ARCHAEOBOTANICAL INVESTIGATIONS AT TELL EL-RETABA

Ramesside Fortresses and 3rd Intermediate Period Town (Area 9)
Polish-Slovak (PCMA) Mission Seasons 2010–14[1]

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Introduction

Tell el-Retaba is a major multi-period site located in the middle of the Wadi Tumilat, Egypt, c. 35 km west of Ismailiya. The site was first investigated by Naville in 1885, by Petrie in 1905 then by various other foreign and Egyptian missions throughout the 20th century[2]. It has been under investigation by a Polish-Slovak Mission (Polish Centre of Mediterranean Archaeology of the University of Warsaw) directed by Slawomir Rzepka and Jozef Hudec since 2007[3]. Excavations began in 2008, and were initially focussed on rescue work along the line of the modern road which cuts through the site, due to road-widening works[4]. The site dates from the Hyksos period through to the modern, consisting of Hyksos and 19th dynasty cemeteries, Hyksos and 18th dynasty settlements, 19th and 20th dynasty fortresses, and 3rd Intermediate Period – Late Period settlement remains[5].

There are not a great number of multi-period settlement sites in Egypt, and even fewer have undergone such extensive detailed excavations involving archaeobotanical research. Other sites include Qasr Ibrim[6] and Memphis (Mit Rahina)[7]. As such, this site offers a wonderful opportunity to investigate continuity and change in patterns of the use of plants within an ancient Egyptian settlement. This report will focus on the 19–20th dynasty fortresses buildings and 3rd Intermediate period settlement remains excavated within one excavation area of the site (Area 9).

The Ramesside fortress and 3rd Intermediate Period town at Tell el-Retaba

Over 5 seasons the Polish-Slovak Mission at Tell el-Retaba have excavated a large area of settlement remains within a fortified area, to the east of the modern road which cuts through the site. To date 15 structures/ discrete areas of activity have been recorded within Area 9[8], dated to 13 discrete phases (A–E3)[9]. See fig. 1.

The site was of major strategic importance throughout its history, with the Wadi Tumilat providing one of the only two land-routes between the Delta and the Sinai. The earliest settlement remains in this excavation area date to the 19th dynasty (there are some Hyksos tombs, but no contemporary settlement detected yet in this excavation area, evidence elsewhere on the site attests Hyksos and 18th dynasty occupation). Beneath the wall 1 foundations (in Area 4), burials[10] dating to the early 19th dynasty provide a *terminus post quem*, with ceramics associated with the walls themselves providing closer dating for the major fortifications. Wall 1 enclosed an area at least 300 m east-west and probably at least 200 m north-south. The core of these walls may have been first constructed in the reign of Seti I, but were completed, and then the barracks were constructed during the reign of Rameses II[11].

The Rameses II fortress fell totally out of use, and was in ruins by the 20th dynasty, although it is apparent that there was some occupation of the

1 The present study was carried out in the framework of a project financed by the Polish National Science Centre, grant no 2012/05/B/HS3/03748. Thanks to the Tell el-Retaba team, the Egyptian Ministry of Antiquities and all the inspectors who have been involved in this project. Thanks to Ł. Jarmużek for all the maps in the report.

2 Rzepka *et al.* 2009:241.

3 Rzepka *et al.* 2009; 2011; 2014.

4 An Egyptian mission, directed by Mustafa Nour El-Din, also carried out rescue excavations in this area see: Rzepka *et al.* 2012/2013.

5 Rzepka *et al.* 2009; 2011; 2014.

6 For discussions relevant to this report see Clapham & Rowly-Conwy 2007; Copley *et al.* 2004.

7 For discussions relevant to this report see murray 2009.

8 Rzepka *et al.* 2011; 2014; report in this volume.

9 Rzepka *et al.* report in this volume for phasing.

10 Górka and Rzepka 2011; Rzepka *et al.* 2011: 155–156.

11 Rzepka *et al.* 2009.

12 Rzepka *et al.* 2014:65.

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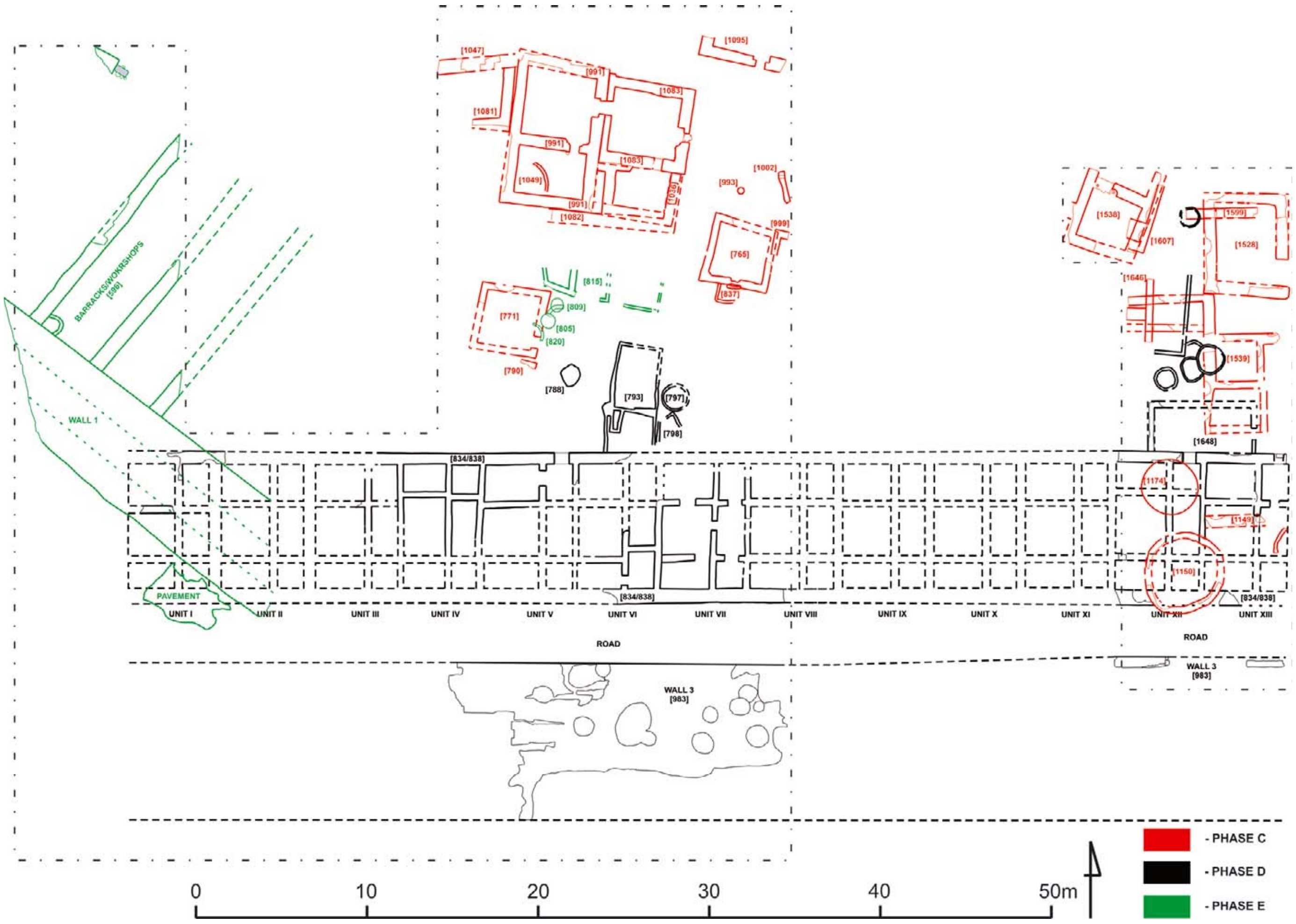

Fig.1 General plan of selected buildings in Area 9 showing the relations between them

area during a hiatus period between the two forts[12] (building [815]). Under the reign of Rameses III a new fort was built, with a large gateway[13] and massive new fortification walls being constructed (walls 2 & 3), enclosing an area of c. 350 m east-west and nearly 200 m north-south[14]. Wall 2 – which was more of a levelling revetment for wall 3 – is securely dated by foundation deposits excavated by Petrie[15]. Inside the southern side of this fort, the remains of a series of regular plan buildings were first detected in 2010[16] (building [834]). These buildings clearly have a primarily domestic function, with food preparation facilities, as well as small-scale industrial activities taking place[17], and were re-modelled during a second phase of occupation at least once. These buildings had a less formally planned annex ([793]) to the north, and associated dumps ('dumping place').

During the 3rd Intermediate period the area was re-occupied with several phases of domestic buildings. Building [991] is the most completely preserved and excavated[18], with remnants of other constructions dating to both earlier, contemporary, and later phases; buildings [1607], [1646], [1082], [1599], [1002], [1528] and [1538]. Elsewhere on the site a 3rd Intermediate period stable area has been excavated[19].

Archaeobotany

Since 2009 the Tell el-Retaba mission have systematically collected samples for archaeobotanical analysis. To date 213 samples have been recovered for analysis from excavations in 8 areas. 19 samples have not been analysed, primarily due to time constraints; many of these 19 represent 2nd or 3rd

13 Hudec in Rzepka *et al.* 2009.

14 Rzepka *et al.* 2009:275–76; 2011; 2014:65.

15 Rzepka *et al.* 2014:73.

16 Rzepka *et al.* 2014:77.

17 Rzepka *et al.* 2014:84.

18 Rzepka *et al.* 2014:87.

19 Jarmużek in Rzepka *et al.* 2011 ; Jarmużek 2013.

Table 1 Table of samples from 2009–2014

Summary of sample information all seasons / areas					
Year	Area	Total number of samples	Total item count	Total sample volume (l)	IPL (Density of items)
2009	1	1	137	5	27.4
2009	2	1	409	5	81.8
2009	3	19	3119	93	33.54
2009	4	6	7023	30	234.1
2009	5	4	4390	20	219.5
2010	3	12	3956	61	64.85
2010	4	1	1166	5	233.2
2010	6	15	8003	66	121.26
2010	9	16	3173	67	47.36
2011	3/5	2	293	8	36.62
2011	4	17	16866	64	263.53
2011	9	24	33765	110	306.95
2012	3	4	546	20	27.3
2012	7	4	2792	16	174.5
2012	9	27	36855	130	283.5
2014	4	14	16851	51.5	327.2
2014	9	24	20651	71.25	289.84
		Total 191	Total 159995	Total 822.75	Avg. 194.46

samples from stratigraphic units with multiple samples, whilst several were left aside based on the low probability of them yielding meaningful results. 3 samples contained no visible identifiable charred plant remains. Therefore in total 191 samples (deriving from 172 stratigraphic units) are included in the site results[20] (see table 1). 76 of these samples were reported in *Äegypten und Levante* XXI[21]. A total of 91 samples have been recovered from Area 9, from 78 stratigraphic units (see table 2). The results are generally very good; charred remains are abundant with a site average of 194.46 plant items per litre (IPL) (see table 1) (almost double that reported in 2012)[22]. As is the case at many ancient Egyptian settlement sites[23], the plant macrofossils (cereal chaff elements, wild grasses, crop weeds, potential fodder plants and potential food plants) generally represent cereal crop processing by-products used as fuel and fodder, preserved by charring (see table 3 for summary); only minimal quantities of desiccated remains have been found, generally these can be attributed to modern contamination. The results presented here include the materials from 2010–2012 and

Table 2 Table of area 9 samples

Area	Building	Period	Phase	Number of Units	Total item count	Volume of samples (l)	IPL
9	BARRACKS	19th Dynasty	E3	6	531	30	17.7
9	BUILDING [815]	19th-20th Dynasty	E1	5	10138	23	440.78
9	DUMPING PLACE	19th-20th Dynasty	E1	3	1688	7	241.14
9	BUILDING [834]	20th Dynasty	D3	5	2115	25	84.6
9	BUILDING [834]	20th Dynasty	D2	11	14002	50	280.04
9	BUILDING [793]	20th Dynasty	D2	9	6235	38	164.08
9	BUILDING [1607]	3rd Intermediate	C4	4	4671	2.75	1698.55
9	BUILDING [1646]	3rd Intermediate	C4	1	3822	0.5	7644
9	BUILDING [1082]	3rd Intermediate	C4	1	7524	5	1504.8
9	BUILDING [1599]	3rd Intermediate	C3	2	710	7.5	94.67
9	BUILDING [991]	3rd Intermediate	C3	2	4774	10	477.4
9	BUILDING [991]	3rd Intermediate	C2	4	1607	20	80.35
9	BUILDING [991]	3rd Intermediate	C1	2	726	10	72.6
9	BUILDING [1002]	3rd Intermediate	C1	2	6107	10	610.7
9	BUILDING [1528]	3rd Intermediate	C2	7	6121	30	204.03
9	BUILDING [1538]	3rd Intermediate	C1	1	91	5	18.2
9	EXTERNAL	19th Dynasty	E2	7	7772	35	222.06
9	EXTERNAL	19th Dynasty	E3	1	11	3	3.67
9	EXTERNAL	19th-20th Dynasty	E1	1	3632	4	908
9	EXTERNAL	3rd Intermediate	C1-C4	3	382	8	47.75
9	EXTERNAL	3rd Intermediate	C4	1	2285	5	457
	Totals/Average			78	84944	328.75	258.38

20 Malleson 2011; 2012; 2013; forthcoming.

21 Malleson 2011.

22 Malleson 2011.

23 Fuller & Stevens 2009; Murray 2000; 2009; Van der Veen 2007.

Table 3 Summary of taxa group presence and abundance in area 9

Density (abundance) and presence of major taxa groups in area 9					
Group	Total Item count	Den-sity (IPL)	% of assem-blage	Number of sam-ples with group present	% Pres-ence (samples in assemb-lage)
Cereal Chaff	61904	75.24	38.69	170	89
Wild Grasses	24635	29.94	15.40	172	90.1
Wet-loving	22333	27.14	13.96	162	84.8
Indeter-minate	21351	25.95	13.34	136	71.2
Legumes	9508	11.56	5.94	160	83.8
Dung	8815	10.71	5.51	116	60.7
Cereal Grain	7680	9.33	4.80	158	82.7
Weeds	2843	3.46	1.78	115	60.2
Fruit / Nuts	454	0.55	0.28	88	46.1
Woody items	217	0.26	0.14	52	27.2
Edible pulses	198	0.24	0.12	44	23
Oil plants	57	0.07	0.04	14	7.3
Total / Average	159995	194.46		191	

autumn 2014 season excavations in Area 9 (see table 2). Materials from other areas (3, 4, 6 & 7) are included in overall discussion. It should be noted that there were no excavations in 2013, and no samples taken during the spring 2014 season for logistical reasons.

