CHAPTER 6

CONSUMPTION AND STORAGE IN THE BRONZE AGE

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INTRODUCTION

The previous chapters have provided a detailed look at systems of staple production in Bronze Age Mesopotamia. We now move beyond the realm of production by focusing on consumption practices and on the channels through which agricultural goods made their way to consumers. This chapter will therefore examine patterns of storage, distribution, and consumption.

Written materials and archaeological evidence provide ample testimony to the types and quantities of staple goods that reached consumers in Mesopotamia, and these can be compared fruitfully with more recent data regarding the basic needs of individuals and households. The goal of the first part of the chapter is, therefore, to describe the full range of food products that were consumed in Mesopotamia and to identify patterning in consumption practices. I then trace the various food products back through the distribution process. This will require an examination of both household-level and institutionally managed forms of distribution. I have chosen to focus specifically on storage, a key component of food distribution systems at both the household and the institutional scale. The abundant archaeological and written evidence for storage practices in Mesopotamia provides an important window onto the complex and evolving webs of food collection and allocation that characterized the Early Bronze Age in the region.

FOOD SOURCES

Although previous chapters have drawn particular attention to the distinction between zones of irrigated and rain-fed agriculture within Mesopotamia, the region is actually composed of a rich mosaic of micro-environments, each offering unique niches for plant and animal exploitation. Not surprisingly, the range of foods consumed during the Bronze Age was correspondingly broad, with a varying mix of wild and cultivated foods finding its way to consumers. The evidence for these different types of food has been pieced together through studies of lexical material preserved in cuneiform documents and through the physical remains recovered by archaeologists. For example, philologists have made careful attempts to correlate ancient and modern words for specific plants and animals, so that we can accurately identify the terminology preserved in Sumerian and Akkadian documents (Chapter 5). These philological efforts have then been compared with the actual remains of plants (e.g. charred seeds, pollen, phytoliths) and animals (e.g. bones, teeth) excavated at archaeological sites across the region.

Cereals were, by far, the dominant variety of plants cultivated in Mesopotamia. Although many different types of cereal are mentioned in the cuneiform sources, the three most important were barley, emmer wheat, and einkorn wheat (Powell 1984: 49; van Zeist and Bottema 1999: 29; see also Chapter 5). Barley, which is more tolerant of both high aridity and high salinity, appears to have been the dominant cereal in both northern and southern Mesopotamia during the Bronze Age, with emmer and einkorn ranking a distant second and third (Powell 1984; Potts 1997: 59-60; van Zeist & Bottema 1999: 30-1; Charles & Bogaard 2001: 325). Thanks to information gleaned from cuneiform documents and artistic representations, we know that these cereals were consumed in a variety of forms, including 'many types of beers, soups, porridges, cakes, and breads' (Reynolds 2007: 177). We can even examine the recipes for particular menu items; for example, there was a dish

composed of small birds encased in dough, as well as a kind of cake that sometimes included dates, nuts, garlic, or cumin (Bottéro 1995; Reynolds 2007: 174-8). Beer made from barley and, often, from emmer wheat, played an important role in Mesopotamian society. It was only occasionally given out as rations (Neumann 1994), but documents record the consumption of beer during ritual events and feasts, as well as in private households and taverns (Michalowski 1994: 29-33; Neumann 1994: 325).[1] Artistic representations, especially scenes carved on cylinder seals, show us that beer was often consumed by individuals or groups of people seated around a large vat and drinking from the vat through long straws (e.g. Oppenheim 1950: plates I and II). Proverbs draw attention to the negative and the positive effects of beer (Neumann 1994: 324), and one text even records what appears to be a drinking song (Civil 1964). A number of 'recipes' and other documents – both literary and administrative – provide details about the ingredients used to make beer and about the brewing process itself. Several different types of beer were produced, including yellowish, dark, dark and sweet, reddish brown, and strained or filtered (Civil 1964; Powell 1994: 104-117).

