



Israel Exploration Journal

VOLUME 64 • NUMBER 1
JERUSALEM, ISRAEL • 2014

ISRAEL EXPLORATION JOURNAL

Published twice yearly by the Israel Exploration Society and the Institute of Archaeology of the Hebrew University, with the assistance of the Nathan Davidson Publication Fund in Archaeology, Samis Foundation, Seattle WA, and Dorot Foundation, Providence RI

Founders

A. Reifenberg, D. Amiran

Former Editors

Michael Avi-Yonah, Dan Barag, Jonas C. Greenfield, Baruch A. Levine, Miriam Tadmor

Editorial Board

Shmuel Ahituv, Aren M. Maeir, Amihai Mazar and Zeev Weiss, *Editors*
Tsipi Kuper-Blau, *Executive Editor*
Joseph Aviram, *President, Israel Exploration Society*

Editorial Advisory Board

Gideon Avni, Ofer Bar-Yosef, Shlomo Bunimovitz, Israel Eph'al, Baruch A. Levine, Ronny Reich, Myriam Rosen-Ayalon

IEJ is now available online on JSTOR

Email: iej.editors@gmail.com

Books for review: Israel Exploration Journal, P.O.B. 7041, Jerusalem 91070, Israel

Guidelines: <http://israelexplorationsociety.huji.ac.il>

Copyright © 2014 Israel Exploration Society

ISSN 0021-2059

The Editors are not responsible for opinions expressed by the contributors

CONTENTS

- 1 ASSAF YASUR-LANDAU, BOAZ GROSS, YUVAL GADOT, MANFRED OEMING
and ODED LIPSCHITS: A Rare Cypriot Krater of the White Slip II Style from
Azekah
- 9 DAVID T. SUGIMOTO: An Analysis of a Stamp Seal with Complex Religious
Motifs Excavated at Tel 'En Gev
- 22 RAZ KLETTER: Vessels and Measures: The Biblical Liquid Capacity System
- 38 SHLOMIT WEKSLER-BDOLAH: The Foundation of Aelia Capitolina in Light
of New Excavations along the Eastern Cardo
- 63 RONNY REICH and MARCELA ZAPATA MEZA: A Preliminary Report on the
Miqwa'ot of Migdal
- 72 RABEI G. KHAMISY: The Treaty of 1283 between Sultan Qalāwūn and the
Frankish Authorities of Acre: A New Topographical Discussion
- 103 ALEXANDER GLICK, MICHAEL E. STONE and ABRAHAM TERIAN: An
Armenian Inscription from Jaffa
- 119 NOTES AND NEWS
- 121 REVIEWS
- 126 BOOKS RECEIVED — 2013

ABBREVIATIONS

- AASOR Annual of the American Schools of Oriental Research
ADAJ Annual of the Department of Antiquities of Jordan
AJA American Journal of Archaeology
AfO Archiv für Orientforschung
ANET Ancient Near Eastern Texts Relating to the Old Testament³, ed. J.B. Pritchard, Princeton, 1969
BA The Biblical Archaeologist
BASOR Bulletin of the American Schools of Oriental Research
BT Babylonian Talmud
CAD Chicago Assyrian Dictionary
CIS Corpus Inscriptionum Semiticarum
DJD Discoveries in the Judaean Desert
DSD Dead Sea Discoveries
EI Eretz-Israel: Archaeological, Historical and Geographical Studies
ESI Excavations and Surveys in Israel
IAA Reports Israel Antiquities Authority Reports
IEJ Israel Exploration Journal
JAOS Journal of the American Oriental Society
JBL Journal of Biblical Literature
JCS Journal of Cuneiform Studies
JEA Journal of Egyptian Archaeology
JNES Journal of Near Eastern Studies
KAI W. Donner and W. Röllig: *Kanaanäische und aramäische Inschriften* 1–3, Wiesbaden, 1962–1964; 1^s, 2002
NEAEHL The New Encyclopedia of Archaeological Excavations in the Holy Land (English Edition), Jerusalem, 1993
PEQ Palestine Exploration Quarterly
PT Palestinian Talmud
QDAP Quarterly of the Department of Antiquities in Palestine
RA Revue d'Assyriologie et d'Archéologie Orientale
RB Revue Biblique
RE Pauly-Wissowa's Realencyclopädie der classischen Altertumswissenschaft
RQ Revue de Qumran
VT Vetus Testamentum
ZA Zeitschrift für Assyriologie
ZDPV Zeitschrift des Deutschen Palästina-Vereins

ANNUAL SUBSCRIPTION RATES

2014: \$60 including postage or equivalent payable to the Israel Exploration Society, P.O.B. 7041, Jerusalem 91070, Israel.
All subscribers are entitled to a 25% reduction on the publications of the Society.
Subscribers should give full name and postal address when paying their subscription, and should send notice of change of address at least five weeks before it is to take effect; the old as well as the new address should be given.
Single issue: \$30 or equivalent.

Vessels and Measures: The Biblical Liquid Capacity System*

RAZ KLETTER
University of Helsinki

ABSTRACT: This paper criticises recent studies concerning the *bath* and other biblical liquid capacity measures, which call for their ‘deconstruction’. Fundamental issues of metrology are addressed: Were there exact measures in antiquity? How was capacity measured? Were *mlk* jars ‘measured’? What are the differences between dry and liquid, ‘approximate’ and ‘exact’ measures? Why are measures ‘just’ or ‘honest’? Did temples employ completely different measures from those of the society as a whole? What is the relation between ‘measures’ and ‘vessels’?

INTRODUCTION

THE Bible differentiates between dry and liquid capacity measures. The central dry measure is the *epha* (originating from the Egyptian *oipē*), with a multiple (*kor*; in Akkadian, *imēru*, ‘ass-load’) and sub-units (*seʿah*, *omer*, *ʿiššarôn*). The central liquid measure is the *bath*, with a multiple (*kor*) and sub-units (*hin*, *log*).

These measures, especially the *bath*, were discussed in two recent studies. Zapasski, Finkelstein and Benenson (2009) were troubled by the fact that Judaeen *mlk* jars vary in size, assuming that Judah was a ‘full-blown state’ employing ‘exact standards’; thus, the authors suggested that the jar capacity was calculated by a ‘simple algorithm’. However, there were no exact standards in the ancient world, and capacity of irregular jars was not calculated with an algorithm, but measured with measuring vessels (Powell 1997: 340; Pommerening 2005; Lang 1956: 7; Kletter 2009a).