Methods

Excavations are conducted using single context methods. The sampling strategy replies upon judgements made by the excavation team. In general, ashy features from heating installations (fireplaces, ovens, kilns), as well as floors and general ashy-looking dump features are sampled for archaeobotanical analysis. All samples are approximately 5 litres, and are processed by the archaeobotanist using the bucket floatation method with 300µm mesh. All samples are sorted using a BMZ zoom stereo microscope at ×7–30 magnification during the season in the project workrooms in Egypt. Based on the time restrictions and the abundance of charred remains in many samples, it has been necessary to implement sub-sampling strategies in order to gain a full overview of material in all sampled stratigraphic units. All the botanical materials (flots) are dry sieved through a graduated sieve stack to ease sorting. Since 2012 all material <500µm has been sub-sampled due to the abundance of items, generally 10 % of this smaller material is examined. This policy was decided upon following the 2011 season during which it was ascertained that whilst the smaller items were abundant, there was little diversity in that material. For these items the item count is multiplied e. g. 10 % sorted – results multiplied by 10. In 2014 it became necessary to sub-sample the entirety of many flots due to time restrictions and abundance of remains. In instances where only a portion of the flot was examined (e. g. 20 %, or 50 % of the flot) the volume of the sample floated was adjusted in the database to reflect the percentage sorted. Statistics are run with Microsoft Access and Excel. The primary quantifications used here are the density of materials – items per litre (IPL), and relative abundance/presence of a species or taxa group – presented as a percentage of the overall assemblage. All counts reflect the partial and complete items total. All specimens were identified on the basis of morphology and comparison with reference illustrations (http://www.plantatlas.eu/ Digital Atlas of Economic Plants in Archaeology and the Digital Atlas of Economic Plants; Nesbitt 2006; Smith 2003) as well as the Flora of Egypt (Boulos 1999; 2000; 2002; 2005). Nomenclature of wild species follows Boulos 1999–2005.

Species present (tables 3 & 4)

The Tell el-Retaba archaeobotanical assemblage (all excavation areas) is dominated by *Triticum turgidum* subsp. *dicoccum* (emmer wheat) chaff (average 72.58 IPL, 37.75 % of the assemblage), and *Lolium* sp. grains (ryegrass / darnel (average 21.48 IPL, 11.17 % of the assemblage). Clovers – Trifolieae tribe seeds (*cf. Trifolium* sp., *cf. Melilotus* sp., *cf. Medicago* sp. and *Scorpiurus muricatus*) make up 5.82 % of the assemblage (11.18 IPL). Species from wetter habitats are also relatively abundant; *Eleocharis* sp. (spike rush) 5.80 % of the assemblage (11.15 IPL), and *Fymbristillis bisumbellata* (annual fimbry) 5.16 % of the assemblage (9.93 IPL). Overall, emmer wheat is more abundant than barley

Table 4 Species list

Species	Common names	Taxa group
Cereals		
Hordeum vulgare L.	Hulled barley	Cereal grain / chaff
Triticum turgidum (L.) subsp. *dicoccum* (Schrank) Thell	Emmer wheat	Cereal grain / chaff
Triticum sp. Free threshing cf. *aestivum/durum*	Bread / durum wheat	Cereal grain / chaff
cf. *Triticum monococcum*	Eincorn	Cereal grain
Cereal indeterminate		Cereal grain / chaff
Wild grasses		
Lolium sp.	Ryegrass / Darnel	Wild Grass
Phalaris sp.	Canary grass	Wild Grass
Bromus sp.	Brome grass	Wild Grass
Poaceae cf. *Sorghum halpense* (L.) Pers *or arundinaceum* (Desv.) Stapf	Sorghum (wild)	Wild Grass
Poaceae indeterminate		Wild Grass
Reeds and sedges		
Schoeneplectus sp.	Rush	Wet-loving
Schoeneplectus cf. *praelongatus* (Poir.)	Club rush	Wet-loving
Eleocharis sp.	Spike rush	Wet-loving
Fymbristyllis bisumbellata (Forssk)	Annual fimbry	Wet-loving
Cyperus sp. culm	Papyrus	Wet-loving
Cyperus esculentus L. – tuber	Tiger nut / Chufa	Wet-loving
cf. *Carex* sp.	Sedge	Wet-loving
Cyperaceae	Sedge family	Wet-loving
Indeterminate Root/Tuber		Wet-loving
Legumes		
Astragalus sp.	Milk vetch	Legume
Vicia cf. *faba*	Fava bean	Legume
Vicia evillia (L.) Willd	Bitter vetch	Legume
Lathyrus sp.	Vetchling	Legume
Lens culinaris Medic	Lentil	Edible pulses
cf. *Ononis spinosa*	Restharrow	Legume
cf. *Trigonella* sp.	Fenugreek	Legume
Melilotus sp.	Meliot	Legume
Scorpiurus cf. *muricatus* L.	Prickly scorpiontail	Legume
Mimusiodae tribe	Acacia family	Woody taxa
Acacia nilotica (L.) Delile – pod fragment	Nile Acacia	Woody taxa
Fruits and oil/linen		
Ficus carica L.	Common fig	Fruit / Nut
cf. *Ficus Sycomorus* L.	Sycomore fig	Fruit / Nut
Phoenix dactylifera L. – stone	Date palm	Fruit / Nut
Hyphaene thebaica (L.) Mart – fruit fragments	Doum palm	Fruit / Nut
Vitis vinifera L.	Grapes	Fruit / Nut
Ziziphus spina-christi (L.) Desf	Christs' thorn / Nebak	Fruit / Nut
Linum usitatissimum L.	Linen / Flax	Oil
Other weed species		
Rumex sp.	Dock / sorrel	Wet-loving
Polygonum sp.	Knotweed	Weeds
Polygonaceae	Knotweed family	Weeds
Glinus lotoides	Damasica	Wet-loving
Portulaca oleraceae L.	Purslane	Weeds
Caryophyllacae	Pink / Carnation family	Weeds
cf. *Silene* sp.	Campion	Weeds
Stellaria sp.	Chickweed	Weeds
Chenopodiaceae	Goosefoot family	Weeds

Fruits and oil/linen		
Beta vulgaris L.	Beet	Weeds
Chenopodium sp.	Goosefoot	Weeds
cf. *Suaeda* sp.	Seablite	Weeds
cf. Cruciferae	Brassica family	Weeds
Rosacae	Rose family	Weeds
Rubus sp.	Bramble	Weeds
Euphorbia sp.	Euphorbia / crown of thorns	Weeds
cf. *Ruta* sp.	Rue	Weeds
Malvacae	Mallow	Weeds
Tamarix nilotica (Ehrenb.) – twigs	Nile tamarisk	Woody taxa
Tamarix aphylla (L.) Karst – leaves	Tamarisk	Woody taxa
Primulaceae	Primula family	Weeds
Boraginaceae	Borage family	Weeds
Lithospermum (Buglossiodes) sp.	Bugloss	Weeds
Lamiaceae	Mint family	Weeds
Solanaceae cf. *Hyosycamus niger*	Stinking nightshade	Weeds
Scrophulariaceae	Figwort family	Weeds
Centaurea sp.	Thistle	Weeds
Crepis sp.	Hawksbeard	Weeds
Compositae	Daisy family	Weeds
Liliaceae	Onion family	Weeds

which was only present in very low numbers (in total just 1.27 % of the assemblage, against 39.75 % represented by emmer wheat). The overall ratio of Emmer to Barley is almost 24:1[24].

Area 9, 19th dynasty – 3rd Intermediate period species list to date can be found in Table 4.

As is the case with the majority of assemblages of charred plant remains[25], this assemblage comprises of the charred plant macro-fossils of cereal-processing by-products. The material therefore constitutes the in-situ and scattered remains of fuel; as opposed 'primary' deposits of stored foods. As such, the assemblage is generally homogenous with no significant patterns of differentiation between materials from different types of contexts. The assemblage reflects routine daily practise within and around the settlement. However, as there are some in-situ deposits, this report will take into consideration both the content and context of the remains in order to examine all the factors affecting the formation of the assemblage.

Archaeobotanical Results from Area 9 excavations (see table 2 for sample information; table 19 = http://epub.oeaw.ac.at/orea/Retaba2015_BotanyReport_Table19 for full raw data).

Barracks/workshops building
(table 5, fig. 2, fig. 3)

The earliest settlement activity (uncovered to date) in Area 9 is the 19th dynasty Rameses II Barracks area (phase E3), the results from which were published previously[26] but are covered in more detail here. Two long narrow barrack / workshop buildings abutting the north face of the Ramesses II fortress enclosure wall ('Wall 1') were partially excavated in 2010[27]. See fig. 3 for plan.

Several dumping layers within the rooms (601), (602), (603), and 2 oven / kiln fills (597) (2 samples), (598) were sampled (see table 5, fig. 2). Oven / kiln (598) showed some differences to the other samples (a much higher proportion of wild grasses), which were all essentially similar; a mix of cereal crop processing by-products made up of a mix of cereal chaff (emmer wheat), wild grasses (predominantly ryegrass / darnel), legumes and other weeds items. This oven / kiln did contain a higher proportion of charred dung, suggesting that this fuel type had been selected for that installation – at least for the final firing. None of these samples were rich in charred remains with between 8–34 IPL – well below the site average.

24 Calculation: Emmer spikelet forks = 2 grains, Emmer glume bases = 1 grain. Barley rachis nodes = 3 grains.

25 Fuller & Stevens 2009; Murray 2009:256; Van der Veen 2007.

26 Malleson 2011:175–176.

27 Rzepka *et al.* 2011:148–151.

Table 5 Table of barracks / workshops area results

Barracks. (Phase E3, 19th dynasty) Density (IPL) of major taxa groups.											
Room	Unit type	Unit	Cereal Chaff	Cereal Grain	Wild grasses	Legumes	Weeds	Wet-loving	Indeter-minate	Dung	Avg.
1	Oven / Kiln	(597)	4	0.7	2	1.2	0.1	0.3			20.8
1	Oven / Kiln	(598)	11.2	0.8	17.2	0.6		2.2		1.4	19.2
2	Dump	(601)	8.2	1.2	2.8	1.6	0.4	1.4	0.2		16
1	Dump	(602)	12.8	1.6	4.2	1	0.2	0.8			8.4
1	Dump	(603)	15	1.4	1.4	1		0.4			33.4

