The Enigma of the Biblical *Bath* and the System of Liquid Volume Measurement during the First Temple Period

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Abstract

In this paper we claim that during the First Temple period, no organized or fixed system of liquid volume measurements existed in Judah. The biblical *bath*, which has been understood to be the basic measurement of the system, was not a measurement at all but a well-known vessel – the Judahite storage jar–also known as the *lmlk* jar. The *nēḇel* and the *kaḏ* were two other vessels that had other uses. The *lōḡ*, *hîn*, and *ʿiśśārôn*, which are usually termed "measurements" and considered part of the system of liquid volume measurements, were actually vessels that were part of the official Temple cult during the Second Temple period and were never part of the First Temple economy and administration.

Reconstructing and Deconstructing the Liquid Volume Measurement System

The basis of the assumed Judahite First Temple period liquid volume measurement system is the *bath*, which is comprised of six *hîn* or 72 *lōḡ* (cf. to de Vaux, 1961, 200–201; Stern, 1962, 851–852; Zapassky *et al*., 2009, 58; Kletter, 2009, 362). Recently, some scholars (Zapassky *et al*., 2009, 53, 59; Kletter, 2009, 362) also included the *ʿiśśārôn*, classified as one-tenth of a *bath*, as a liquid volume measurement. Three main sources have been used for reconstructing this liquid

volume measurement system: the biblical text, epigraphic finds, and various vessels discovered during archaeological excavations. Of the three sources, the biblical text is the most important for First Temple reality, and most scholars assume that biblical references testify to fixed measurements of liquid volume. A close analysis of the text reveals, however, that what scholars have termed "measurements" (and cf. to Albright, 1943, 58–59; de Vaux, 1961, 200–201; Scott, 1970, 350–351; Ussishkin, 1978, 87 note 9; Heltzer, 1989; 2008; Eph-ʿal/Naveh, 1993; Zapassky *et al.*, 2008; Kletter, 2009), are actually vessels that were part of the official Temple cult – most in use during the Second Temple period:

- **The term *lōḡ*** is mentioned five times in the Bible, all in the same chapter in Leviticus (14:10, 12, 15, 21, and 24) (Millgrom, 1991, 846; cf. Cohen, 1978, 60–61). The *lōḡ* is not a measurement but an oil vessel in the Temple cult, that can be lifted for waving (Leviticus 14:12, 24) or be used for pouring (*ibid.* 15). Leviticus 14 is well dated to the post-exilic period, and there is no evidence of using the *lōḡ* within the administration or economy during the First or the Second Temple periods.
- **The term *hîn*** is mentioned in the Bible 22 times, in all cases in association with the Temple cult.[1] Like the *lōḡ,* the *hîn,* too, was not a liquid volume measurement during the First Temple period, but a vessel. The name of this vessel, *hîn*, may be an Egyptian loanword (Ellenbogen, 1962, 68; Muchiki, 1999, 243) for a containing vessel for oil or wine that was used for cult purposes. The *hîn* does not occur in the Deutronomistic history or in epigraphic sources, so there is no evidence of its use in the administration or the economy of the First or the Second Temple periods. Besides, there is no reference for interpreting the *hîn* as a sixth of a *bath* on the basis of the references in Ezekiel (cf. Cook, 1960, 504; Stern, 1963, 854; Rattray, 1991, 896), mainly because one can only learn from these texts that the *hîn* was a well-known containing vessel for cult use (Ezekiel, 46:5, 7; and cf. Block, 1998, 673), for libations (Leviticus 23:13; and cf. Noth, 1974, 171), and for concocting ointments (Exodus 30:24; and cf. Noth, 1966, 238; Propp, 2006, 471–472). One can also use a half *hîn* (Numbers 15:10; 28:14), a third *hîn* (Numbers 15:6, 7; 28:14; Ezekiel 46:14) or a quarter *hîn* (Exodus 29:40; Leviticus 23:13; Numbers 15:4, 5; 28:5, 7, 14). Based on the fact that there is no evidence of the use of the *hîn* within the administration or the economy, it can be speculated that it was a special, probably also a small and open vessel with limited use within the Temple cult.
- **The *ʿiśśārôn*** was not known as a liquid volume measurement, and there is no evidence for its use within the administration or the economy of the Kingdom of Judah during the First Temple period. It is mentioned 33 times

[1] Exodus (29:40 [twice]; 30:24), Leviticus (19:36; 23:13), Numbers (15:4, 5, 6, 7, 9, 10; 28:5, 7, 14 [three times) and in two chapters of the Book of Ezekiel (45:24; 46:5, 7, 11, 14).

in the Bible, all in post-exilic texts in the Pentateuch.[2] In all of the *ʿiśśārôn* occurrences it is used in reference to the Temple cult, dealing with dry capacity, usually semolina, which was mixed with oil in order to prepare burnt offerings.

- **The *kōr*** is mentioned in the Bible eight times, six as a dry capacity measurement, in which semolina, wheat and barley are measured (1 Kings 5:11; 2 Chronicles 2:10; 27:5 [KJV]). In 1 Kings 5:11 it is written, "And Solomon gave Hiram twenty thousand *kōr* of wheat for food to his household, and twenty *kōr* of pure oil: thus gave Solomon to Hiram year by year." Scholars have used this verse as a source in order to understand Ezekiel's prophecy (45:14; KJV): "Concerning the ordinance of oil, the *bath* of oil, ye shall offer the tenth part of a *bath* out of the *kōr*, which is a *ḥōmer* of ten *bath*s; for ten *bath*s are a *ḥōmer*." On the base of this verse, which describes a utopian future, when "You shall have honest balances, an honest ephah, and an honest *bath*" (v. 10), when the prophet is mixing in purpose the liquid and the dry measures in order to emphasis that "The ephah and the *bath* shall be of the same measure, the *bath* containing one-tenth of a *ḥōmer*, and the ephah one-tenth of a *ḥōmer*; the *ḥōmer* shall be the standard measure" (v. 11), the *bath* was reconstructed as one-tenth of a *kōr*, and some scholars have even calculated the ratio of these measurements with the *hîn* and the *lōḡ* (Rattray, 1991). Beside the common assumption that the Book of Ezekiel reflects the exilic or the post-exilic-period reality, primarily of the Temple cult, and not the First Temple reality of the administration and the economy,[3] it is important to note that in the Septuagint and in Book Eight (57) of Josephus' *Antiquities* it is written that Solomon gave Hiram "twenty thousand (χιλιάδας) *bath*s of fine oil,"[4] and in the light of the data presented above it seems that this is the preferred version of the verse (cf. also Fritz, 1996, 61 note 25).[5]

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[2] Exodus 29:40; Leviticus 14:10, 21; 15:6, 9; 23:13, 17; Numbers 15:4, 6, 9; 28:9, 12 (twice), 13 (twice), 20 (twice), 21, 28 (twice), 29; 29:3 (twice), 4, 9 (twice), 10, 14 (twice), 15 (twice), 40.