Other scholars have reached the opposite conclusion: that there was no ‘organized or fixed system of liquid volume measurements’ in Judah (Lipschits *et al.* 2012: 453).¹ They based this view on the Bible, claiming that almost all references

* I wish to thank Tanja Pommerening, Eleanor Robson and Gregory Chambon for the data and advice about ancient measures and mathematics. I am grateful to Katri Saarelainen for her help with locating bibliographic items. I am most grateful to the readers and editors of *IEJ*, whose careful reading and many comments have greatly contributed to this paper.

1 Note that they state that ‘some scholars (Zapassky, Finkelstein and Benenson 2009: 53, 59; Kletter 2009 [=2009a]: 362) also included the *ʿiššarôn*, classified as one-tenth of a *bath*, as a liquid volume measurement’ (Lipschits *et al.* 2012: 453). This citation is erroneous, since I wrote that *ʿiššarôn* is a dry measure (Kletter 2009a: 362).

to liquid capacity units are in ‘late’, post-exilic sources. In their view, these sources relate to cult in the Jerusalem Temple and bear no relation to daily life or administration during the period of the Monarchy.

A crucial part of this latter view is the notion that biblical terms understood so far as capacity terms were not measures, but terms for cultic vessels used in the Temple. The *hin*, for example, ‘was not a liquid volume measurement during the First Temple period, but a vessel... for oil or wine that was used for cult purposes. The *hin* does not occur in the Deuteronomistic history or in epigraphic sources, so there is no evidence of its use in the administration or the economy of the First or Second Temple periods’ ... (Lipschits *et al.* 2012: 454).

With regard to measures, notably *bath*, which do appear in early biblical sources (Isa. 5:10; 1 Kings 7), Lipschits *et al.* acknowledge that ‘in the administration and economy of First Temple Judah the only known measurement for liquid volume was the *bath*’, but contradict this by suggesting that ‘the *bath* was not a fixed measurement for liquid volume but rather the name of a specific jar — the Judahite storage jar’ (2012: 458).² In their view, there was only one general Judaeon ‘oval’ jar (Lipschits 2012; Sergi *et al.* 2012), rather than several types (*lmlk*, *lmlk*-like, rosette, etc.). Since the *lmlk* jars have a capacity of *c.* 45 litres, the authors try to refute Albright (1943), who concluded, on the basis of an Iron Age jar inscribed *bt lmlk*, that the *bath* equaled *c.* 22 litres (Lipschits *et al.* 2012: 458–470; and see further below). Can we ‘purge’ the first-millennium BCE Southern Levant and the Bible (or its supposedly early parts) of all liquid capacity measures?

DRY AND LIQUID MEASUREMENT SYSTEMS

Unlike many countries, such as the U.S., in modern-day Israel there are no separate dry/liquid measures of volume; therefore, the assumption of a single system may seem plausible. Yet even today, different measuring units are employed in Israel: liquids are measured by volume (litres) and dry substances by weight (kilograms).

Different measures for dry substances and liquids are common because the measuring techniques are different. With dry substances, vessels are filled to the rim and often leveled off with a straight tool. This was done by using strickles (Greek: *skutálē*; late Egyptian: *gst* — the scribe’s palette; Old Babylonian: *gišmēšequm*; Veenhof 1985: 303, n. 47; cf. Chambon 2011a: 169–170). With liquids, this might result in spilling. Measuring of grains is also affected by the speed of filling the container and knocking the measure, which settles the grains (Blake 1999: 221–222).

Various dry/liquid measures were common in Mesopotamia (Gelb 1982;

2 I wonder what the difference between ‘known measurement’ and ‘fixed measurement’ is.

Powell 1989–90: 492–493, 503; Proust 2007: 68; Robson 2007: 70; Høystrup 2011: 2, 4). In a Proto-Elamite document, dotted numbers denote quantities of flour and slashed numbers indicate quantities of malt (Friberg 2005: 64). The measures were merged towards the late third millennium BCE (Powell 1989–90: 493; Melville 2008: 26), but ‘distinct systems for measuring non-grain products may have existed ubiquitously’ (Powell 1989–90: 502).

Dry and liquid measures existed in third-millennium Ebla (Chambon 2011a: 133–137). A stone tool for measuring liquids was found at Middle Bronze Tell Tuqan (Chambon 2011a: 172, 178). In second-millennium Nuzi there was an 8-*sila* liquid measure called *tallu* (Zaccagnini 1979; Powell 1989–90: 500; Rougemont 2011: 361–365). Mari texts document a ‘grand measure’ used only for liquids (Chambon 2006; 2011a: 175–177). Dry and liquid measures existed in Urartu (Iron Age; Reindell and Salvini 2001; Payne 2005), as well as in Greece and Rome (Lang 1956: 2; Richardson 2005: 41–45). They go back to linear scripts in the Aegean (Chadwick 1990: 165–166).

Thus, liquid measures were common in many periods and cultures and are not a scholarly invention.

EARLY AND LATE BIBLICAL SOURCES

Lipschits *et al.* (2012) create an imaginary dichotomy between two sorts of biblical sources: ‘early’ (reliable, Iron Age administration/daily life) and ‘late’ (post-exilic cult/utopia). They claim that former scholars used ‘all the possible vague terms in biblical literature with no distinction between early and late vessels for cult purposes and for daily life or administration’ (Lipschits *et al.* 2012: 472). However, scholars have long drawn a distinction between early and late biblical sources and between reliable and doubtful ones (Barton 1916: 201; Barrois 1931: 201–207; de Vaux 1965: 195–209; Powell 1992: 902–904). De Vaux wrote about his reconstruction of the capacity system: ‘We must insist, [it] is hypothetical, and in any case is valid only for a very late date. It depends on identifications which are sometimes uncertain and always late, the oldest being those of Ezekiel. And even of these last, no one can say whether they record measurements which had fallen into disuse, or foretell a reform which was perhaps never put into effect’ (1965: 201).