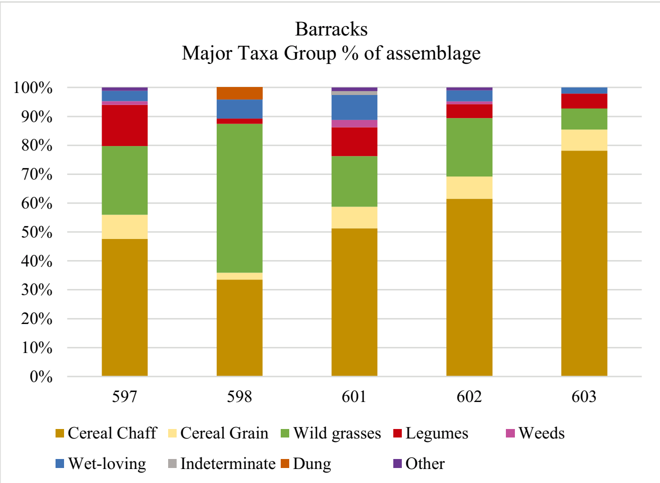

Figure 2 Histogram of barracks/workshops area results

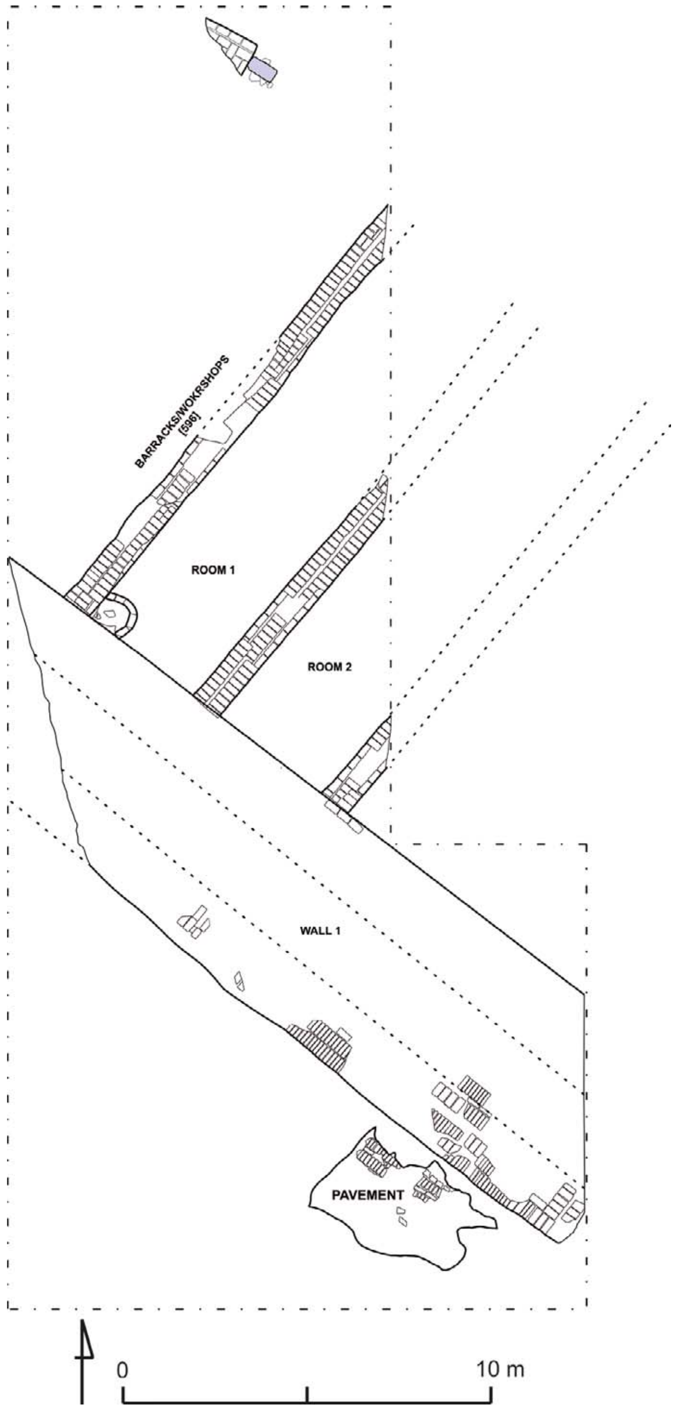

Figure 3 Plan showing barracks/workshops and wall 1

Building [815] (table 6, fig. 4, fig. 5)

Building [815] belongs to phase E1 (19–20th dynasty), comprising of a small domestic area contemporary with a cemetery and dump to the south, built upon the ruins of the Rameses II fortress during a 'hiatus' period prior to the fortress of Rameses III being constructed, excavated in 2011[28]. Very little of this building was preserved, but flotation samples were taken from a 'double' oven / kiln (units (805) & (809)) surrounded by an ashy fill (806) on a low mudbrick platform within a courtyard, and a fireplace within room 3 (824), as well as general dumping into the room post-occupation (827) (see fig. 5 for plan of building [815]).

There is a notable difference between the plant (fuel) assemblages in the courtyard oven / kiln units and the fireplace / general room dump. The 3 courtyard oven / kiln units were far richer in charred plant remains (451–777 IPL) and all con-

[28] Rzepka *et al.* 2014:65–69.

Table 6 Table of building [815] results

Building [815]. Phase E1, 19–20th dynasty. Density (IPL) of major taxa groups.											
Room	Unit type	Unit	Cereal Chaff	Cereal Grain	Wild grasses	Legumes	Weeds	Wet-loving	Indeter-minate	Dung	Avg.
Court yard	Oven / Kiln	(805)	432.6	29.8	135.2	32.6	3	16.2	91.4	35.6	777
Court yard	Oven / Kiln	(806)	162	11.4	52	36.8	69.2	170.8	46.8	92.4	645.8
Court yard	Oven / Kiln	(809)	98.4	6.6	15	67.8	14	92.4	91	64.2	451.2
3	Fire place	(824)	116.33	1.67	14.67	7	2	7.33	16.67	1	53.4
3	Dump	(827)	31.2	0.8	6.8	3.2		2.2	8.2	0.6	167

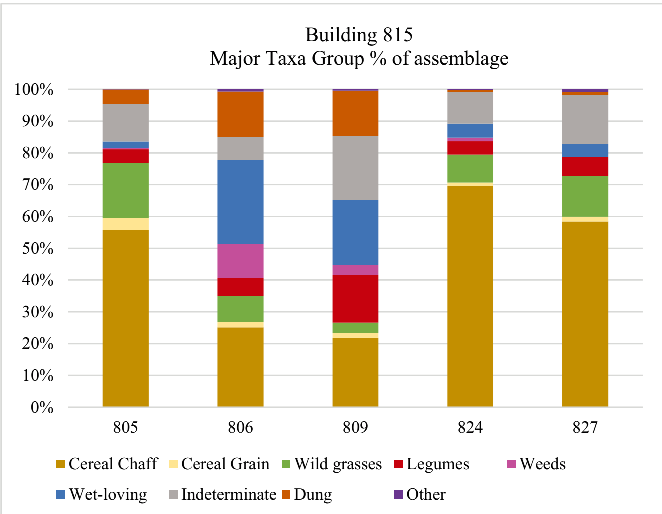

Fig. 4 Histogram of building [815] results

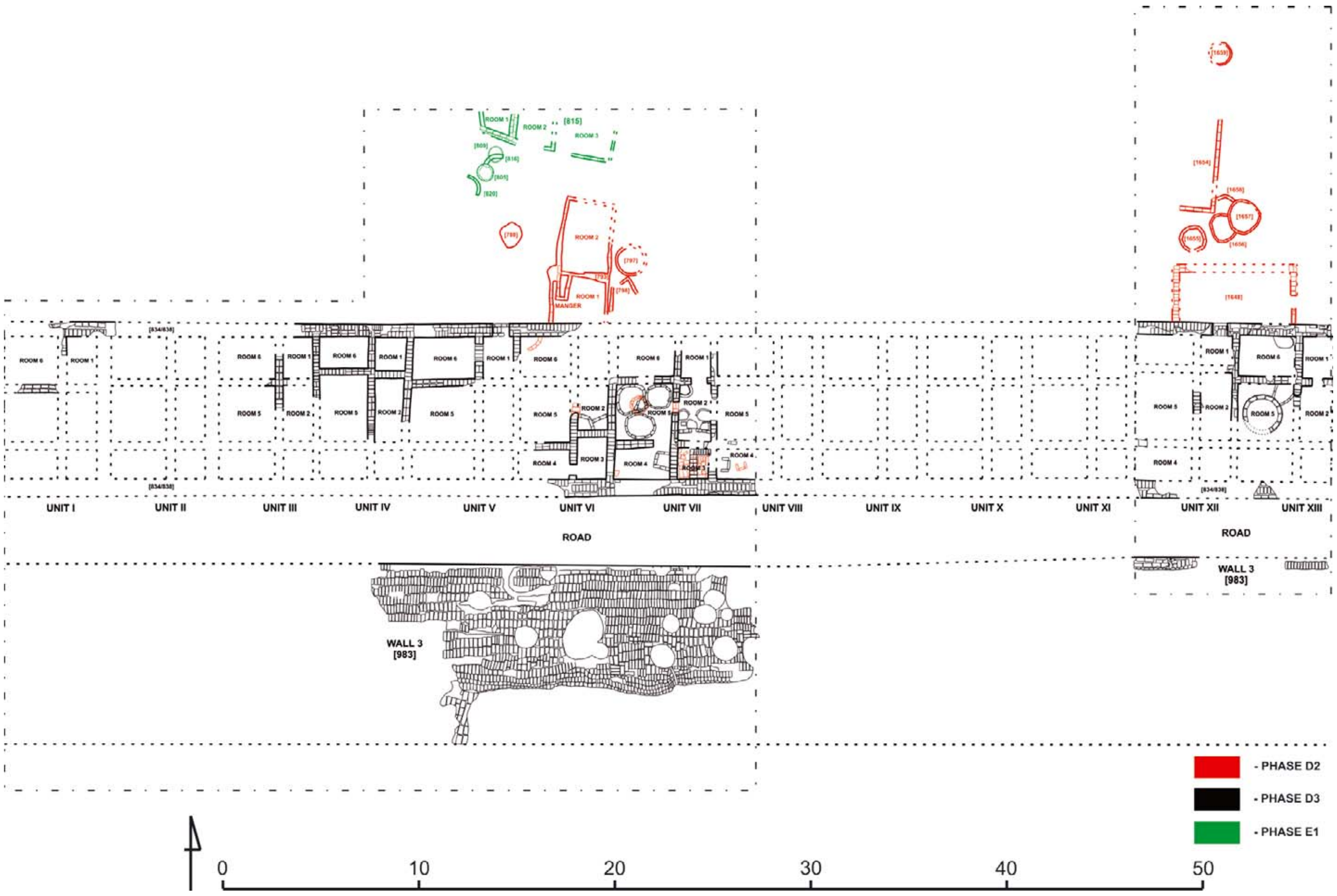

Fig. 5 Plan showing building [815], building [834] and annexe [793]

Table 7 Table of dumping area results

Dumping Area. Phase E1, 19-20th dynasty. Density (IPL) of major taxa groups.											
Phase	Unit type	Unit	Cereal Chaff	Cereal Grain	Wild grasses	Legumes	Weeds	Wet-loving	Indeter-minate	Dung	Avg.
E1	Dump	(1259)	71.11	6.89	20.89	0.89	0.44	4.67	12.89	11.11	129.56
E1	Dump	(1265)	174.4	22.4	106	10	1.6	39.6	49.6	34	442

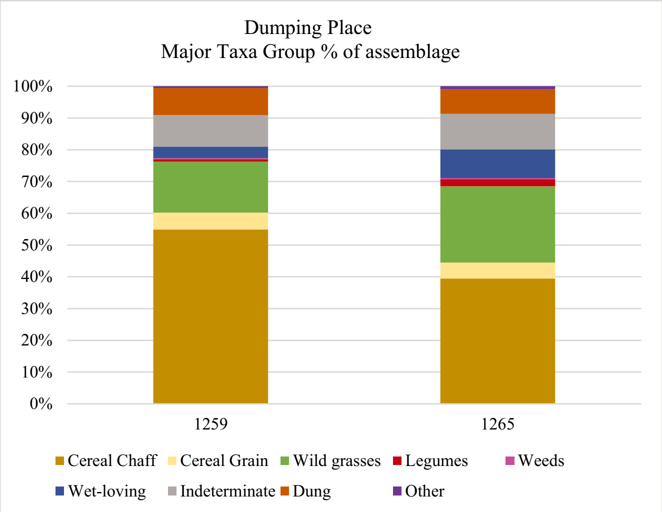

Fig. 6 Histogram of dumping area results

tained a mix of cereal chaff (emmer wheat), grasses, legumes, wet-loving species, weeds and dung (see fig. 4). Unit (806) also contained a significant number of *Beta vulgaris* (beet) nutlets. Beet is found in other similar assemblage from the New Kingdom, and is considered to be a weed of cultivation rather than a cultivated edible vegetable, although it also occurs as a wild-food[29]. The fuel used in these oven / kilns may either have been pure dung fuel, or a mix of dung and cereal-processing by-products used directly as fuel (either of which can contain a mix of cereal chaff, wild grasses, legumes and other wild species). Unit (805) differed from the other 2 oven/ kilns in that it contained a very higher density / proportion of cereal chaff, indication a lack of consistency in fuel choices and / or animal foddering patterns. The fireplace and later room dump-fill both contained a far lower density of remains (167–53 IPL) (see table 6) primarily emmer wheat chaff, with just low quantities of other materials (see fig. 4) and very little dung. This difference may represent a different choices of fuel for different installations; fireplace v. oven / kilns (see discussion section of this report).

[29] De Vartavan 2010:55; Boulos 1999:94.

[30] Rzepka *et al.* report in this volume.

Dumping Area (table 7, fig. 6)

To the south (east) of building [815], this area represents a general dump above a cemetery from phase E1 (transition between 19-20th dynasties), excavated in autumn 2014[30]. Two layers of mixed materials rich in ash (1259) (2 samples) and (1265) were sampled (see table 7). As with the dump feature in building [815] ((827)) these deposits were dominated by charred emmer wheat chaff and wild grasses (primarily ryegrass / darnel) (see fig. 6). Unit (1265) was considerably richer in plant remains (see table 7), but was a much smaller unit; possibly a more discrete dump of ash as opposed to the large mixed waste of unit (1259).

