

Troy III-V: new radiocarbon dates confirm a gap in Blegen's sequence

Donald Easton¹, Bernhard Weninger²

¹ Independent scholar, London, UK; donaldfeaston@hotmail.com

² Universität zu Köln, Köln, DE; b.weninger@uni-koeln.de

ABSTRACT - To investigate the dating of Troy III-V, and in particular to test whether in Blegen's Troy sequence a gap exists between Troy III and Troy IV, 26 bone samples covering Troy III to VIa from the University of Cincinnati excavations were submitted for ¹⁴C-AMS analysis. Excluding outliers, they yield dates that are consistent with a chronological scheme which includes a 110±20 year gap after Troy III, with Troy IV beginning 2060±10 cal BC. The hypothesis of a Proto-IV period which might bridge the gap, featuring deposits known only from the more recent excavations, can therefore be entertained.

KEY WORDS - Troy; Aegean chronology; Anatolian chronology; Early Bronze Age; radiocarbon dating; correspondence analysis

Troja III-V: novi radiokarbonski datumi potrjujejo vrzel v Blegenovi sekvenci

IZVLEČEK - Da bi lahko raziskali datacijo Troje III-V in preverili, ali v Blegenovi sekvenci obstaja vrzel med stopnjama Troja III in IV, smo v ¹⁴C-AMS analizo poslali 26 vzorcev kosti z izkopavanj Univerze v Cincinnati, ki pokrivajo stopnje Troja III-VIa. Ob neupoštevanju odstopajočih vrednosti so ti datumi skladni s kronološko shemo, v kateri je po stopnji Troja III 110±20-letna vrzel. Stopnja Troja IV se začne 2060±10 cal pr. n. št. Hipotezo o stopnji proto-IV, ki bi morda lahko premostila vrzel in vključuje le depozite z novejših izkopavanj, lahko torej sprejmemo.

KLJUČNE BESEDE - Troja; egejska kronologija; anatolska kronologija; zgodnja bronasta doba; radiokarbonsko datiranje; korespondenčna analiza

The background

Stratigraphic analysis of Troy III-V

This paper, which does not necessarily represent the official view of the Tübingen Troy Project, is concerned with the stratigraphy and chronology of periods III to V at Troy. These have a complicated history which it may be helpful to clarify first.

Heinrich Schliemann put forward his original numbering of these periods in 1874 (*Schliemann 1874. v-lvii; 1875.10*) but revised it in 1880 as a result of

his second set of excavations (1878–79). Thereafter he left it basically unchanged. His 1882 season did cause him to subdivide Troy II into two phases and to transfer to it the *epithet* 'burnt' which previously he had applied to City III, but he did not transfer any of the architecture (*Schliemann 1884.52–53, 181–182; Easton 2014.58–60*). The numbering and division of strata remained otherwise unaltered. The same division of the strata, with the same numbering,

was taken over by Wilhelm Dörpfeld (*Easton 2000; 2014.56-63*).

Schliemann's main object in his excavations was to expose the buildings of Troy II across as much of the centre of the mound as he could. In pursuit of this he cleared away most of the overlying strata with little record of the architecture, although he kept quite a full record of the pottery. Consequently when in 1932-1938 Carl Blegen and a team from the University of Cincinnati came to investigate the periods immediately following Troy II he could only do so in isolated areas. Two of the most important of these, in squares E6 and F4-5, were unexcavated 'pinnacles' of deposits, up to 8m tall, which Schliemann had left standing amid the ruins of Troy II. A third area, in F7-8, lay over the southern edge of the Troy II citadel. In these, and to a lesser extent elsewhere, Blegen was able to trace a sequence of occupation, with many building-phases, throughout Troy III, IV and V. He assumed it to be continuous. His numbering of the strata, however, differed from Schliemann's. This was because he misunderstood the change made by Schliemann after the 1882 season and thought that "*the whole of the 'Burnt City' was re-assigned by Schliemann to Troy II*" (*Blegen et al. 1950.207*). In other words Blegen thought that in 1882 Schliemann had transferred to Troy II everything that he had previously called Troy III - architecture, surrounding deposits and all associated finds - not just the epithet 'burnt'. As a result Blegen's Troy II is equivalent to Heinrich Schliemann's Troy II *and* Troy III, his Troy III is equivalent to Schliemann's Troy IV, and his Troy IV and V together are equivalent to Schliemann's Troy V (*Easton 1976.148-149; 1990.436, Fig. 7; 2000; Jablonka 2000.103*). This is important chronologically: we cannot use Schliemann's City IV material to date Blegen's Troy IV. Blegen's numbering has become standard and is followed in this article.

From 1987 to 2012 new excavations were conducted by the University of Tübingen under, first, Manfred Korfmann and then Ernst Pernicka. Korfmann faced the same problem as Blegen and, to expose the III-V sequence, could dig only in a limited number of isolated areas. These have no direct, stratigraphic link with the III-V deposits of Blegen and can only be related to them by a combination of stratigraphic, ceramic and other comparisons. Two of the areas dug by Korfmann have been published in detail: a 'pinnacle' in square E4-5 (*Friedrich 1997; Mansfeld 2001*), and a small area in A5-6, to the northwest of

the Troy II citadel (*Blum 2012*). The architecture and stratigraphy of a third area on the south edge of the Troy II citadel, D7-8 has also been published, but with very limited information about the pottery (*Sazcı 2005; 2007.116-132*). A modification of Blegen's II/III divide is contemplated for the final publication (*Easton 2014.63*).

In a 2018 article the present authors examined the published architecture and pottery of the three Korfmann areas (*Easton, Weninger 2018.36-42*). The trench in D7-8 deepened the south end of Schliemann's north-south trench. The topmost, and latest, 'Troy IV' phase found in it (no.7) must have lain almost immediately below the deepest wall found by there Schliemann in 1872, but that wall is probably the continuation of a wall dated to Troy IVb which Blegen found in square HJ 6-7. It therefore looked to us as though all but one of Manfred Osman Korfmann's and Göksel Sazcı's 'Troy IV' phases in D7-8 were earlier than Blegen's Troy IV. We also looked at the relative percentages of the main ceramic fine wares in the three areas. These too pointed to Korfmann's 'IV' deposits, and in A5-6 also his 'V.1-2' deposits, being earlier than Blegen's Troy IV. Furthermore we found that the ceramic shapes attested in these phases showed a mixture of chronologically significant types: five are known from Blegen's Troy III but do not continue into his Troy IV; four, perhaps six, are absent from his Troy III but are present from the beginning of his Troy IV. The combination suggested that these Korfmann phases might be a transitional period lying between Blegen's III and IV. In this transitional period the classic 'Troy IV' types appear only part way through, out of synch with the architectural periodisation. Peter Demjan and Peter Pavúk (*2020.434-436*) have found just such a pattern in Troy VI. It seems to be characteristic of the site. A difference between Korfmann's 'IV' deposits and Blegen's Troy IV shows up again in the faunal spectra (*Uerpmann 2003.258, Fig. 2*). The Korfmann strata (in D7-8 and A5-6) have a much lower proportion of cattle and a much higher proportion of ovicaprids.

Thus, while a lack of published pottery from D7-8 meant that our information was incomplete, conventional archaeological analysis suggested to us that occupation might not be continuous between the Troy III and IV of Blegen, and that up to six building phases from the three Korfmann areas might need to be inserted between them.

Statistical analysis of Blegen's and Schliemann's pottery

Statistical analysis of Blegen's pottery pointed in the same direction. Bernhard Weninger has for many years been exploring the use of statistics as a means of dating deposits relative to one another and as a supplement to radiocarbon dating. He has carried out an analysis of the entire corpus of Blegen's Bronze Age pottery to try to quantify how it develops over the two millennia *c.* 3000–1000 BC. For this he has used Correspondence Analysis (CA). CA takes groups of items, in this case of pottery, and arranges these groups in order of similarity. Weninger's CA seriation takes the pottery assemblages from every one of the individual deposits described in the four volumes of Blegen's final excavation report, and arranges all of them in a single spectrum which shows where each falls in the ceramic evolution of the site (*Weninger 2002; 2009*). Their order in this spectrum corresponds fairly well with the known stratigraphic and chronological order, showing that a deposit can usually be placed within the sequence with an accuracy of ± 1 building-phase. In 1992 we tested the method on two closely related trenches containing deposits of Early and Middle Troy VI, and found that the CA related them to one another almost exactly as the stratigraphy did (*Easton, Weninger 1993*).

The CA seriation of Blegen's pottery exhibits two gaps. One is between Troy I and Troy II. Weninger estimated that it was equivalent to a gap of 'at least three, perhaps even five, architectural phases' (*Weninger 2002.1043–1044*). Unknown to him at the time was the fact that Easton had postulated just such a gap (*Easton 1976.148, Fig. 1*) and that the intervening building-phases had actually been found in the excavations of 1998 (*Korfmann 1999.8–9*). This demonstrated that a statistical gap in the CA could represent a real, stratigraphic and chronological gap.

The second gap, only identified later, is between Troy III and Troy IV – again in Blegen's pottery sequence (*Weninger, Easton 2014.169–175, especially Fig. 8*). Weninger gave it an estimated length of 100–200 years. Clearly this corresponds well with the stratigraphic observation that allowance might have to be made for up to six additional building-phases between the two periods. So this statistical gap, too, looked as if it might indicate a real stratigraphic and chronological gap in the Blegen sequence (Fig. 1). The possibility that there might be gap at this point was raised a number of times during the new exca-

vations (*Korfmann 1996.23–24; Mansfeld 2001.162–3; Sazci 2005.63–64; 2007.123–124*) but has not been taken up in more recent publications (*Blum 2012.405, Fig. 143; Pernicka 2014.14*).

A different, but complementary, picture was suggested by Schliemann's pottery. Donald Easton had completed a detailed re-working of Schliemann's excavations of 1870–73 based on his unpublished notebooks (*Easton 2002*). He had been able to reconstruct where Schliemann was digging on any given date and (with some reservations) what he found there. He was able to suggest find-spots for over 3000 objects. This produced a somewhat revised pottery sequence. In 2013 we inserted this into the Blegen seriation to see how it compared. A number of pottery shapes showed a longer life in Schliemann than in Blegen, but otherwise there was broad agreement between the two – with the difference that in the Schliemann material a small number of excavation units appeared to bridge the gap between Blegen's Troy III and IV (*Easton, Weninger 2018.42–46, Fig. 3*). While some uncertainty obviously attaches to this, it nevertheless suggested further possible evidence of a transitional period.

Radiocarbon dating

From periods III–V the Blegen excavations have produced only one radiocarbon date, from a late phase of Troy IV: 3575 \pm 100 BP (T-168: *Warren, Hankey 1989.177, 181*). The large standard deviation means that it is of little use. By contrast the Tübingen excavations have produced 63 published radiocarbon dates from the same periods (*Easton, Weninger 2018.67–68, listed under 'Old Phasing'*). Practically all were measured on long-lived charcoal, and many have proved to be either from old wood or from material which must have been re-deposited in antiquity. But some have proved usable (*Easton, Weninger 2018.54–59, Figs. 4, 7*).

Based partly on the ^{14}C data and partly on external evidence, consensus has emerged around dates of *c.* 2170 cal BC for the end of Troy III, and *c.* 1750 cal BC for the end of Troy V/beginning of Troy VI (*Blum 2012.407; Pavúk 2014.403; 2020.69, Fig. 26; Pernicka 2014.14; Easton, Weninger 2014.Fig. 16; 2018.57*). Since Blegen originally dated the Troy V/VI transition to *c.* 1900 BC (*Blegen et al. 1951.229*), these new dates show a length of time between Troy III and Troy VI that is at least 130 years longer than Blegen at that time supposed. This means that, on the

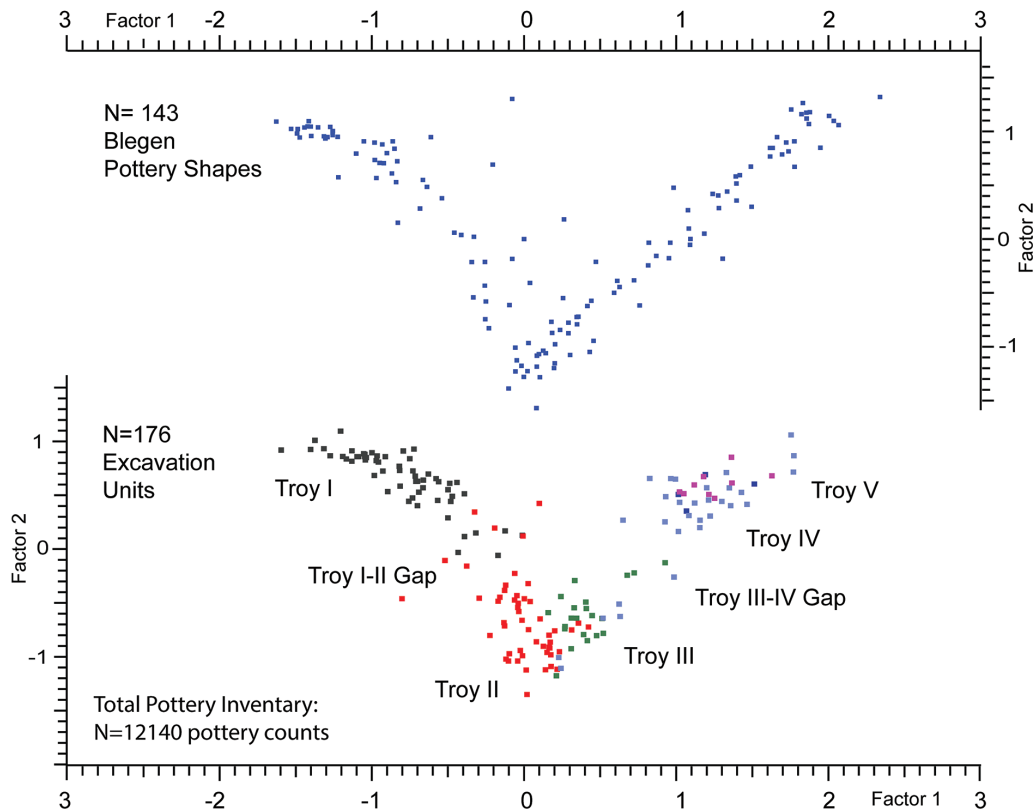


Fig. 1. Correspondence Analysis of pottery from Blegen's Troy I-V. In the lower graph each dot represents the pottery assemblage from a single deposit (as isolated in Blegen et al. 1950; 1951). The spread shows their relative positions in the ceramic evolution of the site judged according to their degree of similarity. The Troy periods are differentiated by colours: Troy I, black; Troy II, red; Troy III, green; Troy IV, blue; Troy V, mauve. A gap is apparent between the units of Troy I and Troy II, as well as between those of Troy III and Troy IV. The upper graph shows where in the stratigraphic sequence the statistical weight of each Blegen pottery shape lies.

conventional model in which the Blegen sequence III-IV-V is seen as continuous, the periods IV and V need to be stretched out. But if there is an additional period of perhaps six building-phases to be fitted in after Troy III this becomes unnecessary.

