CHAFF, DUNG, AND WOOD: FUEL USE AT TELL EL-RETABA. ARCHAEOBOTANICAL INVESTIGATIONS IN THE THIRD INTERMEDIATE PERIOD SETTLEMENT, AREA 9 EXCAVATIONS 2015–2019

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Abstract: *Results of archaeobotanical investigations from the 2009–2014 excavations of the joint Polish-Slovak-Egyptian mission at the site of Tell el-Retaba have previously been reported in Ä&L.*[2] *This article provides an update and discussion of results from excavations conducted in 2015, 2016, 2017 and 2019 in Area 9, within the Third Intermediate Period settlement.*[3] *It has been well-established that plant macro-remains are abundant and generally well-preserved at Tell el-Retaba, and they offer a wonderful opportunity to examine changing patterns in the complex relationship between plants and people over at least one thousand years. Analysis of the charred plant archaeobotanical assemblages in the town reveal that wood, sheet/goat dung, and cereal processing by-products were all used as fuel in households, and that the animals had consumed a sedge-rich diet.*

Keywords: *Archaeobotany. Cereal processing. Cereal chaff. Weeds. Dung. Fuel.*

Introduction

Archaeobotanical investigations have been included in archaeological work at Tell el-Retaba since 2009. The focus of research has been on identifying the ways in which the inhabitants of the town utilised plants, and the ways in which the environment of the Wadi Tumilat shaped the local (agricultural) vegetation and economy. The charred plant macro-remains offer a rich record of the fact that local arable farming of emmer wheat and barley was affected by shifting patterns in hydrology of the Wadi Tumilat.[4] The use of dung as fuel (and subsequent preservation of un-digested plant elements) allows insights into animal husbandry.[5] This article builds on earlier research published in *Ägypten und Levante* 25 and 26.

Methods

Water flotation is the standard method of recovery for charred plant macro-remains, and has been conducted on all samples from this site since 2009. Samples of c. 5 litres are selected on-site by the archaeologists, based on the identification of ash-rich layers or deposits (additionally, most floors are also sampled) and processed at the project workrooms using a basic bucket flotation method (300 µm mesh). The botanical remains (the 'flots') are carefully air-dried in cloth bags and studied under a BMZ zoom stereo binocular microscope using 6-30X magnification. Identifications are based on morphology, working with standard published reference images.[6] Due to time constraints sub-sampling protocols were introduced in 2011, and adapted in 2014.[7] Due to the sub-sampling protocols, some of the sample sizes given in the results presented here appear to be very small, but due to the overarching research goal of identifying "routine practise", priority has been given to studying samples from as many archaeological contexts (stratigraphic units) as possible in order to gain a broad perspective on the assemblages. All item counts given in this report represent the sum total of the partial and complete seeds / grains.

Interpretation of charred archaeobotanical assemblages from settlement sites

Due to the conditions at the site, only charred plant macro-remains are preserved at Tell el-Retaba, as is the case in most settlement sites in Egypt. Most specimens in the samples therefore represent the remains of plants burned as fuel within the town, although some seeds and grains may have become charred through accidentally being

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[2] Malleson 2011; 2015; 2016a.

[3] Financed by the Polish National Science Centre, grant 2015/2017/B/HS3/00597, and supported by the Polish Centre of Mediterranean Archaeology.

[4] Malleson 2016a, 140–142.

[5] Malleson 2015, 196–197.

[6] Boulos & el-Hadidi 1984; Boulos 1999; 2000; 2002; 2005; Nesbitt 2006; Cappers *et al*. 2009; Neef *et al*. 2011.

[7] Malleson 2016a, 132.

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Fig. 1 Phase C5 Oven sequence. Photograph by the author

dropped into fires during cooking. Interpretation of archaeobotanical assemblages requires careful consideration of site formation in order to understand the ways in which the original plant assemblage present in the settlement has been altered though human actions.[8] An adaptation of a system of classifying archaeological deposits proposed by Hubbard and Clapham[9] has been adopted here. They outlined that there are essentially three types of context with respect to plant remains: class A = in-situ storage of plants, class B = mixed deposits of stored plants, and class C = all other contexts.[10]

The overwhelming majority of archaeological contexts (stratigraphic units) excavated in any site are deposits of waste that were dumped into unoccupied buildings. These are defined here as "tertiary" (class 3) contexts as it is essentially impossible to know exactly where the plant remains derive from (Hubbard and Clapham's class C). Floor layers fall within this classification, although the remains in them are more likely to represent waste of burned fuel scattered within a building during its use. Some units are clearly closely associated with ovens or kilns – deposits of ash waste close to the primary features. These are classified as "secondary" deposits (class 2) (these fall into Hubbard and Clapham's class C as well). Some features technically should be classified as tertiary units as they are clearly dumped waste, but, in some instance these dump layers are exceptionally ashy, and so were classified separately as "secondary / tertiary" (class 2.5). A limited number of contexts are in-situ remains of fuel – deposits of ash in ovens, kilns and fireplaces. These assemblages represent primary evidence for activities within specific rooms / buildings at specific points in time, and are therefore classified as "primary" units (class 1). They are not "primary" in the definition of Hubbard and Clapham (class A or even class B), as they are mixtures from potentially multiple sources of plants, but ovens and fireplaces are often the only in-situ remnants of activities within any building, and directly reflect the decision making processes of the inhabitants.

Assemblages of charred plant macro-remains from Egyptian settlement excavations invariably comprise primarily of cereal processing by-products, fodder / forage plants and cereal grains, used as fuel by the inhabitants, and are usually mixed with wood-charcoal.[11] The cereal processing by-

[8] Van der Veen 2007, 968.
[9] Hubbard & Clapham 1992.
[10] Hubbard & Clapham 1992, 118–119.
[11] Murray 2009.

products include the inedible (for humans) parts of cereals (glumes /spikelet forks of emmer wheat (*Triticum turgidum* subsp. *dicoccum)*, rachis internodes of barley (*Hordeum vulgare*), and "straw" (culm nodes and culm bases)), and the seeds / grains of weedy plants that grew in the cereal crops and around settlements (e. g. ryegrass (*Lolium* sp.), canary grass (*Phalaris* sp.), spikerush (*Eleocharis* sp.), and dock (*Rumex* sp.)). These items would have been cleaned out of cereals perhaps prior to storage, but certainly prior to grinding. This "waste" held a significant economic value[12] and was routinely used as fuel, animal fodder, bedding, and temper in ceramics / building materials.[13] In many cases animal dung was utilized as a primary fuel, and tougher seeds / grains / plant parts that survived the animals' digestion were subsequently preserved by charring. The plant remains in dung assemblages may result from animals grazing, foddering of animals with either cereal processing by-products, gathered plants, or specifically cultivated fodder plants.[14]

Earlier archaeobotanical reports from Tell el-Retaba have focused on identification of changing patterns of local ecology.[15] The discussion presented here will focus on identifying different fuel sources.

Results

Since 2009 a total of 382 samples from 330 different stratigraphic units (1319 litres) from all areas and phases have been studied; a total of 280,337 items have been identified. At present, the Third Intermediate Period is the best studied phase of occupation at Tell el-Retaba, in terms of the number of archaeobotanical samples studied and so provides a very viable set of statistics. See Table 1.

The assemblage of archaeobotanical remains at Tell el-Retaba very clearly indicates the use of cereal processing by-products and forage plants as fodder / fuel, and the use of dung (sheep / goat) as fuel. Table 2 and fig. 2 clearly show that the assemblage from the site (all areas, all phases, all years) comprises primarily of cereal chaff elements, with significant quantities of grassy weed grains and wet-loving plant seeds, and smaller quantities of wild/weed seeds, and legumes (Fabaceae family plants not destined for human consumption) .

Phased discussion of Results. Third Intermediate Period, Area 9[16]

Sequence of Ovens. Phase C5 (table 3, fig. 1 and fig. 3)

In 2019 a sequence of ovens was revealed between buildings {2147 and {3111}.[17] Samples were taken from several layers. Oven [3178] (lowest in sequence), unit (3181) consisted of white ash & unit (3189) was debris on the top. Oven [3176] (middle of sequence) unit (3150) consisted of ash around the oven. Oven [3136] (top of sequence) unit (3190) was the black ash at the base. All 4 samples were (perhaps predictably) exceptionally rich in charred plant macrofossils, with 800–3000 items per litre.

The white ash (3181) was dominated by heavily charred (vesicular – listed as "indet") and indeterminate cereal grains, and contained far less wood charcoal than the other layers (just 13 ml / L). It is possible that this relatively large quantity of cereals present might indicate some kind of accident; a comparison with the white ash layers from the other ovens would be informative, and excavation of additional samples will be a priority in future seasons. Above that layer, in oven [3178], the debris (3189) was a mix of vesicular grains and cereal chaff, with a significant quantity of wood charcoal (almost 34 ml / L), with some charred sheep / goat pellets, suggesting a mix of cereal processing waste, dung and wood as fuel. The layer of ash (3150) around the oven [3176] (which was installed above [3178]), was dominated by cereal chaff, with a lot of wood charcoal (30 ml / L) and lots of sheep / goat dung pellets. None of the pellets seem to contain cereal waste (they consist of finely pulverized culms), suggesting the use of sheep/goat dung, wood and cereal-processing by-products as fuel. The black ash (3190) in oven [3136] (on top of oven [3176]), was a homogeneous mix of cereal processing by-products (chaff, legumes, wild grass grains) with very little dung, but a similar quantity of wood charcoal (30 ml / L); suggesting either a

[12] Van der Veen 1999.

[13] Murray 2009.

[14] Miller 1984; For discussions see Moens & Wetterstrom 1988; Murray 2009; and Malleson 2016b.

[15] Malleson 2015; 2016a

[16] For site phasing and all site plans.see Jarmużek *et al*. 2020 (in this volume).

[17] See Jarmużek *et al*. 2020 (in this volume), fig. 3.

Table 1. Overview of all samples 2009–2019

Period	Number of Stratigraphic Units	Total Items	Total sample volume (L)	Density (Items per Litre)
Undated	12	5588	57	98.04
Second Intermediate Period	27	16141	89.8	179.74
18th Dynasty	67	74534	232.93	319.98
18th – 19th Dynasty	2	704	5.5	128
18th Dynasty – Third Intermediate Period	1	40	5	8
19th Dynasty	21	13281	98.75	134.49
19th Dynasty (?)	1	137	5	27.4
19th – 20th Dynasty	10	15836	40.3	392.95
20th Dynasty	29	29416	144.25	203.92
20th Dynasty – Third Intermediate Period	1	1183	5	236.6
Third Intermediate Period	133	106341	519.375	204.75
Late Period	19	9948	91.5	108.72
Modern	7	7188	24.68	291.25
TOTALS	**330**	**280337**	**1319.085**	**212.52**

Table 2. Overview of assemblage, by taxa group (all samples 2009–2019)

Group	Total items	IPL	% of assemblage
Cereal Chaff	98402	73.98	35.23
Cereal Grain	15648	11.76	5.60
Dung fragments	22395	16.84	8.02
Pulses	328	0.25	0.12
Legumes	15178	11.41	5.43
Fruits / nuts	641	0.48	0.23
Wild grasses	42173	31.7	15.10
Indeterminate	29883	21.71	10.34
Oil crops	533	0.4	0.19
Wild / weeds	12365	9.3	4.43
Wet-loving	42290	31.79	15.14
Woody plants	501	0.38	0.18
Totals	**280337**	**212.52**	**Volume 1319.085**

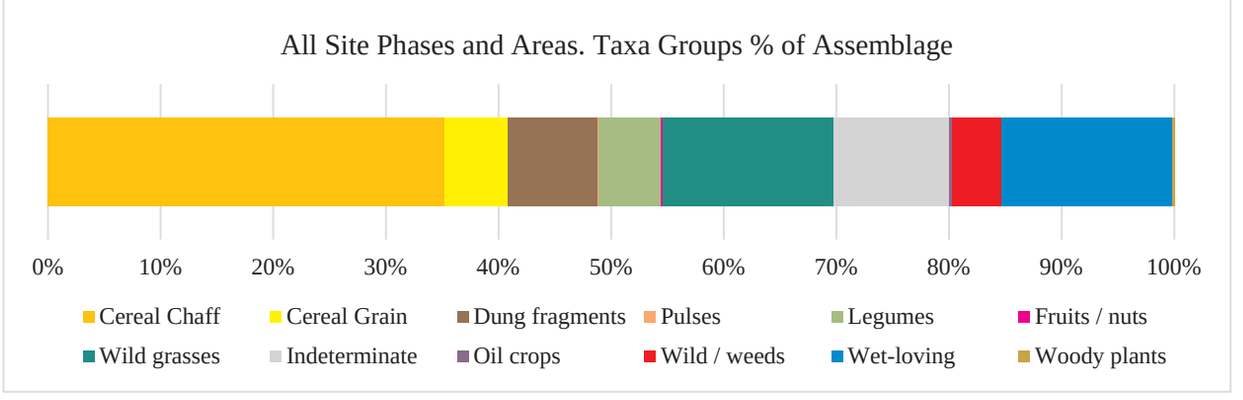

Fig. 2 Overview of assemblage, by taxa group (all samples 2009–2019)

Table 3. Table of results from Ovens, phase C5.