Archaeological excavations have uncovered a wealth of evidence for the physical spaces where these cereal-based foods were prepared and consumed and for the facilities and utensils involved. For example, we have evidence for grain-grinding (e.g. grinding installations at Ebla, Matthiae 1995a: 109; Matthiae 1995b: 173; Marchetti and Nigro 1995-6), for bread baking (e.g. ovens and bread molds at Mari, Margueron 2004: 492, 515-16), and for beer production and consumption (e.g. 'beer kits' at Uch Tepe and Abu Salabikh, Gibson *et al.* 1981: 73-4, Martin et *al.* 1985: pl. XXIIa, XXIIc, XXVIc; a possible brewing complex at Tell Brak, Emberling & McDonald 2001: 31-45).

A number of other plants were also grown and consumed in Mesopotamia. These 'small' crops – *ṣiḫḫirtum* in Akkadian or še nig_2-tur in Sumerian – were generally cultivated on a much smaller scale than were the cereals, but they still played an important role in the Mesopotamian diet. Legumes, for example, were actively cultivated and appear in administrative texts from the Ur III (Maekawa 1985) and Old Babylonian (Stol 1985) periods (Chapter 5). Several varieties of onion, garlic, and leek were also cultivated. Used both in bulb form and as fresh or dried greenery, these root vegetables feature prominently in many of the known recipes (Bottéro 1995: 161); for example, onions, garlic, and leeks were all commonly included as seasonings within meat-based broths (Reynolds 2007: 177-80). For details about other fruits and vegetables, see Chapter 5.

In Bronze Age Mesopotamia, oil was derived primarily from two plants: flax/linseed and sesame. The oil extracted from the seeds of both types of plant can be consumed by humans, but flax is often grown primarily for the production of linen (Gallant 1985: 155). Oil occupied an important place within the Mesopotamian diet. It was sometimes distributed as rations, and it was used in cooking and baking (Potts 1997: 66-8).

Animals were also raised and eaten in Mesopotamia, but they played a relatively minor role in the diet, being reserved primarily for consumption by the elite and for offerings to the gods. The main domestic animals – sheep, goats, cattle, and pigs – were kept for a variety of reasons beyond direct consumption. Cattle, for example, were used as draft animals, while sheep were raised for their wool. Cattle and goats were also milked, and the milk was processed into buttermilk, yogurt, butter, ghee, and cheese (Reynolds 2007: 179). Archaeological remains do, however, demonstrate that these animals were often butchered and eaten (e.g. Weber 2001), and we have recipes describing the many different types of broth that could be produced using the meat, offal, blood, and fat of a range of animals, both wild and domestic (Reynolds 2007: 179-80). Among these were a number of different types of bird. Domesticated geese and ducks, for example, were eaten, alongside an array of marsh birds (Owen 1981; Reynolds 2007: 180). Fish were also raised and caught wild. The southern Mesopotamian environment, in particular, supported a broad range of fish species, and cuneiform sources document the harvesting of both freshwater and saltwater fish (Englund 1990: 8; Sasson 2004: 193-4, note 44). Like many other food products, fish were actively collected and stored by the institutions. Documents dating to the Ur III period, for instance, record the activities of teams of state-affiliated fishermen who were organized under overseers and who were required to meet explicit daily quotas of fish (Englund 1990: 8-9).

[1] Beer was a standard ration for Ur III messengers who, according to the so-called "Messenger Texts", received generous allocations.

These fish were often consumed fresh, for instance in royally sponsored banquets (Sasson 2004), but they could also be preserved by 'salting, drying, smoking or making the fermented sauce *siqqum*, a household staple' (Reynolds 2007: 180). Although they appear relatively rarely in administrative records (e.g. Englund 1990: 91-7), turtles and turtle eggs were also consumed; for example, an Ur III document records the delivery, over a 35-month period, of thousands of turtles and turtle eggs (Owen 1981: 40-3).[2]

NUTRITIONAL REQUIREMENTS

Having outlined the range of foods available in Bronze Age Mesopotamia, I now move on to the more difficult task of identifying the roles played by these foods in the diet. The goal is to understand not only what people were actually eating but also how much they were eating and how varied the diet was across the social landscape. Ultimately, then, we are looking for patterning in consumption practices. As a first step, I lay out a set of baseline nutritional requirements drawn from cross-cultural studies of food consumption, focusing first on the dietary needs of individuals, before looking briefly at the ways in which these changing needs come together within the household.