Our 2018 analysis indicated that the few reliable ^{14}C dates from the Korfmann excavations were consistent with there being a transitional period running from c. 2170 cal BC to c. 1990 cal BC (Easton, Weninger 2018:57–60). This, together with all the other indications, led us to propose the existence of a 'Proto-IV' period. In this scheme Troy IV and V then fell into the period c. 1990 to c. 1750 BC.

A re-dating of Troy IV to later than c. 1990 cal BC flies in the face of its widely accepted synchronism with the Early Helladic III period. We have argued, however, that the well known Trojan vase of Straw-Tempered Ware found in late Lerna IV can equally well be correlated with the Proto-IV period, and

that other supposed EH III synchronisms involving Pefkakia, Manika and elsewhere collapse if we take Schliemann's pottery into account and widen our sights to include parallels in southwest Anatolia (Easton, Weninger 2018:51–2).

The Proto-IV period, if it exists, will be synchronous with the 4.2ka cal BC climate event. It may be that, after the end of Troy III, the climatic deterioration caused occupation on the site to dwindle, leaving some areas temporarily uninhabited. These would include the areas where Blegen dug. But (we have suggested) occupation could have continued in other areas, some of which the Tübingen excavations happened to find (Easton, Weninger 2018:65).

Table 1 shows how our stratigraphic proposal relates to the periodisations of Schliemann and Blegen. Figures 2 and 3 show the strata in squares A5-6 and E4-5 which we have suggested may belong to Proto-IV. We know of no published profile of D7-8.

Summary

The position, then, is this. The pottery and, to some extent, the architecture of the deposits attributed in three areas of the Korfmann excavations to Troy IV suggest that these deposits may actually belong to a transitional period, 'Proto-IV,' that fits in between the Troy III and Troy IV of Blegen. This appears to be supported by the (admittedly rather thin) ¹⁴C evidence from the same (Korfmann) excavations. CA seriation of Blegen's pottery exhibits a gap between Troy III and Troy IV into which this Proto-IV period could perhaps fit.

What we have been lacking until now is a good suite of ¹⁴C dates from Blegen's excavations. This might decide the question whether or not a gap really exists. To rectify this we have turned to the plentiful animal bones from the Cincinnati excavations.

The faunal remains and their documentation

During the Blegen excavations of 1932–1938 samples of animal bones and shells were collected systematically 'from all strata in all areas of digging' and placed in large baskets or, when there were fewer, in wooden trays or small cloth bags. Each container was accompanied by a wooden label which showed "area, section, level, sequence number, date, notebook reference etc" (Blegen et al. 1950.17, 21). For the seasons of 1937 and 1938 Nils-Gustaf Gejvall joined the team and in each year made a selection of specimens for further stud.¹ After each season he published a short preliminary report (Gejvall 1937–1938; 1938–1939). After the 1937 season he also produced a typewritten list of the 5273 specimens he had selected (Gejvall 1937). He sent one copy to Cincinnati and retained another in Stockholm. From the 1938 season he produced no full list of the remaining 1452 specimens until 1947 (Gejvall 1947). That second typewritten list, of which a copy was again sent to Cincinnati, was less detailed than the first because at the time the relevant pieces were still in Istanbul (Blegen

SCHLIEMANN 1874	SCHLIEMANN 1880	DÖRPFELD 1902	BLEGEN	EASTON & WENINGER	cal BC
GAP	VI	VI	VI	VI	c. 1750
			V	V	
IV	V	V	IV	IV	c. 2170
			GAP	Proto-IV?	
III	IV	IV	III	III	
II	III	III	II	II	
Ib	II	II			
Ia	I	I	GAP	Transitional I-II	
			I	I	

Tab. 1. The proposed periodisation of Troy I-V in relation to previous schemes.

1947) and the list was compiled solely from previous documentation. In the interim Gejvall had, however, completed a limited study of the 1937 collection which investigated dogs, horses and cattle (Gejvall 1946). The typescript was circulated privately. He evidently intended to continue work on the Troy collection (Gejvall 1951) but it seems that the duties of his position at the State Historical Museum prevented him from doing so. Nothing more was published or circulated.

The collection, which includes Gejvall's selections from both 1937 and 1938, was stored initially in the Museum of Natural History in Stockholm (Gejvall 1938–1939.2), and subsequently in the Museum of Mediterranean and Near Eastern Antiquities. In 2019 it was moved to the Osteoarchaeological Research Laboratory of Stockholm University where it has been re-organized and catalogued with the help of Gejvall's original documentation which is also preserved.

Gejvall was quite selective in his choice of specimens. For the more common domestic species he general-

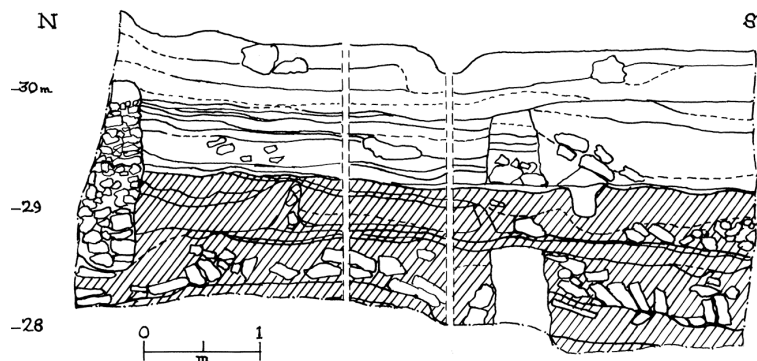


Fig. 2. East profile of the trench A5-6. Shading shows the strata which may belong to the Proto-IV period. Adapted from Blum 2014. Part II: Taf. 57.

¹ For more information about Gejvall see Laszlo Bartosiewicz (2020.13–15).

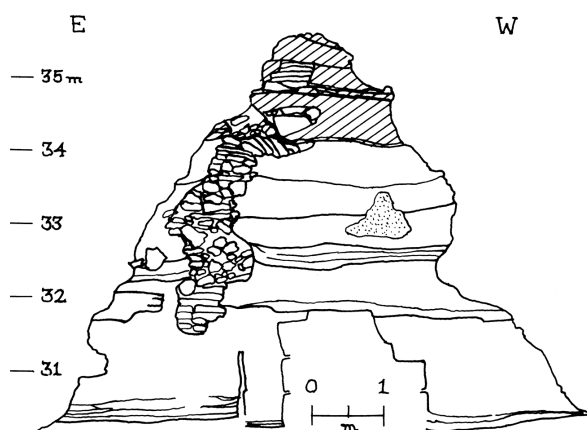


Fig. 3. South profile of the pinnacle E4-5. Shading shows the strata which may belong to the Proto-IV period. Adapted from Frirdich 1997.198, Taf. 0.

ly retained only the jaws, horns, antlers and metapodials. From the less common species he kept more elements. Most bones he labelled individually in ink, using an alphabetic prefix to show the Troy period (I-IX) to which it belonged – A to J in 1937, M to Y in 1938 – followed by a serial number. Some bones he left unlabelled but stored in groups together with their original wooden labels.

To make a broad, preliminary selection of samples for ^{14}C -AMS analysis we used the Cincinnati copy of Gejvall's 1937 list, an example of which is shown in Figure 4. The list is arranged by period (Troy I-IX), subdivided by archaeological context. The description of each context normally notes the square, the area, sometimes a subdivision of the area, the depths from

Fig. 4. A page from Gejvall's 1937 list of bones. The bones are presently stored at the Osteoarchaeological Research Laboratory of Stockholm University. (Department of Classics, the University of Cincinnati).

the local datum, and sometimes a reference to an excavation notebook or pottery notebook. Probably these descriptions were taken originally from the excavators' wooden labels. The numbered bones from each context are grouped together by species with a brief note of the anatomical elements represented. The Cincinnati list, preserved in the Troy Archive of the Department of Classics, has the great advantage that it has been annotated by Marion Rawson (in red) and Carl Blegen (in pencil). Their annotations show the period, phase and sometimes area to which they finally assigned each context. The resulting allocations correspond to those published in the final Troy report, and have the same nomenclature – such as 'Room 300' and 'Street 309.' This mostly makes it very easy to place individual specimens within the archaeological sequence as Blegen finally understood it. We have been able to supplement the published information by referring to the unpublished excavation notebooks, also in the Cincinnati Troy Archive and now available online (see Appendix).

The selection of samples

For the new analysis 26 bone samples were selected first by context and then by physical suitability. Our object was to obtain samples from all phases of Troy III, IV and V, but the 1937 list included no specimens from Troy IVe or Vd so these phases had to be omitted. We did, however, include one sample from Troy VIa. For periods IIIa to Va we chose specimens from the well stratified sequence in square E6; for periods Vb to VIa we used specimens from squares G8 and F8-9 (Fig. 5). The selected samples were taken for analysis to the Tandem Laboratory, Uppsala University. Details of the samples and their contexts are given in Table 2, in which the new Uppsala ^{14}C -ages (Lab Code: Ua) are shown together with the available Tübingen samples (Lab Codes: (mainly) Heidelberg Hd; also Groningen (N=3) GrA). Additional details are given in the Catalogue of Samples (below).

Table 2 provides for each ^{14}C -age all information that is relevant to the following chronological analyses, in which the samples are referred to either by their Lab-Code (e.g., Ua-69599) in combination with the ^{14}C -age (Ua-69599: 3393±29

BP), or by the unique sample ID number as given in the first column. The use of ID-numbers (ID-1 to ID-40) for sample identification is to assist in finding the dates both in Table 2 and in the age-model graphs (Figs. 7 and 8). The ^{14}C -ages we have identified as outliers are shown in a separate table, with the main reason for exclusion given in its own column (Tab. 3). A further discussion of the stratigraphic properties of these outliers is given below in the section Old Bone. The nomenclature of the two tables is otherwise similar.

Next to the Lab Code and conventional ^{14}C -age, the tables include information as to the dated material. In most cases this is short-lived animal bone, but in some instances human bone (here: from burials), seed/fruit or twigs. There is also a small number ($N=6$) of ^{14}C -ages on charcoal samples that were previously shown to be derived from short-lived and phase-contemporaneous (*i.e.* not re-deposited) wood-charcoal (Easton, Weninger 2018.54–59). To avoid transfer of analytical ‘memory-errors’ from these previous studies to the present one we have carefully repeated all the new analyses, by running all models both with and without these specific ^{14}C -ages. Since effectively identical results were achieved in practically all cases, there is no need to discuss all of the many different models that we have tested.

Following the Material column, both tables (Tabs. 2 and 3) provide further information for each sample

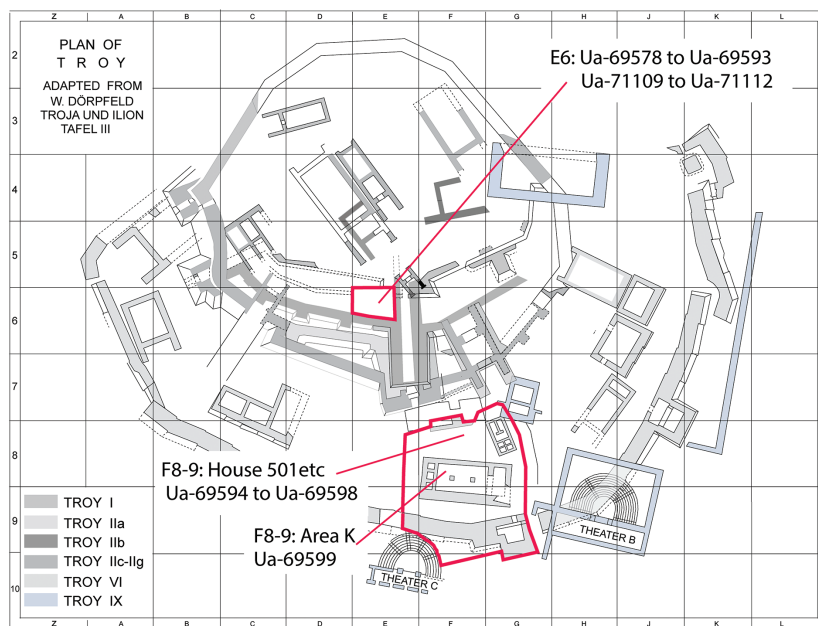


Fig. 5. Plan of Bronze Age Troy showing the areas from which the samples derive. Only a selection of architectural features is shown. Adapted from Blegen et al. 1950.Fig. 147.

as to the excavation square (Area) and *Behälter* (Beh) number as well as the assigned phase/period. For sake of completeness, the single-sample specific calibrated ^{14}C -ages are provided in the CalAge column, with abbreviated (short-hand) cal-scale dating errors noted as shortest 68%-intervals that can be calculated for the often complex-shaped (multimodal) calibrated age distributions. In ^{14}C -age calibration we applied the calibration curve Intcal20 (Reimer et al. 2020) in combination with CalPal-software (Version 2022.4).

Preliminary evaluation and modelling

Of the 26 new Uppsala samples, 11 yielded ^{14}C -dates that, on any accepted chronology, are too early for the contexts in which they were found (Tab. 3). These seem to replicate in bone the well-documented ‘old wood’ problem at Troy (Manning 1995.28; 1997; Kromer et al. 2003; Weninger, Easton 2014.166–168; Easton, Weninger 2018.54–55) and suggest that there was frequent re-deposition of soil from older layers (see further Old Bone, below). One, from IIIc, is much too young. At this stage, therefore, we eliminated the 12 samples concerned from further consideration.