[3] While some of the first scholars (Skinner, 1895; Redpath, 1907, xv, 214) accepted that Ezekiel's prophecy in Chapter 45 is a continuation of previous chapters, dated to "the five and twentieth year of our captivity, in the beginning of the year, in the tenth day of the month, in the fourteenth year after that the city was smitten" (Ezekiel 40:1), other scholars (cf. Torrey, 1970) argued against the connection of this prophecy to Ezekiel himself (but cf. Haran, 1979, 46), and see the earliest layers of the Book of Ezekiel as reflecting the late exilic period, while the book itself was edited during the Persian period (Laato, 1992, 189–196; Tuell, 1992; cf. Also to Block, 1998, 495, with further literature. For a more conservative approach, see Greenberg, 1983, 12–17).

[4] And cf. the Pashitta, in which the number "twenty thousand" is preserved.

[5] On the other hand, Montgomery (1951, 136) and Mulder (1998, 217–218, after Wevers, 1950, 308), argued that the MS version is the original one, while the translations re-

Further liquid volume measurements have been suggested based on archaeological and epigraphic finds. Aharoni (1981, 16; and cf. Aḥituv, 2005, 85; see also: Pardee, 1978, 297–298), based on letter Nº 2 from Arad, which reads (line 5): *ml*ʾ . *hḥmr* . *yyn* ("fill the *ḥōmer* with wine"), ascribed the *ḥōmer* measurement to the liquid volume measurement system (perhaps in accordance with the prophecy in Ezekiel 45:15; and cf. Stern, 1962, 852). Contra this view, the enormous capacity of this shipment (according to Aharoni: 220 liters), must be emphasized, as well as the lack of recipient and the alternative translation for the term *ḥmr* – young/fermenting (*ḥemer*). According to Lemaire (1977, 44–45), Mittmann (1993, 43–45) and Dobbs-Allsopp *et al*. (2005, 14) this is the classification of the type of wine mentioned in line 2 of the same letter, just as the *ḥmṣ* (sour) in line 7 is the classification of the bread in line 4 (Mittman, 1993, 45; *contra* Aharoni, 1981, 16). This can be paralleled to other classifications of the wine in letter 1, lines 9–10: *myy*[*n*] / *h*ʾ*gnt* . *ttn* ("from the wine of the mixing vessel/ krater you shall give") (see discussion in Dobbs-Allsopp *et al.*, 2005, 11–12). We may assume that that letter deals with wine that was mixed with water in the krater, for wine is usually not kept in an open vessel.

Aharoni (1981, 20) used another letter from Arad in order to attribute a different measurement: the tithe (*maʿaśēr*). In letter 5, lines 10–12, Aharoni reconstructed: … *ʾšr* . *y*/[*šlḥ*] . *lk* . *ʾt* . *hmʿ*/[*śr*] . *b*\ 1 1 1 . *bṭrm* ("… Who [will send] to you the ti[the], 3 *baths* before …"). Some scholars accepted this reconstruction, and saw it as evidence of a measurement of one-tenth of a *bath* (cf. Aḥituv, 2005, 20). Nevertheless, the reconstruction of *y*/[*šlḥ*] ("will send") and *hmʿ*/ [*śr*] ("the tithe") is not certain (Pardee, 1982, 38; Dobbs-Allsopp *et al.*, 2005, 20) and there is a different reconstruction by Aharoni (1981, 20, note 1): *ʾšr* . *y*/[*šlḥ*] . *lk* . *ʾth* . *mʿ*/[XX]*bh* ("Who [will send] to you from ʿA[xx]bh"). However, Aharoni made it clear that there is no site known as "ʿA[xx]bh," and therefore this reading is problematic.

Aharoni, in accordance with his findings for Tel Beersheba, also connected the *ʿiśśārôn* to the tithe measurement. In a basement of a Stratum II structure at Tel Beersheba, he found a small jug with a pre-firing inscription that reads: *ḥṣy lmlk* (one-half of royal measurement) (Aharoni, 1975, 160, 162 and fig. 2; Dobbs-Allsopp *et al.*, 2005, 123). The interpretation of this measurement is not well based, and Aharoni (idem, 160) argued that this is one-half of the *ʿiśśārôn*, for in his opinion it is "the most common liquid measure." Because the volume of this jug was measured to be 1.2 liters (idem), and because this was considered by Aharoni as one-half of the *ʿiśśārôn*, a complete *ʿiśśārôn* would have been 2.4 liters. Aharoni connected the *ʿiśśārôn* with the *bath*, and on this basis calculated the volume of the *bath* as 24 liters. He referred to a find of an inscription incised on a sherd from the vicinity of the temple in Arad, which reads: "*ḥṣy*" (half) (1981, 114). The inscription is complete, but one cannot tell the original size of

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flect the secondary version that appears also in 2 Chronicles 2:9, which maximized the wealth of King Solomon (cf. also Cogan, 2001, 229).

the vessel and whether it was incised when it was complete or after it was fractured. As an inscription on a sherd, it could be associated with the Ugaritic term *ḥṣt* ("luck"), and might have been used for casting lots (Dobbs-Allsopp *et al.*, 2005, 104 with further literature). Contrary to Aharoni's reconstruction it must be emphasized that the *ʿiśśārôn* is not mentioned anywhere in the Bible as a liquid volume measurement, and like the *lōḡ* it occurs only in the post-exilic literature as a measurement of dry capacity connected with semolina (cf. above). Against this background it is difficult to accept the interpretation of the *ʿiśśārôn* as one-tenth of a *bath*. Therefore, if Aharoni's reading is correct, then it might be that the jug from Tel Beersheba was used for dry (semolina) storage, and the *ʿiśśārôn* is connected to the measurements of the *ʾêpāh* and the *ḥōmer*. The reason is that while in some places the *ʿiśśārôn* is a measurement for semolina, in other places the semolina is measured as the tenth part of the *ʾêpāh* (Leviticus 5:11; 6:13; Numbers 28:5) and the same measurement is used for flour (Numbers 5:15). It seems that the ratio between the *ʿiśśārôn* and the *ʾêpāh* is clear. Nevertheless, all of these occurrences are post-exilic and therefore they cannot be used to describe the economy and administration of the First Temple period.