Attempts to derive cross-culturally valid nutritional requirements are, of course, fraught with difficulties. For example, an effort must always be made to distinguish between what people *need* to consume, what they *hope* to consume, and what they *actually* consume on a normal basis. Archaeologists working in Mesopotamia have typically relied on relatively rough estimates that focus especially on the quantity of cereals consumed annually by each individual. These estimates can range anywhere from 143 kg (Hunt 1987: 165) to 250 kg (Wilkinson 1997: 88) or higher (see e.g. Schwartz 1994: table 2). This use of average, bulk cereal requirements is understandable, given the nature of the archaeological data and the broad-scale questions that have often been asked (e.g. estimating population, sustaining area, or storage capabilities).

For our purposes, however, more detailed measurements of individual consumption needs are required. Gallant's discussion of households in ancient Greece is especially valuable (1991). After reviewing the data available from a range of ancient and modern societies, Gallant proposes a scheme that specifies total daily caloric requirements as a function of age and gender (1991: 73, table 4.5).

Table 6.1 Daily caloric requirements as a function of age and gender (Gallant 1991: 73, table 4.5).

Children	
4 – 6	1,830
7 – 9	2,190
Male Adolescents	
10 – 12	2,600
13 – 15	2,900
16 – 19	3,070
Female Adolescents	
10 – 12	2,350
13 – 15	2,490
16 – 19	2,310
Adult Male	
20 – 39	3,000
Adult Female	
20 – 39	2,200
Pregnant	2,500

[2] Locusts were also eaten, which is indicative of the wide range of wild resources consumed (Widell 2007; Radner 2004).

He also discusses the relative contribution made to these total requirements by different types of food, such as cereals, pulses, vegetables, oil, and wine (1991: 62-79). For Bronze Age Mesopotamia, the values differentiated by age and gender can be borrowed as a general model for nutrition requirements, but in future models it will also be necessary to examine the evidence from Mesopotamia more closely in order to gauge the relative contribution of the different food types discussed above.

Gallant's study demonstrates very clearly that the total nutritional requirements of a household will vary through time as the composition of the household changes. It has not yet proven possible to model the household life cycle in Mesopotamia along the lines traced out by Gallant (1991) for ancient Greece or Saller (1994) for ancient Rome. We do have plenty of evidence for the development of specific households within Mesopotamia (e.g. for Ur, see Charpin 1986, Van De Mieroop 1992, Brusasco 1999-2000; for Nippur, see Stone 1987), but a broadly applicable model for shifting household composition remains to be developed. For now, we have relied on a study of the household types represented in census data from rural Ptolemaic Egypt (Bagnall & Frier 1994), on the assumption that these data reflect the same general preference for patrilocal, multiple-family households that is visible in Mesopotamia and other parts of the ancient Near East (Schloen 2001; see also Chapter 7). When combined with the individual nutritional requirements discussed above, this patrimonial model for household composition and evolution outlines an important set of baseline needs that must have been met consistently by the households of Bronze Age Mesopotamia.

TYPICAL PATTERNS OF FOOD CONSUMPTION

The social landscape of Bronze Age Mesopotamia was far from uniform. A range of social and economic distinctions – whether based on family ties, institutional affiliation, wealth, occupation, or status – played a role in determining access to food and other material goods. Individuals and households acquired their food through a variety of channels and by means of many different forms of social relationship. For example, some households would have consumed food grown directly in their own fields and gardens, or exchanged it for other products and/or services performed. Others would have relied on wages or rations in kind paid out by central institutions. Still others would have used silver and other exchangeable goods to purchase at least some of their food at local shops or markets. It is also important to keep in mind that, while most everyday consumption would have taken place within the household, feasts of various kinds were also a regular occurrence.