Even early sources underwent later redactions, and thus, their supposed ‘early’ date is no guarantee of reliability; all biblical sources are religious, and cult and utopia are not divorced from daily life and administration. Biblical utopias arise in specific historical circumstances. They reflect on the present, as well as on the past (Ben-Zvi 2006: 56). The ‘Shekel of the Sanctuary’ system in Ezekiel 45, for example, seems to be utopian (Kletter 1998: 101), but was modeled on an existing Iron Age system; it has the same general structure and units as the Judaeen Iron Age system, differing only in certain features.

Lipschits *et al.* draw the following conclusion: ‘The *lōg* is not a measurement but an oil vessel in the Temple cult... There is no evidence of using the *lōg* within the administration or economy during the First or the Second Temple periods... The *hīn*, too, was not a liquid volume measurement during the First Temple period, but a vessel’ (2012: 454).

However, temples were never ‘closed systems’ detached from society. They did not use a measuring system completely different from those used by society as a whole. Verses like Leviticus 23:13 specify ingredients for offerings: one lamb, two *‘iśśarōns* of flour mixed with oil, and a quarter *hin* of wine. The Temple is no place for experiments and improvisations. If the Temple held *log*, *hin* and *bath* vessels, it was precisely because they were measuring vessels, used for measuring cultic ingredients as accurately as possible.³

WRONG MEASURES?

Early scholars could not determine whether *bath* was 40–45 litres, based on Josephus (*Ant.* VIII, 2, 9), or *c.* 22 litres (Batten 1913: 312; Barrois 1931: 198–212; Segré 1945: 361; Scott 1959: 31–32). When part of a jar inscribed *bt lmlk* was found at Lachish, Inge (1938: 248, 253; 1941) believed that it was a *lmlk* jar, hence equal in capacity to the *bath* — *c.* 45 litres. However, Albright (1943: 58, n. 7; 75) noting that the *bt lmlk* jar is much smaller, estimated its capacity as *c.* 20 litres. This became the accepted view (Barrois 1951: 251–252; Ginsberg, in Segré 1945: 357–358, n. 2; Avigad 1953; Scott 1959: 29–30; Sternberg 1971: 380). Lipschits *et al.* try to refute Albright’s conclusions.⁴ It is justified to claim

3 Lipschits *et al.* 2012 neglect to mention Ezra 7:22. Although late, it mentions *bath* for both oil and wine, along with other fixed measures (Williamson 1985: 96–103).

4 It should be noted that in their discussion of Albright’s view, Lipschits *et al.* (2012) present an incorrect history of research. They discuss Albright (1943: 58, n. 7) *before* Inge (1938; 1941) and in between, claim that Diringier ‘insisted that... there is no possibility to measure the capacity of the broken [*bt lmlk*] jar’ and that ‘despite Diringier’s opinion, Albright did try to calculate’ (Lipschits *et al.* 2012: 459). Diringier (1941) voiced no opinion about reconstructing capacity; he spoke only about mending the jar physically. After Albright reconstructed the capacity (based on the questionable parameter of rim diameter — see below), Diringier (1953) accepted his estimate. Presenting these authors in the wrong order creates the impression that Inge refuted Albright, while the opposite is true. Inge never responded to Albright (1943), since he too accepted the reconstruction.

Lipschits *et al.* (2012: 461–462) devote a lengthy discussion to Albright’s reference to Germer-Durand (1910), who identified the *bath* as 21.25 litres on the basis of Roman period vessels. However, in contrast to Lipschits *et al.*, Albright did not base his conclusion on Germer-Durand, but only mentioned him in passing, solely to acknowledge that the latter was the first to state that the *bath* equaled *c.* 20 litres, albeit on the basis of erroneous evidence. Albright cited Barrois (1931: 210), who had

that Albright's use of rim diameters to estimate the capacity of the *bt lmlk* jar found at Lachish was wrong.⁵ But it appears that his suggested capacity of 22 litres for the *bath* was correct, based on an inscribed jar found in Ussishkin's excavations at Lachish. This oval jar with two handles contained *c.* 21 litres (Ussishkin 1978: 85–87, n. 9; Zimhoni 2004: 1801, 1873, fig. 26.45:1). Lemaire (2004: 2123–2124) reads line 3 in this inscription as: *b/*, 'one *bath*'. That *b* is an abbreviation for a measure — *bath* — is known from the Arad Ostraca (cf. Aharoni 1981; Naveh 1992; Mittmann 1991: 66; 1993; Wimmer 2008: 252–253; Aḥituv 2008: 94).⁶

'A PERFECT AND JUST MEASURE' (DEUT. 25:15)

The *topos* of just/honest/complete (in quantity) measures is mentioned in early ancient Near Eastern sources. In Mesopotamia, the concept of measurement was

already refuted Germer-Durand's view. The courtesy that Albright extended to Germer-Durand has thus been misinterpreted.

- 5 Albright based his calculation on rim diameters, deduced from measures given for the *bt lmlk* jar by Inge (1941: pl. 10 left) and for the only complete *lmlk* jar available at the time by Diringer (1941: pl. 10 left): 8.15 and 10.8 cm accordingly. They were not 'his measures'. Surprisingly, the calculation gives a *bath* of 19.5, not 22, litres ($45.33 \text{ litres} \times [8.15:10.8]^3 = 45.33 \times 0.7546^3 = 45.33 \times 0.43 = 19.49$). Rather than use this result, Albright preferred the assumption that a *bath* was half of a *lmlk* jar, and gave a number of 22 litres, but from where he took the figure of 44 litres is unclear. Lipschits *et al.* (2012) claimed that Albright was wrong, since they re-measured the rim of the *bt lmlk* jar as 7.3, not 8.15, cm. Hence, they claim, Albright should have reached a *bath* of *c.* 14 litres ($45.33 \times [7.3:10.8]^3 = 45.33 \times 0.3088$). Unfortunately, Lipschits *et al.* (2012) forgot to amend the second measure in the equation — that of the *lmlk* jar rim. They measured many 'Judaean' jars and state that their rim diameters vary between 8.2–9.4 cm and are 'smaller than Albright's assumed typical *lmlk* jar' (2012: 461; from Sergi *et al.* [2012], one can see that their 'Judaean' or 'oval' jars include *lmlk*, proto-*lmlk*, rosette jars, etc.). Yet Lipschits *et al.* (2012) used the same 'wrong' measure (10.8 cm) for *lmlk* jars used by Albright. Since they did not publish specific data for *lmlk* jars, I will use the median value (8.8 cm) from their range of 8.2–9.4 cm for rims of Judaean/oval jars, admitting that this is short of adequate. With the new measures (7.3 cm *bt lmlk*, 8.8 cm *lmlk* jars), we reach a *bath* of 25.8, not 14, litres ($45.33 \times [7.3:8.8]^3 = 45.33 \times 0.57$).