Ovens. Phase C5. Taxa groups items per litre.														
Strat. Unit	Cereal chaff	Cereal grain	Dung frags.	Leg-umes	Fruit / Nut	Wild grasses	Indet.	Wild / weed	Wet-loving	Woody plants	Total Items	Vol.	Aver-age IPL	ml / L of wood char-coal
3190	195	118.33	3.33	178.33		183.33	98.33	16.67	3.33		478	0.6	796.67	30
3189	361.22	59.18	57.14	2.04		104.08	234.69		26.53		414	0.49	844.9	33.85
3181	414.44	1166.67	121.11	7.78	1.11	112.22	1111.11		41.11		2678	0.9	2975.56	13.33
3150	1118	106	248	68		190	42	60	8	4	922	0.5	1844	30

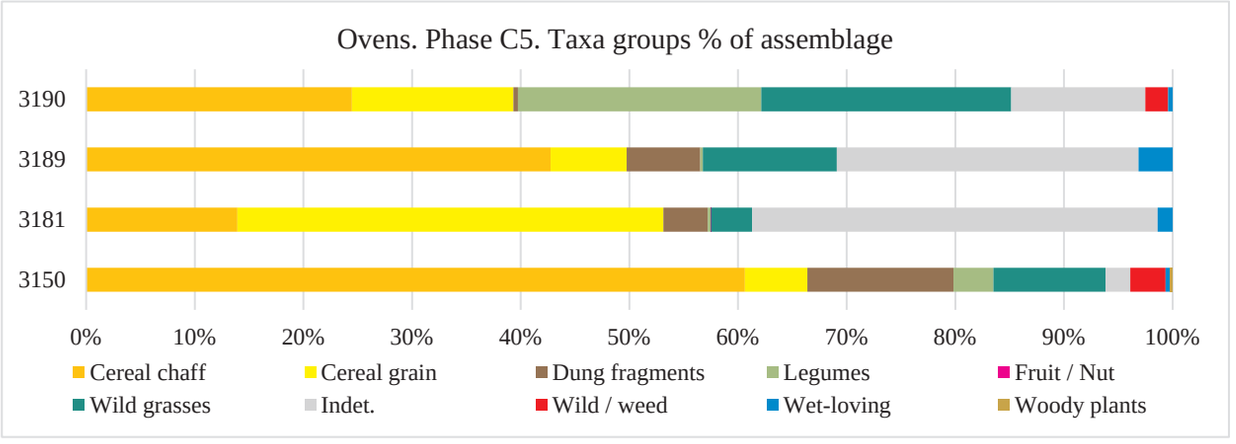

Fig. 3 Histogram of results from Ovens, phase C5.

small shift in fuel preferences, or perhaps the loss of the dung due to degradation caused by repeated use of the oven.

Building {3111} & {1607}. Phase C4. (tables 4 & 5, figs. 4 & 5).[18]
Samples from the fragmentary remains of phase C4 buildings {1607}, {1646} and {1082}, and an external space were discussed in the 2015 report.[19] Building {3111} which lies to the west of building {2147} was excavated in 2019, and placed within phase C4 – C3.[20] Samples were recovered from four phase C4 units in room 1 of this building: the fills of two intact pots (3269) & (3271)[21] (material deriving from generic dumping within the space), one fireplace (3268),[22] and a later floor layer (3231)[23] which covered the pots and fireplace. None of these samples were especially rich in charred plant remains, (14 – 56 items per litre), and only 2–5 ml / L of wood charcoal. Samples from units (3231), (3269) & (3271) all represent generic "background noise" (tertiary) dumping or scatter of fuel waste, all three contain similar assemblages: primarily cereal chaff, some wild grasses, and wild / weed plant / wet-loving plants. Fireplace (3268) represents a primary in-situ burning context, reflecting fuel choices within this building, probably just over a short time-span. The assemblage is similar to the dumping contexts, and the sample was not especially rich (just 56 items per litre). This is likely due to the nature of the fireplace – an "open" fire causes greater destruction of plant remains. The presence of five complete and one partial pulse seeds (probably *Lens culinaris* L.) might suggest that a dish containing lentils might have been prepared on this fireplace at some point.

[18] See also Jarmużek *et al.* 2020 (in this volume), figs. 4 & 6)
[19] Malleson 2015, 186–187, 189–190
[20] Jarmużek *et al.* 2020 (in this volume)
[21] Jarmużek *et al.* 2020 (in this volume)
[22] Jarmużek *et al.* 2020 (in this volume)
[23] Jarmużek *et al.* 2020 (in this volume)

One sample from a unit associated with building {1607} was recovered in 2015, from a dump of ashes (1662) associated with an oven. This assemblage bears similarities with the samples from building {3111}; specifically – a mix of chaff, dung, grasses, legumes and wet-loving seeds. Unit (1894) was an isolated fireplace, in an open area south of building {1607}, containing no wood

Table 4. Table of results from building {3111}, phase C4.

Building {3111}. Phase C4. Taxa groups item per litre													
Strat. Unit	Cereal chaff	Cereal grain	Dung frags.	Pulses	Leg-umes	Wild grasses	Indet.	Wild / weed	Wet-loving	Total Items	Vol.	Average IPL	ml / L of wood charcoal
3271	9.12	0.16	0.48		0.64	0.96			2.08	84	6.25	13.44	1.92
3269	40	1.25	0.5		0.75	5.5	0.5	5.25	0.25	216	4	54	3.5
3268	25.6	4.8	1.2	2.4	1.2	10	4.4	4.4	1.6	139	2.5	55.6	4
3231	23.11	0.89			0.44	6.89		0.22	4.89	164	4.5	36.44	5.11

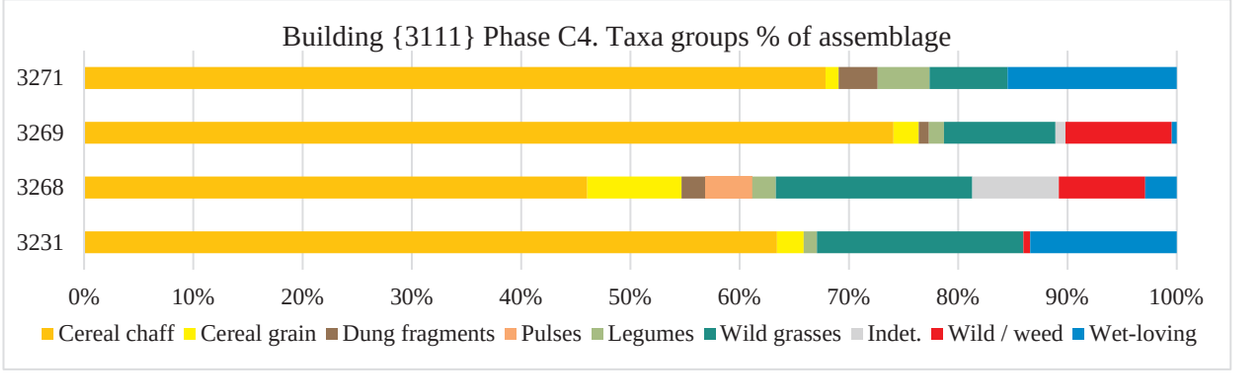

Fig. 4 Histogram of results from building {3111}, phase C4.

Table 5. Table of results from building {1607}, phase C4.

Building {1607}. Phase C4. Taxa groups items per litre														
Strat. Unit	Cereal chaff	Cereal grain	Dung frags.	Pulses	Leg-umes	Fruit / Nut	Wild grasses	Indet.	Wild / weed	Wet-loving	Total Items	Vol.	Aver-age IPL	ml / L of wood char-coal
1662	70	1.6	8	0.8	10	0.4	15.2	5.2	4	30.4	364	2.5	145.60	30
1894	273	6	201		8		69	12	8	455	1032	1	1032	0

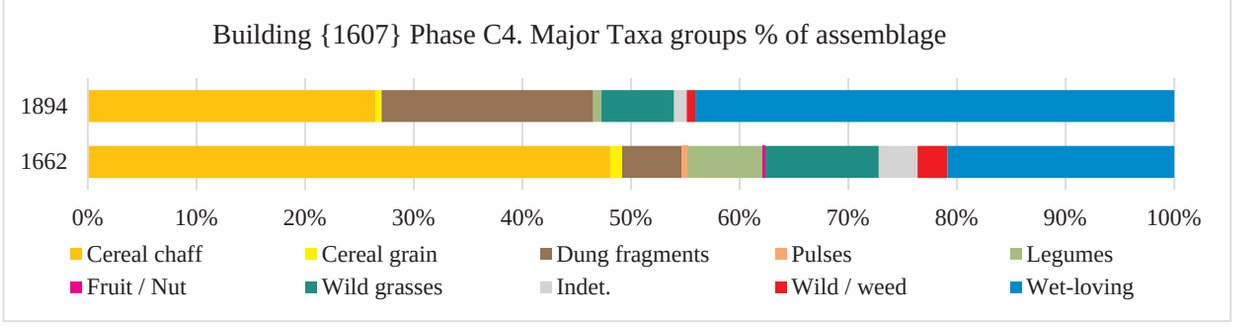

Fig. 5 Histogram of results from building {1607}, phase C4.

charcoal, but filled with charred sheep / goat dung pellets and reed / sedges seeds, indicating the use of dung-fuel from animals that had either grazed along watercourses, or been supplied with gathered forage from these areas.

Building {3111}. Phase C3b and C3a. (table 6, fig. 6).[24]

An open space in the south-eastern area of {3111} was occupied by a courtyard during phase C3. Samples from two fireplaces (3275) & (3277)[25] were recovered from this walled courtyard space, and one ashy dump layer in room 4 (3340)[26] dated to phase C3b, plus one (generic dumping) fill of a pot (3160)[27] in room 1 phase C3a. Additionally, one external fireplace within Area 9 (2623) also dated to phase C3b was sampled. The sample from within the pot (3160) was not rich (24 items per litre), but it contained termite faeces and a more diverse range of taxa including one fragment of a date stone (*Phoenix dactylifera*). Dumping layer (3340) was surprisingly rich in remains (331 items per litre), and had a similar assemblage to the fireplaces in the courtyard. The three fireplaces are primary in-situ burning features. (3275) & (3277) contained similar assemblages, dominated by cereal chaff elements, but (3275) was far richer overall with over 400 items per litre (compared to just 28 in (3277)), and a more diverse range of taxa. All three fireplaces contained a notable quantity of wood charcoal (19–20 ml / L) indicating perhaps that wood may have been the pri-

Table 6. Table of results from building {3111}, phase C3b & C3a.

Building {3111} Phase C3b & C3a. Taxa groups items per litre																
Strat. Unit	Cereal chaff	Cereal grain	Dung fragt.s	Pulses	Leg-umes	Fruit / Nut	Wild grass-es	Indet.	Oil / fibre	Wild / weed	Wet-loving	Woody plants	Total Items	Vol.	Aver-age IPL	ml / L of wood char-coal
3340	186.75	17.47	0.6		4.22		77.71	33.73	0.6	0.6	9.64		550	1.66	331.33	8
3277	18	1					8				1		28	1	28	20
3275	303	10			6	1	70	13			18		421	1	421	18.75
3160	13.5	2	0.25	0.5		0.25	2.5	0.5		1.25	2.75	0.25	95	4	23.75	1.25
2623	50.83	3.33	8.33		5.83		11.67	20.83	1.67		63.33		199	1.2	165.83	20

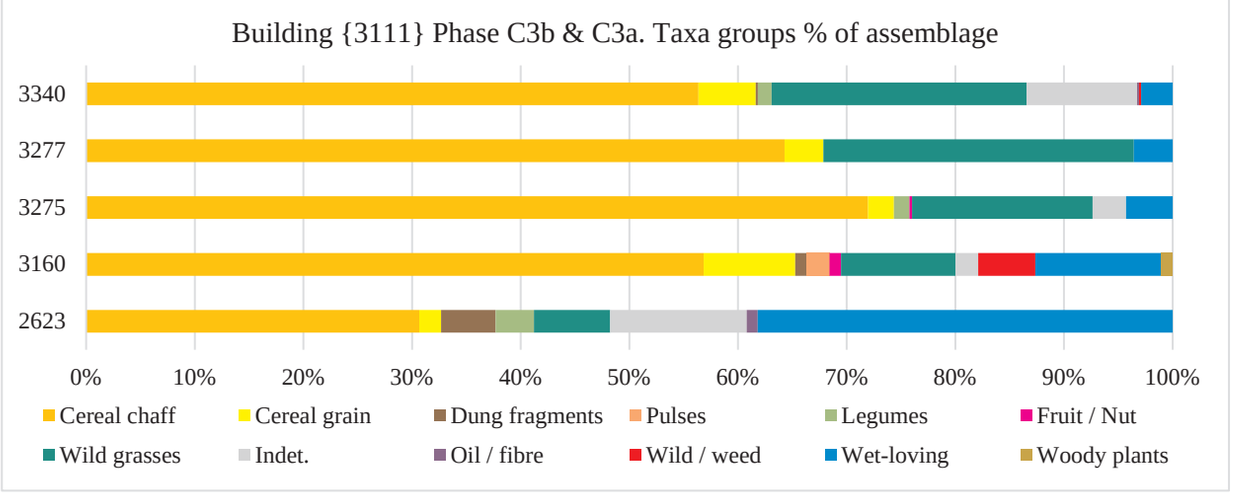

Fig. 6 Histogram of results from building {3111}, phase C3b & C3a

[24] See also Jarmużek *et al.* 2020 (in this volume), figs 18, 20, 22.