The destructive nature of consumption means that the most direct archaeological evidence for the ancient diet will exist within the physical make-up of ancient human bodies. Unfortunately, although plenty of human remains have been recovered from sites in Mesopotamia, studies of bone chemistry that would provide the kind of dietary evidence cited by Gallant (1991: 68-72) are not yet available for Mesopotamia (Potts 1997: 56). Otherwise, food consumption is most visible in contexts where ceramic serving vessels and trash deposits have been recovered. For example, the spatial distribution of ceramic types within a domestic structure can provide information about the rooms where household-level food consumption took place (e.g. Franke 1987), and sometimes it is possible to identify physical traces of the foods that were served in these vessels. In areas where domestic refuse either accumulated or was purposefully deposited, animal bones, seeds, and other food remains can provide further indications about the types and quantities of foods that were consumed (e.g. Zeder 1991; Miller 1997). In some cases, archaeological evidence – for example, within public buildings or squares – also points to larger scale consumption events, such as feasts. These types of archaeological data are often most informative when viewed in the aggregate. For example, in a multi-site analysis of animal bones recovered in the Middle Khabur region, Zeder is able to demonstrate a major shift in the role of animals within the diet. Over the course of the third millennium BC, wild species and domesticated pigs decreased in importance, alongside an increased reliance on sheep and goats (Zeder 1998: 60-4).

The central institutions responsible for the production of much of the cuneiform record were seldom interested in recording the details of daily household meals or, for that matter, aggregate statistics on consumption practices. They did, however, record some useful information regarding feasts and the eating habits of the elite (Schmandt-Besserat 2001). For example, administrative documents and letters from the city of Mari vividly

illustrate both the range of foods consumed and the complex socio-political maneuvering involved in meals held at the 'king's table' (Sasson 2004).

Even if the direct evidence for food consumption is relatively meager, we can still gain some insight into Mesopotamian dietary practices by turning to several types of indirect evidence. Above, we have already used written and archaeological evidence to draw together a list of the foods that were eaten in Bronze Age Mesopotamia, and we have seen that these foods were prepared for consumption in a variety of ways, such as drying, grinding, boiling, and fermenting. If, however, we want to know *who* was eating these foods and in what *quantities*, we need to examine the organization of food production and distribution in Mesopotamia more closely.

During the Bronze Age, the Mesopotamian economy was dominated by the so-called 'great organizations' (i.e. palace and temple), but it was by no means monolithic. Even the institutional system itself was complex and multilayered, composed of multiple, overlapping sources of power and authority (Stein 2001). Some scholars have also argued for the existence of another 'sector' of society that operated largely beyond the bounds of institutional control (e.g. Gelb 1971; Diakonoff 1982). As mentioned above, food consumption would have taken place largely within the household, but individual households were tied into the institutional structure in different ways and to varying degrees. Some households would have been largely self-sufficient, sustained primarily by produce from their own fields and gardens, while others would have relied on rations and wages distributed by the institutions. It is the latter that appear most often in the cuneiform record, and we will begin here with a brief examination of the ration system.

Numerous documents from both southern and northern Mesopotamia record the disbursement of rations to palace and temple dependents. Some individuals received partial rations or irregularly timed food allotments from their institutional patrons, but many workers, craftsmen, and officials received a set measure of barley each month and an annual allotment of wool. The rationing system that operated during the Ur III period in southern Mesopotamia has been most extensively studied (e.g. Gelb 1965; Waetzoldt 1987), but cuneiform texts also indicate the existence of similar distribution mechanisms throughout much of Bronze Age Mesopotamia (for southern Mesopotamia, Charvát 2007; for Ebla, Milano 1995; for Tell Beydar, Sallaberger 1996). It has even been suggested that some standardized bowl types recovered on archaeological sites may have played a role in these ration systems, for example, 'beveled-rim bowls' (Nissen 1988: 84-5) and the 'sila bowls' found at Tell Leilan (Senior and Weiss 1991).