Building [834] (table 8 & 9, fig. 4, fig. 7, fig. 8)

This building forms part of the inner structure of the 20th dynasty (Rameses III) fort. Inside wall 3, to the north of a wide road area is a series of uniform units (13 detected thus far), each comprising 6 rooms with a clearly domestic purpose, excavated in 2011–14[31]. See fig. 4 for plan of building [834]. Samples were taken from building units IV, V, VI, VII and VIII, from both the earlier phase (D3) (see table 8) and the later re-modelled phase (D2) (see table 9) all excavated in 2012.

5 stratigraphic units from phase D3 (the initial use of the buildings) were sampled; floors (995), (1058), (1018), one floor consisting of midden-like laminations of waste (982), and one ‘fireplace’ (1056) (see fig. 7). Each of these deposits contained a mix of cereal chaff (predominantly emmer wheat) with indeterminate items (predominantly two as-yet unidentified seeds, both <0.5 mm), but not much grass. The fireplace (1056) contained the highest density of items (159 IPL), whilst all other features show signs of more degradation of plant remains indicative of tertiary dumping, IPL 107 – 41; (see table 8). Unit (982) (midden-like floor laminations) contained an unu-

[31] Rzepka *et al.* 2014:75–86.

Table 8 Table of results from building [834] phase D3

Building [834]. Phase D3, 20th dynasty. Density (IPL) of major taxa groups.											
Room	Unit type	Unit	Cereal Chaff	Cereal Grain	Wild grasses	Legumes	Weeds	Wet-loving	Indeter-minate	Dung	Avg.
V.1 & V.6	Floor – midden	(982)	36.4	1.8	15	42	0.4	5.4	2	1.6	107.6
IV.6	Floor	(995)	24	0.4	2.2	1.8	0.2	6.6	5.2	0.2	41
VII.6	Floor	(1018)	13.8	0.4	3.2	1.2		8.2	18.4		45.2
VII.4	Fire place	(1056)	68.4	6.4	15.6	8.2	3.6	31	21	4.8	159
VII.4	Floor	(1058)	26.8	4	6	0.6	4.4	10.4	16.2	1.6	70.2

Table 9 Table of results from building [834] phase D2

Building [834]. Phase D2, 20th dynasty. Density (IPL) of major taxa groups.											
Room	Unit type	Unit	Cereal Chaff	Cereal Grain	Wild grasses	Legumes	Weeds	Wet-loving	Indeter-minate	Dung	Avg.
V.1 & V.6	Floor – midden	(974)	17.75	0.5	2.75	5.75	0.5	5.75	8.5		41.5
VI.6	Fire place	(977)	680	72	148	32	14	108	108	36	1198
VI.5	Floor – midden	(1016)	9		2			2	2		15
VI.2	Floor	(1017)	16.2	0.6	2	2		4.2	16	1.4	42.4
VI.4	Floor	(1030)	11	1	2.8	1.4	0.6	3	29.4	0.2	49.4
VII.4 & VII.5	Fire place	(1031)	22	1.6	4	4.2	0.6	1128	8	3	1171.4
VII.1 & VII.2	Floor	(1033)	17.4	0.4	2.4	2.4	0.4	64.4	38	0.6	126
VI.3	Floor	(1034)	6.4	0.6	1	0.2		8	1.6		17.8
VIII.4	Floor	(1040)	26.8	2	7.6	3.4	0.2	7	6.6	0.8	54.6
VII.4 & VII.5	Floor	(1045)	12	0.8	3	0.6		2.8	7.6	0.8	27.6
VIII.5	Floor	(1046)	21.6	8	4.2	1	0.4	9	31.8	1	77

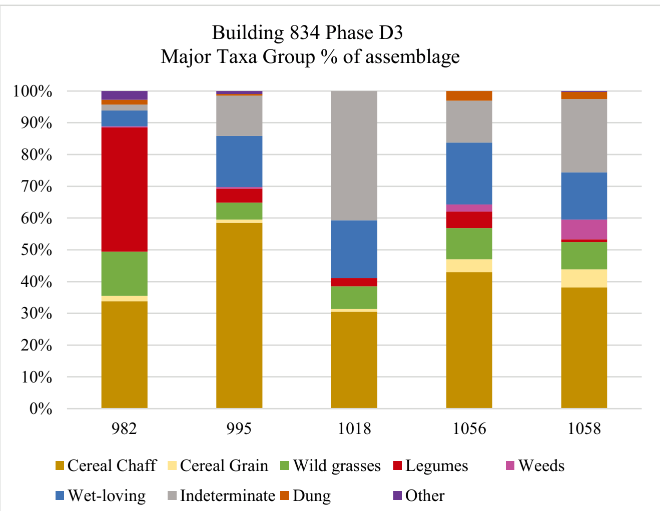

Fig. 7 Histogram of results from building [834] phase D3

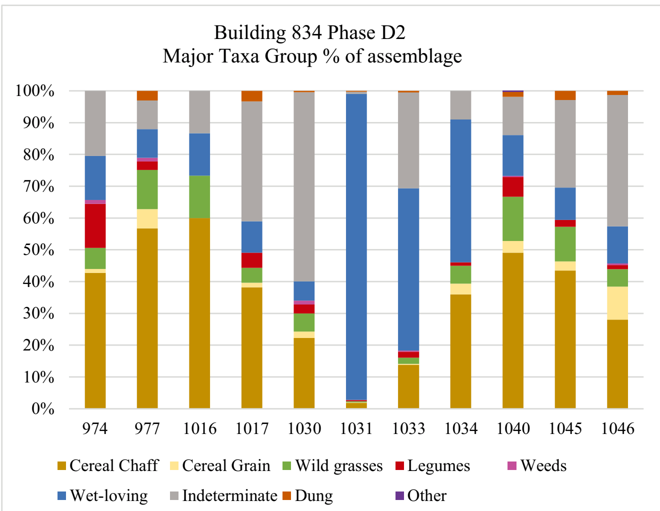

Fig. 8 Histogram of results from building [834] phase D2

sually high proportion of legumes, and a relatively low proportion of chaff.

The samples taken from phase D2 (re-modelled buildings) came from throughout the building. Seven from floors; (1017), (1030), (1033), (1034), (1040), (1045), (1046). Two from more midden-like laminated floor surfaces (974), (1016), and two fireplaces (977), (1031) (see table 9, fig. 8). The material consists primarily of emmer chaff mixed with a lot of tiny indeterminate seeds and a considerable proportion of wet-loving species seeds, but comparatively little grass, legumes and other weeds. A few notable points about these deposits are that the high percentage of indeterminate items in (1030) floor are seed type 1 (as opposed to being damaged items from crushing), the fireplace (1031) contained a massive amount of annual fimbry seeds (5220 in total), whilst floors (1033) and (1034) also contained large amounts of wet-loving species (annual fimbry, spikerush (*Eleocharis* sp.)) and some damasica (*Glinus lotoides*)). Unsurprisingly perhaps, the fireplaces (1031), (977) contained the highest densities of remains – indicative of them being more primary, less disturbed deposits (see table 9).

The most significant aspect of this material is the quantity of wet-loving species in the later phase (D2), potentially reflective of local ecological changes.

Annexe [793] (table 10, fig. 4, fig. 9)

To the north of building [834], during the later phase (D2) a small area of rougher buildings was constructed (excavated in 2011, see fig. 4 for plan). 2 rooms/spaces were found, with a storage pit filled with intact pots cut into a courtyard(?) area to the west[32]. The excavators identified the spaces as possible mangers due to high concentrations of dung found on the surfaces. Interestingly, unlike the 3rd Intermediate Period stable area excavated in area 6[33], this dung was not detected in the botanical samples. Samples were taken from midden-like floor surfaces in room 1 (786), (792) and room 2 (787), as well as from inside each of the pots in the pit (788) (see table 10). Of the 11 pots sampled, only 6 were analysed due to time constraints.

The contents of the pots is unquestionably *not* original contents, the assemblage was entirely typical of the site (charred emmer wheat chaff, ryegrass/darnel grains, spikerush seeds etc.), but like samples from building [834] had comparatively low quantities of wild grasses, and higher quantities of indeterminate items. Potentially due to the fact that the samples from within the pots had had some level of protection there were significant quantities of weed taxa group (see fig. 9) – primarily desiccated purslane (*Portulaca oleraceae*) seeds present. According to De Vartavan purslane has not been reported from a large number of sites in Egypt[34], but it is commonly found[35] and is generally considered to be a weed of cultivation, although the leaves are edible and it can also be used as a wild-food. The sample from floor surface (792) also contained a notably large proportion of general 'weed' group seeds – in this instance the dominance of this taxa group was due to the presence of a large quantity of beet nutlets.

Otherwise, the samples from this area represent the usual mix of cereal-processing by-products. The lack of dung present, is puzzling. Elsewhere on the site desiccated dung was observed in samples[36], whereas in this case, the dung material was not even observed in the samples prior to flo-

Table 10 Table of results from building [793]

Annexe [793]. (Phase D2, 20th dynasty). Density (IPL) of major taxa groups.											
Room	Unit type	Unit	Cereal Chaff	Cereal Grain	Wild grasses	Legumes	Weeds	Wet-loving	Indeterminate	Dung	Avg.
2	Floor	(787)	88.2	10.4	12.8	9	3	21.4	90	7.8	242.8
1	Stable	(786)	19	1	4	3		4.8	4	0.4	36.2
Court yard?	Pots	(788)	69.39	2.87	14	10.91	29.83	43.7	24.96	2.7	200.04
1	Stable	(792)	14	1.2	6.6	4.2	10.4	4	6.8	0.6	47.8

32 Rzepka *et al.* 2011.

33 Malleson 2011:174; 2012:102.

34 De Vartavan 1997:215.

35 Pers. Comm. Clapham 2015.

36 Malleson 2011:174; 2012:102.

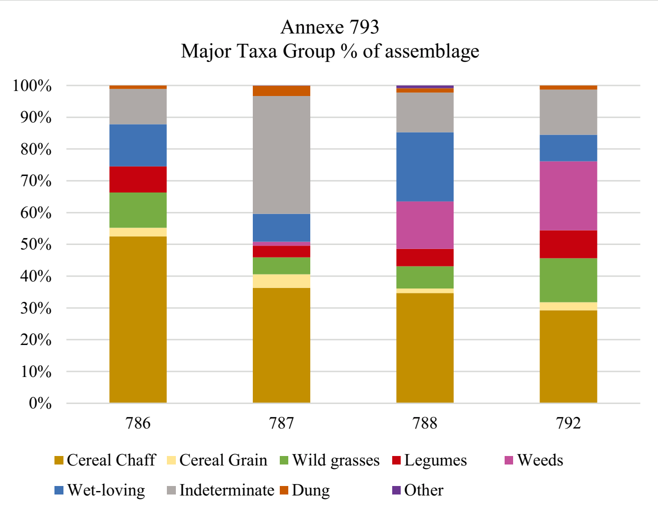

Fig. 9 Histogram of results from building [793]

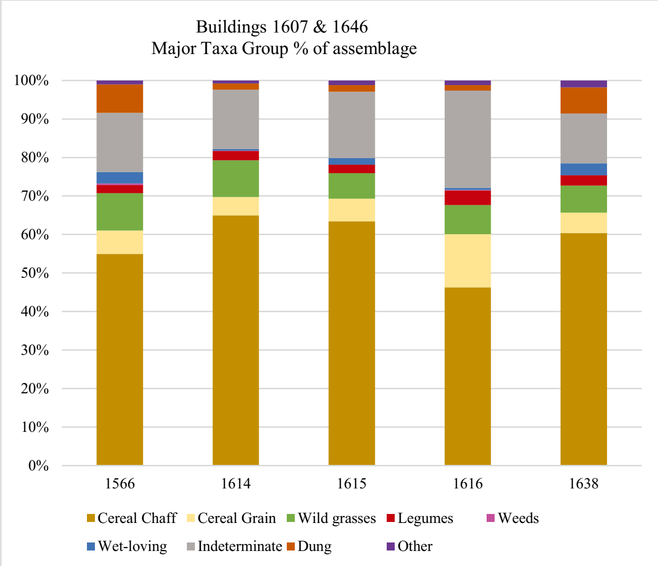

Fig. 10 Histogram of results from buildings [1607] and [1646]

tation. These dumps layers and floors are generally homogenous mixes of cereal processing by-products.

Buildings [1607] and [1646]
(table 11, fig. 10, fig. 11)

Buildings [1646] and [1607] were both in use during the early part of the 3rd Intermediate Period (phase C4); [1646] appears to slightly post-date [1607]. These two structures were excavated in 2014[37]. Only part of building [1607] has been exposed. Thus far a large courtyard has been excavated which contained 2 (not-contemporary) oven / kiln installations and large ashy dump layers. See fig. 11 for plan of building [1607] and [1646]. Lumps of slaggy copper residue were found inside one of these two installations[38]. Samples were taken from in and around the two oven / kilns. (1614) and (1615) from inside oven / kiln [1600], (1616) ashes from south of oven / kiln [1601], and a large ash dump later (1566) from around both oven / kilns. Building [1646] to the south was poorly preserved with only a few fragments preserved[39]. One sample was taken from a thick ashy dump layer (1638). See table 11.