Initial, exploratory age-modelling using single-age calibration, both with and without the set of previously accepted 23 Hd- and 3 GrA-measurements (Tab. 2), showed only a poor fit with the outline chronology proposed by the Tübingen team (with the Troy III-IV transition at *c.* 2200/2150 cal BC). The new Troy IV dates exhibited considerable overlap with those from the deposits assigned to Troy IV in the Tübingen excavations, but it was nevertheless apparent that they represented a slightly later period. Comparison of the two sets of dates by means of a dispersion diagram demonstrates the point (Fig. 6), and the result remains almost the same even if the two samples from squares A5-6, which are less certainly of the same period, are excluded. But there was an equally poor fit with the modelled scheme which we had proposed in 2018 (with a gap after Troy III, and with Troy IV beginning *c.* 1990

cal BC). There appeared to be a good fit, however, with a modified version of our 2018 scheme in which the gap (or Proto-IV period) was shortened and the beginning of Troy IV was placed *c.* 2050 cal BC.

For further, more precise modelling we used the Intcal20 calibration curve and CalPal software (version 2020.4) which has recently been expanded (Doumet-Serhal *et al.* 2022) to allow the graphic presentation of our Gaussian Wiggle Matching (GaussWM) results in context together with Intcal20 raw data (Fig. 7).

The method of Gaussian Monte Carlo Wiggle Matching (GaussWM)

Gaussian Monte Carlo Wiggle Matching (GaussWM) is described in a number of recent publications: Weninger (1986); more recently, Barbara Horejs *et al.* (2012), Weninger *et al.* (2018); Stefanos Gimatzidis and Bernhard Weninger (2020); Claude Doumet-Serhal *et al.* (2022). To remind the reader briefly how the process works: a set of ^{14}C dates is entered into the computer programme along with their known or

ID	Lab Nr	^{14}C -Age [BP $\pm 1\sigma$]	Material	Period and phase	Area / beh	CalAge [calBC $\pm 68\%$]	Reference
1	Ua-69599	3393 \pm 29	bone	V1a	F976, T4.6	1680 \pm 50	This work
2	GrA-nd 2	3532 \pm 29	human bone	V1a	A7.1474	1850 \pm 60	Pavuk 2014
3	GrA-nd 1	3473 \pm 32	human bone	V1a	A7.1335	1800 \pm 60	Pavuk 2014
4	GrA-24678	3520 \pm 50	human bone	LV / EVI	A7.1026-1	1840 \pm 70	Pavuk 2014; 2020
5	Hd-16682	3491 \pm 16	wood	V?	D20.471	1810 \pm 40	Easton, Weninger 2018
6	Ua-69593	3494 \pm 29	bone	Va	E9, T6.5	1810 \pm 50	This work
7	Hd-22226	3516 \pm 37	charcoal	V	x7.357	1830 \pm 60	Easton, Weninger 2018
8	Hd-16508	3520 \pm 36	wood	V?	D20.473	1840 \pm 60	Easton, Weninger 2018
9	Hd-23653	3529 \pm 23	charcoal	V?	A7.1399	1840 \pm 60	Easton, Weninger 2018
10	Hd-22538	3559 \pm 30	charcoal	V	x7.368	1890 \pm 60	Easton, Weninger 2018
11	Ua-69598	3598 \pm 28	bone	Va	E253, T4.5	1960 \pm 50	This work
12	Hd-18913	3575 \pm 34	seed/fruit	LIV / V	K8.727	1930 \pm 50	Pavuk 2020
13	Hd-14440	3594 \pm 32	seed/fruit	LIV / V	K8.367	1950 \pm 50	Pavuk 2020
14	Hd-29191	3624 \pm 25	human bone	IV?	HI 25/26.153	1980 \pm 40	Easton, Weninger 2018
15	Hd-28866	3557 \pm 24	human bone	IV?	HI 25/26.153	1900 \pm 40	Easton, Weninger 2018
16	Hd-29190	3599 \pm 24	human bone	IV?	HI 25/26.153	1960 \pm 40	Easton, Weninger 2018
17	Ua-69586	3730 \pm 30	bone	IVd	D71, T29.41	2120 \pm 60	This work
18	Ua-71110	3635 \pm 33	bone	IVc	D138, T18.12	2010 \pm 60	This work
19	Ua-71109	3701 \pm 33	bone	IVa	D125, T1.4	2090 \pm 50	This work
20	Ua-71112	3772 \pm 33	bone	IVa	D382, T18.27	2200 \pm 60	This work
21	Ua-69592	3798 \pm 30	bone	IVa	D340, T8.9	2230 \pm 60	This work
22	Ua-69589	3716 \pm 30	bone	IVa	D124, T1.4	2110 \pm 60	This work
23	Hd-16831	3767 \pm 53	twig	Proto-IVf	D8.832	2180 \pm 90	Easton, Weninger 2018
24	Hd-23695	3663 \pm 20	charcoal	Proto-IVd-g	A5/6.777	2050 \pm 60	Easton, Weninger 2018
25	Hd-17859	3783 \pm 30	seed/fruit	Proto-IVd	D8.1206	2210 \pm 60	Easton, Weninger 2018
26	Hd-23779	3769 \pm 37	charcoal	Proto-IVc	A5/6.921	2190 \pm 70	Easton, Weninger 2018
27	Hd-17706	3713 \pm 44	plant remains	Proto-IVc	D8.1768	2110 \pm 70	Easton, Weninger 2018
28	Hd-19853	3718 \pm 22	twig	III d	G6.217	2110 \pm 60	Easton, Weninger 2018
29	Hd-15266	3797 \pm 31	twig	III d	E4/5.112	2220 \pm 60	Weninger, Easton 2014
30	Hd-15268	3830 \pm 38	twig	III d	E4/5.112	2290 \pm 80	Weninger, Easton 2014
31	Hd-15267	3751 \pm 25	charcoal	III d	E4/5.178	2140 \pm 60	Weninger, Easton 2014
32	Ua-69581	3857 \pm 31	bone	III c	C181, T3.5	2330 \pm 80	This work
33	Ua-69582	3847 \pm 32	bone	III b	C584, T18.11	2320 \pm 80	This work
34	Hd-15407	3847 \pm 41	twig	III b	E4/5.162	2320 \pm 90	Weninger, Easton 2014
35	Ua-69583	3855 \pm 31	bone	III b	C666, T3.5	2330 \pm 80	This work
36	Ua-69584	3830 \pm 29	bone	III a	C786, T6.3	2280 \pm 70	This work
37	Ua-69585	3764 \pm 29	bone	III a	C847, T18.26	2190 \pm 60	This work
38	Hd-20174	3795 \pm 19	seed/fruit	IIg?	G6.1056	2220 \pm 50	Easton, Weninger 2018
39	Hd-20039	3834 \pm 55	twig	IIg?	G6.558	2300 \pm 100	Easton, Weninger 2018
40	Hd-20414	3860 \pm 40	seed/fruit	IIg?	G6.1054	2330 \pm 80	Easton, Weninger 2018

Tab. 2. ^{14}C -ages used in chronological analysis and age-modelling.

assumed stratigraphic sequence. During computer run-time this fixed sequence of dates is expanded step by step along the calendric timescale. At each step the programme calculates the best fit of the data to the calibration curve, displays the model in real time on the screen, and records the statistical variables. At the end of the run the programme carries out a numeric optimisation of all the variables recorded, and decides on the model that shows the best overall fit between the data-set and the calibration curve.

In mathematical terms the approach is to minimize the statistical distance (on both scales: ^{14}C -scale and calendric) between the sequenced archaeological data and the calibration curve. This optimisation is formally based on a χ^2 test, but there are additional criteria which are adapted to the (not yet widely recognised) fact that the process of ^{14}C -age calibration can fundamentally be best described as a Fourier Transform (Weninger, Edinborough 2020;

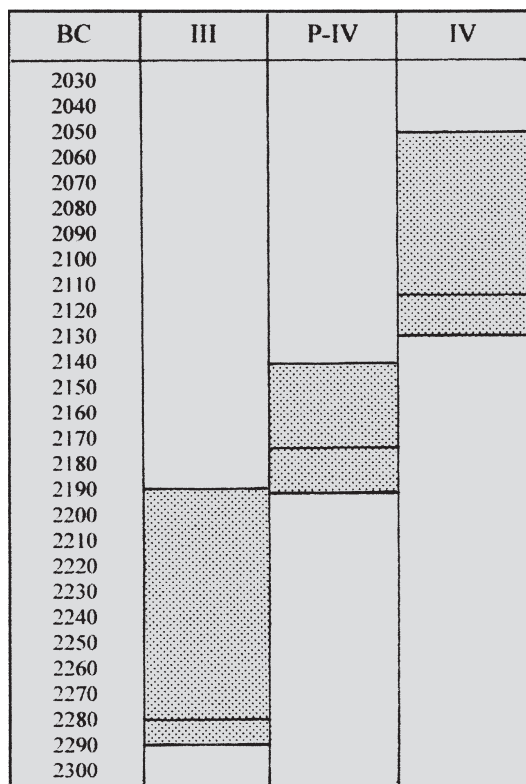


Fig. 6. Dispersion diagram comparing ^{14}C dates from Troy III, the possible Proto-IV period and Troy IV. Only the inner quartiles, as defined by Barbara Ottaway (1973), are shown. (Historically the dispersion calibration method of Ottaway (1973) was the very first procedure that supported graphic display of calibrated sets. We know today that it does not provide the calibrated dates with correct weights.)

Doumet-Serhal et al. 2022). This explains, from the theoretical perspective of quantum theory, practically all observed statistical properties of conventional and calibrated ^{14}C -ages, in particular the often observable (and clearly artificial) clustering, age-shifting, and amplitude-distortion of the dates, that are so typically correlated on both ^{14}C -scale and calendric scales.

The CalPal programme has another characteristic which it is important to understand. Typically it is the case that within a single archaeological phase the true chronological (calendric) order of the samples is unknown. So in CalPal a random number generator is used to vary the positions of the samples *within* the phases to which they have been assigned. The main purpose of this 'Monte-Carlo' re-positioning of samples is to establish quantitatively within each model what are the output errors for each sample position.

Once the entire run (which typically takes a few hours) is completed the optimised chronology is stored to file. The resulting chronology can then be adjusted if numerical refinement or visual improvement is needed. This is achieved in a separate CalPal dialogue (as shown in Weninger et al. 2018.ebda, Fig. 3). This separate dialogue supports, in particular, the largely automated ^{14}C -offset analysis for all laboratories participating in the archaeological study, as well as in calibration curve construction. The new offset-methodology is described in Doumet-Serhal et al. (2022).

Beyond such technical details, perhaps the most urgent need in current Aegean and Near Eastern scientific dating procedures is for a more generalised comparison of the different available statistical packages. There was an initial software-comparison paper by T. C. Aitchison et al. (1989), but very few software/calibration comparisons have been formally published since then. So far as (elementary) single ^{14}C -age calibration is concerned, a comparatively large variety of systematically applied comparisons of the CalPal-algorithms with other calibration software can be found in the CalPal-repository at CERN (doi.10.5281/zenodo.7422618). The 'inter-software' comparison file also contains a detailed historical documentation of the changes in dating that result from the calibration curve updates in the years 2005–2020.

Direct (and more complex) comparisons of the modelling results achieved by application of GaussWM

Lab Nr	¹⁴ C-Age [BP ± 1σ]	Material	Period and phase	Area/container	CalAge [cal BC ± 68%]	Reason for exclusion
Ua-69596	3765 ± 29	bone	Vc	E107, T6.5	2190 ± 60	too old, residual
Ua-69597	3782 ± 29	bone	Vc	E134, T20.5	2210 ± 60	too old, residual
Ua-69594	3746 ± 29	bone	Vb	E45, T11.12	2140 ± 60	too old, residual
Ua-69595	3849 ± 29	bone	Vb	E62, T20.5	2320 ± 80	too old, residual
Ua-69587	3817 ± 33	bone	IVc	D108, T20.4	2260 ± 60	too old, residual
Ua-69588	3827 ± 29	bone	IVc	D111, T1.4	2280 ± 60	too old, residual
Ua-69590	3848 ± 30	bone	IVb	D147, T1.4	2320 ± 80	too old, residual
Ua-71111	3820 ± 32	bone	IVb	D146, T1.4	2270 ± 60	too old, residual
Ua-69591	3971 ± 30	bone	IVb	D148, T4.4	2500 ± 50	too old, residual
Ua-69578	3944 ± 42	bone	III d	C11, T20.3	2440 ± 80	too old, residual
Ua-69579	4048 ± 34	bone	III d	C35, T3.5	2570 ± 60	too old, residual
Ua-69580	3620 ± 34	bone	III c	C135, T18.26	1980 ± 50	too young

Tab. 3. List of outliers excluded from age-modelling.

(CalPal) and of Bayesian Sequencing (OxCal) for the same archaeological data (and effectively the same models) can be found in the recently published papers by Gimatzidis and Weninger (2020) (for the Early Iron Age at Sindos/Greece), by Marion Benz *et al.* (2012) (for the Early Neolithic at Körtik Tepe/Turkey), and by Doumet-Serhal *et al.* (2022) (for Late Bronze and Early Iron levels at the sites of Tel Tayinat/Turkey, Meggido/Israel, and Tel Rehov/Israel). These are, to our knowledge, the only published comparisons of modelling results that have been achieved using the same data and archaeological models, but with two entirely different software packages.

Taking all these results together, to us it appears that for contemporary ¹⁴C-studies it is *possible* to achieve statistically identical chronological results, independently of the applied software or statistical approach (Bayesian or Fourier Transform) method, but only on the error-level of some few decades on the calendric time-scale. Presumably this will also apply to the present results.

The database

In our ¹⁴C database (Tab. 2) we included (a) the 14 new Ua-samples from Blegen's animal bones considered to be reliable; also (b) from the published Tübingen ¹⁴C dates all short-lived samples (from grain, plant remains, twigs *etc.*), which are securely placed stratigraphically and have standard deviations of less than ±51 BP, and which are not obviously too old or too young for their contexts; (c) also from the published Tübingen material, seven samples all probably from Troy IV or Troy V but which cannot be assigned to a definite period with certainty (nos. 5, 8, 12–16 in our database; see Table 2). These were

included partly to help the modelling programme in areas where there were few other dates, and partly to see what periods the programme would place them in. The programme was run both with and without these seven samples with no significant difference to the result.