The entire discussion is irrelevant, since rim diameters are not a reliable means for restoring jar capacities; yet the *bt lmlk* jar from Lachish is certainly much smaller in capacity than the *lmlk* and *lmlk*-like jars, so *bath* cannot be *c.* 45 litres. This is evident from the shape of the remaining shoulder part. Additionally, drawings from Lachish and Tel Batash show many Judaean four-handled *lmlk* and related jars with rims wider than 9.4 cm — *c.* 10 cm or more (for example, most of the jars in Zimhoni 2004: 1818–1820, figs. 26.7–26.8; Mazar and Panitz-Cohen 2001: pls. 16:1–7,9, 17:1–6, 35:3, 18:1–3, 46:1,3,9–10).

- 6 Only one scholar disagreed (Byl 1998), but his view was never accepted, and he did not go back to the idea that the *bath* was *c.* 45 litres.

bound to the notion of ‘righteousness’ and ‘truth’. Sumerian goddesses take responsibility for measuring the land justly and accurately in order to distribute the harvest fairly. Shamash is related to weighing. Kings explicitly and proudly mention taking care of proper measures (Zaccagnini 1994: 276–278; Robson 2008: 118–119; Chambon 2011b: 55). The same holds true for Egypt (Pommerening 2005: 40–45; Morschauser 1995: 101, 107).

The same is true in the Bible, where measures are defined as ‘just’ or ‘honest’ (Deut. 25:14–15; Micah 6:10; Amos 8:5; Lev. 19:36; Ez. 45:10). Leviticus 19:36 reads: ‘you shall have just balances, just weights, a just *ephah*, and a just *hin*’. Ezekiel 45:10 reads: ‘you shall have just balances, a just *ephah*, and a just *bath*’. Contrary to Lipschits *et al.* (2012: 457), such verses prove that *bath* and *hin* were measures, and not only vessels.

In all these sources we always find fixed measures, never a ‘vessel’ *per se*. A jar, a jug, or a flask cannot be ‘just’ or ‘honest’. In addition, there are biblical references to a half, a third, and a quarter *hin*, and such fractions relate to a measure. A jar or a jug do not break into exact halves or quarters. If broken, they can no longer hold their contents and thus, are rendered useless.

THE *BATH*: VESSEL OR MEASURE?

Lipschits *et al.* distinguish between ‘measure’ and ‘vessel’, stating: ‘The biblical *bath*... was not a measurement at all but a well-known vessel’ (2012: 453); and ‘The *bath* was not a fixed measurement for liquid volume but rather the name of a specific jar’ (2012: 458; cf. 2012: 454 for *log* and *hin*).

The Judaeans word for ‘jar’ was possibly *kad* (1 Kings 17:12; Judg. 7:16). In modern typologies we distinguish between various types of jars and give them names and codes (*lmlk*, *lmlk*-like, rosette, pithos, holemouth); but the Judaeans did not have separate names for our modern types. The *lmlk* stamp denoted ownership (to/of the King), not a type of jar. There is no reason to imagine that the Judaeans had a separate name for what we define as ‘*lmlk* jars’. Rather, they would have called *lmlk* jars either just ‘*kad*’ or perhaps ‘*kad lmlk*’.

The inscription *b/* — ‘1 *bath*’ — on the Lachish jar from Ussishkin’s excavations mentioned above is indicative. If *bath* was the name of a jar, as suggested by Lipschits *et al.* (2012), it would be redundant to write ‘1 *bath*’ on this jar. Do we write ‘1 spoon’ on spoons or ‘1 jug’ on jugs? Of course, inscriptions of the name of a measure along with numerals on pottery vessels are well known (Powell 1989–90: 503–504; Payne 2005; Pommerening 2005; Friberg 2007: 130–131; Chambon and Kreppner 2010: fig. 3; for weights, see Kletter 1998: fig. 31:1–5). In addition, names of jars are not shortened into initials, while names of measures often are (*š* for shekel, *b* for *bath*, etc.).

A unit of measure and a measuring vessel, or a vessel holding the same amount, carry the same name. In Deut. 25:14–15, for example, *epha* is the

measuring vessel, and people cheat by using differing measuring vessels. However, Judges 6:19 reads: ‘So Gideon went into his house and prepared a kid, and unleavened cakes from an *ephah* of flour’ (RSV Bible). Gideon did not offer the angel a pottery/wooden item to eat; but a certain amount of prepared food. In v. 21, the fire consumed the ‘meat and the [*epha* = quantity of] unleavened cakes’. The fire consumed the food, and not a measuring vessel. Thus, the same word is used to denote both the vessel and the measure (Mittmann 1991: 61; Gaspa 2007: 154; Cohen, Maran and Vettters 2010: 7; Richardson 2005: 41). Consequently, the statement that the *log*, *hin*, or *bath* were vessels and not measures is meaningless, since they were, in fact, both.

Therefore, the inscription ‘*bt lmlk*’ on the Lachish jar published by Inge means that this is a *bath* jar — a jar that holds the measure *bath*. The measure and the jar (or measuring vessel) holding it were both called *bath*. The word ‘*lmlk*’ on this jar can have two meanings: 1) that this *bath* jar belonged to the king; and 2) that the jar held a royal *bath*, which could be the same or different in capacity from the ‘common’ *bath* (for example, being a double *bath*). Compare the Judaeen ‘common’ shekel weight and ‘royal shekel’ (*ʿbn hmlk*, 2 Sam. 14:26, in this case probably not different in weight; Kletter 1998: 96, 128–131).⁷ Another example is the Neo-Assyrian system of light and heavy (double) weights. We also find in Assyria a ‘Mina of the King’, but as it designates both ‘light’ (c. 504 gr) and ‘heavy’ (c. 1 kg) Mina weights, it is apparently not a different standard, but only some mark of royal ownership or guarantee (see Fales 1996: 14–16).