These samples were generally very homogeneous, with little differentiation (see fig. 10), all contained remarkably high densities of remains (797–7644 IPL) (see table 11), overwhelmingly dominated by emmer wheat chaff. The layer from building [1646] (1638) was by far the richest (7644 items per litre). Although this sample was totally dominated by emmer wheat chaff it actually contained

Table 11 Table of results from buildings [1607] and [1646]

Building 1607 & 1646. Phase C4, 3rd Intermediate Period. Density (IPL) of major taxa groups.												
Building	Room	Unit type	Unit	Cereal Chaff	Cereal Grain	Wild grasses	Legumes	Weeds	Wet-loving	Indeterminate	Dung	Avg.
[1607]	Court yard	Oven / Kiln	(1566)	838	92	148	32	6	46	234	112	1524
[1607]	Court yard	Oven / Kiln	(1614)	3048	224	448	114	2	20	724	74	4692
[1607]	Court yard	Oven / Kiln	(1615)	505.6	47.2	52.8	17.6		13.6	137.6	13.6	797.6
[1607]	Court yard	Oven / Kiln	(1616)	524	156	86	42	2	6	286	16	1132
[1646]	External	Dump	(1638)	4614	408	536	204		236	988	520	7644

37 Rzepka *et al.* report in this volume.
38 Rzepka *et al.* report in this volume.
39 Rzepka *et al.* report in this volume.

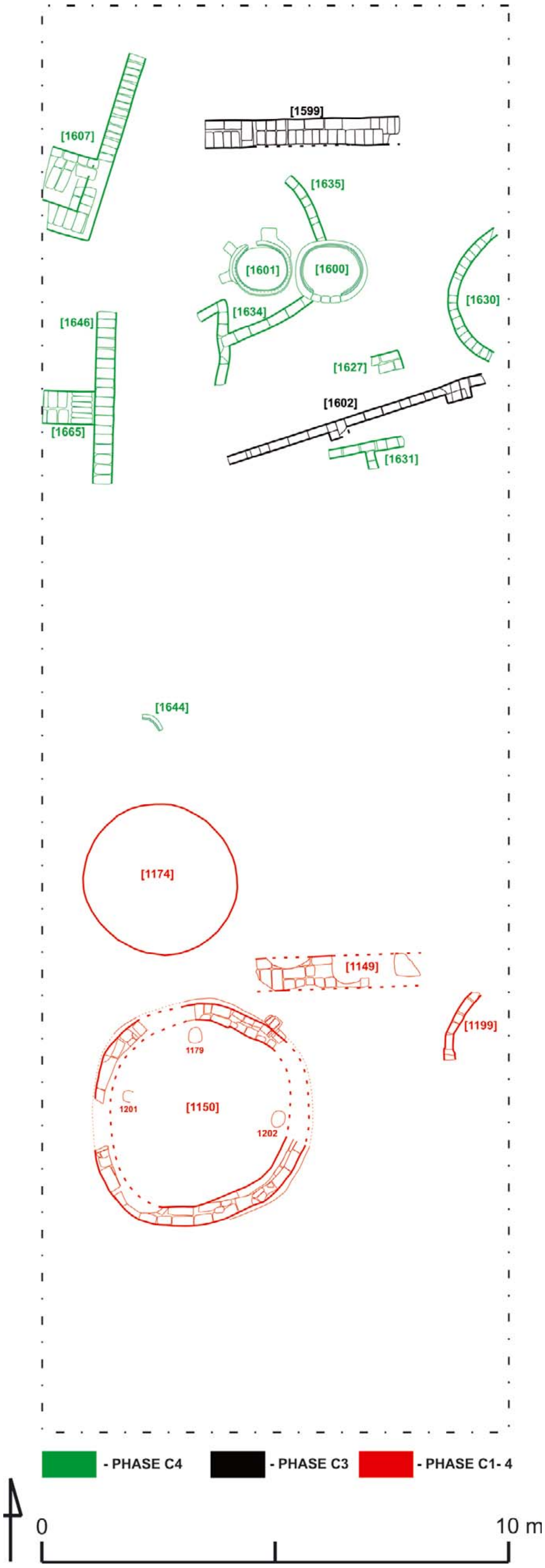

Fig. 11 Plan showing buildings from phase C4 and C3 in the eastern part of Area 9 [1607], [1646], [1599], kilns and other small walls

a remarkable number of rarer (less frequently occurring) edible/economic taxa; fig (*Ficus carica*), lentil (*Lens culinaris*), linen / flax (*Linum ustiatissiumum*) seeds and capsule fragments, and date (*Phoenix dactylifera*) stones all occurred in their highest densities (IPL) in this one feature. 2 of the samples (the larger dump layers (1566) and (1638)) contained a reasonable amount of charred dung but only low amounts of wet-loving species seeds. Dump layer (1638) appears to contain far more residues of food preparation than any other unit perhaps providing a hint of activities taking place in this area. The ovens / kilns did not contain the high proportions of dung found in the earlier installations from building [815], but the high density of charred seeds is exceptional and might be an artefact of the total disintegration of the dung fragments.

Building [1599] (table 12, fig. 11, fig 12)

Dating to the 3rd Intermediate Period – phase C3 – this structure was excavated in 2014. Very little was preserved; essentially only one wall with related deposits north and south[40] built upon the oven / kiln ash dumps of building [1607] (see above). See fig. 11 for plan showing building [1599]. Stratigraphic unit (1595) was sampled, as was a small pit with a pot placed in it (1596). It is highly probable that these two deposits are made up of the same material. Both contained reasonably average density of IPL (see table 12), and consisted almost entirely of emmer wheat chaff (see fig. 12) – remarkably similar to the slightly earlier material below in buildings [1607] and [1646]. Given the lack of associated features relating to these deposits it is hard to put forward an interpretation. As with the other 3rd Intermediate Period deposits from buildings [1607], [1646] and [1082] the assemblage in this building was overwhelmingly dominated by emmer wheat chaff and it seem plausible to suggest that these dumps may derive from similar origins.

Building [991] (table 13, fig. 13, fig. 14)

This building was constructed on top of the ruins of building [1082], 3 phases of use were detected, all dating to the 3rd Intermediate Period (phases C3, C2, C1), excavated in 2012[41]. See fig. 14 for plan showing building [991].

[40] Rzepka *et al.* report in this volume.

[41] Rzpeka *et al.* 2014:87–92.

Table 12 Table of results from building [1599]

Building [1599]. Phase C3, 3rd Intermediate Period. Density (IPL) of major taxa groups.										
Unit type	Unit	Cereal Chaff	Cereal Grain	Wild grasses	Legumes	Weeds	Wet-loving	Indeter-minate	Dung	Avg.
Dump	(1595)	97.2	1.2	6	1.6		4.4	2	1.2	114.4
Dump	(1596)	57.4	5.6	5.8	1.8	0.2	5.2	0.4	7.2	84.8

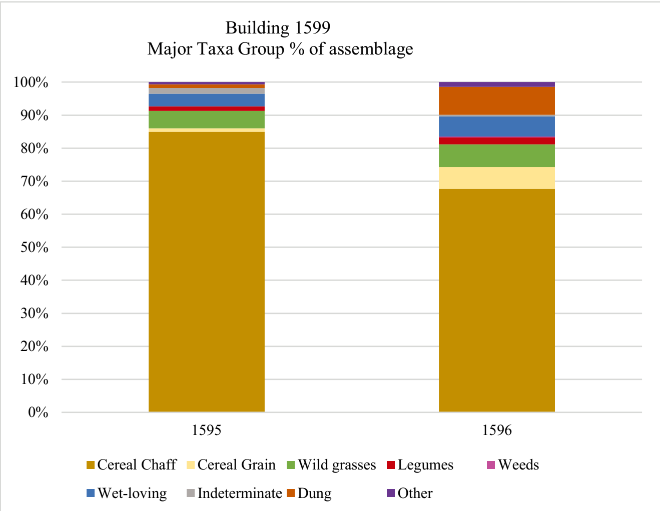

Fig. 12 Histogram of results from building [1599]

Two samples dating to phase C3 (listed as phase 5 in earlier report) were taken from a floor surface in room 2 (1023), and the fill of an oven / kiln (1064) found in the courtyard (see table 13, fig. 13). Within room 2 a great deal of evidence was found for weaving and other domestic activities such as food preparation[42]. The ashy floor surface sample from this room contained a typical domestic fuel assemblage; chaff and other general crop-processing by-products. As with the other 3rd Intermediate Period deposits, (1023) was heavily dominated by emmer wheat chaff. The sample from within the oven / kiln in the courtyard (1064) was entirely different. The sample consisted almost entirely of dung fragments, so much so that it was impossible to quantify using a count of fragments and thus table 13/ fig. 13 do not fully convey this statistic. Of the 186 ml of flot (charred remains), 180 ml consisted of charred dung fragments. It is probably safe to assume that the seeds found in this sample do all derive from the dung – and it is clear that the animals responsible for this dung had consumed annual fimbry, a type of sedge (Cyperaceae), a small seeded clover (Trifolieae tribe <1 mm) and some bugloss (*cf. Lithospermum* (*Buglossiodes*) sp.) – the seeds of which were predominately mineralised and thus may possibly be modern), but very little emmer wheat chaff or other typical crop-processing by-products.

During phase C3 room 2 fell out of use and was used as a general dump space, and a new room (3) was constructed, whilst room 1 continued to be used, clearly functioning as a kitchen area[43]. 4 samples were taken from phase C2 units (see table 13, fig. 13); a floor (1020) and dumped material filling a bin (1054), the dumping from room 2 (992), and the ash from a fireplace in room 3 (1010). Of these units, the floor sample contained the lowest density of items (just 32.4 IPL) almost certainly due to the degradation of charred remains caused by trampling. The contents of these assemblages were generally homogeneous, all containing the usual mix of cereal processing by-products, with the exception of the fireplace (1010) which contained a far higher proportion of heavily charred (vesicular) cereal grains and lentils; the assemblage was generally more diverse and probably reflects casual disposal of food waste and accidental dropping of foods into the fire during cooking.

In the final phase of use the building was enlarged and room 4 was constructed on the ruins of building [1082][44]. Room 2 continued to be used as a dumping space. Samples were taken from unit (976) – the continuation of the dumping in room 2, and unit (1037) – a floor in room 4 (see table 13, fig. 13). The floor ashes were a mix of trampled chaff and grasses, but a notably lower proportion of wet-loving species seeds than had been present in the earlier phases, whilst the dumping in room 2 did in fact contain a higher proportion of this taxa group, possibly an indication that some of this material may be a mix of older ashes cleared out of spaces during the re-modelling of the building.

42 Rzepka *et al.* 2014:87–88.

43 Rzepka *et al.* 2014:89–90.

44 Rzepka *et al.* 2014:90–91.

Table 13 table of results from building [991]

Building [991]. Phase C3, C2, C1, 3rd Intermediate Period. Density (IPL) of major taxa groups.												
Room	Phase	Unit type	Unit	Cereal Chaff	Cereal Grain	Wild grasses	Leg-umes	Weeds	Wet-loving	Indeter-minate	Dung	Avg.
2	C1	Dump	(976)	40	2.8	15.2	10	1.4	19.2	4.6	6.8	100
2	C2	Dump	(992)	86.6	8.4	20.6	2.4	0.2	11.6	23.8	4.8	160.2
3	C2	Fire place	(1010)	13.8	3.2	6.8	5		4.2	12.8		54.6
1	C2	Floor	(1020)	16.8	1.2	2.6	1	0.2	4.8	5	0.2	32.4
2	C3	Floor – midden	(1023)	58	4.2	10	7.4		9	13.8	3.2	106.4
4	C1	Floor	(1037)	26.4	1.6	10.2	2.2		1.2	3.4		45.2
1	C2	Dump	(1054)	43.4	5.2	5.8	5.6		9.6	4.4	0.2	74.2
Court yard	C3	Oven / Kiln	(1064)	10.4	0.8	16.8	141.6	83.4	192.8	2.4	400	848.4

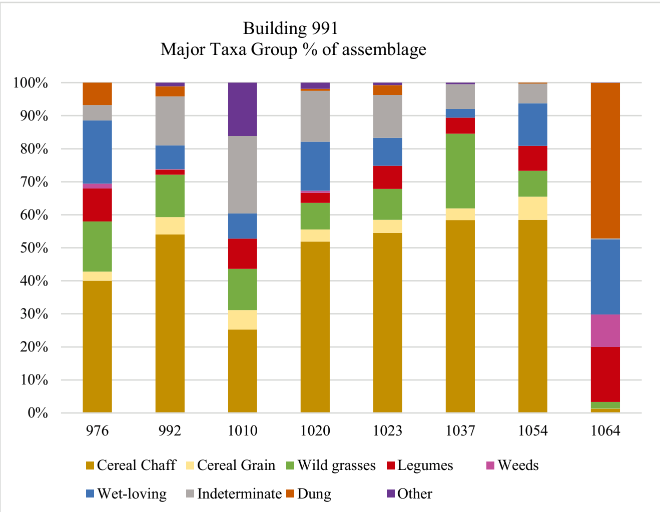

Fig. 13 histogram of results from building [991]

Generally speaking the materials from building [991] bear similarities to the much earlier remains from buildings [815] and [834] – a real mix of cereal chaff, grass, legumes, wet-loving plants and weeds – not overly dominated by 1 or 2 taxa groups like buildings [1607], [1646] and [1599].