The results

Our results are shown in Figures 7 and 8. Modelling details are given in the respective figure captions. Troy III begins 2267±10 cal BC. This is later than the date proposed in the Tübingen scheme (*c.* 2340 cal BC). It has the advantage, in age-modelling, that more time is available for the numerous preceding building-phases of Troy II (probably 11 or 12: *Easton 2002.307–308, Figs. 196–198; Ünlüsöy 2010*). The period ends 2170±10 cal BC, as already proposed (*Easton, Weninger 2018.Figs. 7, 8*), and this date is entirely compatible with Tübingen's (*Blum 2012.Fig. 143; Pernicka 2014.14*).

It is interesting to note how the immediately following ¹⁴C-ages, from periods Proto-IV and Blegen IV, follow the calibration curve, and in particular its two strong wiggles at *c.* 2150 cal BC and 2050 cal BC (Fig. 7). The dates from the hypothetical Proto-IV period and also the many (N=6) new Ua-dates from Blegen IV all fit well into the general sequence at this point. Decisive are the new ¹⁴C-ages on samples 17–22 (from Blegen's IV), in combination with the previous Hd-measurements in samples 23–28 (from Proto-IV). Both data groups are clearly differentiated from the preceding Troy III dates, derive from different excavations (Korfmann and Blegen) and were independently measured by two laboratories (Hd and Ua). The combined data bring the end of

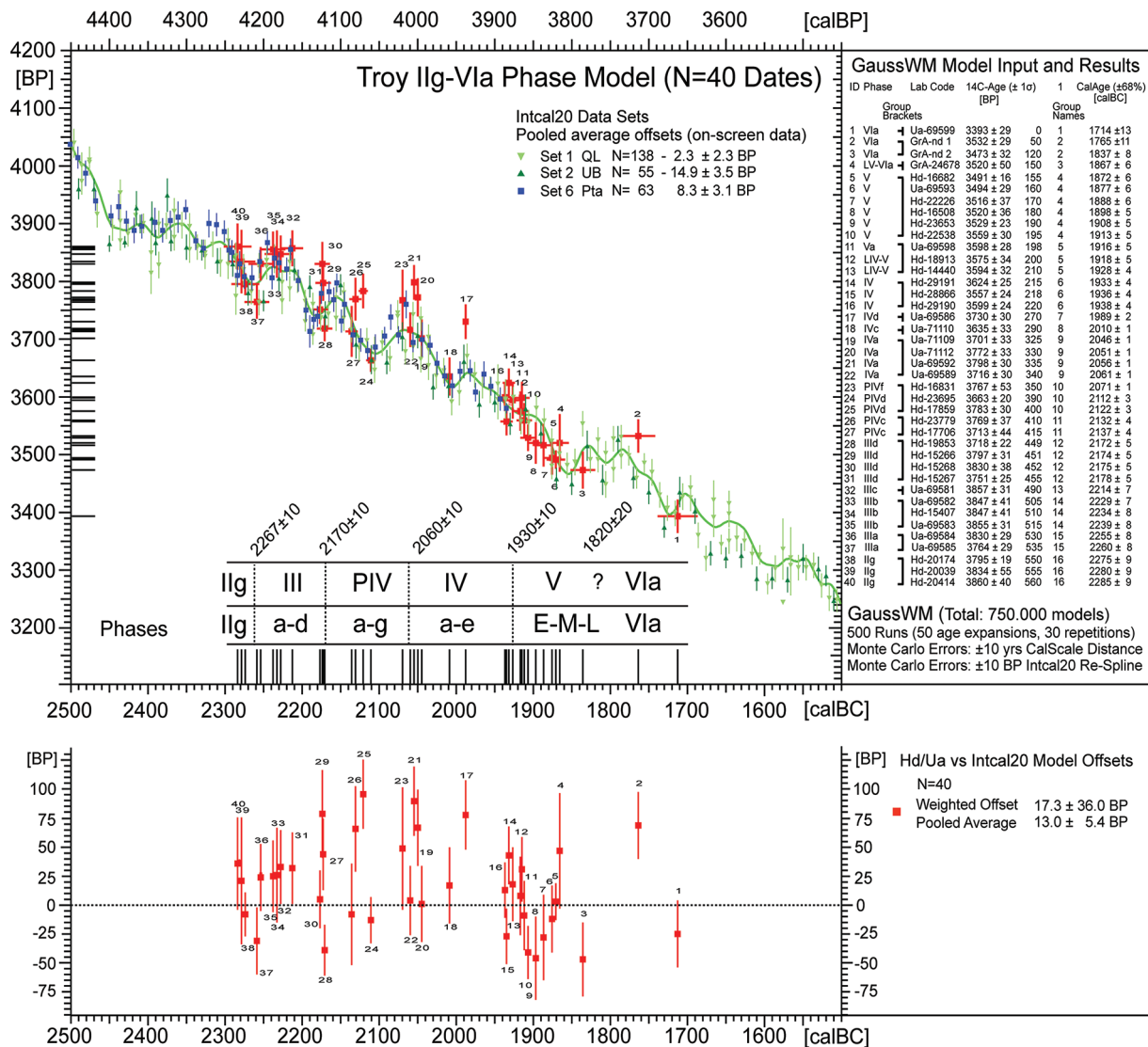


Fig. 7. Archaeological age model for Troy (periods/phases IIg-VIa), based on N=40 ¹⁴C-dates (Data: Table 2, with outliers removed).

Data list (upper right): GaussWM model input and results. The ¹⁴C-ages are arranged in stratigraphic order, with samples assigned to architectural phases and application of phase-internal randomisation (by grouping) of samples that are stratigraphically indistinguishable (cf. group brackets). The applied equal phase-length GaussWM modelling is based on 500 runs (run-time 12 hrs) with modelling errors of ±10 yrs applied to Monte Carlo sample re-positioning, and Monte Carlo errors of ±10 BP applied to the raw-data used in Intcal20 re-splining. Otherwise of interest in terms of the (quite exceptional) modelling stability indicated by this, all listed (calculated) GaussWM model errors with values smaller than ±10 yrs (68%) are deemed unrealistic.

Central graph: Due to the applied group-wise sample-order randomisation, the specific ('optimal') sample-sequence shown in the central graph represents only one of many (altogether: 750 000) tested sample-sequences. Statistical fitting of the data to the IntCal20 calcurve is based on a non-central chi-squared metric with non-centrality parameter λ=10.

Lower graph: Calculated model-offsets between the data and IntCal20, as shown with sample-specific ID-numbering, indicate that the statistical spread of the modelled ¹⁴C-ages is predominantly due to random processes. This applies both in terms of (calendric-scale) sampling 'noise' as well as for noted ¹⁴C-errors. The spread of modelled ¹⁴C-ages around the calibration curve for strong 'down'-wiggles (at c. 2260/2170/2110 cal BC) and strong 'up'-wiggles (at c. 2220/2150/2070 cal BC) can be seen at higher graphic resolution in Fig. 8.

the Proto-IV period to 2060 ± 10 cal BC. Overall the result suggests a duration of 110 ± 20 years for this period, if it exists (see The Proto-IV Hypothesis below for further comment). Blegen's Troy IVa falls at 2060 ± 10 cal BC if samples 19 and 22 may be taken as determinative. Samples with ID 20 and 21 perhaps represent old bone re-deposited. No. 18 places Troy IVc at 2010 ± 10 cal BC, after which two further phases (d, e) must be allowed for, bringing the end of Troy IV to 1930 ± 10 cal BC or later. The one previous sample from Blegen's Troy IV, T-168, has a central value of 3575 BP, *c.* 1950 cal BC, which fits well with this result. Two grain samples from square K8, Nos 12 and 13, fit well into the resulting Late IV, as previously suggested (*Easton, Weninger 2018.56–57*, and *online supplement 8–9*), although by both context and date they might almost as well be assigned to Troy V (*Pavúk 2014.390–392*).

The age-modelling results for Troy V and VIa are less clear. For the optimisation process samples with ID nos 5–10 have all been treated as belonging to the same phase, with unknown phase-internal order. Ultimately all but No. 6 are of uncertain phase, and Nos. 5, 8, 9 are not even certainly from Troy V. But the model has placed No. 6, which is certainly from Troy Va, latest in this group at 1877 ± 10 cal BC.² When considering the seemingly precise position of all samples as shown in Figures 7 and 8, it should be borne in mind that the ordering of samples within a single phase is entirely random. The same group could arguably belong in the region 1877–1830 cal BC, with the internal order reversed. The only other sample certainly from Troy Va is No. 11, placed at 1916 ± 5 cal BC, but this could again be old bone re-deposited. For the initial date of Troy V, therefore, we can only say that it lies in the region 1916–1877 cal BC.

The uncertainties are even greater when we turn to Troy VIa. This is partly due to the very small number of short-lived samples (only three),³ and partly to the plateau in this area of the calibration curve. Sample No. 1 is from a very late stage within phase VIa and may even come from debris levelled off after its destruction. It yields a modelled date of 1714 ± 13 cal BC which is consistent with Pavúk's proposal for the end of his Ceramic phase 1, *c.* 1720 cal BC (*Pavúk 2020.69*). For the beginning of VIa the model

suggests a date of 1820 ± 20 cal BC. But the model position assigned to sample 3 may be affected by the lack of samples from Troy Vb and c, in which case there are potentially more exact dates for VIa. A date of 1780/1750 cal BC, as proposed by Pavúk (*Pavúk 2014.394–396, 404*), is perhaps as likely as our modelled date, if not more so, but depends to a large extent on external synchronisms. We have allowed for this in the scale of phases at the bottom of Figure 7. Thus our model for Troy VIa is far from final.

Overall the model exhibits a good fit both with the Intcal20 curve and with much of the raw data on which it is based (see Figure 7 upper), and appears to provide inter-laboratory offsets with similar range (see Figure 7 lower). It confirms the existence of a gap between Blegen's Troy III and IV, but of slightly shorter duration (110 ± 20 years) than was originally proposed (150 ± 20 years).

The Proto-IV hypothesis

In our previous article we did not assert that a Proto-IV period definitely exists. We proposed it as a hypothesis, provisional in that it is in part based on incomplete data from preliminary reports and is subject to alteration or invalidation by further work (*Easton, Weninger 2018.37, 66* and *online supplement: 1*). The final Tübingen report covering this period of the site's history is not yet published, and it is to be expected that, in this complex site, mature consideration and additional data may reveal new correlations between excavated areas and possibly some new phasing of deposits.

The Proto-IV hypothesis is not directly confirmed by the new samples since none come from the deposits which might be assigned to it. But when they are set alongside the dates from the Tübingen samples a suggestive picture emerges. Given some of the late dates for Blegen's Troy IVa (samples 19, 22) and IVc (sample 18), it would be difficult to regard these deposits as contemporary with those assigned to Proto-IV. The dispersion diagram (Fig. 6) supports this view. Thus, based on the data we presently have, the Proto-IV hypothesis looks plausible although the period would be slightly shorter than we originally suggested.

² Note that, as the Monte Carlo modelling error has a potentially over-precise value of ± 6 years, we have rounded all such values up to minimum error of ± 10 years.

³ No. 4, from a burial associated with a jug of probable MMIIb or IIIa date, may belong equally well in Late V or Early VI; *Pavúk 2007.305–306; 2014.371–374; 2020.63–66; Easton, Weninger 2018.57*.

Old bone

As noted above, practically all the ^{14}C -ages that we have identified as outliers (Tab. 3) must be considered too old for the contexts in which they were found. This to some extent replicates the situation with charcoal samples, although in the latter case there are other factors to be allowed for, such as the use of inner rings and the re-use of old timber. In short, the site shows evidence of frequent re-deposition of

old material. Animal-bones, being from short-lived organisms, provide the more certain indication of this, but the available data from Troy show that bones and charcoal are similarly affected (both in number and stratigraphic depth).

In Troy III-V Blegen recorded many cases where successive floors were separated by deposits of earth mixed with sherds, shells, bones and other materials.

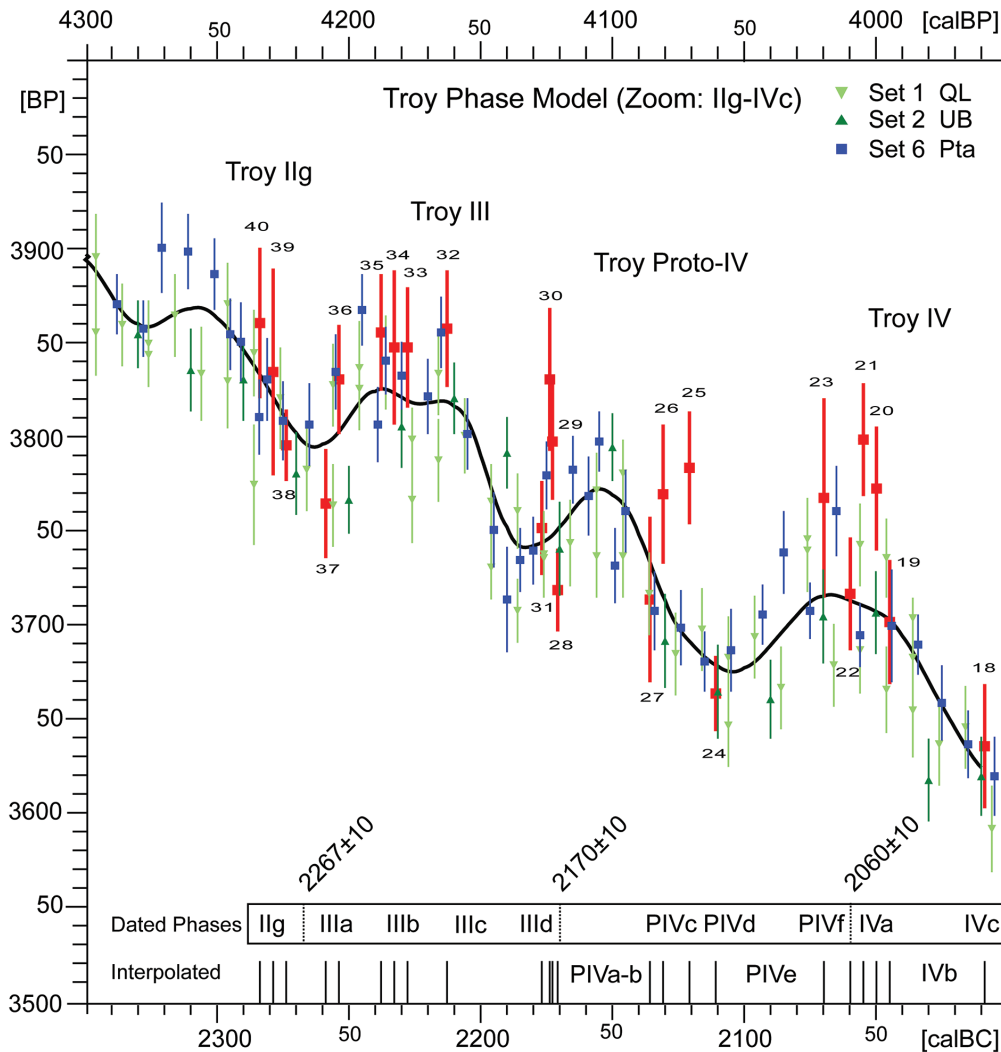


Fig. 8. Graph identical to Figure 7, but now at higher graphic resolution to facilitate visual quality comparisons for archaeological modelling and Intcal20 calibration curve construction. The graph shows the modelled dates for periods/phases Troy II(g), Troy III (abcd), Troy Proto-IV (abcdef), and Troy IV (abc), with (directly ^{14}C) dated and (only) interpolated architectural phases as indicated in the chronology scheme. The model-derived calendric ages for the transitions Troy II to III (at 2267 ± 10 cal BC), Troy III to Proto-IV (at 2170 ± 10 cal BC), and Troy Proto-IV to IV (at 2060 ± 10 cal BC) are indicated by age-interpolated dashed lines and given values (with assigned 68%-errors). We observe generally good agreement between all dates in the archaeological sequence and the Intcal20 calibration curve, as well as generally good agreement between the laboratory raw-data (SET 1: Queens's Lab (QL); SET 2: University Belfast (UB); and SET 3: Pretoria (Pta), used in Intcal20-construction (Reimer et al. 2020). The observed high conformity between the many different data sets (i.e. the archaeological ^{14}C -ages, the sample phase assignments, the Intcal20-calibration curve, the inter-laboratory data sets) provides some striking new evidence and verification for the existence of a gap between Blegen's Troy III and IV and hence also for the possible existence of Proto-IV.