[25] Jarmużek *et al.* 2020 (in this volume)

[26] Jarmużek *et al.* 2020 (in this volume)

[27] Jarmużek *et al.* 2020 (in this volume)

mary fuel, mixed with cereal processing by products. The external fireplace (2623) has a very different assemblage, with far more seeds of wet-loving species present (Cyperaceae family). The cereal chaff elements in this sample were degraded, which might be indicative of having passed through the gut of a ruminant. It is possible that the fuel used in this fireplace was a mix of wood (charcoal) and animal dung, and that the animals had consumed cereal processing by-products. The cyperaceae seeds may therefore be present either because the crops were grown in wetter fields and contained many sedges, or that the animals had been grazing along water-courses.

Building {2147}. Phase C3 (table 7, fig. 7).[28]
Building {2147} is one of the more completely preserved, and extensively excavated houses on the Tell, the remains are placed within phase C3-C2. A number of units from the early occupation of the building (phase C3) were sampled: an ashy dump (2223) in bin [2221],[29] a fireplace (2614),[30] the fills

Table 7. Table of results from building {2147}, phase C3.

Building {2147}. Phase C3. Taxa groups items per litre															
Strat. Unit	Cereal chaff	Cereal grain	Dung frags.	Pulses	Legumes	Fruit / Nut	Wild grasses	Indet.	Wild / weed	Wet-loving	Woody plants	Total Items	Vol.	Average IPL	ml / L of wood charcoal
2668	55.08	3.38	1.08		1.08	0.15	8.15	11.54	0.46	3.38	0.46	551	6.5	84.77	6.15
2649	26.3	1.9	0.3		1.7	0.2	6.4	7.9	1.6	1.6		479	10	47.9	0.8
2614	18.89	0.44	4.22	0.22	0.22		1.56	4.22	0.22	4		153	4.5	34	3.33
2610	51.33	4.33			0.67	0.33	6.33	2.67	0.67	5		214	3	71.33	2
2223	17.45	6	1.64		2.18	0.36	9.82	15.64	2	5.45		333	5.5	60.55	1.09
2216	16	20						4		8		12	0.25	48	1.2
2213	28.25	2.5	12.38	0.25	2.88	0.38	4.5	16.25	0.75	5.62	0.38	593	8	74.13	1

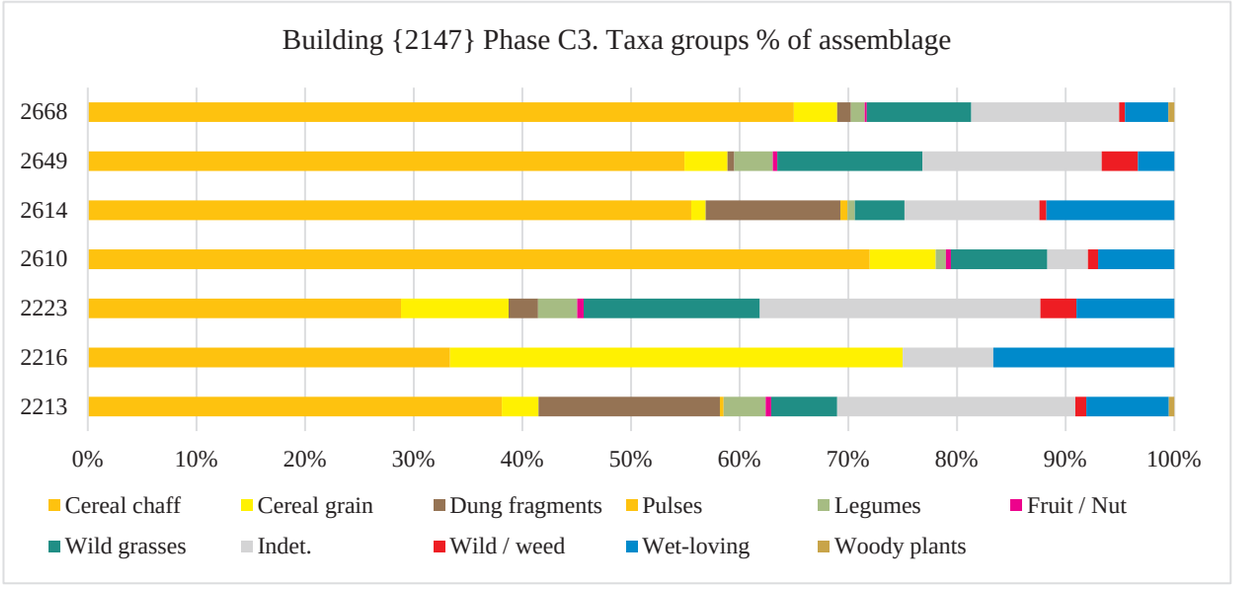

Fig. 7 Histogram of results from building {2147}, phase C3.

[28] See also Jarmużek *et al.* 2019, figs 13 and 14
[29] Jarmużek *et al.* 2020 (in this volume)
[30] Jarmużek *et al.* 2019, 55

in two storage vessels (2213)[31] & (2668)[32] (generic dumping waste), and a dumping layer above the features (2216)[33] in room 1, the fill of storage vessel in room 4 (2610),[34] and the fill of a vessel (2649) in the courtyard (more generic dumping waste).

There is no obvious pattern to the assemblages in these units. Only (2614) is a primary in-situ burning feature (fireplace). The remaining features are all tertiary dumping of waste and therefore, as would be expected, do not contain particularly high densities of items per litre or wood charcoal, although the vessel (2668) contained a relatively high density of items (85 items per litre), and more wood charcoal (6 ml / L). As with the samples from building {3111}, the assemblages all contained wet-loving plant seeds, but, as usual, were all dominated by cereal chaff remains.

Building {2147} Phase C2b (table 8, fig. 8).[35]
The use of spaces within building {2147} changed after several walls collapsed, room 1 fell out of use, room 2 was added, and an open (courtyard) space between buildings {2147}, {2664} and {1095} came into use (sub-phase C2b2).[36] Slightly later (sub-phase C2b1) this space filled with debris.[37] The courtyard space attached to {2147} contained an oven [2677], filled with ash (2691), surrounded by a dump of ashes from the oven (2678) – both of which were sampled, as was a small fireplace (2625) located 3 m south of the oven.[38] Both the fill (2691) and dump (2678) from the oven contained large quantities of charred sheep / goat dung pellets and indeterminate heavily charred (vesicular) cereals ("indet"). It is unlikely that the cereals derive from the caprid dung, and so they may (like the ovens in phase C5) represent accidental burning of cereals during roasting, or deliberate disposal of infected or infested grains. Room 3 in this building had a sequence of thin floor layers, including (2577) and (2582). The (perhaps surprisingly) ashy nature of these floor units (240 / 321 items per litre) may be explained by the presence of three small walled fireplaces: [2648] filled with ash (2647), [2572] filled with ash (2571) and [2628] filled with ash (2627).[39] All three of these fireplace deposits had large quantities of wood charcoal (20–70 ml / L), indicating that wood was perhaps the primary fuel. All five of these units in room 3, the floors and fireplaces, contained relatively similar homogenous assemblages dominated by cereal chaff, vesicular (indet.) cereals, and wild grasses (predominantly *Lolium* sp.). The one major difference was that the two floor layers (2582) & (2577) both contained large quantities of very small-seeded weedy taxa specimens, of as-yet unidentified species.

Two floor units from the later sub-phase C2b1 were sampled: (2212) from the courtyard space, and (2723) from room 3. Both samples contained a similar generic mix of cereal processing by-products, although (2723) did also contain two fragments of date stone (*Phoenix dactylifera*).

Building {2664}. Phase C3 and C2b (table 9, fig. 9).[40]
One small corner of building {2664}, which lies to the east of {2147} was excavated during the 2017 and 2019 seasons.[41] Two floors (2711) & (2732), and a dumping layer (3263) from the earlier occupation phase (C3), and two ashy dumping layers from the end of use of the building (phase C2b) (2681) & (2674)[42] were sampled. All these units represent tertiary dumping of waste or scatters of debris on floors, but some of them did have high densities of charred plant remains ((2674) had 334 items per litre), but low quantities of wood charcoal (0.4 – 6 ml / L). The ashy dump layers (2674) & (2681) were the richest in plant remains, with large quantities of heavily charred vesicular cereal grains ("indet" in the charts). The assemblage in (3263) does not suggest that is was a primary burning feature, but it may well be secondary dumping of ashes from perhaps a kiln: a pot-sherd with bronze slag attached was found within the building.[43] The sample contained a notable quantity of scilified plant material – suggesting perhaps a higher burning temperature, and the higher quantity of wood charcoal (almost 6 ml / L) might indicate a preference for wood fuel.

31 Rzepka *et al.* 2017, 56; Jarmużek *et al.* 2019, 55
32 Jarmużek *et al.* 2019, 57
33 Rzepka *et al.* 2017, 57; Jarmużek *et al.* 2019, 57
34 Jarmużek *et al.* 2019, 57
35 See also Jarmużek *et al.* 2019, figs 14 and 25
36 Jarmużek *et al.* 2019, 60–61
37 Jarmużek *et al.* 2019, 65–66
38 Jarmużek *et al.* 2019, 62
39 Jarmużek *et al.* 2019, 62
40 See also Jarmużek *et al.* 2019, figs 13 and 14
41 Jarmużek *et al.* 2019, 52–53
42 Jarmużek *et al.* 2019, 52
43 Jarmużek *et al.* 2019, 53

Table 8. Table of results from building {2147}, phase C2b.