Building [1002] and [1082]
(table 14, fig. 14, fig. 15)

Dating to phase C4 (early 3rd Intermediate Period), a small fragment building [1082] was uncovered in 2012[45]. See fig. 14 for plan showing building [1082]. The small part that was preserved initially comprised of two rooms, which were merged into one at some point – the centre wall was covered with a thick layer of ash (1029) (see table 14, fig. 15). This assemblage in this deposit was made up primarily of emmer wheat chaff, an indeterminate seed and a large quantity of heavily charred 'vesicular' cereal grains. It also contained a higher proportion of seeds of wet-loving species – more in keeping with the earlier late-20th dynasty pattern. Overall the remains from this group of buildings contained less diversity of the major taxa groups and was far more heavily dominated by emmer wheat chaff.

To the east of building [991], contemporary with the final phase of use (C1, late 3rd Intermediate Period), a series of very poorly preserved walls were excavated in 2012[46] with associated ashy layers. See fig. 14 for plan showing building [1002]. Samples were taken from units (989) and (993) (see table 14, fig. 15). Whilst (993) was almost twice as rich in charred plant remains, the two units contained almost identical assemblages, both heavily dominated (50 %) by vesicular (heavily charred) cereal grains, with almost equal proportions of grasses and emmer chaff (all c.20 % of the assemblage each).

The lack of contextual information for the samples from building [1002] and [1082] makes it difficult to interpret these remains, although this anomalous dominance of charred cereals is of interest, indicative of a different formation process. It is also worth noting that the samples here were comparatively rich in plant remains – 420–1504 IPL.

45 Rzepka *et al.* 2014:86–87.

46 Rzepka *et al.* 2014:90–92.

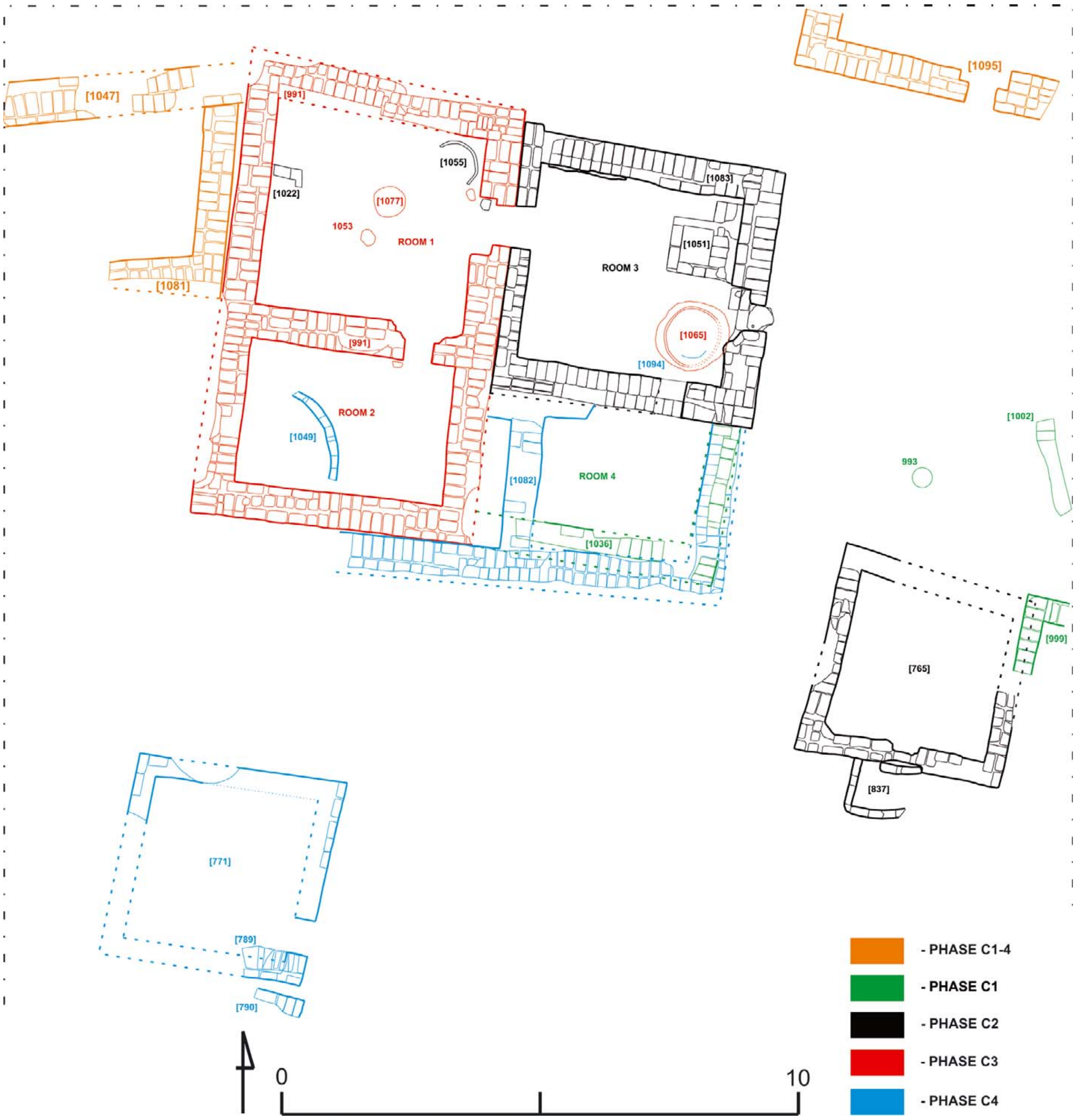

Fig. 14 Plan showing buildings from all C phases in the western part of Area 9 [1082], [991], [1002] and others

Table 14 Table of results from buildings [1002] & [1082]

Building [1002]. Phase C1 & building [1082] Phase C4, 3rd Intermediate Period. Density (IPL) of major taxa groups.												
Build-ing	Room	Unit type	Unit	Cereal Chaff	Cereal Grain	Wild grasses	Leg-umes	Weeds	Wet-loving	Indeter-minate	Dung	Avg.
[1002]	External	Dump	(989)	80.2	21.2	73.4	10.2	1.4	16	212.4	1.2	420.2
[1002]	External	Dump	(993)	186	23.4	115	25.4	1.4	17.4	417.6	1.6	801.2
[1082]	1	Dump	(1029)	569.6	55.4	110	19.2	13	173.2	532	23.2	1504.8

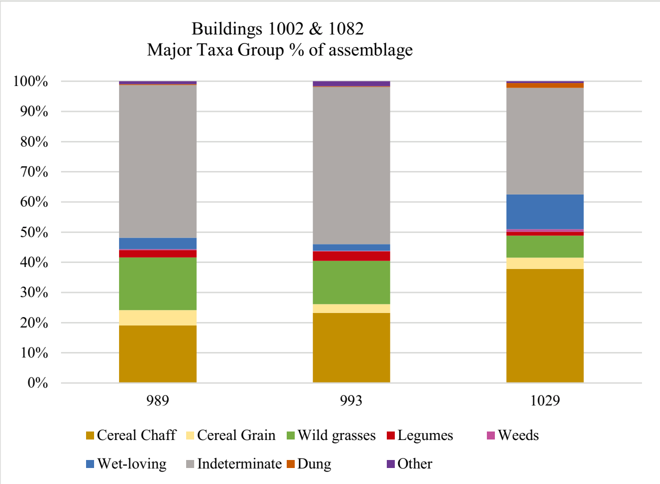

Fig. 15 Histogram of results from building [1002] &[1082]

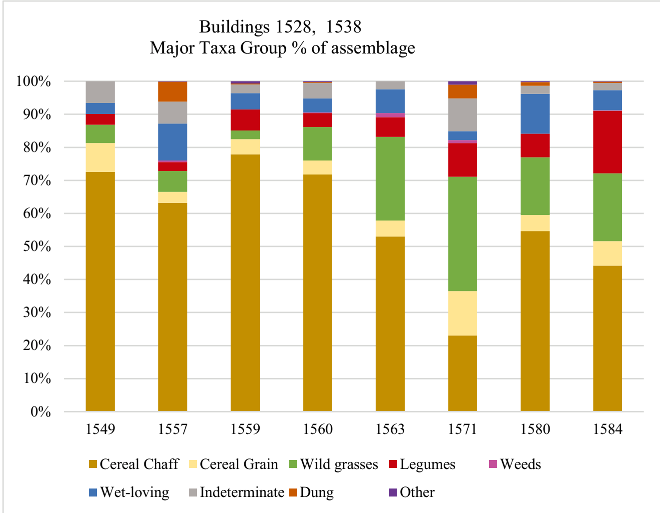

Fig. 16 Histogram of results from buildings [1528], [1538]

Table 15 Table of results from buildings [1528], [1338]

Buildings [1528], [1538]. Density (IPL) of major taxa groups.													
Building	Room	Phase	Unit type	Unit	Cereal Chaff	Cereal Grain	Wild grasses	Legumes	Weeds	Wet-loving	Indeterminate	Dung	Avg.
[1538]	1	C1	Floor	(1549)	13.2	1.6	1	0.6		0.6	1.2		18.2
[1528]	2	C2	Floor	(1557)	80	4.2	8	3.4	0.6	14.2	8.4	7.6	126.6
[1528]	3	C2	Floor	(1559)	95.2	5.6	3.2	7.8		6	3.2	0.4	122.2
[1528]	4	C2	Floor	(1560)	55	3.2	7.8	3.2	0.2	3.2	3.6	0.2	76.6
[1528]	1	C2	Floor	(1563)	8.8	0.8	4.2	1	0.2	1.2	0.4		16.6
[1528]	Court yard?	C2	Fire place	(1571)	110	64.4	165.6	48.8	4.4	12.8	47.6	20	478.4
[1528]	Court yard?	C2	Dump	(1580)	187	16.6	59.8	24.6		41.2	8.4	3.6	342.2
[1528]	Court yard?	C2	Dump	(1584)	265.6	44.8	123.6	114	0.8	36.4	13.2	2.4	601.6

Building [1528] & [1538] (table 15, fig. 16, fig. 17)

Building [1528] was detected during the 2014 excavations. Originally it comprised of room 1 only, with one mixed cultural material midden-like floor level preserved (1563), dating to the later 3rd Intermediate Period (phase C2). This building was then expanded, (within phase C2) and at least 3 new rooms were added to it (rooms 2–4)[47]. See fig. 17 for plan showing building [1528]. Several floors from these new rooms were sampled (1557), (1559), (1560), as well as a fireplace (1571), and two dumping layers (1580), (1584) from an open space (possible courtyard) to the north of building [1528][48] (see table 15, fig. 16). The courtyard fireplace and dump samples were considerably richer in charred plant remains than the room floor samples, as might be expected. Generally speaking all these samples did contain a higher proportion of wild grass (ryegrass / darnel (between 6–35 %)) and there was a higher proportion of legumes present, but the samples were overwhelmingly dominated by emmer wheat chaff.

Just two rooms of building [1538] were detected in 2014 (dating to phase C1), only one of which was fully explored. Each had one floor level preserved, floor (1549) consisted of ashes with bone and ceramics, with a number of objects including 5 loom weights and a needle[49]. Like other floor layers, the assemblage was dominated by cereal chaff, with a small amount of cereal grains, grasses, and other weeds

47 Rzepka *et al.* report in this volume.

48 Rzepka *et al.* report in this volume.

49 Rzepka *et al.* report in this volume.

External dumping areas (table 16, fig. 18)

A number of dumping layers un-associated with specific buildings have been excavated from across the excavation area. These date to several different phases (see table 16, fig. 13).

The densities of remains in the dumps varied enormously from 3.67 IPL to 1139.8 IPL, pointing at a variety of origins, formation processes and taphonomic factors. The assemblages in these dumps all consist of at least 35 % cereal chaff – up to 65 % – and most contain a significant quantity of either legumes and / or wild grasses. There are no clear chronological patterns. Some of the samples appear to have strange assemblages, dominated by just 3–4 taxa groups (577), (588), (556), but each of these had extremely low densities of remains. As with other dumps across the site these assemblages attest to the process of general mixing of ashes from various sources, and as is to be expected of tertiary dump features, they contribute more to the overall picture of the major role played by cereal processing by-products as an economically important commodity[50].