He explained these deposits as rubbish accumulated during the course of habitation (*e.g.*, Blegen *et al.* 1951.5, 37, 57, 60, 65–68, 90, 158, 214, 216, 255, 273, 276, 284, Figs. 4, 202). But the presence in them of evidently re-deposited animal bones suggests that, in some instances at least, they are perhaps to be explained as bedding deliberately laid down before the installation of a new floor or indeed of a new building. It appears that earth was taken from abandoned areas of the site without removing the sherds, shells, bones or charcoal left by earlier occupants, and would then be spread over an old floor in a layer several centimetres thick. The available ¹⁴C dates show a pattern in this activity. In Troy III the inhabitants mostly used deposits from Late Troy I and Early Troy II. In Proto-IV (if it exists) and IV they drew on deposits of Late Troy II and Early Troy III. In Troy V it was deposits from Troy III and (Proto-)IV that they mostly used.

When carrying out such an operation the ancient Trojans would presumably have removed inconveniently large objects such as whole pots or antlers. But, if this explanation of the many re-deposited samples in the Troy ¹⁴C database is correct or partially correct, then it must set a question-mark against statistical studies – whether of pottery, faunal or botanical remains – which include smaller items from such deposits. Whether there was frequent re-deposition upwards, or even frequent intrusion downwards, the

Blegen deposits nevertheless clearly exhibit a clear statistical gap between periods III and IV. And when it comes to dating, the importance of the normal archaeological rule must be underlined: that only the latest dateable item can be relied upon.

Conclusions

The ¹⁴C-testing of 26 samples of animal bone from Blegen's Troy excavations appears to confirm the existence of a gap between his Troy III and Troy IV periods. The gap has an approximate length of 110 years. This is slightly shorter than the 150 years previously suggested but, with two-sided dating errors in the order of ± 10 years (minimum), the difference has no crucial statistical relevance. The hypothesis that the III/IV gap, observable in the Blegen-CA, was bridged by a Proto-IV period (unknown to Blegen but attested in the new excavations) is not directly confirmed but is, we propose, quite consistent with the newly acquired ¹⁴C-ages.

The new ¹⁴C-ages supply additional evidence for the extensive re-deposition of materials in antiquity. The inhabitants seem frequently to have used earth from abandoned parts of the site when laying the bedding for new floors and new structures. This must induce caution when including items from such deposits in statistical or other studies.

Acknowledgements

For the generous funding which made this research possible we are very grateful to the Richard C. MacDonald Iliad Endowment of the Archaeological Institute of America and to the Gerald Averay Wainwright Fund of the University of Oxford, both of whose trustees very kindly also agreed to an alteration of plans caused by the coronavirus pandemic. Permission to take samples from the Troy collection of animal bones was most kindly granted by the Department of Classics, the University of Cincinnati, who also gave permission to reproduce the page from Gejvall's 1937 list of bones shown in Figure 4. Dr Jeffrey L. Kramer, the archivist, was especially helpful in supplying copies of many excavation notebooks from the Troy archive in Cincinnati. Professor Jan Storå, who has re-housed and re-ordered the large collection of Troy animal bones in the Osteoarchaeological Research Laboratory of the Department of Archaeology and Classical Studies, Stockholm University, gave us valuable information on Gejvall's documentation and in the pandemic himself went out of his way to take on the physical selection and sampling of specimens and their delivery to the laboratory. He has also given helpful comments on this paper. He has earned our deepest thanks. Our thanks also go to the staff of the Tandem Laboratory, Uppsala University, and especially to Karl Håkansson and Lars Beckel. We are grateful, too, to Dr Stephan Blum and Professor Ernst Pernicka for their comments. They should not be held responsible for the views expressed here. We should also like to thank our anonymous reviewers for their comments and suggestions which we found very helpful.

References

- Aitchison T. C., Leese M., Mook W. G., +9 authors, and Weninger B. 1989. Comparison of Methods used for the Calibration of Radiocarbon Dates. *Radiocarbon* 31(3): 846–864. <https://doi.org/10.1017/S0033822200012479>
- Bartosiewicz L. 2020. Bones of contention: reflections on osteoarchaeology and the Baltic region. *Archaeologia Lituana* 21: 11–26. <https://doi.org/10.15388/ArchLit.2019.21.1>
- Benz M., Coşkun A., Hajdas I., Deckers K., Riehl S., Alt K. W., Weninger B., and Özkaya V. 2012. Methodological Implications of New Radiocarbon Dates from the Early Holocene Site of Körtik Tepe, Southeast Anatolia. *Radiocarbon* 54(3–4): 291–304. <https://doi.org/10.1017/S0033822200047081>
- Blegen C. W. 1947. Letter to Nils-Gustav Gejvall dated 1st April 1947. The letter is in the university archive, the University of Cincinnati.
- Blegen C. W., Caskey J. L., Rawson M., and Sperling J. 1950. *Troy: General Introduction. The First and Second Settlements*. Princeton University Press. Princeton.
- Blegen C. W., Caskey J. L., and Rawson M. 1951. *Troy: The Third, Fourth and Fifth Settlements*. Princeton University Press. Princeton.
1953. *Troy: The Sixth Settlement*. Princeton University Press. Princeton.
- Blum S. W. E. 2012. *Die Ausgehende Frühe und die Beginnende Mittlere Bronzezeit in Troia*. Studia Troica Monograph 4. Verlag Philipp von Zabern. Darmstadt.
2016. The final stages of the Early Bronze Age at Troy: cultural development, chronology and interregional contacts. In E. Pernicka, S. Ünlüsoy, and S. W. E. Blum (eds.), *Early Bronze Age Troy: Chronology, Cultural Development and Interregional Contacts. Proceedings of an International Conference Held at the University of Tübingen, May 8–10, 2009*. Studia Troica Monograph 8. Eberhard Karls Universität Tübingen. University of Cincinnati. Verlag Dr. Rudolf Habelt GmbH. Bonn: 89–122.
- Demjan P., Pavúk P. 2021. Clustering of calibrated radiocarbon dates: site-specific chronological sequences identified by dense radiocarbon sampling. *Radiocarbon* 63(2): 429–438. <https://doi.org/10.1017/RDC.2020.129>
- Doumet-Serhal C., Gimatzidis S., Weninger B., von Rügen C., and Kopetzky K. 2022. An interdisciplinary approach to Iron Age Mediterranean chronology through combined archaeological and ¹⁴C-radiometric evidence from Sidon, Lebanon. *PLOS ONE* forthcoming. <https://doi.org/10.1371/journal.pone.0274979>
- Easton D. F. 1976. Towards a chronology for the Anatolian Early Bronze Age. *Anatolian Studies* 26: 145–73. <https://doi.org/10.2307/3642722>
1990. Reconstructing Schliemann's Troy. In W. M. Calder III, J. Cobet (eds.), *Heinrich Schliemann nach Hundert Jahren. Symposium in der Werner-Reimers-Stiftung, Bad Homburg im Dezember 1989*. Vittorio Klostermann. Frankfurt: 431–47.
2000. Schliemann's 'Burnt City.' *Studia Troica* 10: 73–83.
2002. *Schliemann's Excavations at Troia, 1870–1873*. Studia Troica Monograph 2. Philip von Zabern. Mainz am Rhein.
2014. The first excavations at Troy: Brunton, Calvert and Schliemann. In E. Pernicka, C. B. Rose, and P. Jablonka (eds.), *Troia 1987–2012: Grabungen und Forschungen I. Forschungsgeschichte, Methoden und Landschaft*. Studia Troica Monograph 5. Habelt. Bonn: 32–103.
- Easton D. F., Weninger B. 1993. Troy VI lower town – Quadrats I8 and K8: a test case for dating by pottery seriation. *Studia Troica* 3: 45–96.
2018. A possible new Bronze Age period at Troy. *Anatolian Studies* 68: 33–73. <https://doi.org/10.1017/S0066154618000029>
- Friedrich C. 1997. Pinnacle E4/5 – Die Keramik der Periode II im Vergleich. *Studia Troica* 7: 111–258.
- Gejvall N-G. 1937. *List and a Preliminary Report of the Animal Bones and Sea Shells etc. from the Excavations at Troy*. Typescript. Copies in the Troy Archive, Department of Classics, University of Cincinnati and in the Osteoarchaeological Research Laboratory, Stockholm University.
- 1937–1938. The fauna of the different settlements of Troy: preliminary report. *Årsberättelse 1937–1938 Kungliga Humanistiska Vetenskapssamfundet I Lund*: 51–57.
- 1938–1939. The fauna of the successive settlements of Troy: second preliminary report. *Årsberättelse 1938–1939, Kungliga Humanistiska Vetenskapssamfundet I Lund*: 1–7.
1946. *The Fauna of the Different Settlements of Troy. Part I: Dogs, Horses and Cattle*. Privately circulated

- typescript. Copy in the Institute of Archaeology, University College, London.
1947. *List of Bones from Troy, 1938 Collection*. Typescript. Copies in the Troy Archive, Department of Classics, University of Cincinnati and in the Osteoarchaeological Research Laboratory, Stockholm University.
1951. Letter to Carl Blegen dated 30th October 1951. The letter is in the university archive, the University of Cincinnati.
- Gimatizidis S., Weninger B., 2020. Radiocarbon dating the Greek Protogeometric and Geometric periods: The evidence of Sindos. *PLOS ONE* 15(5): e0232906. <https://doi.org/10.1371/journal.pone.0232906>
- Horejs B., Milić B., Ostmann F., Thanheiser U., Weninger B., and Galik A. 2015. The Aegean in the early 7th Millennium BC: Maritime Networks and Colonization. *Journal of World Prehistory* 28: 289–330. <https://doi.org/10.1007/s10963-015-9090-8>
- Jablonka P. 2000. Computergestützte Rekonstruktion und Darstellung der Stratigraphie von Troia. *Studia Troica* 10: 99–122.
- Korfmann M. 1996. Troia – Ausgrabungen 1995. *Studia Troica* 6: 1–64.
1999. Troia – Ausgrabungen 1998. *Studia Troica* 9: 1–34.
- Korfmann M., Kromer B. 1993. Demircihüyük, Beşik-Tepe, Troia – eine Zwischenbilanz zur Chronologie dreier Orte in Westanatolien. *Studia Troica* 3: 135–171.
- Kromer B., Korfmann M. and Jablonka P. 2003. Heidelberg radiocarbon dates for Troia I to VIII and Kumtepe. In G. A. Wagner, E. Pernicka, and H. P. Uerpmann (eds.), *Troia and the Troad: Scientific Approaches*. Springer. Berlin, Heidelberg, New York: 43–54. https://link.springer.com/chapter/10.1007/978-3-662-05308-9_4
- Manning S. W. 1995. *The Absolute Chronology of the Aegean Early Bronze Age*. Sheffield University Press. Sheffield.
1997. Troy, radiocarbon and the chronology of the northeast Aegean in the early Bronze Age. In C. G. Doumas, V. La Rosa (eds.), *Poliochni e l'Antica Eta del Bronzo nell'Egeo Settentrionale*. Scuola Archeologica Italiana di Atene. Athens: 498–521.
- Mansfeld G. 2001. Die Kontroll-Ausgrabung des 'Pinnacle E4/5' im Zentrum der Burg von Troia. *Studia Troica* 11: 51–308.
- Ottaway B. S. 1973. Dispersion diagrams: a new approach to the display of Carbon-14 dates. *Archaeometry* 15: 5–12. <https://doi.org/10.1111/j.1475-4754.1973.tb00073.x>
- Pavúk P. 2007. What can Troia tell us about the Middle Helladic period in the southern Aegean? In F. Felten, W. Gauss, and R. Smetana (eds.), *Middle Helladic Pottery and Synchronisms. Proceedings of the International Workshop Held at Salzburg, October 31st–November 2nd, 2004*. Denkschriften der Gesamtakademie Band XLII. Österreichische Akademie der Wissenschaften. Wien: 295–308.
2010. Pottery processing at Troy. Typology, stratigraphy and correspondence analysis: how do they work together? In B. Horejs, R. Jung, and P. Pavúk (eds.), *Analyzing Pottery: Processing – Classification – Publication*. Comenius University. Bratislava: 73–98.
2014. *Troia VI Früh und Mitte. Keramik, Stratigraphie, Chronologie*. Studia Troica Monograph 3. Eberhard Karls Universität Tübingen. University of Cincinnati. Verlag Dr. Rudolf Habelt GmbH. Bonn. <http://hdl.handle.net/10900/73960>
2020. Chronologie. In M. Pieniazek, P. Pavúk, D. Thumm-Doğrayan, and E. Pernicka (eds.), *Troia 1987–2012: Grabungen und Forschungen III: Troia VI bis Troia VII: Ausgehende mittlere und späte Bronzezeit*. Studia Troica Monograph 7. Eberhard Karls Universität Tübingen. University of Cincinnati. Verlag Dr. Rudolf Habelt GmbH. Bonn: 16–88.
- Pernicka E. 2014. Preface. In E. Pernicka, C. B. Rose, P. Jablonka (eds), *Troia 1987–2012: Grabungen und Forschungen. I: Forschungsgeschichte, Methoden und Landschaft*. Studia Troica Monograph 5. Eberhard Karls Universität Tübingen. University of Cincinnati. Verlag Dr. Rudolf Habelt GmbH. Bonn: 10–16.
- Reimer P. J., Austin W. E. N., Bard E., +38 authors, and Talamo S. 2020. The INTCAL20 northern Hemisphere Radiocarbon Age Calibration Curve (0–55 Cal kBP). *Radiocarbon* 62(4): 725–757. <https://doi.org/10.1017/RDC.2020.41>
- Sazcı G. 2005. Troia I-III, die maritime und Troia IV-V, die anatolische Troia Kultur: eine Untersuchung der Funde und Befunde im mittleren Schliemanngraben (D07, D08). *Studia Troica* 15: 35–98.
2007. *The Treasures of Troy*. Aygaz. Istanbul.
- Schliemann H. 1874. *Trojanische Alterthümer*. Brockhaus. Leipzig.
1875. *Troy and Its Remains*. John Murray. London.