Building {2147}. Phase C2b. Taxa groups items per litre.																
Strat Unit	Cereal chaff	Cereal grain	Dung frags.	Pulses	Leg-umes	Fruit / Nut	Wild grass-es	Indet.	Oil / fibre	Wild / weed	Wet-loving	Woody plants	Total Items	Vol.	Aver-age IPL	ml / L of wood char-coal
2723	84.5	7.5	1	0.5	7	0.5	18.5	13.5		2.5	6.5		285	2	142.5	6.5
2691	54.67	18.22	357.78		10.22		74.22	444.44		0.44	16		2196	2.25	976	0
2681	52	1			2.5	0.75	9.75	50.5		1	6.75		497	4	124.25	2.5
2678	88.89	16.22	97.11		11.56		46.44	152.89	0.22	7.56	62.22		2194	4.5	487.56	1.11
2647	148.67	14	1.33	0.67	2	0.67	44.67	192.67	1.33	1.33	5.33		619	1.5	412.67	20
2627	103.5	7.5	2		4.5		17.5	50		0.5	32	1.5	438	2	219	30
2625	68	3.33	0.67	1.33	3.11	0.22	22.22	37.78			2.22		637	4.5	141.56	3.33
2582	93.67	15	0.33		8		125.67	5.67		34.33	37.33	1.67	965	3	321.67	2.67
2577	118.75	10.25	2.75	1	14.25	1.25	28.75	7.5	0.25	37.5	16		963	4	240.75	6.25
2571	392.5	42.5	6.67	3.33	17.5	2.5	80	79.17			49.17	5	814	1.2	678.33	73.33
2212	25.4	2.6		0.4	1.4	0.4	3.4	12.2			0.8		233	5	46.6	0.8

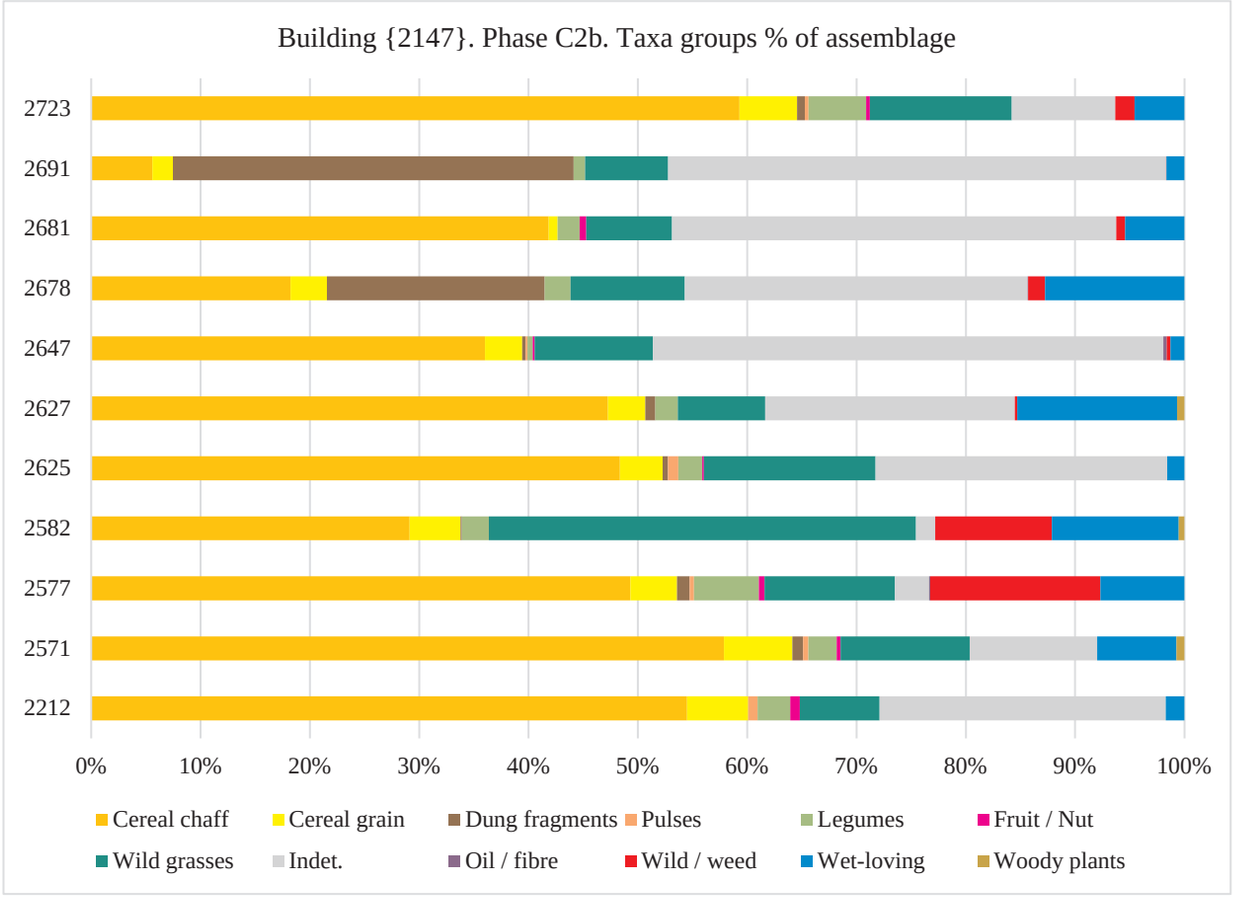

Fig. 8 Histogram of results from building {2147}, phase C2b.

Table 9. Table of results from building {2664}, phases C3 – C2b.

Building {2664}. Phase C3 – C2b. Taxa groups items per litre															
Strat. Unit	Cereal chaff	Cereal grain	Dung frags.	Pulses	Leg-umes	Fruit / Nut	Wild grasses	Indet.	Wild / weed	Wet-loving	Woody plants	Total Items	Vol.	Aver-age IPL	ml / L of wood char-coal
3263	31.53	1.88	0.47		2.82		8	2.35		44.71		195	2.125	91.76	5.88
2732	45	0.75		0.5	1.25	0.5	3.25	25.75		1		312	4	78	3.75
2711	31.8	4.4	3.2		1		6.8	18	0.4	3.4		345	5	69	1.4
2681	52	1			2.5	0.75	9.75	50.5	1	6.75		497	4	124.25	2.5
2674	107.8	5.4	3.8		7.2	0.6	35.4	159.4	2	12	0.4	1670	5	334	0.4

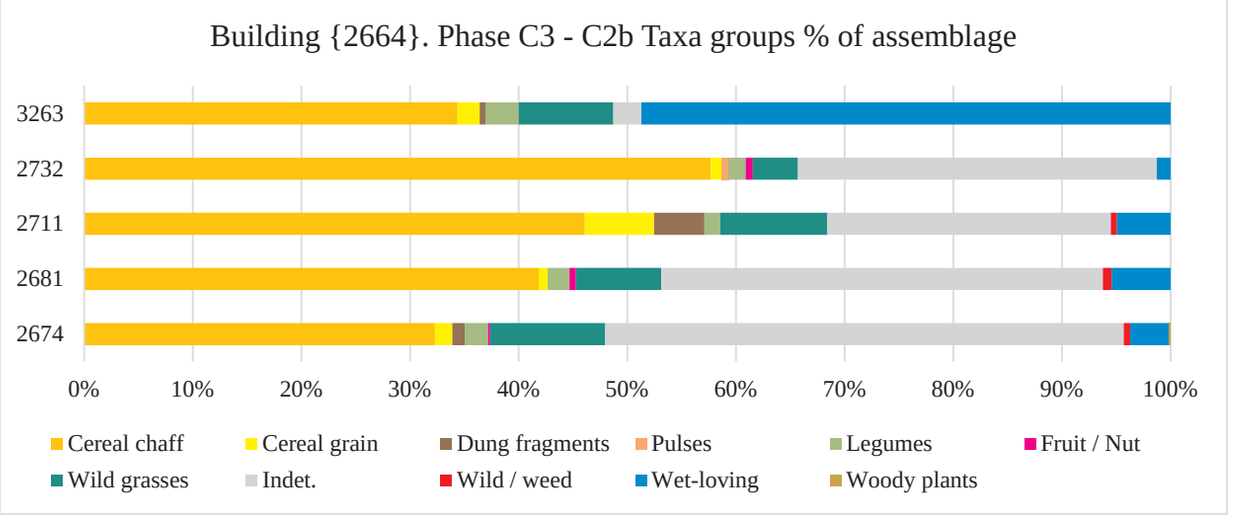

Fig. 9 Histogram of results from building {2664}, phases C3 – C2b.

Buildings {2640} and {3118}. Phase C3 (table 10, fig. 10).[44]

Building {3118} lies to the north-west of building {3111} with a passage running between the two, building {2640} abuts {3118} to the north-east.[45] Most of these buildings are in the early stages of excavation but it has been established that {2640} was first constructed during phase C4 (possibly earlier), and building {3118} was constructed during phase C3 on the ruins of {3200} (which dates to at least phase C4).

Samples from these buildings derive from: building {2640}, room 3 floor (3374); building {3118} room 2 ashy dumping layer (3301) in bin [3302], and 2 pot fills (generic waste) (3167) & (3187).[46] All these units represent tertiary dumping and scattering of waste. Unit (3301), the ashy dump in a bin room 2 of building {3118} quite clearly contains a very different type of assemblage. The sample was exceptionally rich in plant remains (1262 items per litre) and consisted almost entirely of charred sheep / goat dung pellets and indeterminate (heavily charred) cereal grains with some cereal chaff – similar to the oven in building {2147} (units (2678) & (2691)). All other samples from these building reflect the same kind of pattern as is found in the Third Intermediate Period samples – cereal chaff, a few cereal grains, wild grasses and some wet-loving plant seeds / nutlets.

[44] See also Jarmużek *et al.* 2020 (in this volume), figs 18, 19, 22

[45] Jarmużek *et al.* 2020 (in this volume)

[46] Jarmużek *et al.* 2020 (in this volume)

Table 10. Table of results from buildings {2640} & {3118}, phase C3.

Buildings {2640} & {3118}. Phase C3. Taxa groups items per litre															
Strat. Unit	Cereal chaff	Cereal grain	Dung frags.	Pulses	Leg-umes	Fruit / Nut	Wild grasses	Indet.	Wild / weed	Wet-loving	Woody plants	Total Items	Vol.	Aver-age IPL	ml / L of wood char-coal
3374	43.75	4		0.5	0.25		2.75	1.25	0.5	4.25		229	4	57.25	2.25
3301	196.15	499.04	480.77		3.37		72.12			10.1	0.96	2626	2.08	1262.5	4.8
3187	27.43	2.71	0.57	0.29	0.43	0.14	4.71	1.43	0.57	8	0.14	325	7	46.43	1.93
3167	27.5				0.5		6.25			2.75		148	4	37	1

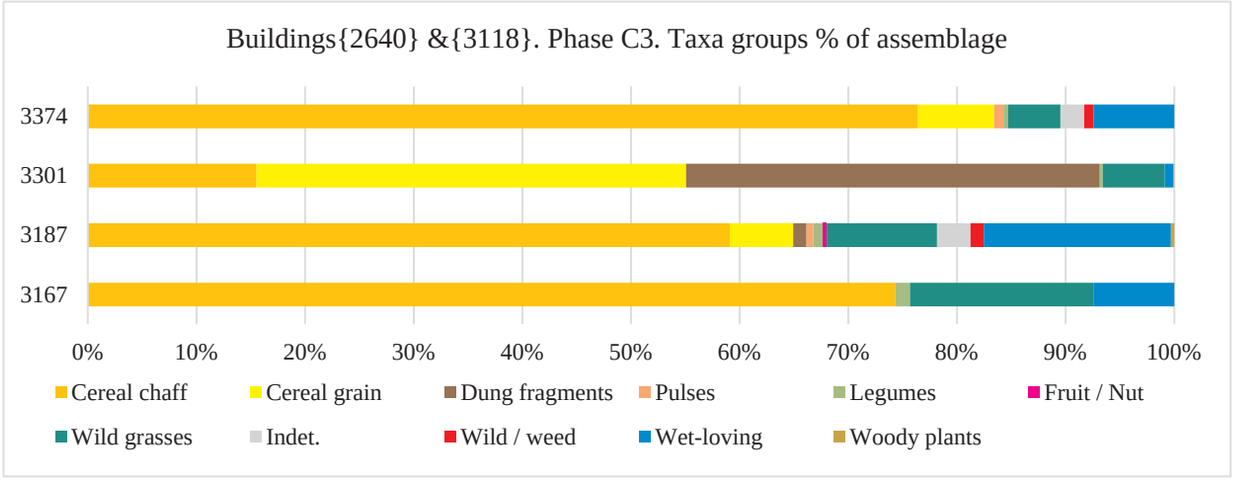

Fig. 10 Histogram of results from buildings {2640} &{3118}, phase C3.

Table 11. Table of results from building {3143}, phase C3 & C2.

Building {3413}. Phase C3 & C2. Taxa groups items per litre												
Strat. Unit	Cereal chaff	Cereal grain	Pulses	Leg-umes	Fruit / Nut	Wild grasses	Indet.	Wild / weed	Wet-loving	Total Items	Vol.	Average IPL	ml / L of wood charcoal
3377	66.67	3.56	0.67	3.11	0.44	13.11	1.78	0.67	4.67	426	4.5	94.67	2.67
3360	16	3.76	0.47	1.65		2.35	0.71	0.71	1.65	116	4.25	27.29	1.65
3177	4.25	0.25		0.25		1.25			0.5	26	4	6.50	1.25

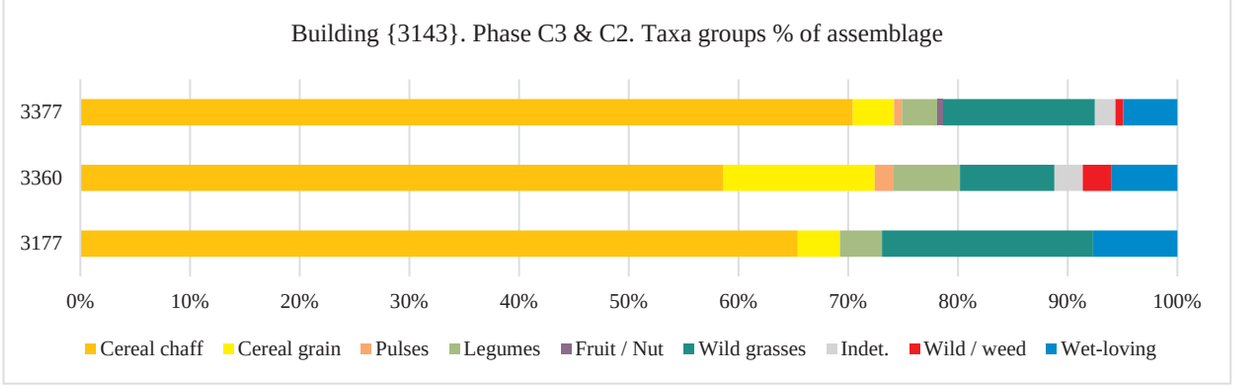

Fig. 11 Histogram of results from building 3143}, phase C3 & C2.