Lipschits *et al.* (2012) also confuse ‘fixed’ and ‘approximated’ measures. A fixed measure (e.g., a shekel) is part of a set, with multiples and sub-divisions. Such sets enabled the accurate measuring of quantity in ancient periods, with a divergence of up to 5% in either direction. While today, we tend to use precise measurements, we still sometimes pay per item, rather than per weight or volume, e.g., in a flea market or artisan shop (Kletter 2009b: 832, 838). Approximated measures (e.g., a loaf of bread) were common in the past and may vary by 10–20% and more. They are not part of a set and they are not measured, because their entire *raison d’être* is to avoid the cumbersome process of measuring.

MORE EVIDENCE FOR IRON AGE LIQUID MEASURES

There is further decisive evidence that *bath* and *hin* were fixed Iron Age measures:

1. In 1 Kings 7:26,38, *bath* is used to measure paraphernalia of the Temple. Here

⁷ Another jar from seventh-century BCE Tel Miqneh/Ekron carries the inscription *bt* (Ahituv 2005: 317). It holds 32 litres, but the measure in Ekron could differ from Judah. The shape of the jar has not yet been published, but no known *lmlk*-type jar has such a low capacity.

it is a measure or a measuring vessel, not merely a jar. One may doubt its appearance for the molten sea in v. 26, but not for the lavers in v. 38 (cf. Gaspa 2007: 169–170).

2. In Isaiah 5:10, a certain area of vineyard yields a *bath*, while a certain area of field yields a fixed dry measure (*epha*). There is a clear juxtaposition here; in addition, the areas too are fixed measures (Powell 1992: 901).⁸ All the measures here are fixed, and so is the *bath*.
3. If there were no liquid measures, why does Isaiah 5:10 not use the *epha* for the vineyard too? The term *epha* is always used for dry substances, and never for wine/oil (de Vaux 1965: 199). In cultures lacking a distinction between dry and liquid substances, the same capacity measure is used for both. ‘Stripping’ the Bible of liquid measures leaves it with a crippled measuring system. Lipschits *et al.* (2012: 467) claim that ‘oil or wine was measured by the jars that contained them, and not by measurement units’. They ignore explicit evidence for the measurement of oil/wine in Egypt and Mesopotamia with fixed measures. In addition, if something was ‘measured’, it must have been a ‘fixed’ measure, since ‘approximated’ measures (see above) were not measured.

Lipschits *et al.* (2012) point out that *kor* appears with dry substances. This is not a new observation. A ‘mixed’ use of liquid measures for dry capacities is documented elsewhere (Richardson 2005: 43–44). *Kor* could never be a vessel, because it was too big. We do not know the exact size, but it is assumed to be *c.* 150–220 litres: no person could lift it and it could not be ‘the name of a jar’. It was a measuring unit, used chiefly for accounting.

Lipschits *et al.* (2012: 472) claimed that ‘the Ugaritic *kd* is a kind of jug’, citing only one reference in support — a lexicon of the Old Testament. Experts in Ugaritic studies point out that in the Ugarit documents, we sometimes hear that certain smaller measures are missing from the *kd*:

- CAT 4.778 lines 11–12 and CAT 4.882 lines 7–8: ‘*kd šmn mlthm ḥsr*’, meaning (after Heltzer and Pardee): one jar of oil less two *mlth*.
- CAT 4.778 lines 7–8 and CAT 4.778 lines 5–6: ‘*kd šmn t̄t ḥsr*’ meaning (as agreed by all scholars): one jar of oil less one *t̄t*.

On the size of these smaller measures and the possible relation of *mlth* with biblical *leteh*, see Heltzer 1989: 198–200; Pardee 2003–04: 60, 68–69; Tropper 2000: 372–375; Cohen, Maran and Veters 2010: 6–8; Zamora 2003; del Olmo Lete and Sanmartin 2003: 410, 429, 558, 893. One does not break a jar/jug and remove a half or one-twelfth of its fragments, but one can subtract

⁸ Before studying this verse in more depth, I too followed the view that the measures for the area are approximated measures (Kletter 2009b: 840).

a half or one-twelfth from a measure — the quantity inside. One must conclude, therefore, that *kd* in Ugarit was a measure; the word *kd* could, of course, denote both the measure and the vessel holding it.

4. Ostrakon 6 from Kadesh Barnea (Lemaire and Vernus 1983; Wimmer 2008: 103–110) preserves six columns consisting of two lists of measures, each ranging from the smallest to 10,000. Lemaire and Vernus (1983: 325–326) realised that these were metrological lists. Such lists ‘give the sequence of quantities in a given metrological domain and provide practice in writing... Each series proceeds in increasing size from the smallest quantity up to some large unit; and the series were learned in the order of capacity, weight, area, and length’ (Melville 2008: 28; cf. Friberg 2007: 114–115; Proust 2007: 91, 98–117, 152–153; 2009: 2, 18–21; 2010; Robson 2007: 86–88; Chambon 2011b: 56–57).

The same order (first capacity, then weight) appears in Ostrakon 6. Columns IV–VI concern weight. They are not a 1:1 rendition of the Judaeen weight system, since they include counted values, but they reflect it well (cf. Proust 2009: 7). Columns I–III concern capacity. Columns II–III list values from 2 to 9,000 of a measure marked by an *ε* like sign. The same sign occurs in Hebrew ostraca. It is a capacity measure, perhaps *homer* or *kor* (Lemaire and Vernus 1983: 313; Aharoni 1981; Wimmer 2008: 103–110, 256–257; Lemaire 2004: 2128; Cross 2008: 345). Column I must be sub-units of this measure. The sequence is difficult; there are unknown signs, and the author might have made mistakes (cf. column IV:17). The letter *b* — probably the abbreviation for *bath* — appears in column I:2. It cannot refer to *beqa* since weights appear in columns IV–VI (Lemaire and Vernus toyed with this idea; but cf. Wimmer 2008: 106). Thus, we have *bath* appearing in an Iron Age metrological list as part of a set of ‘fixed’ capacity measures, in the role of a sub-part. This provides conclusive evidence that *bath* could not be the name of a jar.