1884. *Troja: Results of the Latest Researches and Discoveries on the Site of Homer's Troy, 1882*. John Murray. London.
- Uerpmann H.-P. 2003. Environmental aspects of economic changes in Troia. In G. A. Wagner, E. Pernicka, H. P. Uerpmann (eds.), *Troia and the Troad: Scientific Approaches*. Springer. Berlin, Heidelberg, New York: 251–262.
- Ünlüsöy S. 2010. *Die Stratigraphie der Burg von Troia II*. Unpublished PhD thesis. University of Tübingen. Tübingen. <https://tobias-lib.uni-tuebingen.de/volltexte/2010/4509>.
- Warren P., Hankey V. 1989. *Aegean Bronze Age Chronology*. Bristol Classical Press. Bristol.
- Weninger B. 2002. Pottery seriation dating at Troy in the Early Bronze Age, based on the Cincinnati classification system. In R. Aslan, S. Blum, G. Kastl, F. Schweizer, and D. Thumm (eds.), *Mauerschau. Festschrift für Manfred Korfmann*. Verlag Bernhard Albert Greiner. Remshalden-Grunbach 1035–1062.
2009. Pottery seriation dating at Troia in the Middle and Late Bronze Age, based on the Cincinnati classification system. *Studia Troica* 18: 135–62.
- Weninger B., Clare L., and Bartl K. 2018. High-resolution chronology of Shir. In K. Bartl (ed.), *The Late Neolithic site of Shir/ Syria I. The excavations at the South Area 2006 – 2009*. Damaszener Forschungen 18. Verlag Philipp von Zabern GmbH. Darmstadt: 181–196.
- Weninger B., Easton D. F. 2014. The Early Bronze Age chronology of Troy (periods I–III). Pottery seriation, radiocarbon dating and the gap. In B. Horejs, M. Mehofer (eds.), *Western Anatolia before Troy: Proto-Urbanisation in the 4th Millennium BC? Proceedings of the International Symposium held at the Kunsthistorische Museum Wien, Vienna, Austria, 21–24 November 2012*. Österreichische Akademie der Wissenschaften. Wien: 157–199.
2017. A gap in the Early Bronze Age pottery sequence at Troy, dating to the time of the 4.2ka calBP event. In F. Höflmeyer (ed.), *The Late Third Millennium in the Ancient Near East: Chronology, C14 and Climate Change*. Oriental Institute Seminars 11. Institute for the Study of Ancient Cultures. University of Chicago. Chicago: 429–450.
- Weninger B., Edinborough K. 2020. Bayesian ¹⁴C-Rationality, Heisenberg Uncertainty, and Fourier Transform. *Documenta Praehistorica* 47: 536–559. <https://doi.org/10.4312/dp.47.31>
- THE TROY ARCHIVE** in the Department of Classics, the University of Cincinnati, is now largely available online at <https://drc.libraries.uc.edu/handle/2374.UC/757552>

∴

Appendix

Catalogue of Samples

The samples are listed below by Troy phase and by laboratory number. Against each we note also the serial number given in Gejvall's 1937 list (e.g., C786) and his description of the context from which the specimen came. As mentioned above, his descriptions include measurements of depth (e.g., 5.40–5.85m). These were taken from local datum points. The E6 datum lay at 38.10m A.T. (*Rawson Notebook 12, 1937. 53*; the point lay 7.3m above the Propylon IIC threshold at 30.79m A.T.), the F8-9 datum at 37.52m A.T. (*Caskey Notebook 6, 1936.112*). In the comments which follow we have supplemented the information available from Blegen's published report by referring to the relevant excavation notebooks: for E6 those of Friedrich Goethert (1932), Walter Heurtley (1932) and Marion Rawson (1933 onwards); for F8-9 those of Margo Taft (1935; 1936) and John Caskey (1935 onwards). For E6 the Pottery Notebook I (PN I) of Marion Rawson is also sometimes helpful. The loca-

tions from which samples came are shown in Figs. 9–13 (sections and plans).

Phase IIIa

Ua-69584. Gejvall 1937: C786. *Bos*, mandibula. 64.3g. 'E6, Room 400 / 5a / East Half. 5.40–5.85.' Excavators' annotations: Phase IIIa, Room 300.

The excavation of this deposit is described on numerous pages in *Rawson Notebook 5, 1934.75–125* and *Notebook 6, 1934.25–35*. Sketch plan at *M. Rawson Notebook 5, 1934.90*. *M. Rawson Pottery Notebook I. 139* notes a half sepet (wicker basket) of bones. The "east half" is the area southeast of the mudbrick bin (*Blegen et al. 1951.Fig.264*). The depths (32.70–32.25m A.T.) place the deposit below the floor of phase IIIb, descending to what Rawson identified as the original IIIa floor of the building (*Notebook 6, 1934.90*; *Blegen et al. 1951.66* locates it at

32.19m A.T.). Here, below thick, sloping layers of shells and ashes alternating with thin layers of earth and carbonised matter, she found "a different kind of earth", brown and burned looking (*Rawson Notebook 5, 1934.75*). These deposits are described in a general way by Blegen (*Blegen et al. 1951.66, Fig. 4*).

Ua-69585. Gejvall 1937: C847. Cervus, maxilla. 12.1g.
 'E6, Room 400 / 5b / West End, 5.40-5.85, 5.50-5.75. PN II p. 138.' (PN II is an error for PN I and refers to Marion Rawson's pottery notebook.) Excavators' annotations: Phase IIIa, Room 300.

The "west end" is the area northwest of, and including, the mudbrick bin (*Blegen et al. 1951.Fig. 264*). Otherwise all the comments on Ua-69584 (above) apply also to this sample.

Phase IIIb

Ua-69583. Gejvall 1937: C666. Sus, cranium. 2.6g. 'E6, Room 400 / 3 / 4.45-5.10. PN 130-32.' Excavators' annotations: Phase IIIb, Room 300.

The excavation is described at *Rawson Notebook 5, 1934.33-62*; see plan at *Blegen et al. 1951.Fig. 265*. The pottery notebook (No. 1) records one set of

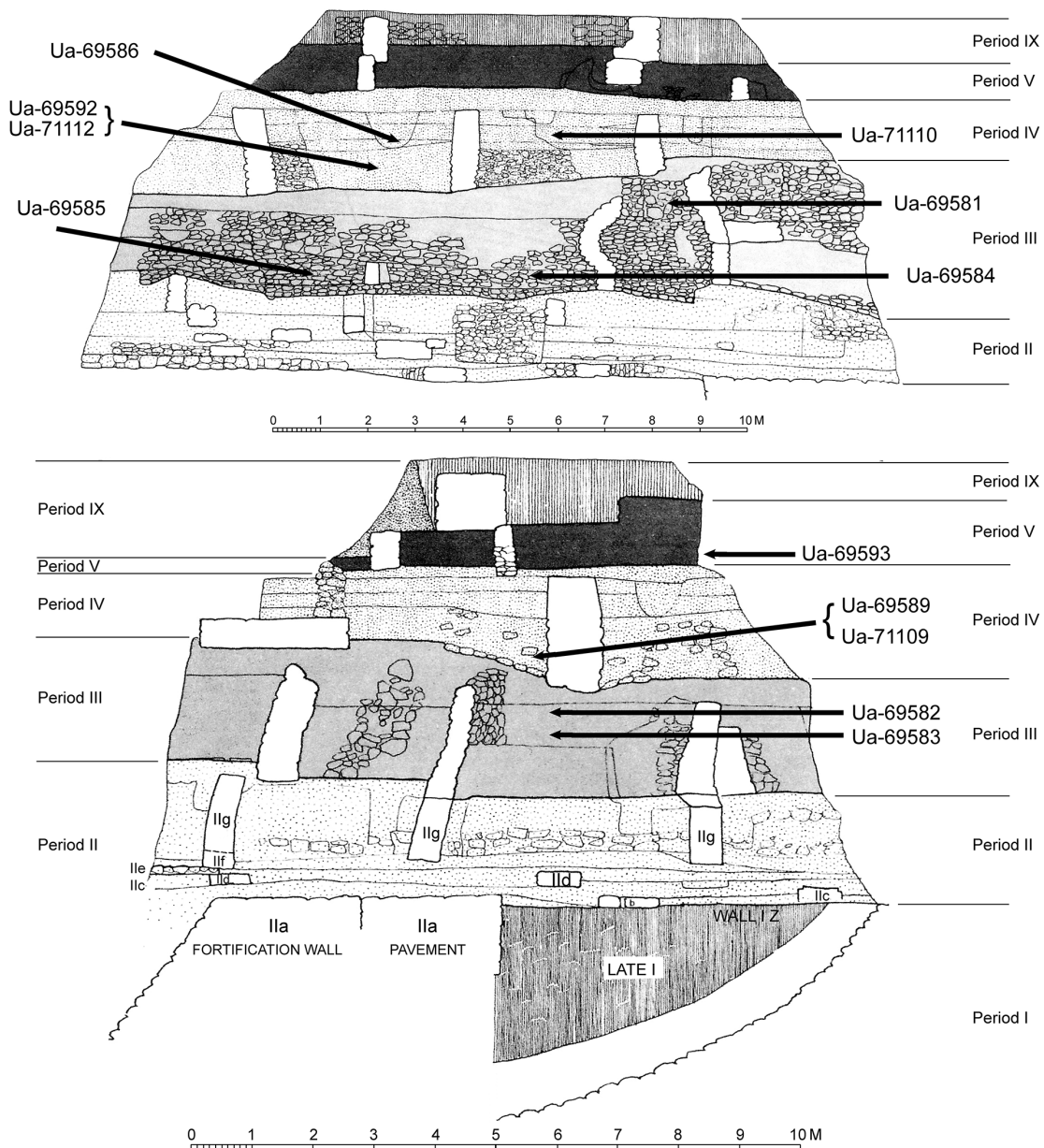


Fig. 9. Diagrammatic sections in square E6 as seen from southwest (above) and from southeast (below). Adapted from Blegen et al. 1951.Figs. 261 and 262.

bones. The depth of 5.10m (=33.00m A.T.) takes this deposit down to the level of the IIIb floor at c. 32.94m A.T. noted by Blegen (*Blegen et al. 1951.67*).

Ua-69582. Gejvall 1937: C584. *Cervus*, mandibula. 40.3g.
'E6, Room 400/2/ 4.35 - 4.45. PN p.128.' Excavators' annotations: Phase IIIb, Room 300.

The excavation is described at *M. Rawson Notebook 5, 1934.16-36*; see plan at *Blegen et al. 1951.Fig. 265*. The pottery notebook (No.1) records the collection of two bags of bones, clams, oysters, limpets, mussels and finger shells. Within the deep deposits in House 300 Blegen mentions floors at 32.94m A.T.

(attributed to IIIb) and at 33.79m A.T. (IIIc) (*Blegen et al. 1951.67*), implying an interval of 85cm between them. That interval was filled with "ashy debris and vast quantities of shells in thick strata alternating with layers of earth and clay" (*Rawson Notebook 5, 1934.17, 32-34*). The depths ascribed to the group of bones from which this sample comes (33.65-33.75m A.T.) place our specimen in the top-most 14cm of the accumulation, and mean that this sample was deposited later in the phase than Ua-69583.

Phase IIIc

Ua-69580. Gejvall 1937: C135. *Cervus*, mandibula. 10.6g.