Monthly food rations varied in type and quantity according to distinctions in age, sex, profession, and status (Waetzoldt 1987: 121). The typical, baseline barley ration, however, remained relatively constant throughout the Bronze Age in both southern and northern Mesopotamia. Most adult males received 60 $sila_3$ (ca. 60 liters) of barley each month, while most adult females received 30-40 $sila_3$ (30-40 liters) (Waetzoldt 1987: 121-2). Some individuals, especially high functionaries in the bureaucracy, were compensated with much larger quantities of barley. For example, during the Ur III period certain agricultural supervisors were given 900 liters per month, and a scribe in the office of prefect could receive as much as 5000 liters per month. The range of variation in rations for women was much more restricted, with an upper limit of around 100 liters per month for some highly skilled weavers (Waetzoldt 1987: 122-3). Interestingly, children were also provided with rations. The Ur III documentation suggests the existence of three categories of children defined according to age:

> 'The "ten liter" ration group would have encompassed children to about the age of five; the "fifteen liter" group would have covered those between five and ten years of age. After this children passed over into the "twenty liter" ration norm for "adolescents" and then, between the years of 13 and 15, into the "grownup" norms.' (Waetzoldt 1987: 133)

The fact that even newborn babies received barley rations lends credence to the claim that these rations – at least the average ones at the low end of the scale – represented some kind of generally recognized individual subsistence requirement. We can, therefore, use these as a tentative indicator of the quantities of food consumed

by certain classes of people in ancient Mesopotamia, and we can compare them to the daily caloric needs cited by Gallant (see above).

The daily food ration for a typical adult male would have been 2 liters of barley (i.e. 60 liters per month). This converts to approximately 4000-4500 calories per day, which is well in excess of basic nutritional requirements (Widell 2005: 397). This is hardly surprising, if we assume that these rations – and those contributed by other family members – represented the main income for the household in question. The household would have needed to exchange surplus barley both for other types of food and for a variety of other necessities that were not provided by the palace or temple as rations (Waetzoldt 1987: 134; Widell 2005: 397). Some texts do record the provision of other types of food as rations, but this appears to have been an exceptional circumstance, either driven by economic and political circumstances or provided as a special additional payment (Waetzoldt 1987: 123-8). We know relatively little about the small-scale, everyday exchanges in basic necessities that must have transpired among households (Widell 2005), but it is at least possible to use officially recorded prices to estimate the purchasing power represented by an individual family's barley ration (see Waetzoldt 1987: 134). A rough estimation produces the following image of ration-based household subsistence:

> '…the monthly barley allotment was sufficient to keep one alive when all members of the family were able to work as their age and health permitted. If, however, father or mother were unable to work for a month or more, then immediate difficulties would have arisen.' (Waetzoldt 1987: 134-5)

The information provided by ration lists is far from perfect, and it certainly is not representative of the entire population of Bronze Age Mesopotamia. It does, however, allow us to begin reconstructing household-level consumption practices.

FOOD STORAGE

As the preceding brief discussion of the ration system should have made clear, it is difficult – perhaps impossible – to reconstruct patterns of food consumption in Bronze Age Mesopotamia without also examining patterns of production and distribution. This was not a society composed solely of self-sufficient households that owned their own land and consumed foods produced directly through their own labor. Some households received their sustenance from monthly rations paid out to each individual by the central institutions. Others grew their own food either in fields that had been granted by the institutions as so-called 'subsistence plots' or in fields that had been rented from the institutions or other large landowners in exchange for a proportion of the crop. Still others may have farmed land that was held by communal or family groups operating largely beyond the bounds of institutional control. And most households probably had to obtain at least some of their food through exchange.