5. Other biblical liquid measures are ancient. The term *hin* originates from the Egyptian *hnw*, a fixed measure since the New Kingdom. Measuring *hnw* vessels appear on wall drawings and in excavations. This measure appears in the El-Amarna archive, as well as on an Iron Age II alabaster from Samaria (Reisner, Fisher and Lyon, 1924: 243a, 334, fig. 205, pl. 56g; Kitchen 1995: 324–325; Pommerening 2005: 412, V37; McCarter, Bunimovitz and Lederman 2011). *Lg/lgm* appears in relation to wine and oil at Ugarit (Cohen, Maran and Veters 2010: 7, 11; Oliva 2000: 33; del Olmo Lete and Sanmartin 2003: 494). An alabaster vessel fragment was found at Susa with a Hebrew inscription dated by Naveh to the seventh century BCE: ‘One *hin* and one half *log* and a quarter *log*’ (Ahituv 2008: 242–243). Fixed measures did not serve in isolation, but in sets; consequently, evidence of even one measure implies the existence of an entire system.

CONCLUSIONS

Lmlk jars were never ‘standard’ vessels. They could be filled with two *bath* each, using measuring vessels (Kletter 2009a: 364; 2009b: 839). To test this hypothesis, one should look not for average, but for minimal, capacity (Lang 1956: 7). Restorable stamped *lmlk* jars from Lachish contain *c.* 45 litres (Ussishkin 1978: 77; 2004b: 2133–2144). So do unstamped *lmlk* jars from Tel Batash/Timna (with the exception of one incomplete jar, which is not indicative; Mazar and Panitz-Cohen 2001: 93–96, pl. 46:7). However, leaving air inside jars would not be beneficial to wine.⁹ Alternatively, *lmlk* jars could serve as approximate units, or their contents could be measured when allocated, using measuring vessels.

Major ancient Near East weight systems were interrelated at least from the Late Bronze Age (Parise 1981; 1991; Peyronel 2011). Capacity systems must have been interrelated too, since exchanges between kingdoms involved commodities measured by capacity (wine, oil, grains). Each side had to understand quantities and their value in local terms. Value in that time was expressed by weight of silver. If one considers a possible exchange of fish from Ashkelon for grains from Judah (Master 2003; Faust and Weiss 2005), an Ashkelonian had to understand the value of ‘X Judaeen *epha* of grains’ in Ashkelonian terms, and vice versa. As a crude suggestion, I propose that 1 Egyptian *oipe* (*c.* 19.2 litres) = 1 Judaeen *epha/bath* = 3 Babylonian *sutu*. Fuller discussion would require a separate paper.

Pottery traditions did not change after each political upheaval. Continuity of production and storage of food should not be confused for continuity of administration or political history (Ussishkin 2011; 2012). All ancient kingdoms had to produce and store foods. All had an administration dealing with it, whether or not involving stamped jars. Judah was not unique in marking jars (cf. Egypt, McGovern 1997: 72; Urartu, Payne 2005; and classical periods, Lawall 1998). Judah never had a ‘*lmlk* administration’ (Lipschits, Sergi and Koch 2010: 28) or ‘jar handle systems’ (Lipschits, Sergi and Koch 2011: 29), unless we mean a rubber-stamping administration. Only a fraction of the *lmlk* jars were stamped — in an arbitrary, careless way (Ussishkin 1978: 80; 2004b: 2145; Mazar and Panitz-Cohen 2001: 195). Judaeen administration was not concentrated in a Shephelah pottery workshop occupied with stamping jars, but in Jerusalem, receiving and issuing orders and *papyri* which did not survive.

The *hin* was a fixed measure in Egypt and Palestine in the Late Bronze and Iron Ages, and the *log* is documented from Ugarit. There is conclusive evidence that *bath* and *hin* were fixed liquid capacity measures in biblical sources, *bath* as

⁹ Some wines were more resilient (e.g., boiled wine). A thin layer of olive oil could effectively seal wine and prevent oxidation, but evidence for its use in antiquity is lacking.

early as the Iron Age. The ‘liquidation’ of the biblical liquid measures does not hold water.

REFERENCES

- Aharoni, Y.
1981 *Arad Inscriptions*, Jerusalem
- Ahituv, S.
2008 *Echoes from the Past: Hebrew and Cognate Inscriptions from the Biblical Period*, Jerusalem
- Albright, W.F.
1943 *The Excavations at Tell Beit Mirsim III. The Iron Age*, New Haven CT
- Avigad, N.
1953 Another *bat le-melekh* Inscription, *IEJ* 3: 121–122
- Barrois, A.
1931 La métrologie dans la Bible, *RB* 40: 185–213
1951 *Manuel d’archéologie biblique* II, Paris
- Barton, G.A.
1916 *Archaeology and the Bible*, Philadelphia
- Batten, L.W.
1913 *The Books of Ezra and Nehemiah* (ICC), Edinburgh
- Ben-Zvi, E.
2006 (ed.), *Utopia and Distopia in Prophetic Literature*, Helsinki
- Blake, H.
1999 Sizes and Measure of Later Medieval Pottery in North-Central Italy, in de Boe, G. and Verhaege, F. (eds.), *Material Culture in Medieval Europe — Papers of the ‘Medieval Europe’ Brugge 1997 Conference 7*, Zellik, Belgium: 221–250
- Byl, J.
1998 On the Capacity of Solomon’s Molten Sea, *VT* 48: 309–314
- Chadwick, J.
1990 Linear B and Related Scripts, in Hooker, J.T., *Reading the Past. Ancient Writing from Cuneiform to the Alphabet*, Avon: 137–196
- Chambon, G.
2006 Écritures et pratiques métrologiques: Le grande mesure à Mari, *Revue d’Assyriologie* 100: 101–106
2011a *Normes et pratiques. L’homme, la mesure et l’écriture en Mésopotamie I. Les mesures de capacité et de poids en Syrie ancienne, d’Ébla à Émar*, Berlin
2011b Numeracy and Metrology, in Radner, K. and Robson, E. (eds.), *Oxford Handbook of Cuneiform Culture*, Oxford: 51–67
- Chambon, G. and Kreppner, J.
2010 Hohlmassysteme und deren ‘Standardisierung’ in Assyria und Volumina vor