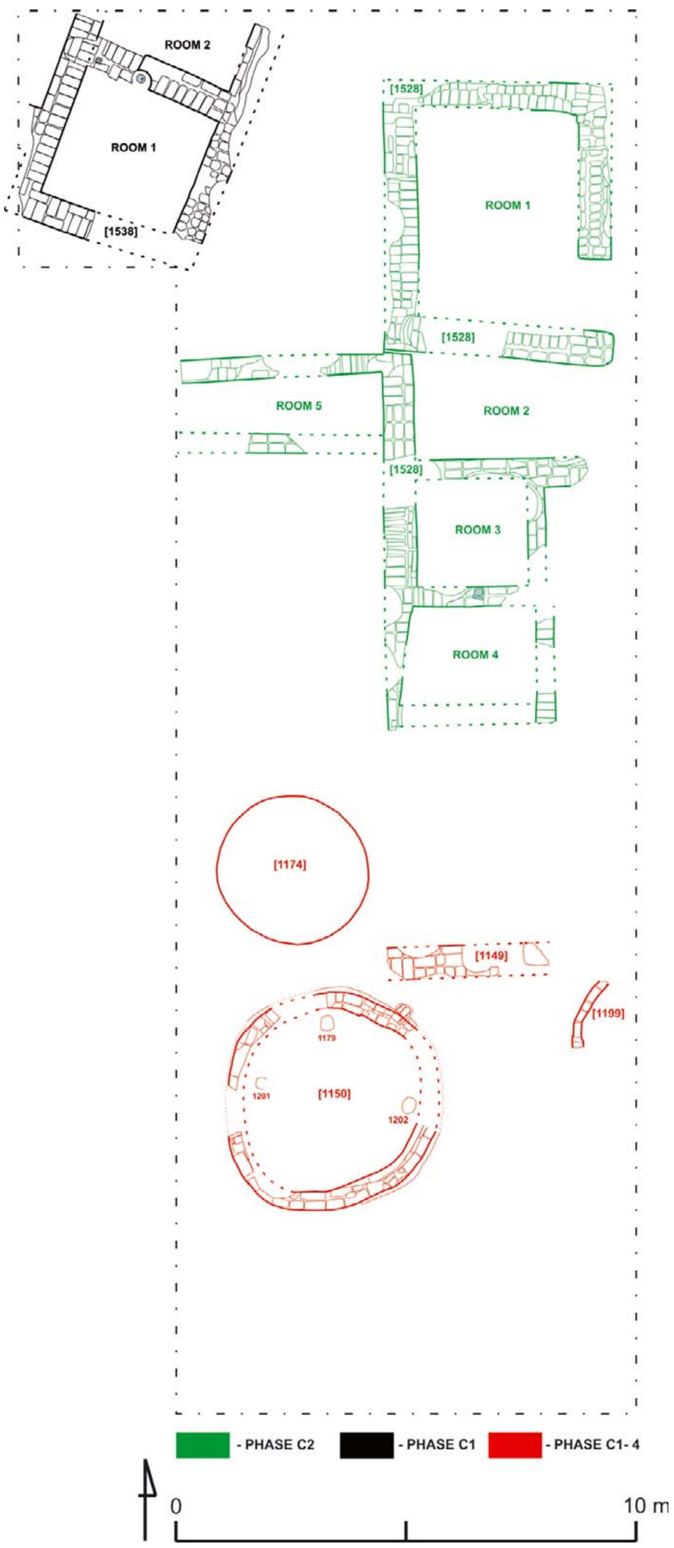

Fig. 17 Plan showing all buildings from phase C2 and C1 from the eastern part of Area 9 [1528], [1538] and others

Discussion

Overall observations

Generally speaking, the Tell el-Retaba assemblage is a result of repeated dumping and mixing of ashes from many different installations; oven / kilns and fireplaces. The results show a high level of homogeneity, with remarkably little clear spatial patterning or differentiation between deposits from different feature types, other than the fact that in-situ ash samples tend to be richer in charred remains (higher IPL). This is entirely typical of archaeobotanical assemblages from settlement sites, the dumps all contain a mix of different fuels from different locations. Other than the occasional occurrence of food waste from fruits and the remains of flax processing, the assemblage consists entirely of cereal-processing by-products (chaff and 'weeds') utilised as fuel either directly, or first fed to animals with the dung then being used as fuel. As such, the results have the potential to address three main issues: changing local ecology/ environment as reflected in the presence of different crop 'weed' species, different choices of fuel types reflected in the in-situ fireplaces, ovens and kilns, and changing patterns of animal husbandry reflected in patterns of contents of dung.

Ecology / environment

The most striking result from the analyses of the Tell el-Retaba assemblage is the very clear pattern of an inverse correlation between the quantities of wet-loving species and wild grasses, changing over time (see fig. 19 & 20).

50 Van der Veen 1999.

Table 16 Table of results from external dumping areas

External spaces. All Phases, all periods. Density (IPL) of major taxa groups.											
Phase	Unit type	Unit	Cereal Chaff	Cereal Grain	Wild grasses	Legumes	Weeds	Wet-loving	Indeter-minate	Dung	Avg.
C1-C4	Dump	(556)	2.33		1	1.33	1.33				6
C1-C4	Dump	(559)	9	0.67	1.67	3.33	0.67	1.33	1.33	0.67	18.67
C1-C4	Dump	(563)	100	15	13.5	11		10.5	1	3	154
E3	Dump	(577)	2		0.67		0.33	0.33	0.33		3.67
E2	Dump	(588)	8.2	2.4	2			0.4			13
E2	Dump	(594)	6.6	0.2	2	0.8	0.2				10
E2	Floor – midden	(595)	52.7	3.3	21.5	7.5		2.8	9.7		98.1
C4	Dump	(767)	262.4	18.8	27.2	43.8	3.2	39.4	43.2	18.4	457
E2	Dump	(780)	485	65	372.6	46.2	3.8	84.6	55.2	22	1139.8
E2	Dump	(781)	25.2	2.2	14	2.2	1.2	6	18	0.6	69.6
E1	Dump	(807)	468.75	88.5	114.5	46	6.5	59.5	115.25	3.75	908
E2	Dump	(836)	72.8	3.8	17.8	2.6	0.4	6.8	19.2	1.6	125.8

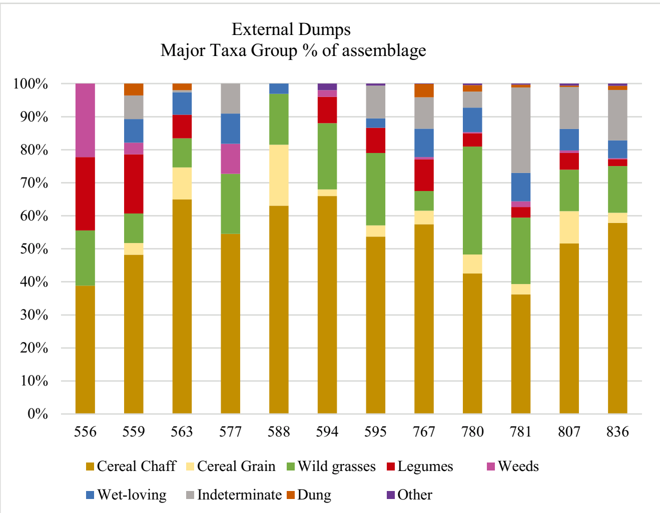

Fig. 18 Histogram of results from external dumping areas

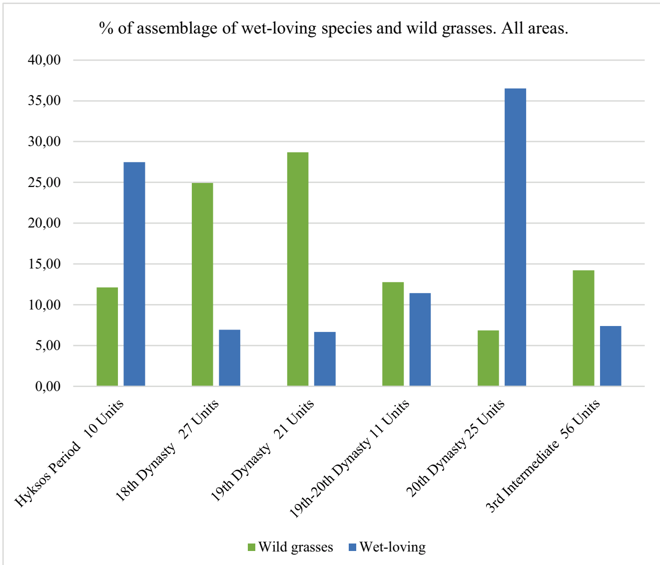

Fig. 19 Histogram of grasses and wet-loving species for all areas

Looking first generally at all dated material from the site (areas 3, 4, 5, 6, 7, 9) (see fig. 19) it is very clear that as the percentage of the assemblage represented by wet-loving species increases – the grasses decrease. During the Hyksos period there is a far greater proportion of wet-loving species than grasses present in the assemblage. During the 18th dynasty this reverses, with grasses becoming more dominant, but then the situation gradually reverts back to a wetter assemblage by the 20th dynasty before 'drying up' again during the 3rd Intermediate Period.

Looking closely at the material from phased areas within the fortified area (Areas 3, 6 & 9) (fig. 20) the situation becomes even more clear. During the Hyksos period (phase G1) wet-loving species represent just under 15 % of the assemblage. That percentage drops to a low of 5 % during the 18th dynasty (phase F3), then gradually increases, leaping up to nearly 39 % in the later 20th dynasty (phase D2), before dropping back down to below 5 % by the end of the 3rd Intermediate Period (phase C1). Conversely wild grasses (primarily *Lolium* sp.) represent just over 20 % during the Hyksos period (G1), and rise to over 44 % by the 18th dynasty (phase F3), before dropping down to around 6 % by the end of the 20th dynasty (D2), remaining low until the latter half of the 3rd Intermediate Period (phases C2-1).

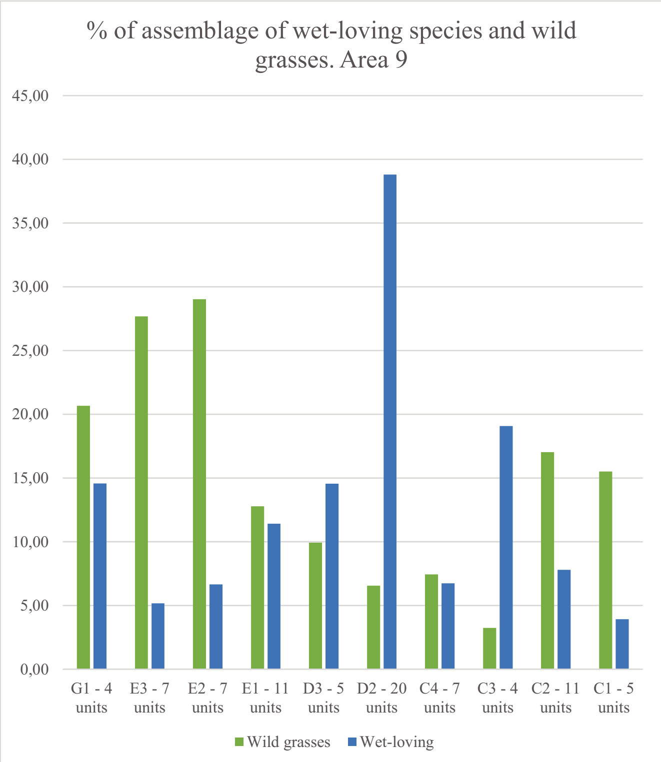

Fig. 20 Histogram of grasses and wet-loving species for Area 9

The most obvious explanation for this is a change in the local ecology – dry phases in the 18th dynasty and 3rd Intermediate Period, with wetter phases earlier during the Hyksos period and 20th dynasty. Interestingly, this 'drying-up' from the Hyksos period to the 18th dynasty is emphasised when the Hyksos period archaeobotanical remains from nearby Tell el-Maskhtua are taken into consideration[51]. At that site the assemblage consisted of 35 % wet-loving species (sedges), whilst grasses (ryegrass/darnel and canary grass (*Phalaris* sp.)) made up 15 %[52]. Compare this to Hyksos period Tell el-Retaba with 27 % wet and 12 % grasses.

Other explanations should also be investigated. If the changes in dominant taxa are representative of an ecological shift, it may well not have been wide-spread. It is possible that the change reflects a purely localised alteration in the availability of water. Marshy areas adjacent to the site may have either increased in size or dried up, either naturally or via human intervention. It is possible that during the 20th dynasty occupation of the fort there were interventions into the hydrology of the area in order to supply sufficient water to this key strategic location along the route out of Egypt to the east. If the plants derive predominantly from dung, this change may actually reflect a change in foraging or foddering strategies; perhaps during the 'wet' phases livestock was grazing, whilst in the 'dry' phases they were consuming specifically provided / selected fodder. The supply of cereal processing by-products (and other plant fuels) as a commodity to military / government establishments is attested both archaeobotanically and textually[53], so it is entirely possible that the 19–20th dynasty remains do not derive from the local area. However, this change in taxa group abundance does not appear to tie in clearly to the changing use of the site; it is not the case that during the occupation of the fort (19–20th dynasties) the assemblage is markedly different to occupation of the 3rd Intermediate Period town. Perhaps at least some of the chaff / by-products were supplied to both the town and the fort from elsewhere for use as fodder and fuel, and thus the change in taxa present may be reflective of conditions elsewhere, and might even be the result of a mixed supply of plants from a variety of different locations. The situation is clearly complex and requires more detailed investigation.

