6th - 7th seasons (2010-2011) by Rome "La Sapienza" University and the Palestinian MOTA-DACH. *Scienze dell'Antichità* 17: 571–97.

Nigro L, Taha H Renewed excavations and restorations at Tell es-Sultan/ancient Jericho. Fifth season – March-April 2009. *Scienze dell'Antichità* 15: 733–44.

van der Plicht J, Bruins HJ. 2001. Radiocarbon dating in Near-Eastern contexts: confusion and quality control. *Radiocarbon* 43(3): 1155–66.

Regev J. 2017. Radiocarbon assessment of Early Bronze Arad: the 20 year lifespan of Stratum II. *Tel Aviv* 44(2): 165–77.

Regev J, de Miroschedji P, Greenberg R, Braun E, Greenhut Z, Boaretto E. 2012a. Chronology of the Early Bronze Age in the Southern Levant: new analysis for a high chronology. *Radiocarbon* 54(3–4): 525–66.

Regev J, de Miroschedji P de, Boaretto E. 2012b. Early Bronze Age chronology: radiocarbon dates and chronological models from Tel Yarmuth (Israel). *Radiocarbon* 54(3–4): 505–24.

Regev J, Finkelstein I, Adams MJ, Boaretto E. 2014. Wiggle-matched ^{14}C chronology of Early Bronze Megiddo and the synchronization of Egyptian and Levantine chronologies. *Ägypten & Levante* 24: 243–66.

Reimer PJ, Bard E, Bayliss A, Beck JW, Blackwell PG, Bronk Ramsey C, Buck CE, Cheng H, Edwards RL, Friedrich M, et al. 2013. IntCal13 and Marine13 radiocarbon age calibration curves 0–50,000 years cal BP. *Radiocarbon* 55(4): 1869–87.

Sala M. 2012. Egyptian and egyptinizing objects from EB I-III Tell es-Sultan/ancient Jericho. *Vicino Oriente* XVI: 275–302.

Sellin E, Watzinger C. 1913. *Jericho. Die Ergebnisse der Ausgrabungen* (Wissenschaftliche Veröffentlichung der Deutschen Orient-Gesellschaft, 22). Leipzig: Auflage.

Stuiver M, Polach HA. 1977. Discussion: Reporting of ^{14}C data. *Radiocarbon* 19(3): 355–63.

Stuiver M, Reimer PJ, Reimer RW. 2018, CALIB 7.1 [WWW program]. Seattle: Quaternary Research Center, University of Washington. URL: < http://calib.org > .

Waterbolk HT. 1990. Quality differences between radiocarbon laboratories illustrated on material from SW Asia and Egypt. In: Mook WG, Waterbolk HT, editors. *Proceedings of the Second International Symposium, ^{14}C and Archaeology* (PACT 29). Groningen: Council of Europe. p 141–58.

Weinstein JA. 1984. Radiocarbon dating in the Southern Levant. *Radiocarbon* 26(3): 297–366.