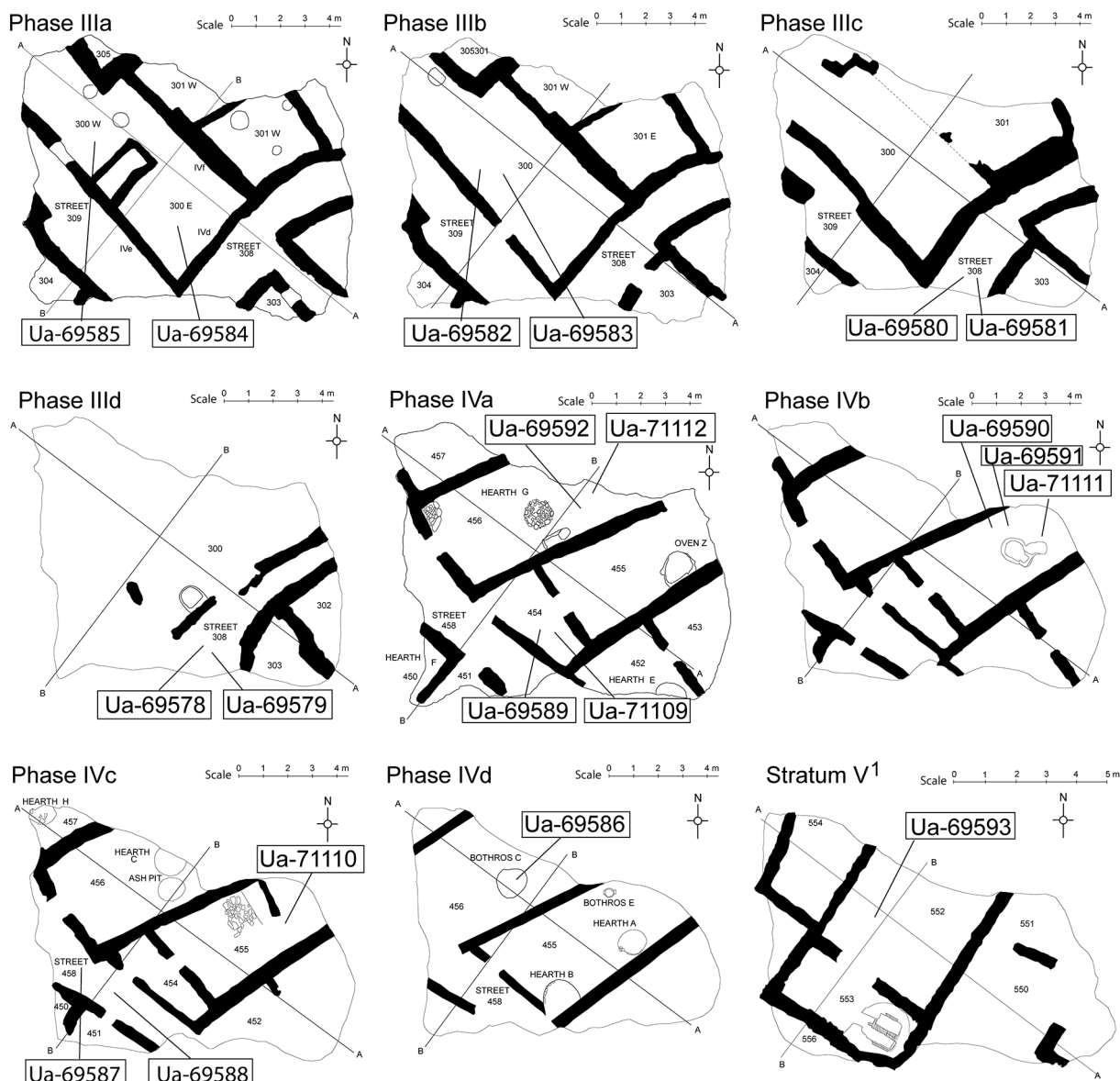


Fig. 10. Plans of square E6 in phases IIIa to V1, showing approximate find-spots of all samples from this area. Adapted from Blegen et al. 1951.Figs. 264-267,269,271-273,280.

Ua-69581. Gejvall 1937: C181. *Sus*, cranium. 58.6g. 'E6, 4th Street / 2 / 3.65–4.00 (4.25 in the case of C181). PN I p.107.' Excavators' annotations: Phase IIIc, Street 308.

"4th Street" in the notebook is the same as Street 308 in the final publication (*Rawson Notebook 3, 1933.93*; Blegen et al. 1951.45–46, Figs. 8–11, 266). The pottery notebook mentions only the depths of 3.65–4.25, not 3.65–4.00, and refers to two boxes of bones (three in *Rawson Notebook 4, 1933.147–148*). The depth of 3.65m represents the assumed lower limit of Troy IIIc (see comments on Ua-69578 and 69579). The depth of 4.20 / 4.25 (33.90 / 33.85m A.T.) seems arbitrarily to have been selected as a division.

Phase IIIc

Ua-69578. Gejvall 1937: C11. *Ovis/capra*, maxilla. 13.4g.

Ua-69579. Gejvall 1937: C35. *Sus*, cranium. 77.5g. 'E6, 4th Street / 1 / to 3.65. PN I p.104.' Excavators' annotations: Phase IIIc, Street 308.

The excavation is recorded at *Rawson Notebook 3, 1933.64, 77, 88, 94, 96, 99, 102*. On the identity of "4th Street" with Street 308 see phase IIIc, above. The existence of the street was first suspected on 27th May 1933 when Rawson was removing the overlying deposit of IVa to a depth of 3.40m below the local datum, i.e. to c. 34.70m A.T. (*Rawson Notebook 3, 1933.76*). The bones, from a collection of 1.5" baskets, come from the deposit immediately below this, "under Wall Z1", the southeast wall of Room 455 (*Rawson, Pottery Notebook 1.104*). Rawson (*Pottery Notebook 1.79*) places the bottom of Wall Z1 at a depth of 3.34 to 3.42 (= 34.76 to 34.68m A.T.). The depth of 3.65m (34.45m A.T.) was reached three days later when Rawson noted "tremendous numbers of sherds, bones + shells ... Deposit hard and gray looking, everywhere looks green" (*Rawson Notebook 3, 1933.96, 99*). As the Troy III deposits in this street reached down to c. 32.39m A.T. and had a total depth of 2.25m or more (Blegen et al. 1951.45), these samples evidently came from the topmost Troy III strata. Blegen, however, noted that the area produced many sherds that apparently belonged to Troy I, "suggesting that earth taken from an earlier deposit had been dumped in the street" (Blegen et al. 1951.46). The early dates of our samples are consistent with that.

Phase IVa

Ua-69589. Gejvall 1937: D124. *Sus*, mandibula. 55.9g.

Ua-71109. Gejvall 1937: D125. *Sus*, mandibula. 21.6g.

'E6, Sect.IIb / 2[?] / 3.27 – 3.65. MR p.64.' Excavators' annotations: Phase IVa, Room 454.

'MR p.64' is a reference to *Rawson Notebook 3, 1933.64*. *Rawson Notebook 2, 1933.15* confirms that Section IIb included Room 454 of the final publication (cf. Blegen et al. 1951.114–115, Figs. 268–269). The final report notes that one bag of animal bones was collected from this phase of Room 454, although this is not mentioned in the notebook. On 23rd May 1933 Rawson had 'finished leveling off this area' to depths varying from c. 3.45 to 3.66 (34.65–34.44m A.T.), and she records a "very hard clayey deposit, possibly floor, or under floor. Practically no carbonized matter." The depth of 3.27 referred to in Gejvall's description had been reached a week earlier (*Rawson Notebook 3, 1933.40*) and the deposits immediately below it had included carbonised matter and a lot of fallen mudbrick (*Rawson Notebook 3, 1933.45*).

Ua-69592. Gejvall 1937: D340. *Sus*, scapula. 52.2g.

Ua-71112. Gejvall 1937: D382. *Cervus*, maxilla. 14.4g.

E6, Sect III / 3 / 3.00 – 3.50. PN I pp.78–79.' Excavators' annotations: Phase IVa, House 456.

Rawson Notebook 2, 1933.15 confirms that Section III included House 456 (cf. Blegen et al. 1951.Figs. 268–269; see also pp.157–158, Figs. 117–122). The pottery notebook mentions shells but not animal bones. The 3.00m depth (35.10m A.T.) is that of the floor attributed to phase IVb (*Rawson Notebook 2, 1933.107, 109*; cf. Blegen et al. 1951.177). The underlying floor of IVa was found only at depths of 3.85 to 3.88 (*Rawson Notebook 3, 1933.54*) i.e. at 34.25 to 34.22m A.T. (cf. Blegen et al. 1951.158, 34.29 to 34.04m A.T.). But the deposit from which the bones came had its lower limit at c. 3.50 (34.60m A.T.), almost 40cm higher. The deposits at this depth, shown in a photograph in the published report (Blegen et al. 1951.Fig. 122) are described as "alternate layers of clay and rubbish" (*Rawson Notebook 3, 1933.52*) containing ashes, carbonised matter, bones, shells, sherds and decomposed brick (*Rawson Notebook 3, 1933.22, 25, 28, 30*) whereas the floor deposit at 3.88 was "quite different" (*Rawson Notebook 3, 1933.54*).

Phase IVb

Ua-69590. Gejvall 1937: D147. *Sus*, mandibula. 17.9g.

Ua-69591. Gejvall 1937: D148. *Sus*, maxilla. 25.1g.

Ua-71111. Gejvall 1937: D146. *Sus*, mandibula. 13.5g. 'E6, Sect. IIa / 2 / 2.75 to Floor at 2.78–2.90.' Excavators' annotations: Phase IVb, Room 455.

The equation of E6, Section IIa with Room 455 is confirmed by *M. Rawson Notebook 2, 1933, 15* (see plan at *Blegen et al. 1951, Figs. 270–271*). The level of –2.75 is that of the assumed floor of phase IVc of the same building (see comments on Ua-69587 and 69588 below), those of –2.78 and 2.90 indicate the floor attributed to phase IVb (*Rawson Notebook 2, 1933, 62, 63, 83, 91*). She refers (p.83) to the floor at 2.78–2.98, and the latter depth agrees better with the 35.14m A.T. of *Blegen et al. 1951, 174* than Gejvall's 2.90. The latter may perhaps be an error. Rawson noted at this depth "a thick layer of burned stuff ... which extends across the whole room"; "everywhere the remains of burning are extensive" (*Rawson Notebook 2, 1933, 62, 70; cf. Blegen et al. 1951, 173–176, Figs. 125–127, 270–271*). The number of pots (at least ten) from this level indicates the existence of a genuine floor deposit (*Rawson Notebook 2, 1933, 48–49, 63, 68, 70*), but the relatively early dates of the samples suggest that at the same depth there was earth that had been brought in from elsewhere to level the area before the next floor, perhaps of IVc, was laid.

Phase IVc

Ua-69587. Gejvall 1937: D108. *Ovis/capra*, maxilla. 16.8g.

Ua-69588. Gejvall 1937: D111. *Sus*, mandibula. 30.7g. 'E6, 5th Street / 1 / 2.35–2.75.' Excavators' annotations: Phase IVc, Street 458.

The identification of "5th Street" with Street 458 of the publication is confirmed by *Rawson Notebook 2, 1933, 15, 35* (see plan at *Blegen et al. 1951, Fig. 272*). The area was excavated by Heurtley in 1932 and Rawson in 1933, but as it was Rawson who named it "5th Street" the samples must come from 1933. Her work was concentrated on the northwestern end of the street (*Rawson Notebook 2, 1933, 28, 35, 51, 54, 58, 60, 64, 69, 76, 82*). The published report makes clear that the accumulated deposits of fallen stone, disintegrated brick, ashes, carbonised matter, shells, animal bones and sherds were homogeneous (*Blegen et al. 1951, 149, 173, 186; see also Figs. 110, 123*), so the division into phases was evidently rather arbitrary.

A possible pivot stone based at a depth of 2.70m (35.40m A.T.) may have suggested a relationship with the phase IVc floor of Room 455 (*Rawson Notebook 2, 1933, 69; see comment on Ua-71110 below*). Blegen says that the IVc strata in E6 began at 35.40m A.T., with a further 30 to 50cm on top (*Blegen et al. 1951, 186*). The depths of 2.35–2.75m thus denote the deposits below those of phase IVd (*Heurtley Notebook 3, 1932, 8*) and above the floor of phase IVc.

Ua-71110. Gejvall 1937: D138. *Cervus*, mandibula. 21.6g.

'E6, Sect. IIa / 1 / 2.55–2.75. Middle.' Excavators' annotations: Phase IVc, Room 455.

Rawson Notebook 2, 1933, 15 confirms that Section IIa in E6 is Room 455 of the published report (see plan at *Blegen et al. 1951, Fig. 272*). A small paved area (or platform?) and a number of pots were taken to be an indication of a floor at c. 35.43m A.T. (*Blegen et al. 1951, 187; see also Figs. 126, 272*). Levels for the stone paving and the pots are at *Rawson Notebook 2, 1933, 26, 46, 48*; the stones appear on the plan on p.23. A slightly higher level (–2.58) for the stones is given at *Heurtley Notebook 3, 1932, 8, 10*. This corresponds roughly to the –2.75 level. The feature was first noted in 1932 (*Heurtley Notebook 3, 1932, 6, 8, 10–12*), but the sample probably comes from 1933 when the division of the area into 'sections' was introduced by Rawson. The deposit above the 2.75 level appears to have been a destruction deposit consisting of burnt and fallen mudbrick and other charred matter (*Rawson Notebook 2, 1933, 17–18, 21*). Thus the sample can probably be assigned to the end of phase IVc.

Phase IVd

Ua-69586. Gejvall 1937: D71. *Lepus*, mandibula. 2.9g. 'E6, Sect. III / 1 / from bothros.' Excavators' annotations: no phase indicated.

The sample must come from 1933 when Marion Rawson introduced 'sections' into the area. Its location in Section III places it in House 456 and the pit ('bothros') must be Bothros C (*Rawson Notebook 2, 1933, 15, 20; cf. Blegen et al. 1951, 201–204, Fig. 273*). The rim of the pit lay at c. 35.70m A.T. (*Blegen et al. 1951, 201; Heurtley Notebook 2, 1932, 66*). It was exposed and partly emptied in 1932, the operation continuing in 1933 (*Heurtley Notebook 2, 1932, 66, Rawson Notebook 2, 1933, 20–22, 26, 31, 107, 112*). Rawson's operation there in 1933 began at 35.21m

A.T. and descended to 35.10m A.T. (*Rawson Notebook 2, 1933.26*). Thus the sample must have come from near the bottom of the pit. The pit had remnants of plaster (*Blegen et al. 1951.201*) so may originally have been for storage, but the contents – charred matter, pieces of bone, sherds, pieces of burnt mud-

brick and small stones – were plainly general debris. Possibly it was filled up in levelling operations at the end of the phase.

Phase V.1

Ua-69593. Gejvall 1937: E9. *Bos*, mandibula. 268.3g. 'E6, West /1-4/ 0-1.85 + Central Rooms 1.85-2.00.' Excavators' annotations: Phase V¹.