The review above demonstrates that the method described as the liquid volume measurement system of the First Temple Judah is invalid. The only measurement of the First Temple period that should be discussed is the *bath.*

The *bath* is mentioned 13 times in the Bible, and always as a fixed liquid volume measurement for water, oil, or wine. According to 1 Kings 7:26, the molten sea in the Temple court held two thousand *bath* (and cf. 2 Chronicles 4:5: "three thousand *bath*"),[6] and according to verse 38 the ten lavers contain forty *bath* each. According to Isaiah 5:10, "ten acres of vineyard shall yield one *bath*, and the seed of a *ḥōmer* shall yield an *ʾêpāh*." Ezekiel 45:10 mentions "a just *bath*" as a liquid measure, together with a "just balance" for weighting payment means (metals) and "a just *ʾêpāh*" for dry measurement (and see the six other occurrences of the *bath* in verses 11 and 14). In 2 Chronicles 2:10 one can learn the difference between this measurements of the dry and the liquid:

> "And behold, I will give to thy servants, the hewers that cut timber, twenty thousand *kōr* of beaten wheat, and twenty thousand *kōr* of barley, and twenty thousand *bath* of wine, and twenty thousand *bath* of oil."

In the light of the occurrence in Ezekiel it is acknowledged in the scholarship that the capacity of the *bath* was equal to the capacity of the *ʾêpāh* (cf. Dobbs-Allsopp, 2005, 123), but it is not clear whether the Ezekiel standardization re-

[6] The Septuagint version of Kings has no reference to the molten sea's capacity, and Josephus (Antiquities, book eight, 3:5) describes the capacity as the Book of Chronicles does: 3,000 *bath*s. On this subject see the literature and discussion in Hognesius, 1994, 249–258; Byl, 1998, 309–314 with further literature.

flects the First Temple period reality in the economy and the administration, or a utopian future.

The conclusion from the above review is that in the administration and economy of First Temple Judah the only known measurement for liquid volume was the *bath*. With this measurement it was possible to estimate the volume of large vessels – with thousands of *bath* – and also of smaller ones – with dozens of *bath*. Nevertheless, there is no evidence of the exact capacity of the *bath* or of the way the bath itself was calculated by the ancients.

The Biblical *Bath* – the Judahite Storage Jar?

We propose, on the basis of archaeological finds and parallels from the ancient Near East, that the *bath* was not a fixed measurement for liquid volume but rather the name of a specific jar– the Judahite storage jar – well-known in archaeological research from the late eighth to the early sixth century BCE. Manufacture of the Judahite storage jar began in Judah in the ninth century BCE, but it was only in the late eighth century that its shape became standardized, diversities within the jar capacity decreased (Mazar, 1990, 509; Zimhoni, 1997, 171; 2004, 1706; Gitin, 2006, 512–517; Katz, 2008, 52–53; Lipschits/Sergi/Koch, 2010, 7; Segi/Karasik/Gadot/Lipschits, forthcoming), and it began to be mass-produced (Mommsen/Perlman/Yellin, 1984). This jar was named *bath*, in our opinion, during that period, and the name for this type of jar continued in the seventh and early sixth centuries BCE, when the small changes in the shape of the jars (from the so called "*lmlk*" and "*lmlk*-like" jars to the rosette jars), did not affect the name of this type of jar.

Early Attempts to Understand the *Bath*

As mentioned above, some scholars attempted to reconstruct the liquid volume measurement system of First Temple Judah based on epigraphic finds and biblical references. Most who dealt with this subject assumed that the capacity of the *bath* was 20, 22 or even 24 liters.[7] The genesis of this "scholarly tradition" ap-

[7] Most scholars sided with the capacity of 19 to 22 liters: Albright, 1943, 58–59 note 7; Serge, 1945, 357–358; Scott, 1958, 205–214; de Vaux, 1961, 202; Stern, 1962, 854; 1971, 380; Aharoni, 1981, 13; Heltzer, 1986, 161; 1989, 197; 2008, 71*; Mittmann, 1991, 66; 1993, 47; Powell, 1992, 902; Zapassky *et al*., 2009. Busink (1970, 327, note 611) estimated that the capacity of the *bath* was 23 liters (and cf. Hognesius, 1994, 357). Powell (1992, 161) estimated the *bath* as 24 liters, and Kletter (2009, 363) as 19.22 liters. On the contrary, some scholars argued that the *bath* is equal to the average storage jar capacity (Barrois, 1931, 212; Inge, 1941, 109; Lemaire, 1977, 157). Lemaire based on one storage jar found in Gibeon, measured by Pritchard (1964, 25) as 45 liters. He argued that this is the capacity of the *bath* measurement, and used also de Vaux (1961, 202–203), who didn't really take a stand and his estimation that the *bath* measurement equals 45 liters is based on a find from Qumran, and therefore cannot be sustained.

pears in a footnote in the third Tell Beit-Mirsim Report (Albright, 1943, 58–59, note 7) (fig. 1). In this note, Albright discussed a post-firing incision on a pottery sherd that reads *bt* (Albright, 1932, 78 and fig. 12:1; 1943, 58 note 7, and pl. 60:2).[8] He compared this sherd to the upper part of a storage jar found in Lachish that was incised before firing with the inscription: *bt . lmlk* ("*bath* of the king" = a royal *bath*?) (Locus H17:1078; Field Number 7066, and see Inge, 1938, 248, 253; Diringer, 1953, 356–57 and pl. 49:1) (fig. 2).[9]

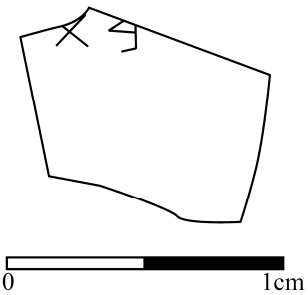

Fig. 1: The *bt* incision from Tell Beit-Mirsim
(After Albright, 1943, pl. 60:2).

Diringer (idem, 356) insisted that this jar resembles the *lmlk* jars but that they are not identical, and that there is no possibility to measure the capacity of the broken jar or to reconstruct the capacity of the royal *bath* measurement. Despite Diringer's opinion, Albright did try to calculate the volume of the Lachish *bt. lmlk* jar, and by that to learn the volume of the biblical *bath* measurement:

1. The proportions of the *bt. lmlk* jar and a typical *lmlk* jar are identical. Thus, the ratio of one dimension to the next is fixed, say C. Therefore, the volume is C^3.
2. What remained was to derive the ratio C, which could be obtained from the diameter of the jar's rim: 8.15 cm for the *bt . lmlk* jar, and 10.8 cm for a "typical" *lmlk* jar.