Building {1599} phase C3 & building {991} Phase C3 and C2 – reported in 2015.[47]

Building {3143}. Phase C3 & C2 (table 11, fig. 11).[48]

Building {3413} abuts building {2199}, both of which are located on the north side of an east-west street to the north of buildings {2147} / {2664}.[49] It was established at least during phase C4, but excavations are in their early stages, and to-date only three samples have been recovered. From phase C3 room 1, two dumping layers (3360) and (3377) were sampled, and from phase C2 a floor (3177) in room 2 was sampled. The floor, unsurprisingly contained very few plant remains. What is noteworthy about these samples – considering the identification of this space as a manger,[50] and the presence of urine-soaked floors – is the total lack of dung (of any kind) in the assemblages. But, it has to be remembered that only fuel remains are present in the samples, this is not a reflection of use of the space, but a reflection of the post-"occupation" dumping of waste.

Building {2196}. Phase C2a (table 12, fig. 12).[51]

After building {2147} fell out of use, buildings {2196} and {2227} were constructed above the ruins, following a similar plan.[52] Two bins [2204] & [2202] were discovered in room 2, each filled with ashy debris (2203) & (2201), and a thin floor layer (2205) built up around the bins.[53] One thin

Table 12. Table of results from building {2196}, phase C2a.

Building {2196}. Phase C2a. Taxa groups items per litre																
Strat. Unit	Cereal chaff	Cereal grain	Dung frags.	Pulses	Leg-umes	Fruit / Nut	Wild grass-es	Indet.	Oil / fibre	Wild / weed	Wet-loving	Woody plants	Total Items	Vol.	Aver-age IPL	ml / L of wood char-coal
2205	73.78	7.33	5.11	1.78	6.67		12.89	7.33	0.22		4.89		540	4.5	120	1.11
2203	21.75	4.25	9.75		5	0.75	6.25	34.75		5.5	15.75		415	4	103.75	1.25
2201	24	2.44	4.67	0.67	1.56	0.22	4.44	4.22		0.22	4.22		210	4.5	46.67	0.44
2195	18.2	0.8	1.2		0.6		3.8	9.2			0.6		172	5	34.4	0.2
2194	33.6	10.4	1290.4	2.4	135.47	0.53	32.27	88		11.73	527.47	0.53	7998	3.75	2132.8	1.42

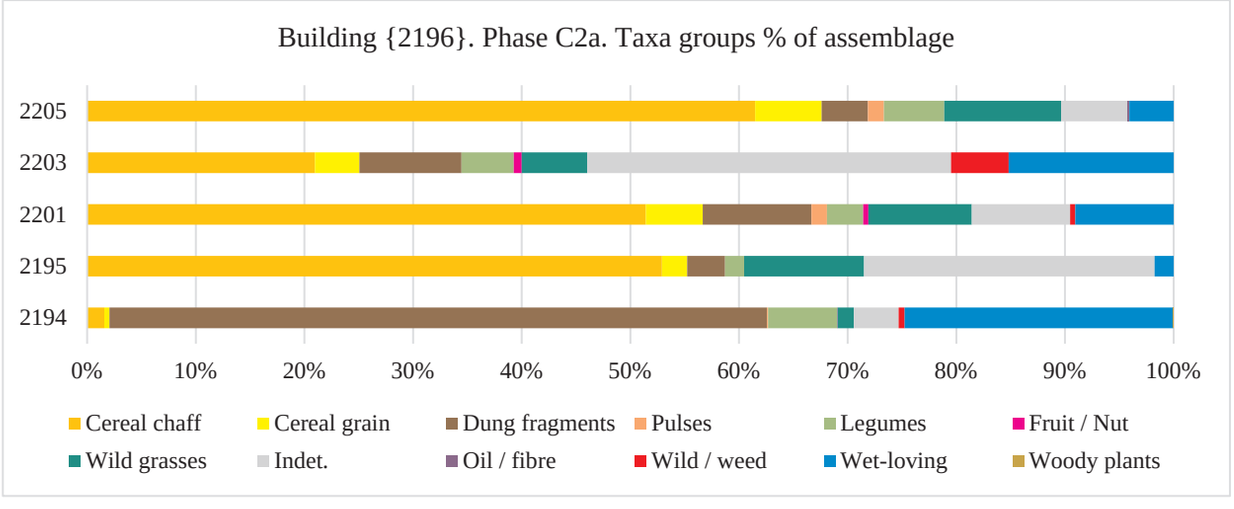

Fig. 12 Histogram of results from building {2196}, phase C2a.

[47] Malleson 2015, 187–189

[48] See also Jarmużek *et al.* 2020 (in this volume), figs 18, 21, 22, 36

[49] Jarmużek *et al.* 2020 (in this volume)

[50] Jarmużek *et al.* 2020 (in this volume)

[51] See also Jarmużek *et al.* 2019, fig. 30

[52] Rzepka *et al.* 2017, 64–66; Jarmużek *et al.* 2019, 70–71

[53] Rzepka *et al.* 2017, 65–66

floor layer (2195) was sampled from room 3, which occupied the northern part of the vacant space between building {2147} and building {1095}.[54] Various features in room 1 suggest the presence of an oven,[55] and the room gradually filled with ashy debris, including unit (2194) from which samples were excavated in 2016 and 2017.

The contents of bin [2202] – unit (2201) – and the floor (2205) contain very similar and typical assemblages (primarily chaff, *Lolium* sp., vesicular cereals, and sedges) and the floor in room 3 (2195) was much the same. The fill of bin [2204] – unit (2203) – contained large quantities of heavily charred vesicular (indet.) cereals, and much less chaff – suggesting a different source for the debris dumped within it. The contents of the thick ashy layer (2194) in room 1 may very well add to the evidence for an oven in this room. The ashy layer consisted almost entirely of charred sheep / goat dung pellets. The number of fragments recorded does not reflect the true picture, as the amount was so large it was almost impossible to quantify. The wet-loving species seeds present was almost all nutlets of *Eleocharis* sp. (spikerush), and *Fimbrystillis bisumbellata* (annual fimbry). These seeds are sometimes found in the caprid dung pellets, so the specimens in these samples most likely all derive from the dung in the oven – indicating that the sheep / goats whose faeces was used as fuel had quite probably been grazing along local watercourses, or had been fed specifically gathered plant forage.

Building {2227}. Phase C2a (table 13, fig. 13).[56] As noted above, building {2227} was constructed above the ruins of the west side of building {2147}. In the north-eastern corner of room 1 an ash filled cut (units (2537) & (2539)) was interpreted to be the base of an oven, and a second ash feature (unit (2544)) was thought to be the remains of a fireplace in the centre of the room.[57] This fireplace was exceptionally rich in remains (3075 items per

Table 13. Table of results from building {2227}, phase C2a.

Building {2227}. Phase C2a. Taxa groups items per litre															
Strat. Unit	Cereal chaff	Cereal grain	Dung frags.	Pulses	Legumes	Fruit / Nut	Wild grasses	Indet.	Oil / fibre	Wild / weed	Wet-loving	Total Items	Vol.	Average IPL	ml / L of wood charcoal
2544	157	36	2161	3	75		69	132	2	18	422	3075	1	3075	10
2539	20.8	1.8	1.2	1.8	3.2	0.2	2.4	8.8		0.4	7.4	240	5	48	2.4
2537	7.75	0.5	1	0.75	0.5		3	1.75		0.5	62.25	324	4	81	0.75

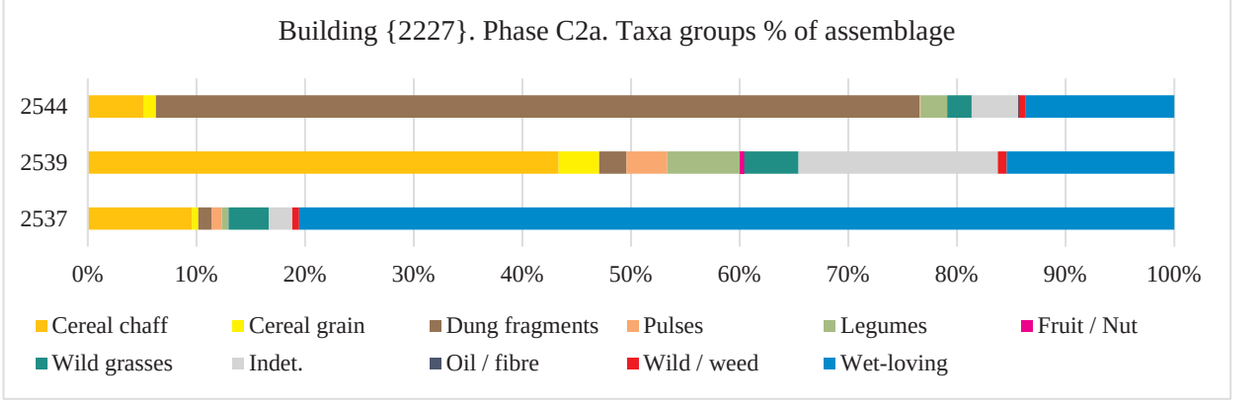

Fig. 13 Histogram of results from building {2227}, phase C2a.

[54] Rzepka *et al.* 2017, 66; Jarmużek *et al.* 2019, 71
[55] Rzepka *et al.* 2017, 65; Jarmużek *et al.* 2019, 71
[56] See also Jarmużek *et al.* 2019, fig. 30
[57] Jarmużek *et al.* 2019, 69

litre), and contained 10 ml / L of wood charcoal, as well as a significant quantity of fragmented sheep / goat pellets alongside large quantities of *Eleocharis* sp. nutlets – suggesting a similar fuel choice (and diet of animals) to the potential oven in room 1, building {2196} (see above). The sample from one of the layers in the oven (unit (2537)) was totally overwhelmed with *Fimbrystillis* sp. (not *F. bisumbellata*) nutlets, possibly *F. ferruginea*.[58] Several other samples from Tell el-Retaba have massive quantities of *Fimbristyllis* sp. (usually *F. bisumbellata*); (809) 19th dynasty kiln / oven,[59] (1959) 19th dynasty fireplace, (1031) 20th dynasty fireplace,[60] and (1064) Third Intermediate Period (phase C3 building {991}) kiln / oven.[61] In most cases the samples also contained significant quantities of caprid dung. This very nicely illustrates a consistent pattern of foraging goats / sheep in the vicinity of the site along water-courses or – gathering of these plants for fodder, and use of their dung as fuel.

Building {1095}. Phase C2 (table 14, fig. 14).[62]
Building {1095} lies to the east of {2147}/{2196}, and currently is understood to have been established during the earlier part of phase C2b.[63] It's use continued into phase C1 (see below). Several floor layers were sampled: room 1 (2183) & (2100), room 3 (2093) & (2114), and room 4 (2116).[64] These floors contained relatively large quantities of ashy debris, with 92 – 164 items per litre, but, not much wood charcoal. It is worth noting that the floor layer in room 4 contained a lower relative quantity of dung fragments (see histogram). Interestingly – given this fact – room 4 was the only room that appeared to contain any in-situ burning features; units (2153) & (2154) were both identified as fireplaces.[65] Both of these units primarily contained cereal processing waste (chaff), and – like the floor – almost no dung fragments. They did not contain much wood charcoal, suggesting perhaps that cereal processing waste may have been the primary fuel utilised in this room. Three (ashy) dumping layers were sampled from room 4 (2113) & (2156), and room 1 (2217), that mark a short period of abandonment of the building.[66] (2113) contained a very high density of remains (236 IPL), predominantly cereal chaff, but also wild grasses and (indet.) vesicular cereal grains, and may be a more "secondary" dump from an oven.

Building {1095}. Phase C1 (table 15, fig. 15).[67]
Following the abandonment, building {1095} came back into use, and the layout of the rooms changed very little during phase C1.[68] One fireplace in room 1 (2208), and a possible fireplace in room 5 (3214) were sampled, as well as a floor layer in room 4 (2090) and one ashy dumping layer from within room 3 (2071).[69] There are significant differences between these four assemblages. The fireplace (2208) was filled with fragmented dung, and in this instance it was not clearly identifiable as sheep / goat pellets. There were minimal quantities of seeds / grains / chaff, indicating that the diet of the animals responsible for the dung had not included any plants with elements that survive digestion – perhaps they consumed primarily fresh culms or soft leafy green plant parts.