Despite the multiplicity of pathways through which agricultural goods made their way to consumers in Mesopotamia, some elements of the process were unavoidable. In particular, I focus here on the storage of food. The seasonality of the agricultural cycle would have meant that some degree of storage was inevitable; in the face of an arid and highly variable climatic regime, storage would also have played a crucial role in mitigating the effects of periodic harvest failures. It is hardly surprising, therefore, that storage facilities are well represented in both the archaeological and the written record from Mesopotamia. Archaeological excavations, in particular, have documented the existence of a range of different types of storage facilities, from high-capacity centralized grain silos to small, multi-purpose storerooms within residential structures. When combined with information gleaned from the cuneiform sources and with the dietary parameters discussed above, this archaeological evidence provides an important, but relatively underexploited, means of quantifying patterns of food allocation and, therefore, consumption. Here, I restrict the discussion to grain storage facilities, but it should be clear by now that many other foods would also have been stored. I focus first on the evidence for institutionally managed storage systems, before turning to smaller scale, household-level facilities.

The most striking archaeological evidence for grain storage has come from a series of excavations conducted over the past few decades in northern Mesopotamia. For example, rescue excavations along the middle reaches

of the Khabur River in Syria uncovered the remains of a number of small villages that were dominated by large-scale storage buildings during the first half of the third millennium BC. The storage facilities at these sites included rectilinear silos (e.g. Tell Atij; Fortin 1998), semi-subterranean vaulted chambers (e.g. Tell al-Raqa'i; Schwartz & Curvers 1992), and so-called 'grill-plan' buildings (e.g. Tell Ziyadeh; Hole 1999; Tell al-Raqa'i). Although grain was only rarely recovered *in situ* within the storage buildings at these sites, it was probably the primary stored commodity. Several large rectilinear silos were also uncovered at the contemporaneous site of Tell Hajji Ibrahim (Danti & Zettler 1998), a tiny hamlet near the urban center at Tell es-Sweyhat on the Middle Euphrates. Excavations at the site of Telul eth-Thalathat in northern Iraq unearthed an even larger storage structure that included ten separate rooms, all lying above a grill-plan ventilation system (Fukai *et al.* 1974). This impressive storage facility also dates to the first half of the third millennium BC. A vaulted storage building of similar dimensions, recovered at the site of Tell Beydar in the western part of the Upper Khabur region in Syria, dates to the second half of the third millennium (Sténuit 2003). A number of other possible storage areas were also identified in contemporary levels at Beydar in proximity to the palace at the center of the settlement and the temple complex to the south (Suleiman 2007). Several of the large urban centers that emerged in northern Mesopotamia during the second half of the third millennium have also produced evidence for institutional-scale grain storage; among these are Tell Leilan (Weiss *et al.* 2002), Tell Mozan (Buccellati & Kelly-Buccellati 1995-6), Tell Brak (Emberling & McDonald 2001), Ebla (Dolce 1988), and Kazane Höyük (Creekmore 2008).

The archaeological remains of grain storage in contemporary southern Mesopotamia have not, so far, received much attention. As many as 30 cylindrical silos were, however, identified at the site of Fara / Shuruppak (Martin 1988: 42-7), and a pair of similar silos may have been located immediately adjacent to the ziggurat at Nippur (Trümpelmann 1990). The monumental palace and temple complexes uncovered at Kish (Moorey 1978), Eridu (Safar *et al.* 1981), Nippur (Zettler 1992), Ur (Woolley 1974), Khafajah (Delougaz 1940), Tell Asmar (Frankfort *et al.* 1940), and other sites certainly included areas devoted to storage, but it is often difficult to identify exactly which spaces were dedicated specifically to grain storage. On the eastern edge of the south Mesopotamian heartland, excavations at a series of small, fortified sites in the Hamrin Basin have uncovered some more modest grain storage facilities. For example, in the Early Dynastic I levels at Tell Gubba, a group of small structures appears to have been purpose-built for the storage of grain, with ventilation passages allowing air to flow beneath the stored goods (Fujii 1981: 148). At the similar, but slightly later, site of Tell Razuk, a small, rectangular storage structure sat near the center of the Round Building and was rebuilt through several phases of occupation (Gibson *et al.* 1981: 35, 48).