What is perhaps of more interest is the fact that this wetter phase during the later 20th dynasty detected at Tell el-Retaba is actually the exact opposite of other records. Ancient Egyptian texts and flood records indicate a rise in wheat prices probably due to a series of low floods during the later Ramesside period, followed by high floods and low land prices during the 21st dynasty[54]. This is certainly an issue needing closer investigation, but it is increasingly apparent that the region was undergoing regular ecological shifts.

Fuel choices

Based on analyses of the 2011–2014 materials, in general it appears to be the case that dung was the favoured fuel at the site for larger installations, whilst for smaller more domestic heating installations cereal-processing by-products may have been used more directly alongside casual/accidental disposal of food waste. Wood is present in small quantities, generally smaller shrubby taxa – the scarcity of wood in the area is almost certainly responsible for the extensive use of cereal by-prod-

51 Crawford 2003.

52 Based upon data presented in Crawford 2003.

53 Moens & Wetterstrom 1988; Murray 2009; Van der Veen 1999.

54 Baer 1962:29; Murray 2000: 515.

Table 17 Table of taxa groups in unit types

Unit types. Density (IPL) of major taxa groups.									
Unit type	Cereal Chaff	Cereal Grain	Wild grasses	Legumes	Weeds	Wet-loving	Indeter-minate	Dung	Avg.
Dump	144.45	16.78	48.75	14.03	1.5	23.67	67.4	7.54	326.69
Fire place	178.24	22.82	52.16	15.29	4.24	251.37	36	10.67	573.02
Floor	31.09	2.6	4.68	2.38	0.58	9.79	15.89	1.27	68.43
Floor – midden	43.16	2.6	14.12	13.8	0.16	5	8.48	0.96	89.28
Oven / Kiln	170.86	14.54	42.6	40.4	22.62	64.32	51.71	81.75	490.97
Pots	69.39	2.87	14	10.91	29.83	43.7	24.96	2.7	200.04
Stable	16.5	1.1	5.3	3.6	5.2	4.4	5.4	0.5	42

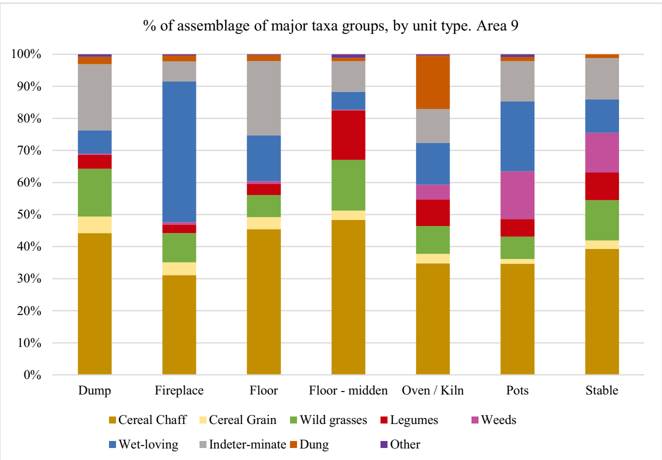

Fig. 21 Histogram of taxa groups in unit types

ucts / dung as fuel and the resulting exceptionally high densities of charred plant remains in the assemblage[55]. Dung is well-known to have been used as fuel in Ancient Egypt[56], and continues to be used today. It burns steadily and is considered a reasonably good fuel for cooking, although due to its' smokiness it is best used in outdoor spaces i.e. ovens / kilns in courtyards, and is sometimes a preferred fuel for installations such as kilns[57], although the evidence is varied – some sources pointing towards wood charcoal as the favoured industrial fuel[58]. Cereal processing by-products were also used, but these tend to flare more quickly and are less reliable for maintaining temperatures[59]. Dung fuel is inevitably favoured when wood fuel is scarce.

Looking generally at the statistics, the 'in-situ' deposits of fuel in oven / kilns in Area 9 contain significant proportions of charred dung fragments, whilst the fireplaces do not display the same pattern (see table 17, fig. 21). These statistics appear to reflect a pattern of daily household cleaning of cereals from silos, with some of the by-products being used directly in the household fireplaces – saving the dung fuel for facilities that needed a more regulated temperature.

However, looking more closely at the individual units themselves, the pattern is not so clear cut. The installations from building [1607] (3rd Intermediate Period) actually contain relatively low proportions of dung. The oven / kiln from building [991] (3rd Intermediate Period) was so densely pack with dung that it is responsible for this apparent phenomenon, the installations from building [815] (19–20th dynasties) do all contain relatively high proportions of dung. The fact that oven / kilns from all periods contain dung does suggest at least some continuity in the choice of fuel materials, unaffected by the changing nature of the settlement. The fireplaces within all the buildings appear to contain a more even distribution of the different taxa groups, but when examined in more detail they display no real patterns of the selection of specific plants. This is likely to be a result of the casual disposal of food processing remains[60], with each fireplace containing just the remains of the final fire lit in that location. This not only acts as a cautionary

55 Van der Veen (2007:969) comments that in desiccated assemblages the IPL is high – from 200 up to 1000. This highlights how extraordinarily rich the Tell el-Retaba assemblage is.

56 Murray 2012:257; Moens & Wetterstrom1988:167.

57 Murray 2012:257.

58 Crawford 2003: 115.

59 Murray 2012:257.

60 Van der Veen 2007:979.

note to look beyond the apparent general patterns within the assemblage, but highlights the complexities of the realities of ancient activities.

Dung, and potential animal husbandry issues

Due to the fact that many plant parts pass through animals undigested[61], dung can be used as a source of information on animal husbandry practises and a source of information on local ecology[62]. However, the question of whether the cereal chaff, grasses, legumes and other weeds in any assemblage *all* derive from dung or not is a complex issue[63].

The features of these remains which are considered to be of help in determining the origin of the plants is the presence or lack thereof of charred lumps of dung, and the relative quantities of fodder species and certain chaff elements[64]. Some studies have suggested that the presence of large quantities of plants recognized as fodder (legumes) – in samples also containing high densities of dung – is evidence to suggest that the majority of the seeds derive from dung, allowing for conclusions regarding animal husbandry patterns[65] although this theory is now being questioned. An additional consideration is that whilst many of the harder chaff parts and seeds of plants consumed by the animals actually pass right through the guts of the animals[66] (thus appear in the charred assemblage), seeds deriving from dung will show signs of chewing or degradation by digestive enzymes, and very few of the more delicate plant parts will survive[67].

Looking at the condition of the materials, generally speaking the remains at Tell el-Retaba are abundant but not always in perfect condition. The majority of the emmer wheat chaff is broken into individual glume bases, and is generally fairly degraded. Emmer wheat glume bases form just over 28 % of the entire site assemblage (53.99 IPL), whilst intact spikelet forms form just under 12 % of the assemblage (15.81 IPL) (see table 18).

This could of course be more to do with processing methods (pounding of emmer), or the archaeological recovery method (bucket flotation), than degradation due to animal chewing. Very few morphological characteristics are preserved on any items; as can be seen in table 2 very few specific species have been identified, generally most items are identifiable only to genus. The problem of using this method to determine if the seeds are derived from dung is that as mentioned above – the majority of the samples were from dumping contexts, meaning that much of the degradation could well be due to frequent disturbance rather than chewing by animals.

Table 18 Table showing emmer wheat chaff statistics

Item	Item count	% of assemblage	IPL
Triticum dicoccum glume base	44417	28.08	53.99
Triticum dicoccum spikelet forks	13011	11.17	15.81

The presence or absence of dung fragments is difficult to quantify. Dung fragments are present in c. 60 % of samples from the site overall (see table 3), which does point to a conclusion that it was a common fuel type at the site. The majority of the dung fragments can actually be identified as being sheep / goat pellets, but this is not the case for all samples, and indeed is not the case for the samples with the highest densities of dung present.

What does have to be born in mind is that the taphonomic effects of repeated disturbance of the ashes may well have broken down much of the dung into unrecognizable dusty material. The only way to be more certain of dung presence throughout the assemblage would be to conduct analyses for micro-remains e. g. spherulites and phytoliths[68] – which is unlikely to be possible for these samples. The relative ubiquity of dung throughout the assemblage could be taken as an indication that the majority of the charred remains may derive from dung – meaning that it is plausible to draw some conclusions regarding animal husbandry patterns.

Within the Tell el-Retaba samples (all areas / seasons), potentially cultivated fodder species (leg-

61 Anderson & Ertung-Yaras 1998; Charles 1998; Miller 1984.

62 Crawford 2003.

63 Anderson & Ertung-Yaras 1998: Charles 1998; Gardner et al 1993; Lancelotti & Madella 2012; Murray 2012; Valamoti 2013.

64 Anderson & Ertung-Yaras 1998; Charles 1998; Miller 1984.

65 Crawford 2003; Miller 1984; Moens & Wetterstrom 1988; Malleson (in preparation) questions this theory.

66 Anderson & Ertung-Yaras 1998.

67 Valamoti 2013.

68 Lancelotti & Madella 2012.

umes) are not actually especially prevalent. Whilst legumes do occur in most samples (nearly 84%), they form just under 6% of the overall assemblage (IPL 11.56) (see table 3). At other sites where legumes were thought to be cultivated fodder they form between 15–40% of the assemblage[69]. Compare this to wild grasses and wet-loving plants which occur in 90% and 84.8% of the samples at Tell el-Retaba respectively, forming nearly 30% (grasses) and over 27% (wet) of the assemblage with average densities of 15.4 IPL (grasses) and 13.96 IPL (wet-loving). The complicating factor in this discussion is the fact that if legumes are being cultivated and fed as fodder, they are in fact highly unlikely to appear in the archaeobotanical record; they are most nutritionally beneficial when fed as young plants which have not yet gone to seed. Assuming (for the sake of discussion) that the assemblage does derive mainly from dung – the animals appear to have been consuming a mixture of cereal chaff, grasses and reeds/sedges. Ryegrass / darnel (*Lolium* sp.) is recognized as having been the most prevalent cereal crop weed in ancient Egypt[70] and given the changing conditions at the site (see above) it seems probable that the wet-loving species represent cereal crop-weeds for the wetter periods. The relative lack of cereal grains in the samples is typical of this type of assemblage – the grains themselves have either been extracted for human consumption, or have been fed to animals either prior to processing, or mixed with processing by-products to enrich the fodder. In either case the grains are naturally absent from the assemblage having been digested.

One issue that must be noted, with respect to the identification of this material as being primarily dung-derived, is the abundant presence of ryegrass/darnel If these specimens are darnel (*Lolium temulentum*) as opposed to ryegrass (*Lolium perenne*), that presents a problem. Darnel can be toxic due to the presence of a fungus (ergot), but it is not known if this fungus was indeed present in ancient Egypt, and thus this may not pose a problem to the interpretation of the consumption of darnel by cattle. The degraded nature of much of the material makes it difficult to be sure of the species identification, but both *L. temulentum* and *L. perenne* have been identified in ancient Egyptian plant assemblages, however *L. temulentum* is considerably more common[71].

The prevalence of cereal chaff in the assemblage, mixed with either grasses or reeds/sedges leads to a conclusion that the animals' diet consisted either of pre-processed crops (resulting in the preservation of just the tougher chaff and weed seeds), or that they were fed just the crop-processing by-products.

The question of exactly where these crop-processing by-products came from is also a complicated issue. As discussed above, the possibility that food / fodder / fuel was supplied to the 19-20th dynasty forts and indeed the 3rd Intermediate Period town has to be considered. The homogeneity of the assemblage through time and the consistent occurrence of dung and chaff / weeds throughout the samples from all periods does however point towards a situation in which there no major changes in the subsistence strategies at the site. The only significant change is in the abundance (or lack) of wet-loving species as discussed above, and that does not appear to tie into the changing nature of the settlement. As already noted, the situation is clearly complex and deserves far more in-depth analyses.

Summary

Whilst leading to more questions than answers, the analyses of the archaeobotanical assemblage at Tell el-Retaba do lead towards several working hypotheses. Firstly, that there were regular changes in the use / presence of species from different habitats; an abundance of reeds and sedges during the Hyksos Period and 20th dynasty, with more wild-grasses and fewer wet-loving taxa present in the 18–19th dynasties and 3rd Intermediate Period. The cause of this phenomenon needs further investigation. Secondly, that the inhabitants were utilising a mix of dung and crop by-products as fuel, and in some instances making a specific choice to use dung fuel in specific installations. Thirdly, that livestock at the site were consuming a diet of cereal-processing residues possibly mixed with local foraging.

The archaeobotanical remains from Tell el-Retaba throw up a number of interesting problems, all of which require further analyses and more in-depth research. What they do highlight is the exceptionally complex and perhaps unpredictable nature of the realities of daily life in ancient Egyptian settlements.

[69] Moens & Wetterstrom 1998: table 1.

[70] Samuel 2000.

[71] Boulos & Fahmy 2007; Fahmy 1997.

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