- Gefasskeramik aus Dūr-Katlimu, in Kühne, H. (ed.), *Studia Chaburensia*, Wiesbaden: 11–32
- Cohen, C., Maran, J. and Veters, M.
 2010 An Ivory Rod with a Cuneiform Inscription, Most Probably Ugaritic, from a Final Palatial Workshop in the Lower Citadel of Tiryns, *Archäologischer Anzeiger* 2: 1–22
- Cross, F.M.
 2008 Inscriptions in Phoenician and Other Scripts, in Stager, L.E. et al., *Ashkelon I. Introduction and Overview*, Winona Lake IN: 333–372
- Diringer, D.
 1941 On Ancient Hebrew Inscriptions Discovered at Tell ed-Duweir (Lachish) — II, *PEQ*: 104–106, pls. 9–10
 1953 Early Hebrew Inscriptions, in Tufnell, O. (ed.), *Lachish III. The Iron Age*, London: 331–359
- Fales, M.
 1996 Prices in Neo-Assyrian Sources, *State Archives of Assyria Bulletin* 10/1: 11–18
- Faust, A. and Weiss, E.
 2005 Judah, Philistia, and the Mediterranean World: Reconstructing the Economic System of the Seventh Century BCE, *BASOR* 338: 71–92
- Friberg, J.
 2005 *Unexpected Links between Egyptian and Babylonian Mathematics*, Hackensack NJ — Singapore
 2007 *A Remarkable Collection of Babylonian Mathematical Texts*, New York
- Gaspa, S.
 2007 Vessels in Neo-Assyrian Documents. Capacity Measures and Listing Conventions, *State Archives of Assyria Bulletin* 16: 145–184
- Gelb, I.J.
 1982 Measures of Dry and Liquid Capacity, *JAOS* 102: 585–590
- Germer-Durand, E.
 1910 *Études Palestiniennes et Orientales. Conférences de Saint-Étienne*, Paris
- Heltzer, M.
 1989 Some Questions of Ugaritic Metrology and Its Parallels in Judah, Phoenicia, Mesopotamia and Greece, *Ugarit-Forschungen* 21: 195–211
- Høyrup, J.
 2011 *Written Mathematical Traditions in Ancient Mesopotamia: Knowledge, Ignorance, and Reasonable Guesses* (Contribution to the Conference Traditions of Written Knowledge in Ancient Egypt and Mesopotamia. Frankfurt am Main, 3.–4. December 2011), 1–27, <http://www.akira.ruc.dk/~jensh>
- Inge, C.H.
 1938 Excavations at Tell ed-Duweir, *PEQ* 68: 240–256
 1941 Postscriptum, *PEQ* 72–73: 106–109

Kitchen, K.A.

1995 *The Third Intermediate Period in Egypt (1100–650 BC)*, Warminster

Kletter, R.

1998 *Economic Keystones: The Weight System of the Kingdom of Judah*, Sheffield

2009a Comment: Computational Intelligence, Lmlk Storage Jars and the Bath Unit in Iron Age Judah, *Journal of Archaeological Method and Theory* 16: 357–365

2009b Weights and Measures, *New Interpreters Dictionary of the Bible* V, Nashville TN: 831–841

Lang, M.

1956 Numerical Notations on Greek Vases, *Hesperia* 25: 1–24

Lawall, M.

1998 Ceramics and Positivism Revisited: Greek Transport Amphoras and History, in Parkins, H. and Smith, C. (eds.), *Trade, Traders and the Ancient City*, London: 73–98

Lemaire, A.

2004 Hebrew Inscriptions. Section A: Ostraca and Incised Inscriptions, in Ussishkin 2004a: 2099–2132

Lemaire, A. and Vernus, P.

1983 L'ostrecon paléo-hebreu no. 6 de Tell Qudeirat, in Görg, M. (ed.), *Fontes Atque Pontes. Eine Festgabe für Helmut Brunner*, Wiesbaden: 302–326

Lipschits, O.

2012 Archaeological Facts, Historical Speculations and the Date of the LMLK Storage Jars: A Rejoinder to David Ussishkin, *Journal of Hebrew Scriptures* 12/4, <http://www.jhsonline.org/jhs-article.html>

Lipschits, O., Koch, I., Shaus, A. and Guil, S.

2012 The Enigma of the Biblical Bath and the System of Liquid Volume Measurement during the First Temple Period, *Ugarit-Forschungen* 42: 453–478

Lipschits, O., Sergi, O. and Koch, I.

2010 Royal Judahite Jar Handles: Reconsidering the Chronology of the Lmlk Stamp Impressions, *Tel Aviv* 37: 3–32

2011 Judahite Stamped and Incised Jar Handles: A Tool for the Study of the History of Late Monarchic Judah, *Tel Aviv* 38: 5–41

Master, D.M.

2003 Trade and Politics: Ashkelon's Balancing Act in the Seventh Century B.C.E., *BASOR* 330: 47–64

Mazar, A. and Panitz-Cohen, N.

2001 *Timnah (Tel Batash) II. The Finds from the First Millennium BCE*, Jerusalem

McCarter, K.P., Bunimovitz, S. and Lederman, Z.

2011 An Archaic Ba'al Inscription from Tel Beth-Shemesh, *Tel Aviv* 38: 179–193

McGovern, P.E.

1997 Wine of Egypt's Golden Age. An Archaeochemical Perspective, *JEA* 83: 69–108

Melville, D.J.

- 2008 Review of Proust, C., *Tablettes Mathématiques de Nippur*, Paris, *Aestimatio* 5: 23–33

Mittmann, S.

- 1991 Königliches *bat* und *teṭ*-Symbol. Mit einem Beitrag zu Micha 1, 14b und 1 Chronik 4, 21–23, *ZDPV* 107: 59–76
 1993 Gib den Kittäern 3 b(at) Wein: Mengen und Güter in den Arad-Briefen, *ZDPV* 109: 39–48

Morschauer, S.N.

- 1995 The Ideological Basis for Social Justice/Responsibility in Ancient Egypt, in Irani, K.D. and Silver, M. (eds.), *Social Justice in the Ancient World*, Westport CT: 101–114

Naveh, J.

- 1992 The Numbers of Bat in the Arad Ostraca, *IEJ* 42: 52–54

Oliva, J.

- 2000 The Alalakh Tablet A432 from Level VII Reconsidered, *Studi epigrafici e linguistici* 17: 31–41

del Olmo Lete, J. and Sanmartin, J.

- 2003 *A Dictionary of the Ugaritic Language in the Alphabetic Tradition*, Leiden

Pardee, D.