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[8] Contrary to Sukenik's opinion (in Albright, 1943, 58) it is not clear whether the inscription is complete (Dobbs-Allsopp *et al*., 2005, 133), and one can compare this sherd to one that was found in Gezer, inscribed after firing with the inscription …*bt*… (Dever, 1986, pl. 62) or a sherd from Hazor, inscribed with *btz|h* (Yadin *et al*., 1960, 71–72 and pl. 169:3; item A382/1, Area A, Locus 151, Stratum VIII – ninth century BCE, but cf. recently Sass, 2005, 85–86). In those three cases it is not clear whether the inscription is complete (idem; Dobbs-Allsopp *et al*., 2005, 133, 165), and it seems one should not use it for the discussion about the *bath*.

[9] In this context, Avigad (1953) read an inscription from Tell en-Nasbeh (Mccown, 1947, 168 and pl. 57:21) as *bt . lmlk*. His reading was not accepted (except Heltzer, 1989, 197), however, and most of the scholars accept Mccown's reading: *'bn . qn*[*yw*].

3. Therefore, the ratio between the volumes is $C^3 = (0.7546)^3 = \sim 0.43$.
4. On the basis of the ratio between the different volumes, the *bt*. *lmlk* jar is smaller than a "typical" *lmlk* jar by half. If so, then the *bath* measurement is one half of the volume of a *lmlk* jar (44 liters), and is therefore 22 liters.

Fig. 2: The *bt*. *lmlk* jar from Lachish as photographed in the British Museum by S. Guil (14.5.2009), with the kind permission of Dr. Jonathan Tubb, Assistant Keeper for the Ancient Levant in the Middle East Department of The British Museum, and with the kind assistance of Dr. Rupert Chapman, Curator, Middle Eastern Antiquities, British Museum.

Albright's calculations are flawed. Mathematically, it is impossible to estimate the shape of the *bt*. *lmlk* jar from Lachish only according to its rim as the proportions of the vessel are far from being constant, and it is impossible to determine the ratio between it and the *lmlk* jars. The measurement of 120 Judahite storage jars[10] indicated that the diameter of the jars is between 8.2 and 9.4 cm (smaller than Albright's assumed "typical" *lmlk* jar). Furthermore, Albright's measurements of the *bt*. *lmlk* jar from Lachish were proven to be inaccurate. S. Guil located the *bt*. *lmlk* jar at the British Museum (Museum registration number 1980–12–14,16706); the actual diameter of the jar's rim is 7.3 cm (and cf. to the measures published by Tufnell, 1953, 356). The corrected calculation, therefore, even according to Albright's method, is

$$C^3 = (7.3:10.8)^3 = (0.6759)^3 = 0.31.$$

According to Albright's formula, this would result in the *bath* being equal to approximately 14 liters.

In terms of scholarship, Albright (1943, 58–59, note 7) declared that his calculation was just an endorsement of Gremer-Durand's assessment of some stone vessels that were exhibited in the Notre Dame Museum in Jerusalem, which he claimed proved that the volume of the *bath* was 21.25 liters.

Albright did not explain what Germer-Durand's stone vessels were, or the basis for Germer-Durand's calculations, nor did he quote his publication, referring instead to an article published by Barrois (1931). In this article, Barrois (1931, 210, note 3) dealt with a few stone vessels described by Germer-Durand in a lecture given on November 24, 1909 under the title *Mesures de capacite des Hebreux au temps de l'Evangile*. The lecture was published later as a paper in the book *Études Palestiniennes et Orientales, Conférences de Saint-Étienne, 1909–1910*. Germer-Durand (idem, 92) argued that the finds from his excavations at the present day Church of Saint Peter in Gallicantu on Mt. Zion in Jerusalem led him to calculate the measurements that were used during the Gospel period. He mentioned four vessels, found in 1894, 1904, and 1907 (see fig. 3). The second vessel, he maintained, equals three-quarters of the first one; the third equals one-half of the first, and the fourth equals one-quarter of the first. In light of this ratio, Germer-Durand argued that the larger vessel equals the whole measurement, while the remainder equals its three parts. The volumes of the vessels, as they were measured, were

[10] In 2008, a study supported by the Early Israel Fund of Tel Aviv University began 3D scanning procedures for reexamining the typology of the Judahite storage jars based on mathematical criteria. The project is conducted by Oded Lipschits, Omer Sergi, Avshalom Karasik and Yuval Gadot, and includes the 3-D imaging of 120 complete or semi-complete Royal Judahite storage vessels (Sergi/Karasik/Gadot/Lipschits, forthcoming).

- the whole unit: 21.250 liters,
- three-quarters of the unit: 15.937 liters,
- one-half of the unit: 10.625 liters,
- one-quarter of the unit: 5.312 liters.

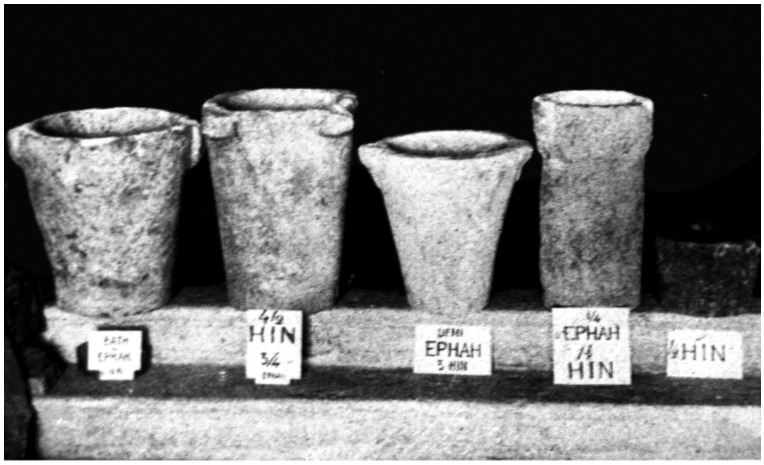

Fig. 3: Four Stone Vessels as discovered by Germer-Durand in his excavations at the present day Church of Saint Peter in Gallicantu on Mt. Zion (Germer-Durand, 1909–1910, 92).

The conclusion of all the above is that Albright was thrice wrong: in the measures and formula he used, as well as in referring to Roman period "stone measures" which supposedly represent the volume unit of the Iron Age *bath*. Despite this the measure of the *bath* according to his calculation became a milestone in research and many scholars have treated the 22 liter measure of the *bath* as an irrevocable fact.

A contrary view regarding the volume of the *bath* was proposed by Inge (1941, 107), who dealt with the differences between the measurements of the Lachish jar and the impressed *lmlk* jars, estimating their capacities as equal to about 44 liters. Inge (idem, 108) supposed that the inscription *lmlk* on the stamp impressions was an abbreviation of *bath-lmlk*; he was also the first scholar to propose that "*bath*" was the name of the jar itself (idem, 109). His proposal was highly criticized by Albright (1943, 58–59, note 7), and was rejected by scholars who dealt with the subject in the following years.