The floor layer (2090) very unusually contained a large quantity of charred tuber fragments, possibly *Cyperus esculentus* or *C. rotundus*. The fireplace (2627) in phase C2b building {2147} (see above) also contained a surprisingly large quantity of these items, and a fireplace (977) dating to the 20th dynasty (phase D2) in building {834}.[70] The presence of occasion high densities of tubers may indicate either the charring of these items due to the plants growing in cereal crops and the tubers becoming incidentally mixed with cereal processing by-products, or possibly occasional accidental charring during the process of roasting tubers for human consumption. It is unlikely that they would survive the digestion process of any mammal, so they are unlikely to derive from the dung-fuel pathway into the assemblage. The tubers of *Cyperus esculentus* are one of the most ancient food-sources in Egypt, they are still consumed today,

58 Tentatively identified in samples at Kom el-Hisn, see Wetterstrom & Wenke 2016
59 Malleson 2015, 181–183
60 Malleson 2015, 183–185
61 Malleson 2015, 187–189
62 See also Jarmużek *et al.* 2019, figs 25 and 30
63 Jarmużek *et al.* 2019, 64; see also Jarmużek *et al.* 2020 (in this volume)
64 Rzepka *et al.* 2017, 59–63
65 Rzepka *et al.* 2017, 61–63
66 Rzepka *et al.* 2017, 64
67 See also Rzepka *et al.* 2017, fig 89
68 Rzepka *et al.* 2017, 68
69 Rzepka *et al.* 2017, 68–70
70 Malleson 2015, 183–185

Table 14. Table of results from building {1095}, phase C2.

Building {1095}. Phase C2. Taxa groups items per litre																
Strat. Unit	Cereal chaff	Cereal grain	Dung frags.	Pulses	Leg-umes	Fruit / Nut	Wild grass-es	Indet.	Oil / fibre	Wild / weed	Wet-loving	Woody plants	Total Items	Vol	Aver-age IPL	ml / L of wood char-coal
2217	69.71	5.43	9.14		1.14	0.57	8.86	55.43			1.71		532	3.5	152	2.86
2183	61	11.5	9.5	3	4	1	28	44			2		328	2	164	5
2156	37.33	0.33	0.17	0.33	0.5		5.67	35.5	0.17		0.5		483	6	80.5	0.5
2154	27.11	1.56	0.22		5.11	0.22	14.22	23.33		2	11.56	0.22	385	4.5	85.56	2.22
2153	23.8	2.2			2		9.2	28			4		346	5	69.2	0.4
2116	45.7	7.5	0.2	0.6	4	0.6	17.1	13.6		0.7	11.9		1019	10	101.9	1.4
2114	53.5	7.75	6.5		5.75	0.5	23	23.25	0.25	1	17.25		556	4	139	1.25
2113	71.5	9.5	1.75		26.25	0.5	42.75	63.25		2.75	18.25		946	4	236.5	2.5
2100	38.5	0.75	2.75		3.75	0.5	13.75	23.5		0.25	8.75		370	4	92.5	3
2093	59	2.8	11		2.6	0.6	5.6	12.2	0.4	0.2	9		517	5	103.4	0.8

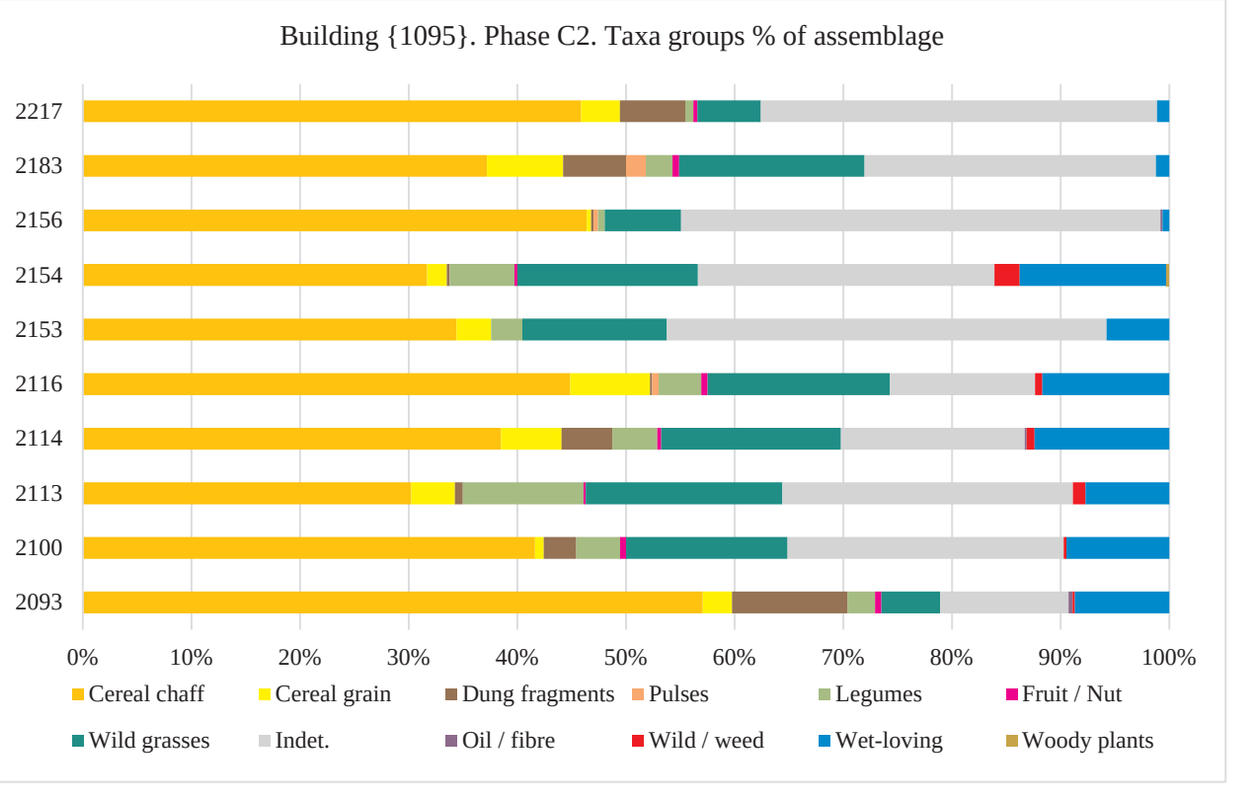

Fig. 14 Histogram of results from building {1095}, phase C2.

and are sometimes roasted.[71] The second (possible) fireplace (3214) only contained a small number of items, but, considering the size of sample and low number of charred seeds, the presence of 5 ml / L of wood charcoal might indicate that wood was the preferred fuel in this instance.

[71] Hillman *et al.* 1989, see p. 189 for roasting; Murray 2000, 636

Table 15. Table of results from building {1095}, phase C1.

Building {1095}. Phase C1. Taxa groups items per litre														
Strat. Unit	Cereal chaff	Cereal grain	Dung frags.	Leg-umes	Fruit / Nut	Wild grasses	Indet.	Oil / fibre	Wild / weed	Wet-loving	Total Items	Vol.	Aver-age IPL	ml / L of wood char-coal
3214	6.4	7.2				4.8	3.2				27	1.25	21.6	5
2208	7.6	0.8	211.2	4.4		23.2	25.2		6	6.8	698	2.5	279.2	0.2
2090	5.2	0.6	0.4	0.4		0.4	2.8	0.2		14	120	5	24	2.2
2071	57.8	6.2	4.4	1.6	0.4	10.4	35.4		0.2	11	637	5	127.4	6

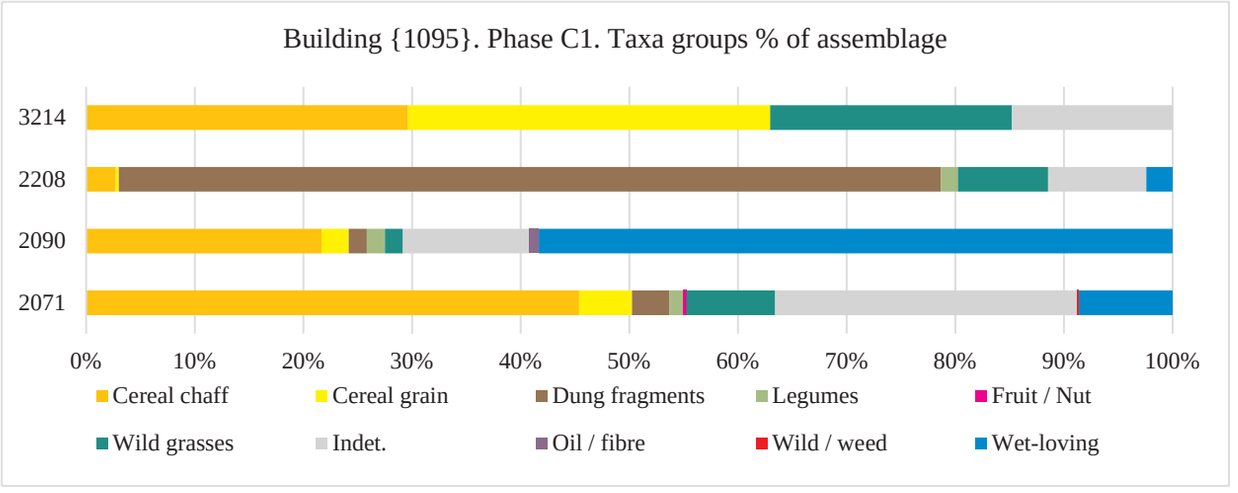

Fig. 15 Histogram of results from building {1095}, phase C1.

Building {1047}. Phase C2 & C1 (table 16, fig. 16).[72]

Building {1047} abuts building {991} to the west, and is only partially excavated. Two fireplaces (2120) & (2118) in room 1 (phase C2) and one floor (2115) in the same room (phase C1) were sampled.[73] All three samples contained a familiar mix of taxa. The two fireplaces were slightly different to each other: (2120) contained more dung and a broader range of weedy taxa – suggesting perhaps the use of dung from grazed animals alongside the primary wood fuel (24 ml / L). The floor layer contained a notable quantity of common fig seeds (*Ficus carica*). These were charred, and so must derive from scattering of fuel ashes, but fig seeds are not especially common on the site, and this sample contained the largest number identified to-date. It has to be remembered that of course one fig contains thousands of "seeds" so this does not necessarily represent a large quantity of figs.

Building {2199}. Phase C2 and Building {2149}. Phase C1 (table 16, fig. 16)[74]

Building {2199} lies to the east of {3413} dates to at least phase C3, but has only very partially been excavated.[75] To-date just one unit has been sampled (generic waste fill in a pot (3162)) from phase C2. Only 11 items were present in the sample, and so at present it is not really possible to draw any conclusions.

Building {2149} was constructed on the ruins of {2147}, but only a small part of the building was preserved.[76] Two ashy dumping layers (2168) & (2141) from within room 1 phase C1 were sampled. These two dump layers contained quite different assemblages. (2168) – the lower layer[77] – contained

[72] See also Rzepka *et al.* 2017, figs 73 and 89

[73] Rzepka *et al.* 2017, 66–68

[74] See Jarmużek *et al.* 2019, fig. 30, and Rzepka *et al.* 2017, fig. 89

[75] Rzepka *et al.* 2017, 57; for phased plans see Jarmużek *et al.* 2019

[76] Rzepka *et al.* 2017, 70

[77] Rzepka *et al.* 2017, 71

Table 16. Table of results from building {1047}, phase C2 &C1.