The written evidence for institutional-scale grain storage derives almost exclusively from sites in southern Mesopotamia. This evidence exists primarily as scattered references to storage spaces and grain shipments within administrative documents, and it has not yet been compiled in a comprehensive manner.

One reference to a large, institutionally administered granary appears in an Early Dynastic text from the city of Shuruppak (Fara). The tablet records the distribution of rations from a silo (Sumerian gur_7) with a capacity of 2400 gur-mah or approximately 921.6 m^3 (921,600 liters) (Martin 1988: 47). Direct references to storage capacities are, unfortunately, rare, but the cuneiform record does bear witness to the presence of similar storage facilities within many of the major cities of Mesopotamia during the second and third millennia BC. For example, during the Old Babylonian period, both the palace and the Shamash-temple in the city of Sippar-Jahrurum administered large granaries, in which barley was collected and loaned out for repayment at harvest time (Van Lerberghe 1993). These large, urban granaries were stocked with grain that was brought in from outlying agricultural areas. For example, a series of Old Babylonian documents records the delivery of grain into the granaries of Larsa from several towns in the surrounding region. These deliveries ranged in size from 180 to 720 gur (Breckwoldt 1995/1996). An even more closely managed collection system has been identified in the province of Umma during the Ur III period. In the abundant cuneiform material from Umma, Steinkeller has identified as many as 85 small hamlets that were spread widely across the landscape and that served as collection points, where grain was temporarily stored for later trans-shipment to Umma and other towns (Steinkeller 2007: 190-2).

Ideally, we would like to be able to determine exactly who was being supported by the grain stored in each of these institutionally managed storage facilities, but this level of comprehensive and detailed information is not available. Instead, rough estimates for the number of people that could have been fed with the stored grain must suffice. A number of scholars have attempted to derive such estimates from archaeologically recovered storage structures. For example, Schwartz argues that the grain stored in the small settlement at Tell al-Raqa'i could have supported between 280 and 500 people, which is well in excess of his population estimate for the site (Schwartz 1994: 25-8). Likewise, the large, multi-roomed storage building at Telul eth-Thalathat may have held enough grain to feed 250-400 people for a year (85-130 m^3; Fukai *et al.* 1974: 24-5), while the vaulted building at Tell Beydar may have held 500 m^3 of grain, three times the capacity of the Telul eth-Thalathat structure (Sténuit 2003). The rectilinear silos at Tell Hajji Ibrahim each enclosed a volume of 2.64 m^3 (1320 kg of grain, enough to feed 6.6 people for one year) for every meter in height of stored grain (Danti 2000: 131). Some measurements have also been published for the cylindrical silos excavated at Fara in southern Mesopotamia (Martin 1988: 47). Martin estimates that each of these silos could have accommodated approximately 125 cubic meters of grain. According to Visicato, therefore, the 30+ silos identified at the site could have held as much as 8000 gur of grain, enough for 3.5 million typical rations and enough to support 20,000 people for a period of six months (Visicato 1993). These are massive silos, but they pale in comparison to the size of the granary (921.6 m^3) mentioned in the document from Fara mentioned above. Perhaps this granary was, in fact, composed of a collection of smaller silos, like those excavated at the site. We do not have any good information about the size of the small granaries that would have dotted the countryside in southern Mesopotamia, but hypothetical parallels have been drawn with the relatively modest structures excavated at Tell al-Raqa'i on the Middle Khabur and Tell Karrana in northern Iraq (Steinkeller 2007: 190-2).