Recent Attempts to Understand the *Bath*

A few recently published papers re-examined the First Temple period liquid volume measurement system (Zapassky *et al.*, 2006; 2009; Benenson, 2009; Kletter, 2009). The major assumption of these papers is that the *bath* was the basic measurement of liquid volume in the First Temple period and that its ca-

pacity was about 20 liters (22.4/22.5 liters in Zapassky *et al.*, 2009, 53; 19.22 liters in Kletter, 2009, 363). Furthermore, Zapassky *et al.* assumed that the volume of the *lmlk* jars was a matter of interest to the administrative system, that the manufacturers of the jars had the option of calculating the vessels' volumes (and therefore the capacity of the commodities that were stored in them), so that during the production they could accurately reproduce entire series of identical jars (Zapassky *et al.*, 2009, after *ibid.*, 2006).[11]

These scholars' preconception (Zapassky *et al.*, 2009, 54) was that the uniformity of the *lmlk* jars' volume was a crucial issue for both the potters and the consumers of the commodities stored in the vessels. Furthermore, they assumed that the potters had the ability to control the height and shape of the jars to a 3.4 % degree of accuracy. As a result, they maintained, the potters could be accurate in defining volume and in achieving the required measurement (idem, 60).

But Zapassky *et al.*(idem) were surprised to find out that the actual variation in the jars was 10.4 %, and therefore admitted the dissonance between the "need for accuracy" and the potters' abilities.[12] Because of this dissonance and in light of the basic assumption that the jars' volume accuracy was important to the Judahite administration, despite the variation in their capacity, Zapassky *et al.* proposed that the administrative system had developed a calculation method to overcome this problem. This assumption is based on a conjecture raised by Ephʿal and Naveh (1993) that the central authority monitored the different measurements by placing standard vessels at the city gates: "The Jar of the Gate" that was found at Tel Kinnerot (and see below), and "Stone of the Gate" that was found at Deir Alla (Hofijzer / van der Kooij, 1976, 275).[13] Ephʿal and Naveh (1993, 63) argued that because the *lmlk* jars were not identical in their volume, their capacity was measured before they were filled with a special fixed-volume jar, while Zapassky *et al.* (2009) presented a computational solution according to which the capacity of the jars was measured by the existence of a hypothetical algorithm that enabled the calculation of the capacity of the jars despite the vari-

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[11] While in their first paper the scholars dealt with the calculation of simple cylinder-shaped vessels from the Iron-Age Negev, in their second paper they dealt with the *lmlk* jars from the late eighth century BCE.

[12] The basic assumption, concerning the need for accuracy seems as not well-found. In weights, where the accuracy seems even more important, there is a variation of about 5 % (Kletter, 1998, 80–82, 139–140; 2009, 358), and a variation of 10 % was not considered as a problem in Egypt (Janssen, 1975; 1988, 14–15, and cf. Powell, 1992, 899). For this matter, cf. Kletter's answer (2009) to Zapassky *et al.* (2009).

[13] It must be emphasized that the "Gate System" proposed by Ephʿal and Naveh is not a fixed and standard system: it is based on two sherds of a vessel, one stone and a non-provenance weight (cf. Kletter, 1998, 147–148; 2009, 360). It might be that officials checked the capacity of the vessels, held by the city merchants, but it is not evidence for a fixed system.

ation of their volumes. In Zapassky's *et al*. opinion, the volume of the jars could be measured based on external dimensions, and this algorithm had to be simple and based on adding two measures and subtracting a constant (idem, 61–62). For the presentation of the algorithm Zapassky *et al.* used the *bath* as the basic measurement for liquid volume used by the ancients, and an additional measurement – the hypothetical *ʿiśśārôn* (and see above), while for the length measurement they used the *finger* and the *cubit* (idem, 62).

According to these guidelines, Zapassky *et al.* proceed to reconstruct the equation used by the ancients. They first arrive at two different candidate formulae:

(1) V(a) = P(f) – 16f
(2) V(a) = L(f) – 19f

Where

- V(a) = volume in *ʿiśśārôn*,
- P(f) = half of the maximal horizontal circumference,
- L(f) = half of the maximal vertical circumference.

Although these equations are fairly accurate in predicting the volume (3–4 %), the authors admit that the 16f and 19f constants are not "meaningful." In addition, the calculation is "risky" as it is only dependent on either P(f) or L(f), for if there is even a single minor mistake with one of the measurements it will directly affect the calculated volume of the jar.

Therefore, a third formula was proposed by Zapassky *et al*., with another constant of 2c (= two cubits):

(3) V(a) = P(f) + L(f) – 2c

The calculation using this formula requires three stages: measuring the length P (the horizontal circumference) and L (the vertical circumference) in *fingers*; subtracting 2 *cubits*; the sum in *fingers* is approximately the volume in *ʿiśśārôn*. Thus, according to this formula, during the First Temple period it was possible to calculate the volume of a jar in *ʿiśśārôn* with an average accuracy of 3 % – 4 %, with the addition of half of the horizontal circumference of the jar with half of its vertical circumference and by subtracting two *cubits* (idem, 65). Zapassky *et al.* proposed this formula because it takes into consideration both circumference measures and not only one.

Aside from the preconception that the Kingdom of Judah's administrative system (or any other ancient Near Eastern kingdom's administrative system) cared about jar volume accuracy and therefore tried to calculate it, there are many other problems with the above theory. The three formulae that were presented by Zapassky *et al.*, 2009, are actually special cases of the more general family of "linear" equations of the form:

$V = a \cdot P + b \cdot L - c,$

Where a, b and c are appropriate constants:

(1) $a = 1, b = 0, c = 16 \rightarrow V = P - 16$
(2) $a = 0, b = 1, c = 19 \rightarrow V = L - 19$
(3) $a = 1, b = 1, c = 56 \rightarrow V = P + L - 56$

This type of formula was probably chosen because of its simplicity. However, one can adjust to these measurements (horizontal and vertical circumference) other similar and "easy to use" formulae, by different usage of the variables a, b and c, for example:

$0.5P + 0.5L - 17.5$

This formula is an average of the formulae (1) and (2), and its ability to avoid measuring mistakes in the jar's circumference is higher than the third proposed formula. Furthermore, addition of more parameters (like the diameter of the jar rim or its circumference) may improve the accuracy of the formula. Nevertheless, the improvement of the accuracy, even by addition of the third formula, is negligible for P or L, or any other measurement, is a linear variable. The "real" risk in this kind of calculation is not connected to the type or number of the variables. Instead, the estimation of any non-linear function such as volume is doomed as its accuracy will only be high in the mean values of the linear predictors. Unsurprisingly, we see a prediction error of two, three, and even more than four *ʿiśśārôn* (more than five liters) in smaller than average vessels (below 22 *ʿiśśārôn*). In addition to such significant prediction inaccuracies, a simple measurement error of one *finger* would have resulted by adding or subtracting a whole *ʿiśśārôn* from the estimated volume.