Building {1047}. Phase C2 & C1. Taxa groups items per litre															
Strat. Unit	Cereal chaff	Cereal grain	Dung frags.	Leg-umes	Fruit / Nut	Wild grasses	Indet.	Oil / fibre	Wild / weed	Wet-loving	Total Items	Vol.	Aver-age IPL	ml / L of wood char-coal
2120	200	14.67	46.67	21.33	1.33	41.33	26.67		21.33	66.67	330	0.75	440	24
2118	216	22	3	16	6	51	28		3	34	379	1	379	10
2115	133.6	26.8	2.4	1.2	11.6	56.4	48.8	0.4		85.6	917	2.5	366.8	8

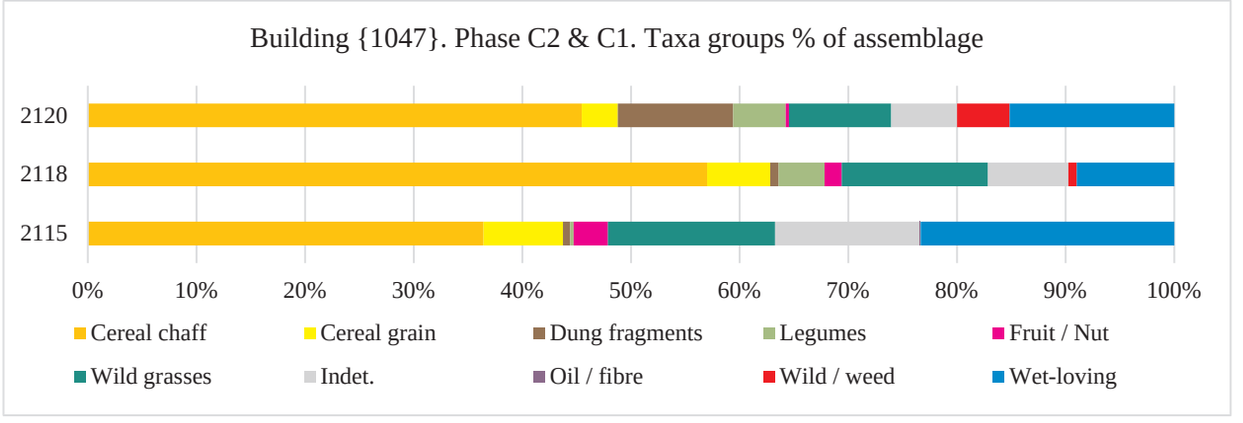

Fig. 16 Histogram of results from building {1047}, phase C2 & C1.

Table 17. Table of results from buildings {2199} & {2149}, phase C1.

Building {2199}, phase C2 & building {2149}, phase C1. Taxa groups items per litre															
Strat. Unit	Cereal chaff	Cereal grain	Dung frags.	Pulses	Leg-umes	Fruit / Nut	Wild grasses	Indet.	Wild / weed	Wet-loving	Woody plants	Total Items	Vol.	Aver-age IPL	ml / L of wood char-coal
3162	1.11	0.89			0.44							11	4.5	2.44	0.33
2168	36	6.4	170.4	4.8	41.6	0.4	42	61.6	1.2	342.8		1768	2.5	707.2	6
2141	47.33	8.67	2.44	2.67	8	1.11	22.89	58.44		55.33	0.44	933	4.5	207.33	2.22

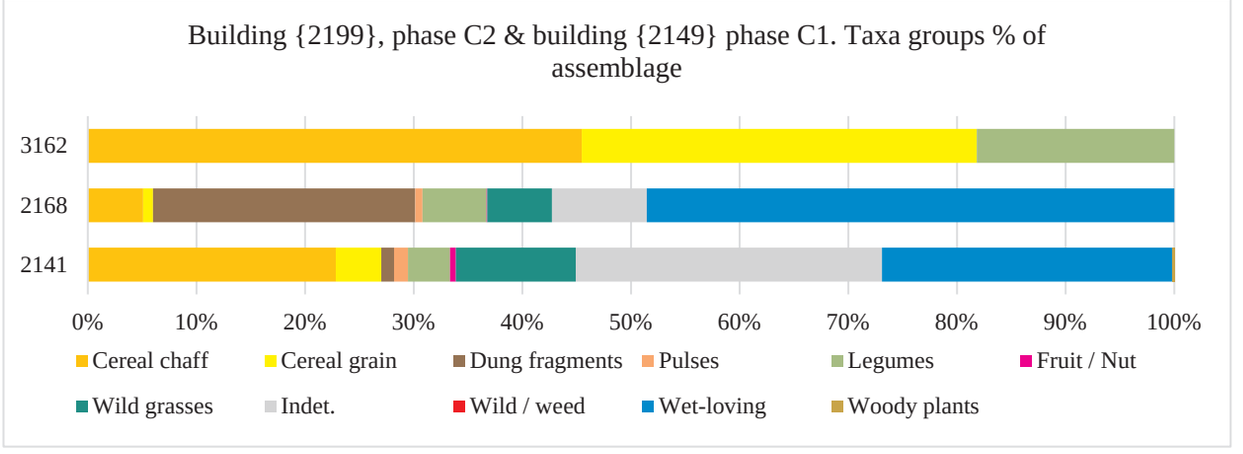

Fig. 17 Histogram of results from buildings {2199} & {2149}, phase C1.

a large quantity of fragmented sheep/goat dung pellets, and nutlets of wet-loving taxa (*Eleocharis* sp., and *Fimbrystillis bisumbellata*), notably also – relatively few cereal chaff elements. This follows a now-familiar pattern, indicating the dumping of fuel comprised of a mix of wood charcoal and dung from caprids that had been grazed alongside watercourse, or supplied with forage gathered from these locations. The upper dumping layer (2141)[78] contained a more generic mix of taxa: cereal chaff elements, vesicular (indet.) grains, wet-loving plants and wild grasses.

Discussion – routine practise and fuel choices at Tell el-Retaba

The value of this assemblage for the investigation of everyday activities (routine practise) in this settlement is very apparent when looking at the statistics. By analysing the assemblage using the classification of stratigraphic units into tertiary (3) / secondary (2) / primary (1) units it is immediately that the assemblages are almost uniform, showing that the materials from the dumping units (tertiary / secondary units including floors, dumps etc.) came from the primary units (fireplaces, ovens etc.). This homogeneity is exactly what is expected in an assemblage of charred plant remains from a settlement context.[79] Looking at all the Area 9 Third Intermediate period samples, the densities of items per litre vary quite considerably (see table 18), but the overall percentage of the assemblage of each taxa group is remarkably similar for each unit type classification (see fig. 18), the one – perhaps expected – difference being that the tertiary dumping / floors (3) all have lower quantities of identifiable dung fragments, which is almost certainly a result of the fact that the material in these units has been moved about / trampled causing the dung to fragment beyond recognition. Otherwise – the ratios of each taxa group are almost identical.

When examined carefully it is clear that the fireplaces and ovens (class 1) actually almost mirror the oven dumps, and ashy dumps (classes 2 and 2.5), while all the class 3 units – pot (fills), floors,

Table 18. Table of results from Area 9, Third Intermediate Period units

Taxa groups items per litre, classified by Tertiary (3), Tertiary / Secondary (2.5), Secondary (2) and Primary (1) feature types, Area 9, Third Intermediate Period																
Unit class	**Count of Units**	**Sample Volume**	**Total Items**	**Average IPL**	Cereal chaff	Cereal grain	Dung frags.	Pulses	Legumes	Fruit / Nut	Wild grasses	Indet.	Oil / fibre	Wild / weed	Wet-loving	Woody plants
3	**52**	**236.75**	**28602**	**120.81**	57.55	5.32	3.03	0.27	4.38	0.48	12.09	23.89	0.05	2.48	11.14	0.13
2.5	**20**	**74.115**	**32009**	**431.88**	118.64	25.89	58.07	1.05	20.16	1.42	41.21	71.6	0.47	4.95	56.25	0.2
2	**5**	**7.99**	**5135**	**642.68**	236.55	32.67	74.97	1.38	27.03	0.5	65.33	145.56	0.13	7.38	51.19	0
1	**28**	**63.9**	**25602**	**400.66**	104.27	28.34	64.66	1.5	21.06	0.5	34.68	63.85	0.22	7.43	42.72	0.2

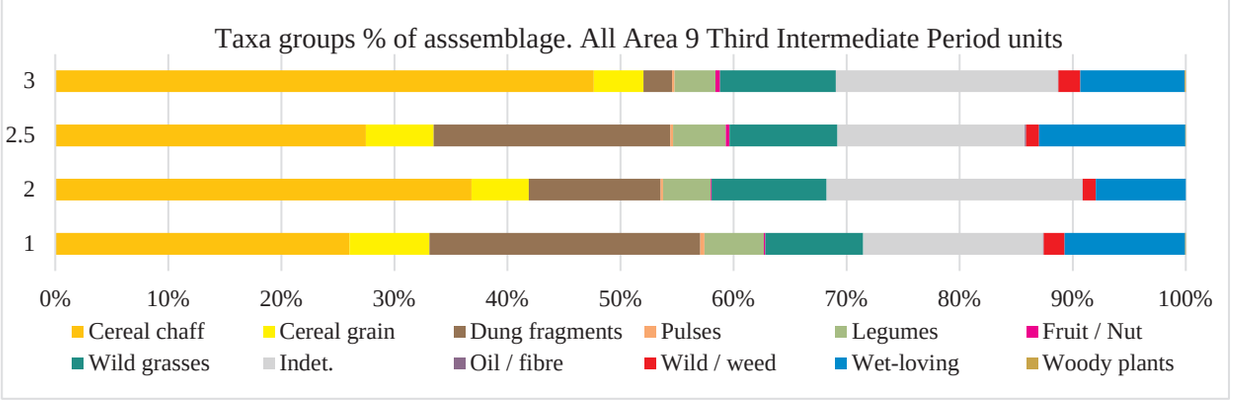

Fig. 18 Histogram of results from Area 9, Third Intermediate Period units

[78] Rzepka *et al.* 2017, 71

[79] Fuller *et al.* 2014, 179

and dumps – are generally similar (see table 19 and fig. 19). When the number of different units per type are taken into consideration – the one very obviously different unit type – Kiln – is represented by 1 unit only.

In order to understand fuel type choices, it is important to directly compare the quantities of

Table 19. Table of results from Area 9, Third Intermediate Period units

Taxa groups items per litre, classified by detailed feature types, Area 9, Third Intermediate Period																
Unit type (and class)	Number of Units	Sample Volume	Total Items	Average IPL	Cereal chaff	Cereal grain	Dung frags.	Pulses	Legumes	Fruit / Nut	Wild grasses	Indet.	Oil / fibre	Wild / weed	Wet-loving	Woody plants
Surface (3)	1	4	234	58.50	45.5	0.5	0.5		1		5	4.75		0.25	1	
Pot (3)	10	57.25	2716	47.44	27.58	1.94	2.08	0.1	1.1	0.16	4.68	5.34		1	3.32	0.14
Oven dump (2)	5	7.99	5135	642.68	236.55	32.67	74.97	1.38	27.03	0.5	65.33	145.56	0.13	7.38	51.19	
Oven (1)	8	15	10181	678.73	230.87	93.13	73.6	2	17.87	0.87	52.47	177.67	0.07	3.07	26.93	0.2
Kiln (1)	1	5	4242	848.40	10.4	0.8	400		141.6	0.2	32.6			70	192.8	
Floor – midden (3)	1	5	532	106.40	58	4.2	3.2	0.4	7.4		10	13.8			9	0.4
Floor – ashy midden (2.5)	4	14.5	5146	354.90	162.41	19.59	2.48	0.62	33.72	0.48	75.86	7.72	0.07	18.28	33.31	0.34
Floor (3)	23	105.5	8323	78.89	42.02	3.96	1.99	0.28	2.55	0.48	9.05	10.18	0.07	0.52	7.73	0.05
Fireplace? (1)	6	9.95	5349	537.59	102.81	10.25	238.99	0.9	12.06	0.7	31.06	37.29	0.4	2.81	100.2	
Fireplace (1)	13	33.95	5830	171.72	62.59	9.07	19.15	1.68	7.36	0.32	28.19	30.75	0.27	1.5	10.72	0.29
Dump – sandy (3)	1	4	488	122.00	81.25	3.25	0.75		3.75		14.75	12.75		3	2.5	
Dump – ashy (2.5)	16	59.615	26893	451.11	107.99	27.43	111.85	1.16	16.86	1.64	32.29	87.14	0.57	1.71	61.83	0.17
Dump (3)	16	61	16299	267.20	111.74	11.39	6.03	0.43	10.64	0.87	25.89	67.28	0.07	7.02	25.77	0.25