The “west room” is House 554 of the final publication and the “central room” is House 552 (*Heurtley Notebook 2, 1932.12,22 (plans)*; cf. *Blegen et al. 1951.Figs 280,281*). Heurtley excavated the central room (552), and identified the floor of the V2 phase at 1.70m. The levels 1.85–2.00 thus belonged to an earlier phase. But no clear floor level for the V¹ phase is recorded, and the 2m level seems to be a generalisation from the base level of the walls (*Heurtley Notebook 2, 1932.22*). If those walls were laid in foundation trenches, a sample from 1.85–2.00m could then have come either from the earliest deposits of Troy V or from late Troy IV. The depths translate to 36.25–36.10m A.T. Blegen located the V1 floor of House 552 at approximately 36.34m A.T. (*Blegen et al. 1951.262,264*; also 262–268 and *Figs. 210–216,280–283* for the phase generally). This too could permit an attribution of the sample to Late IV, although the excavators clearly considered it to derive from V1. In the west room, dug mainly by Goethert, the depths of 0–1.85 might in theory have included everything from Troy V to Roman; but the marginal note assigning this and other bones of the same group to V1 was written by Marion Rawson who took over the area in 1933, so should probably be trusted. The ‘1-4’ in Gejvall’s description of the context may refer to cuts made by Goethert.

Phase Va

Ua-69598. Gejvall 1937: E253. *Sus*, maxilla. 20.4g. F8, 'Area 110, 2-70-2.80.' Excavators' annotations: Phase Va.

For this phase see *Blegen et al. (1951.255–256, Figs. 188,190,304)*. Area 110 lay in the northeast corner of the trench and corresponds to the Area 502 shown in the publication (*Caskey Notebook 6, 1936.52 (general plan)*; cf. *Blegen et al. 1951.Fig. 304*). The depths of 2.70–2.80 translate to altitudes of 34.72–34.82m, so the sample does not come from the very deepest Va deposits in this area which descended to 34.52m (*Blegen et al. 1951.255*). The publication describes the Va deposits here as “earth and habitation depos-

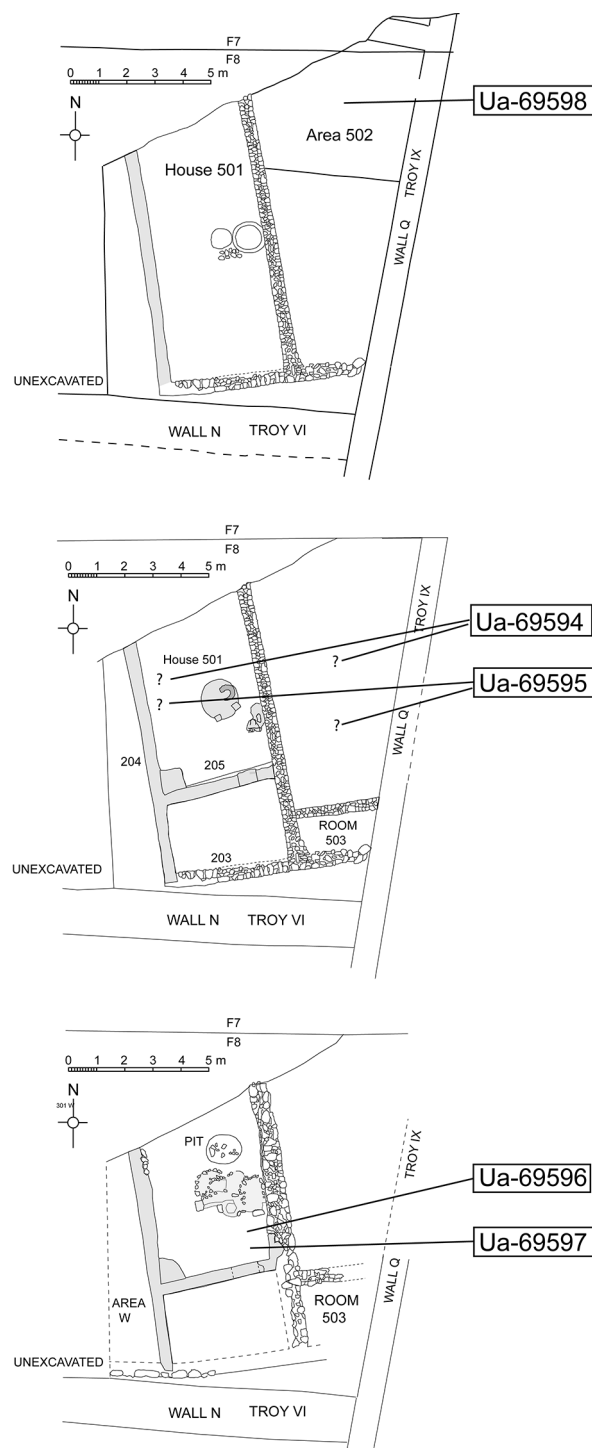


Fig. 11. Plans of square F8 in phases Va to Vc, showing approximate find-spots of all samples from this area. Adapted from Blegen et al. 1951.Figs. 304, 305,307.

its with bones and carbonized matter” which were “laid down horizontally, obviously as a result of gradual accumulation.”

Phase Vb

Ua-69594. Gejvall 1937: E45. *Bos*, maxilla. 9.1g

Ua-69595. Gejvall 1937: E62. *Ovis/capra*, maxilla. 30.5g.

‘F8-9, 1935, Area B+D.’ Excavators’ annotations: Phase Vb, ‘House 204 (3.40–3.90 floor deposit?)’

For this phase see Blegen et al. 1951.258–259; Figs. 191,192,194,305. “House 204” is identifiable as the House 501 described in the final publication (*Taft Notebooks 1, 1935.50 (plan) and 3, 1936.7–32; cf. Blegen et al. 1951.Fig. 307*). Area B lay in the west half of the trench, partly outside the west wall of House 501, and Area D lay entirely outside the east wall of the same house (*Taft Notebook 1, 1935.50*). It is not clear why the excavators’ marginal note places the samples within “House 204/501” or gives the depths of 3.40–3.90. The depths (34.12–33.62m A.T.) are those recorded for the floor of the north room (*Taft Notebook 1, 1935.55*). If correct they would place the samples in, or contemporary with, a 30cm-thick deposit described as “a deep layer of habitation” which “may have comprised several different floor levels but if such is the case they were so close together that it was impossible to divide them” (*Taft Notebook 1, 1935.109*).

Phase Vc

Ua-69596. Gejvall 1937: E107. *Bos*, mandibula. 136.2g.

Ua-69597. Gejvall 1937: E134. *Ovis/capra*, maxilla. 23.9g.

‘F8-9, 1935, Area C, above 3.20.’ Excavators’ annotations: Phase Vc, ‘House 204, second floor.’

For this phase see Blegen et al. 1951.271–273, Figs. 196–204,307. “House 204/501” is House 501 of the final publication (see above on Ua-69594 and Ua-69595). Area C (‘section’ C in the notebook) lay in the east half of the north room (*Taft Notebook 1, 1935.50, plan*). It is not entirely clear where the upper limit of the deposit lay, except that it cannot have been higher than an overlying floor of the succeeding Vd building at 34.95 (north end) to 34.25 (south end) (Blegen et al. 1951.284). The lower limit of 3.20 (34.32m A.T.) places the deposit immediately over a floor of phase Vc (*Taft Notebook 1, 1935.55, section; Taft Notebook 3, 1936.8*). The floor in fact sloped down to c. 34.20m at its south end, a figure which Blegen et al. 1951.272 gives as the average. The “thin layer” of the floor was “recognizable ... by remnants of plaster coating, the comparative blackness of the deposit, the large quantities of bones, shells and ashes” (*Taft Notebook 3, 1936.8*). It sounds as though the floor was not easily traced. There is therefore the possibility that the deposit included some fill either from below the Vc floor or from above it. If this had been taken from earlier deposits elsewhere on the site it could explain the earlier dates of our samples.

Phase VIa/b

Ua-69599. Gejvall 1937: F976. *Sus*, maxilla. 17.1g.

‘F8-9, Area 3, 6.40–7.40.’ Excavators’ annotations: Phase VIa.

“Area 3” is the Area K described in the final publication (see plan and section in *Caskey Notebooks 6, 1936.52 and 7, 1937.54 and Blegen et al. 1953.Figs. 449,460*). The deposit was excavated as a horizontal spit in 1935 (*Caskey Notebook 4, 1935.107*), and lay at 31.12–30.12m A.T., so at the deepest level of the excavated area. The deposit is described by Blegen (Blegen et al. 1953.133, Figs. 122–123,449,460) and

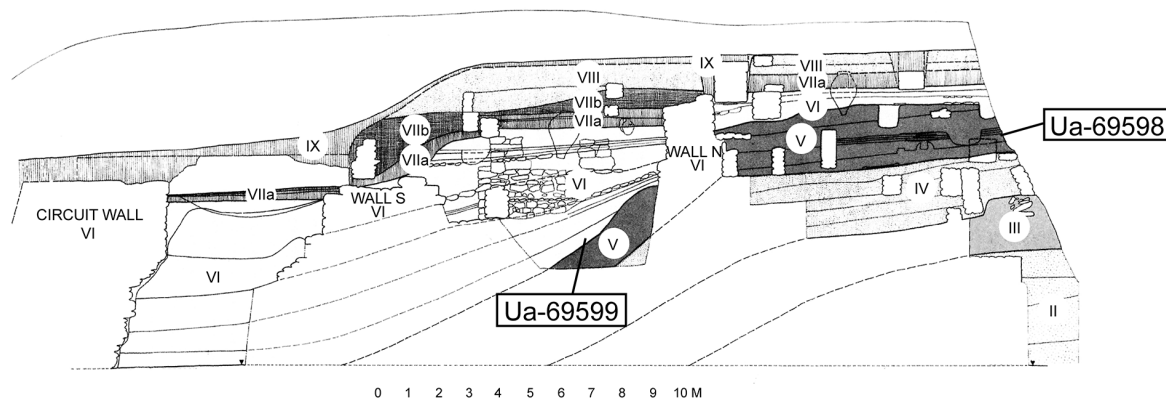


Fig. 12. Diagrammatic section of squares F 7-8-9, looking west, to show approximate find-spots of samples 1 and 11. Adapted from Blegen et al. 1953.Fig. 453.

appears to have been a layer of fill sloping down over the face of a fall of stones (or perhaps a glacis?) abutting what he took to be a circuit wall of Troy IV, V and perhaps Early VI. The latest pottery in the fall of stones was of Early VI date (Blegen et al. 1951.139, Fig. 309). The overlying deposit, from which our

sample comes, must be at least of the same date but could include material of Blegen's VIb layer, as Pavúk notes (Pavúk 2014.120–121). Consequently the context may belong to either Ceramic phase 1 or Ceramic phase 2 in Pavúk's terms and could date as late as 1635/1600 BC (Pavúk 2020.69).

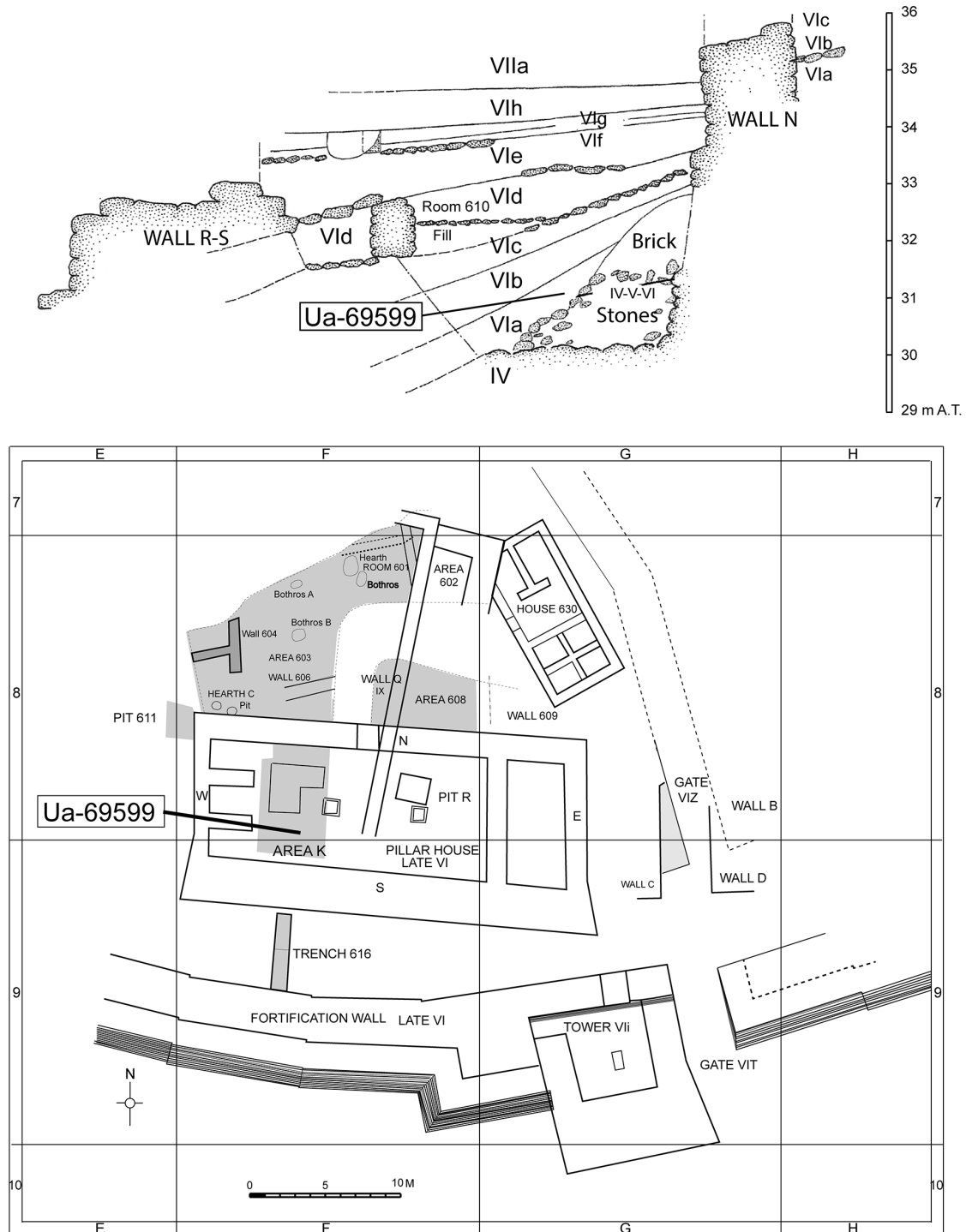


Fig. 13. Above: Diagrammatic section showing strata of Troy VI in Area K, as seen from east, with approximate stratigraphic position of sample 1 (Ua-69599). Below: plan of squares EFGH 7-8-9-10 in Early Troy VI, showing approximate find-spot of the same sample. Adapted from Blegen et al. 1953.Figs. 460,449.