To sum up, it is clear that in northern and southern Mesopotamia the major institutional powers, the palaces and temples, relied on large-scale storage facilities that were carefully administered and documented and that were sometimes organized into regional-scale grain collection systems. For southern Mesopotamia, neither the rich written material nor the archaeological evidence has been systematically explored, but both hold great potential, especially with regard to the reconstruction of highly centralized systems of redistribution. In the north, however, where the written record is much sparser, we are now beginning to see hints of some larger patterns. Pfälzner has recently outlined some trends in the development of grain storage practices in the region (Pfälzner 2002: 266-83). Focusing especially on the Middle Khabur sites, he identifies a movement from village-based, communal storage to forms of household-based production and storage that were ultimately encompassed by an institutionally managed redistributive economy. This interpretation contrasts sharply with that offered by Schwartz (e.g. 1994a, 1994b), who identifies a political development in the region from complex chiefdoms into city-states. More specifically, he argues that the Middle Khabur storage facilities represent not a form of local, communal storage but special purpose settlements set up by an emerging state (e.g. based at Mari) as part of a larger project to extract agricultural surpluses from the Upper Khabur region (Schwartz 1994b: 28-32). These competing models – and, likewise, that offered by Hole (1991, 1999) – rely partly on divergent interpretations of the local and regional context of the storage facilities, but they also make use of very different calculations of storage capacity and the number of people that could have been fed with the stored grain. It is also worth mentioning one other model that has been offered, in this case to explain the presence of large silos at the tiny site of Tell Hajji Ibrahim near Tell es-Sweyhat on the Middle Euphrates. Danti argues that the silos may have held grain that was used primarily as feed for herds of sheep and goats (Danti 2000). If hand-feeding of livestock was, in fact, common during this period, then we may need to take this into account in our reconstructions of storage systems more broadly.

Although large-scale, institutional grain storage was clearly important in Bronze Age Mesopotamia, there was also plenty of smaller-scale storage happening within domestic spaces. This type of storage does not feature prominently in the written record, but excavations within residential zones have shown that household food storage practices made use of a range of features, including jars, bins, pits, shelves, and storerooms (Pfälzner 2002: 274-9). The best archaeological evidence derives from sites in northern Mesopotamia. For example, Pfälzner has drawn attention to the sites of Tell Bderi and Tell Melebiya, both in the Middle Khabur region. He contrasts the abundant evidence for domestic storage at these sites with the lack of storage spaces in the houses at Tell al'Raqa'i (Pfälzner 2002: 273). Considering the importance of the household as a unit of consumption –

and, if Pfälzner is correct, production – the evidence for domestic storage could provide some very important quantitative data, but this evidence has not yet been comprehensively compiled and analyzed. Once a systematic survey of household storage capacities has been produced, the real challenge will be locating these forms of storage with respect to the developing institutional economy. Once again, this will mean broadening the perspective to examine the degree to which households were producing their own food, rather than receiving and then storing rations and other forms of payment from the palace and/or temple.

This raises some larger questions about the role of grain storage in Bronze Age Mesopotamia. In marginal climatic zones, where agricultural production can be highly variable and can be subject to considerable risk and uncertainty, food storage commonly serves as a 'buffering mechanism' (Halstead & O'Shea 1989: 3-4). At the same time, however, large-scale systems of grain storage have often played a role in political projects aiming to extract and accumulate agricultural surpluses for use by centralized powers. In Mesopotamia, we are almost certainly dealing with a mixture of these two motivations. Farmers certainly had to deal with periodic hardships, such as droughts and plagues of locusts (Heimpel 2003: 419-27; Widell 2007; Paulette 2012), and storage would have provided a crucial means of surviving the resulting lean years. Thanks to the rich documentary record, we also know a lot about the institutional management of grain supplies and about the wealth that was accumulated within the upper levels of the social system; recall, for instance, the wide variability in the quantities of grain provided as rations. Although the evidence is not especially clear, it is also possible that centralized grain stores served as a kind of safety net, a fund from which grain could be distributed to the population more broadly in times of food shortage.

Any examination of consumption and food availability in Mesopotamia must, therefore, consider issues of sustainability at both the household and the settlement level, and it must take into account the role of the institutions, whether as insurance providers or as tools of extraction and domination. It is also important to keep in mind that we are dealing here with a complex, multi-layered, and multi-centric system that changed through time. Nonetheless, the individual and household consumption patterns discussed above can provide us with a baseline for understanding the motivations behind a range of everyday practices, such as food storage, and they can help us to model both the short- and the long-term implications of these practices.

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