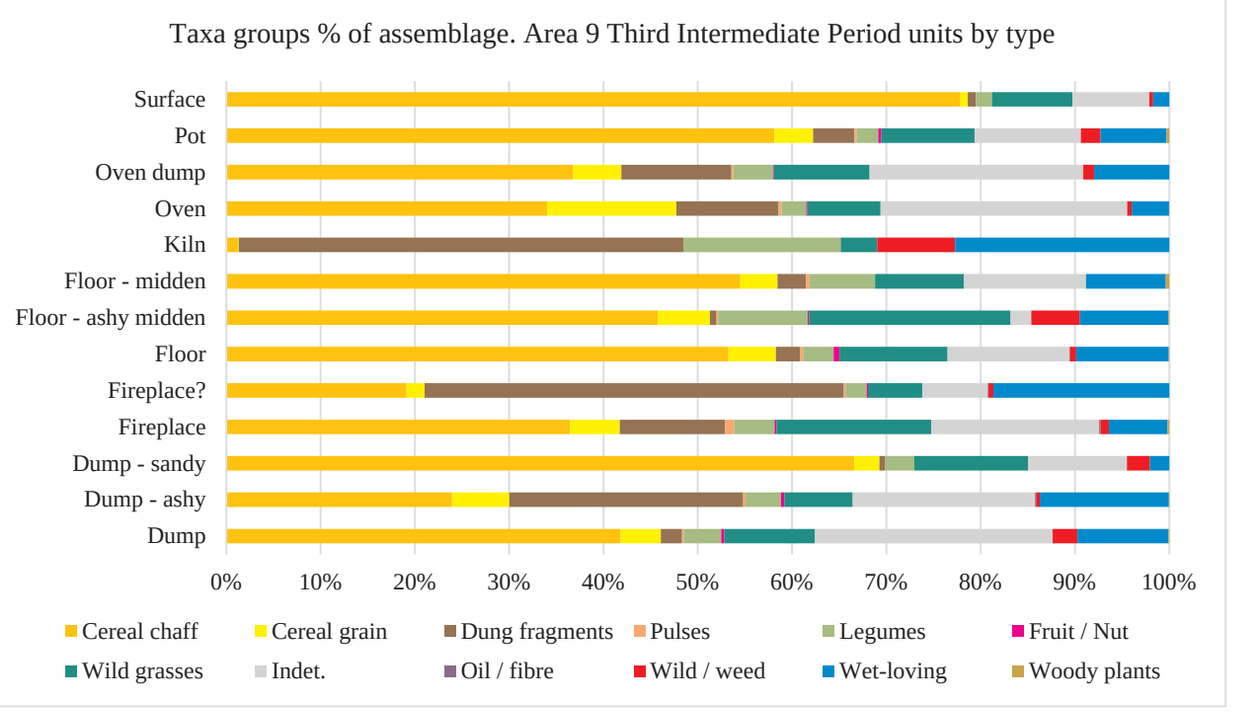

Fig. 19 Histogram of results from Area 9, Third Intermediate Period units

Table 20. Table showing wood charcoal and dung comparisons, Area 9 Third Intermediate Period

Unit type	Dump	Dump – ashy	Dump – sandy	Fire-place	Fire-place?	Floor	Floor – ashy midden	Floor – mid-den	Kiln	Oven	Oven dump	Pot	Surface
ml / L wood charcoal	3.85	3.03	1	13.65	7.84	2.32	5.71	2	0	15.68	13.24	2.38	1.75
IPL Dung	6.03	71.59	0.75	19.15	37.99	1.89	2.48	3.2	400.00	73.6	74.97	2.08	0.5

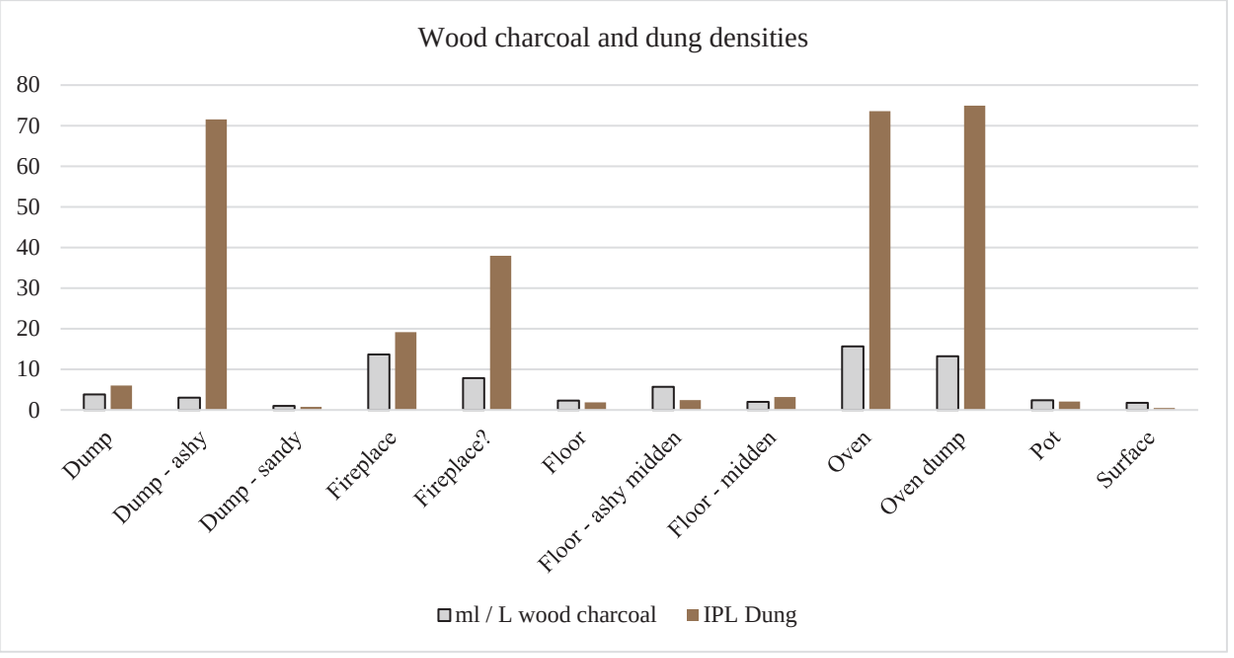

Fig. 20 Histogram showing wood charcoal and dung comparisons, Area 9 Third Intermediate Period

wood charcoal and dung in samples. The count of dung fragments is only a very rough reflection of the relative quantity of dung used as fuel, but the same can be said of wood charcoal, so a comparison between the two can be trusted to reveal some patterns. As might be expected the primary in-situ burning features (ovens, and fireplaces) and secondary features (oven dumps) all contain more wood charcoal than the tertiary features. What is interesting is that there seems to be a general preference for dung in the ovens when compared to the units identified as fireplaces. The apparent dominance of dung in ashy dumps is suggests that the ashes in these layers might derive from ovens, rather than household fireplaces. However, the major problem with assessing this assemblage in this general way is that for each unit type classification, there are outliers within each category. For example, the apparent dominance of dung in the uncertain fireplaces (five units included here) is caused by the mass of dung found in just two units – (1894) & (2544). The ovens appear to contain lots of dung, with the exception of two of the ovens (2537) & (2539) which contain almost no dung.

There is no clear pattern of fuel types associated with certain categories of installation. Conclusions reached in 2015[80] which were based on a much smaller number of samples suggested that there might be a pattern of preference for dung in "larger installations" (ovens / kilns), but that caution was needed due to several outliers in the data. The additional material now available clearly demonstrates the value of, and need for consistent and extensive sampling policies in archaeobotany in order to properly appreciate the diversity and nuances in ancient routine practises.

The ovens in phase C5 are, at present rather isolated and their full context and relationship to other buildings is not yet understood, but it is clear that in the earliest phase of use (units (3181) &

[80] Malleson 2015, 194–196

(3189)) a large quantity of cereal grains were perhaps accidentally burned, possibly through a parching / roasting accident. It is also possible that these were grains that had become infected (fungus) or infested (weevils) and were thus burned to dispose of them. If the grains are removed from the statistics, the assemblage clearly consists of dung pellets, cereal chaff, and grassy weed grains with lots of wood charcoal – suggesting the use of wood supplemented with dung and cereal processing by-products as fuel. This mix of fuel is found in the upper oven deposits (3150) & (3190), although again, there are differences as the uppermost layer contained almost no dung.

In phase C4, the remains of fuel in the fireplace (3268) in building {3111} clearly comprised of cereal processing by-products (emmer wheat chaff, *Lolium* sp. grains, and tiny as-yet unidentified weed seeds), with (as discussed above) a possible accidental charring of lentils. What this might represent is the use of by-products ("waste") produced by the routine cleaning of cereals in preparation for bread production in this household. This is remarkably similar to the charred fuel remains in building {1607} (reported in 2015). Two oven fills (1614) & (1615) and the surrounding oven dumps (1566) & (1616) all contained almost exclusively the "waste" from cleaning cereals (emmer wheat chaff and *Lolium* sp.). Like the ovens in phase C5, they did also contain significant quantities of heavily charred (vesicular / indeterminate) cereal grains, but – no dung. Oven (1894) however fits the dung-with-sedges pattern: charred fragmented sheep/goat pellets, nutlets of wet-loving plants and no wood charcoal.

A number of primary in-situ ash deposits were recovered from phase C3 buildings: fireplaces (3275) & (3277) in building {3111}, an external fireplace (2623), a fireplace (2614) in building {2147}, and the kiln (1064) in building {991} (reported in 2015). The fireplaces in building {3111} contained just cereal processing by-products (emmer wheat chaff and *Lolium* sp. grains), although (3277) contained so few remains overall it is not necessarily a statistically viable sample. Fireplace (2614) (building {2146}), also contained primarily charred emmer chaff, but also vesicular grains, and sheep / goat dung pellets with associated reed / sedge nutlets (*Eleocharis* sp.) suggesting a more homogeneous mix of fuels. The fuel in the unit identified as a kiln in the courtyard of building {991} – (1064) – was sheep / goat dung[81] with no wood charcoal noted at all. The diet of these animals consisted of gathered (possibly grazed) sedges (*Fimbrystillis bisumbellata* and cf. *Schoenoplectus* sp.), legumes (small seeded Trifolieae) and Bugloss (*Lithospermum* sp.).

In building {2147} the fuel in four fireplaces dated to phase C2 ((2647), (2627), (2625) & (2571)) consisted primarily of wood charcoal, mixed with some cereal processing waste, and – like the fireplace in phase C3 – significant quantities of vesicular cereal grains, suggesting possible parching / roasting accidents, or disposal of infected / infested grains. The oven and associated dump in the courtyard show a different pattern of fuel use more like the kiln in building {991} (see above): no wood charcoal and lots of sheep/goat dung. The difference being that – like many other units – these ovens also contained large quantities of heavily charred cereals (vesicular / indet.). The two layers identified as oven deposits in building {2227}– (2537) & (2539) – contained minimal quantities of wood charcoal and dung, but were clearly fuel with cereal processing waste, more like the ovens in phase C4, building {1607} (see above). Conversely, the fireplace in building {2227} contained lots of wood and dung (with associated wet-loving species nutlets). The fireplaces in phase C2 buildings {1047}, {1095}, {991} and {1539} all contain a mix of wood charcoal, cereal processing by-products (primarily chaff and wild grasses), alongside vesicular grains, and occasionally some dung. Fireplace (1010), like (3268) contained a notable quantity of charred lentils. The two phase C1 fireplaces differ a great deal to each other, but (2208) looked more like the Kiln, or Ovens (2691) / (1894) than any other unit – totally dominated by dung pellets.

Summary

This investigation shows that decisions regarding fuel for cooking, baking and possible industrial activities at Tell el-Retaba in the Third Intermediate Period varied a lot. Cereal processing by-products, dung pellets from sheep / goats, and wood were all utilised in varying quantities. The analy-

[81] Malleson 2015, 189

sis of these fuel assemblages also reveals other aspects of life in the town.

There does seem to be a correlation between abundance of wet-loving taxa and caprid dung remains, indicating a pattern of grazing sheep and goats alongside watercourses, or foddering with gathered reeds / sedges, and the use of their dung as fuel. Often, but not always, the installations containing lots of dung, contain little or no wood charcoal. Generally speaking, cereal processing by-products are the most ubiquitous elements, suggesting that this "waste" was a major fuel source in the settlement, accompanied by either dung, or wood. It is important to note that the source of the cereal processing "waste" may be dung from ruminants (cattle). This is far harder to detect than caprid dung, and the possible use of chaff as dung-cake temper complicates the matter even further. It was noted in 2015[82] – and is still the case – that much of the cereal chaff is heavily degraded, and most seed / grain / nutlet specimens are also lacking diagnostic traits, suggesting the possibility that these elements may have passed through the gut of a ruminant. It is important to note that at other sites where cattle dung was identified as a primary fuel, seeds of clovers (Trifolieae tribe) are abundantly present, the conclusions being that the animals had been provided with specifically cultivated fodder crops of clover (*Trifolium alexandrinum*).[83] The quantities of these small-seeded legumes at Tell el-Retaba are minimal, especially during the Third Intermediate Period.

The patterns – or lack thereof – strongly indicate daily decision making, based on what was available and possibly what kind of temperature or duration of fire was needed. There is no indication of any level of organised provisioning of the kind that is frequently found at "state" settlements – this is a more "normal" village environment, in which human behaviour would have been less-prescribed, less-structured, and more reflective of the diversity of decision making processes.

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[82] Malleson 2015, 196

[83] Theories first introduced by Moens & Wetterstrom 1988; observed by Crawford 2003 at the nearby site of Tell el-Maskhuta; but questioned in Malleson 2016b

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