Was the Exact Volume of the Storage Jars Necessary to the Administration System in Judah?

The fundamental question, which Zapassky *et al.* did not answer, is related to the potters' "ability" (idem, 60). All the potters had to provide the recipient of the jars with the maximal possible accuracy. If this is the case, why then, despite their "abilities," did the potters not produce identical jars? Zapassky *et al*., 2009, offer no solution to this question, and their thesis transfers the burden of approximately measuring the volume to some hypothetical ancient inspector, armed with a string marked with finger/cubit units. There is no reference to the need for accuracy of the volume of the jars, which varied by 10% and even more. It is clear, therefore, that the potters' "ability" had no function within the calculation of the volume of the storage jars. Furthermore, it seems that according to Zapassky *et al*.'s preconception, the need for accuracy is a reflection of the modern concept, which has no background in the reality of the ancient world (Powell, 1990, 899–900; Kletter, 2009, 361–62), while the position of the concrete reality (that rises also from the measuring of the jars) was taken over by

"Virtual Reality," based on assumed calculations.[14]

Hundreds of *lmlk* jars were used in the administrative system in order to store agricultural commodities (see recently Lipschits/Sergi/Koch, 2010; 2011). The average volume of most of these jars balances the inaccuracy that exists in the margins of the system (about 10 %). Therefore, one may ask if the administrative system took into account the variation in the volume of the jars? And if so, was it necessary to know the exact volume of each one of the hundreds of the jars?

Wallace (2004, 429–430) clearly demonstrated that even during the Classical period there was no accuracy in capacities of amphorae. He concluded that while the variation was sometimes over 10 % and hence it might be a problem for a costumer who buys a single jar (for he gets less commodity of liquid), it was neglected when a large amount of jars is discussed. Even during the Classic and late Hellenistic periods, with the knowledge of measuring liquid volume (cf. Lang, 1956; Finkielsztejn, 1999; Lawal, 2002), there was no need for accuracy. This is evident by the Rhodian amphorae assemblages, in whom there was a deviation of ca. 20 % (Wallace Matheson / Wallace, 1982, 296–297). The amphorae of the Mendaian wine, that were also produced in large quantities and sold all over the Mediterranean (Papadopoulos/Paspalas, 1999), had a capacity of between 8 and 10 choes, which, based on measurements (presented in Wallace, 1986), should amount to between 26 and 32.5 liters. As such, the cargo of ship was not measured by its weight but rather by the number of the jars (Cousteau, 1954)

This wide scale of variation is connected to the *bt. lmlk* jar from Lachish. The different measurement of the *bt. lmlk* jars and the *lmlk* jars was already recognized, as mentioned above, by Diringer (1953, 356), who wrote that the first one "resembles, but is not identical with 'la-melekh jars.'" Zimhoni (2004, 1797) accepted Diringer and Inge's assumption, and speculated that the *bt. lmlk* jar was a two-handled jar, belonging to a different group of storage jar, other than SJ1 ("*lmlk* jar") or SJ2 ("*lmlk*-like jar") – SJ3 (and *cf.* type SJO6 in Gitin, 2006, 519, 521) (fig. 4 – Judahite storage jars from Lachish). These conclusions are problematic in two areas: first, the measurements of the *bt. lmlk* jar are smaller than the "typical" *lmlk* jar, but one cannot construct the whole shape of it and by doing so determine that it does not belong to the royal storage jar group, or determine the number of its handles simply from the measurements of the rim and half of its shoulder. Furthermore, distinguishing between *lmlk* jars and *lmlk*-like jars (Zimhoni, 2004, 1794–1796), merely by using the size and color of the jar, is currently considered insufficient data (Gitin, 2006, 508–509; Sergi/Karasik/Gadot/Lipschits, forthcoming), and as a result one can reject the exclusion of the Lachish *bt. lmlk* jar from the corpus of the royal Judahite storage jar.

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[14] Benenson's response to Kletter (2009, 366), "Our arguments are simple and come from the classroom mathematics", only strengthens the conclusion that one cannot project modern reality on an ancient one.

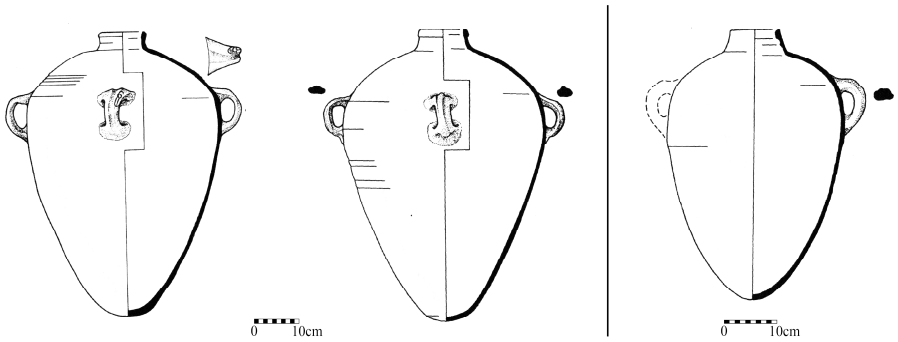

Fig. 4: storage jars from Lachish: SJ1 (left; Zimhoni, 1997, fig. 5.8.2), SJ2 (center; Zimhoni, 1990, fig. 8:4), and SJ3 (Zimhoni, 1997, fig. 5.16:3; right).

The *bt. lmlk* jar from Lachish was re-examined at the British Museum in May 2009, revealing that the differences between it and other jars are much more significant than scholars assumed in the past, and it appears that the diameter of the rim of the *bt. lmlk* jar (7.3 cm) is much smaller. The average diameter of the *lmlk* jars is 8.2–9.4 cm, only four jar rims (out of 120) had a diameter smaller than 8 cm, and no other *lmlk* jar was smaller than 7.5 cm. In light of this data, it seems that one should reject the conclusions of Albright, Diriger, Zimhoni and others concerning the *bt. lmlk* jar. Furthermore, we support the view raised by Gitin (2006) to classify the jars according to their shape and not their size. The *bt. lmlk* jar from Lachish, of which only the upper part survived, cannot be classified for certain, but it is, without doubt, a Judahite storage jar. On this basis we point back to Inge's proposal (1941, 109) that the *bath* was the jar itself, with no connection to its exact size, and during a long period when the average size and the general shape of the jars were changed in a slow and gradual process.