- 2003–04 Josef Tropper, *Ugaritische Grammatik*. Münster, Ugarit-Verlag, 2000, *Archiv für Orientforschung* 50: 1–404

Parise, N.F.

- 1981 Mina di Ugarit, mina di Karkemish, mina di Khatti, *Dialoghy di Archeologia* NS 3: 155–160 (English translation: The Mina of Ugarit, the Mina of Karkemish, the Mina of Khatti), in Zaccagnini, C. (ed.), *Production and Consumption in the Ancient Near East*, Budapest: 333–341
 1991 Unita ponderali e circolazione metallica nell’ Oriente mediterraneo, in Hackens, T., Naster, P., Colaert, M., Van Laere, R., Moucharte, G., de Callatey, F. and van Driesche, V. (eds.), *A Survey of Numismatic Research 1985–1990*, I, Brussels: 28–34

Payne, M.

- 2005 *Urartian Measures of Volume*, Louvain

Peyronel, L.

- 2011 Mašqaltum kittum. Questioni di equilibrio: bilance e sistemi di pesatura nell’ Oriente antico, in Ascalone, E. and Peyronel, L. (eds.), *Studi Italiani di metrologia ed economia del Vicino Oriente antico dedicati a Nicola Parise in occasione del suo settantesimo compleanno*, Rome: 105–162

Pommerening, T.

- 2005 *Die altägyptische Hohlmasse*, Hamburg

Powell, M.A.

- 1989–90 Masse und Gewichte, in Ebeling, E. and Meissner, B. (eds.), *Reallexikon der Assyriologie und vorderasiatischen Archäologie* VII, Berlin: 457–517

- 1992 Weights and Measures, *The Anchor Bible Dictionary* 6, New York: 889–908
- 1997 Weights and Measures, in Meyers, E.M. (ed.), *The Oxford Encyclopedia of Archaeology in the Near East*, Oxford: 339–342
- Proust, C.
- 2007 *Tablettes mathématiques de Nipur*, Istanbul
- 2009 Numerical and Metrological Graphemes: From Cuneiform to Transliteration, *Cuneiform Digital Library Journal* 2009/1: 1–27, http://www.cdli.ucla.edu/pubs/cdlji/2009/cdlj2009_001.html
- 2010 Mesopotamian Metrological Lists and Tablets: Forgotten Sources, in Bretelle-Establet, E. (ed.), *Looking at It from Asia. The Processes that Shaped the Sources of History of Science*, New York: 245–276
- Reindell, I. and Salvini, M.
- 2001 Die Urartäischen Hohlmasse für Flüssigkeiten, *Studi Micenei ed Egeo-Anatolici* 43: 121–141
- Reisner, G.A., Fisher, C.S. and Lyon, D.G.
- 1924 *Samaria I. Harvard Excavations at Samaria 1908–1910* (2 vols.), Cambridge MA
- Richardson, W.F.
- 2005 *Numbering and Measuring in the Classical World* (rev. ed.), Bristol
- Robson, E.
- 2007 Mathematics in Mesopotamia, in Katz, V.J. (ed.), *The Mathematics of Egypt, Mesopotamia, China, India and Islam. A Sourcebook*, Princeton NJ: 57–186
- 2008 *Mathematics in Ancient Iraq. A Social History*, Princeton NJ
- Rougemont, F.
- 2011 Oil at Nuzi and in the Linear B Records. A First Step Towards a Comparative Study, *Ugarit-Forschungen* 43: 345–410
- Scott, R.B.Y.
- 1959 Weights and Measurements of the Bible, *BA* 2: 21–40
- Segré, A.
- 1945 A Documentary Analysis of Ancient Palestinian Units of Measure, *JBL* 64: 357–375
- Sergi, O., Karasik, A., Gadot, Y. and Lipschits, O.
- 2012 The Royal Judahite Storage Jar. A Computer-Generated Typology and Its Archaeological and Historical Implications, *Tel Aviv* 39: 64–92
- Sternberg (Bashan), E.
- 1971 Weights and Measures, *Encyclopedia Judaica* IV, Jerusalem: 376–392
- Tropper, J.
- 2000 *Ugaritische Grammatik*, Münster
- Ussishkin, D.
- 1978 Excavations at Tel Lachish — 1973–1977, *Tel Aviv* 5: 1–97
- 2004a (ed.), *The Renewed Archaeological Excavations at Lachish (1973–1994)*, Winona Lake IN
- 2004b The Royal Judean Storage Jars and Seal Impressions from the Renewed Excavations, in Ussishkin 2004a: 2133–2147

- 2011 The Dating of the *lmlk* Storage Jars and Its Implications: Rejoinder to Lipschits, Sergi and Koch, *Tel Aviv* 38: 220–240
- 2012 *lmlk* Seal Impressions Once Again: A Second Rejoinder to Oded Lipschits, *Antiguo Oriente* 10: 13–24
- de Vaux, R.
1965 *Ancient Israel I. Social Institutes*, New York
- Veenhof, K.R.
1985 SAG.ÍL.LA = SAGGILÛ, ‘Difference Assessed’ on Measuring and Accounting in Some Old Babylonian Texts, in Durand, J.-M. and Kupper, J.R. (eds.), *Miscellanea Babylonica. Mélanges offerts à Maurice Birot*, Paris: 285–306
- Williamson, H.G.M.
1985 *Ezra, Nehemiah* (WBC), New York
- Wimmer, S.
2008 *Palastinisches Hieratic: Die Zahl und Sonderzeichen in der althebraischen Schrift*, Wiesbaden
- Zaccagnini, C.
1979 The Tallu Measure of Capacity at Nuzi, *Aššur* 2: 29–34
1994 Sacred and Human Components in Ancient Near Eastern Law, *History of Religions* 33: 265–286
- Zamora, J.A.
2003 El ánfora Cananea y las medidas de capacidad en el oriente Mediterráneo de la edad del Bronce Final, *SPAL (Revista de Prehistoria y Arqueología de la Universidad de Sevilla)* 12: 231–257
- Zapassky, E., Finkelstein, I. and Benenson, I.
2009 Computing Abilities in Antiquity: The Royal Judahite Storage Jars as a Case Study, *Journal of Archaeological Method and Theory* 16: 51–67
- Zimhoni, O.
2004 The Pottery of Levels II and II, in Ussishkin 2004a: 1789–1899