As will be demonstrated below, this conclusion suits the biblical text and the epigraphic finds, according to which oil or wine was measured by the jars that contained them, and not by measurement units.

The Biblical *Bath* as the Judahite Storage Jar

During the eighth century BCE, processes that had begun during the Iron Age IIa climaxed under Neo-Assyrian imperial dominance. While being a vassal kingdom of Assyria, Judah developed a central administrative system that included royal estates in charge of producing agricultural commodities raised for use as tax to the imperial regime (Katz, 2008, 171–178, with further literature; Lipschits/Gadot, 2008; De-Groot/Greenhut, 2009), along with the development of new technologies of agricultural production (Faust/Weiss, 2005; Katz, 2008, 55–59) and a new weight system (Kletter, 1998, 145–147; Katz, 2008, 78–79, with further literature). In addition, instead of the small pottery workshops that produced a variety of types, the production of one central workshop, producing

storage jars of specific types, was preferred (Lipschits/Sergi/Koch 2010, 7). A major part of this economic system was concentrated in Jerusalem by the central government. The most frequent storage jar of the late-eighth to seventh century BCE, with its two/three types (SJ1 and SJ2 according to Zimhoni [2004, 1794–16]; SJO3 and SJO4 according to Gitin [2006, 514–517]), was common in Judah, and was also preferred by private individuals. This jar was in use during the late monarchy until the destruction of Jerusalem (Type SJO5 according to Gitin, 2006), while in Benjamin and other areas in the Province of Judah it was still in use during the sixth century BCE (Lapp, 1981, 88–89; Lipschits, 2005, 199, with further literature). This uniformity of the pottery is also reflected in the biblical text and the epigraphic finds.

As mentioned above, the *bath* occurs in the Bible 13 times (1 Kings 7:26, 38; Isaiah 5:10; Ezekiel 45:10, 11, 14; 2 Chronicles 2:9; 4:5); it is not divided into sub-units, and unlike other vessels (such as the *kaḏ* or the *nēḇel*) was not used for the transfer of liquids from place to place.

A similar picture emerges from the epigraphic finds, which shows the existence of units of liquids but not of volume measurements. In some cases oil or wine is mentioned without indicating their measurements or vessels, and parallels can be noticed in Akkadian and Ugaritic (*ṯlṯ . šmn*, "three [jars of] oil," KTU 4.41.2; *m'yt . yn . tb*, "a hundred [jars of] fine wine," KTU 4.213.11; cf. Dobb-Allsopp *et al.*, 2005, 213). In other cases vessels like *kaḏ* or just "vessel" are mentioned (KTU 4.269). The lack of unit or measurement was usually filled by scholars, according to their preconceptions, their interpretation of the liquid volume measurement system, which they learned from the biblical text, and that never really existed in the First Temple period.[15]

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[15] Thus, the ostracon from Tel Qasila (Mazar 1950–1951, pl. 37a; 1951, pl. 11a; surface find) that reads *lmlk 'l*[*p*] / *šmn wm'h* / ['] *ḥyhw*, was reconstructed by Mazar (1951, 265–67) as "Belonging to the king, a thousand and one hundred *lōḡ* of oil / *'ḥyhw*" (cf. Dobbs-Allsopp, 2005, 403). This assumption has no basis within the biblical text or the epigraphic find, and it seems that Mazar's reconstruction is anachronistic and does not reflect the reality of the First Temple period. Two ostraca, found in Jerusalem by Kenyon (Lemaire, 1978, pls. 23B, D, E; Dobbs-Allsopp, 2005, 212–214, 216–218), bear the word *šmn*/*šmnm*, and like the Tel Qasila ostracon, they mention no measurement. Lemaire (1978, 161) dated the ostraca to the late eighth – early seventh century BCE. The first ostracon reads *50 . 7 . šmnm* / | | | | *šbrm*" (57 oil, 4 grain). The second mentions oil (*šmnm*) four times, while on the fifth line there are eight vertical lines, probably counting oil once again (Dobbs-Allsopp, 2005, 218). On the other side of the ostracon there is an inscription that reads *gt . prḥ*, probably the origin of the commodities (*idem*, 218). On another ostracon from the same assemblage, the word *nēḇel* was reconstructed before the mentioned wine (Dobbs-Allsopp, 2005, 211–212). This way of measuring wine is known from Samaria, and if this is the case, then one can reconstruct the delivery of agricultural commodities from the Jerusalem vicinity to the capital. Heltzer (2008, 70*) argued that these numbers are the counting of the well-known volume measurement called *nēḇel*. Nevertheless, it must be emphasized that in all cases in which they are mentioned, the numbers are the counting of the vessels themselves (Stern, 1962, 855). In this case, one

It seems that in the late seventh and the early sixth century BCE, oil was measured in well-known units. In Arad ostraca the oil is measured by units (thus, letter 10 reads: … *yyn b* | | | / [ ] *m* ’[ ]*tym* . *wšmn* | (“3 *baths* of wine … 1 oil …”; Aharoni, 1981, letter 10, line 3; and cf. 14, line 3; 17, line 4), while the wine is measured by *bath* (idem, letter 1, line 3; 2, line 2; 3, line 2; 4, line 3; 7, line 22; 8, line 5; 9, line 3; 10, line 2; 11, line 3; 61, line 2). The common formula is “*yyn*. b\ [no. of vertical lines]”. According to Aharoni (1981, 13; cf. Dobbs-Allsopp *et al.*, 2005, 10), the term *b* is an abbreviation for the word *bath*, while the vertical lines mark the number of the *bath*. In the course of this interpretation, Gibson (1971, 51–52) notes that all the lines (the diagonal and the vertical ones) mark the number of the *bath*, while Naveh (1992, 52–53) argued that only the diagonal line is connected to the *bath* itself, and the vertical ones mark the amount of the *hîn* measurement, which he interpreted as one-sixth of a *bath* (and cf. after him, Aḥituv, 2005, 84). Naveh’s assumption is problematic, for while the interpretation of the *b* as *bath* is founded, there is no evidence within the Arad ostraca for the use of the *hîn*. Furthermore, as mentioned above, the *hîn* is not known from any First Temple sources, and there is no evidence of its usage during that period.[16]

In the same manner, the abbreviation “b\” appears on a complete jar from Lachish Level II (Ussishkin, 1978, 85–87 and fig. 29). Based on this interpretation, Ussishkin (idem, 87, note 9) argued that the capacity of the jar (20.85–21.15 liters) equals the volume measurement – the *bath.* To this jar one should add the *bt*. *lmlk* jar from the same site (see above), and a jar from Tel Miqneh (Stratum I), with an inscription that reads “bt” (Aḥituv, 2005, 317). The capacity of the jar is 32 liters, and it is difficult to accept that in the seventh century, under the Neo-Assyrian hegemony, when the borders between the kingdoms were open, there would be different volume measurement systems in two bordering kingdoms.

As discussed above, in light of the biblical text, we suggest identifying the *bath* with the Judahite storage jar. The Bible mentions no other “candidate” and

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must assume that the volume of the *nēḇel* was known and fixed, or at least, like the *lmlk* jar phenomena, that the shape of the vessel was standard. The same picture emerges from an ostracon that was found at the Ashkelon harbor (Cross, 2008, 333–372), that reveals the reality of the late Iron Age coastal Phoenician and Philistine cities: wine, oil and ail where counted by units (idem, 341). Thus, ostracon 1.5 reads *škr* | | | | |, and ostracon 1.7 reads *š*[*mn*] | |, and cf. ostracon 1.10, in which the grain is counted by measurement (according to Cross, 2008, 345 – the *ḥōmer*).

[16] A further strengthening to the interpretation of the *bath* as a vessel and not a measurement come indirectly from Aharoni’s reading to Arad letter number 32 (1981, 62–64). In the ostracon, the wine (symbol d according to Aharoni, 1981, 64) appears next to a symbol for a pot (symbol e, idem) and not next to the measurement, the *ḥeḳat*, which appears all along the letter. It seems that there is an analogy between the common *bath* and the pot that is mentioned in letter 32.

in all the texts, as well as in the extra-biblical sources, the *bath* is mentioned in connection with wine or oil, and no other vessel is mentioned with it.[17]

Two other Biblical Vessels: *nēḫel* and *kaḏ*

As a storage jar, the *bath* is comparable to two other vessels that held liquid, and which were used in daily life and the economy: the *nēḫel* and the *kaḏ*. Like the *bath,* these two vessels were also interpreted as liquid volume measurement.

The *nēḫel* was probably used for transporting liquid, mostly wine. It is mentioned 10 times in the Bible, primarily as a vessel for carrying liquid on a journey.[18] The translation of *nēḫel* as skin is not well founded in the biblical text, for Isaiah 30:14 says explicitly: "And he shall break it as the breaking of the potter's *nēḫel* that is broken in pieces; he shall not spare," and therefore it is assumed that the *nēḫel* was made out of clay (Jacobson, 2001; Cline, 2001, 594; Heltzer, 2008, 70*). It might be that the *nēḫel* preserved its prototype, which was made out of skin, but it seems preferable to accept the opinion of Koehler and Baumgartner (1995, 664) and Brandt (1953, 333), that the connection to the skin is secondary and late. It might be that the origin of this connection is in the Greek translation (cf. the Septuagint translation of 1 Samuel 1:24; 2 Samuel 16:1; Jeremiah 13:12), while there was no basis for it in biblical Hebrew. Our view is strengthened by the occurrences of the *nēḫel* in other languages, such as Ugaritic (Gordon, 1965, 19, 1598), Syriac (Brockelmann, 1966, 411), Punic (Jean/Hoftijzer, 1965, 173) and Etruscan (Masson, 1967, 69). In all of these languages the *nēḫel* appears as a clay vessel, not as a skin.

The *nēḫel* occurs 23 times in the Samaria ostraca: 13 occurrences in relation to wine, 10 in relation to oil (Risener *et al.*, 1924). In all these cases, the wine and the oil are measured by *nēḫel*s.[19] According to the traditional interpretation, it was accepted that the Samaria *nēḫel* is a containing vessel for liquid (idem, 245; Honeymann, 1939, 84–85; Kelso, 1948, 25; M. Aharoni, 1979; Kaufmann, 1982, 229; Bornstein, 1991, 76). However, some scholars proposed that the *nē-*

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[17] It is noteworthy that the common Hebrew word for 'jar', קנקן, is not mentioned in the Bible.

[18] According to 1 Samuel 1:24, when Hannah took her small child to Shiloh, she brought "a *nēḫel* of wine" together with "three bullocks, and one *'ēpāʰ* of flour". According to 1 Samuel 10:3, the prophet said that Saul would meet three people on his way, "one carrying three kids, and another carrying three loaves of bread, and another carrying a *nēḫel* of wine." Two *nēḫel* of wine were given to David by Abigail (1 Samuel 25:18), and one *nēḫel* was on the couple of saddled asses of Ziba, the servant of Mephibosheth (2 Samuel 16:1). In other cases (Isaiah 30:30; Jeremiah 13:12 [twice]; 45:12; Lamentations 4:2) the *nēḫel* is mentioned as a pottery vessel for liquid, while in the Book of Job (38:37) the clouds are described as *nēḫel*s.

[19] Nº 1, line 2; 4, line 2; 5, line 2; 6, line 2; 7, line 2; 8, line 2; 9, line 3; 10, line 3; 11, line 1; 12, line 3; 14, line 3; 15, line 2; 16, line 2; 17, line 2; 18, line 2; 19, line 2; 20, line 2; 53, line 2; 54, line 2; 55, line 2; 59, line 1.

ḫel was a fixed measurement for liquids during the First Temple period. Bornstein (1991, 76) assumed that the *nēḫel* was identical to the *bath*, measuring 45 liters, as was revealed from measuring jars from Gibeon and Lachish. Nevertheless, while the *nēḫel* was considered a liquid containing vessel (cf. Honeyman, 1939, 81), there is no evidence for identifying the *bath* with the *nēḫel*. Jacobson (2001) argued in the same vein, basing his case on extra-biblical sources: the scriptures of the fourth-fifth century CE church fathers Saint Jerome and Epiphanius of Salamis, who claimed that the *nēḫel* was a liquid volume measurement. Heltzer (2008), who furthered Jacobson's argument, used the description of the church fathers from the Byzantine period, and estimated the *nēḫel* to be 11.3 liters (idem, 72*). In addition, Heltzer (idem, 73*) argued that the *nēḫel* was half of the Phoenician *kd* and the Judahite *bath*. To strengthen his argument, he pointed (idem, 72*–73*) to the wreck of the ancient Phoenician ship found near the Ashkelon shore (cf. Stager, 2003); one of the intact jars found among the ruins held 20.4 liters – a measurement close, in Heltzer's opinion, to the Phoenician *kd* and the Judahite *bath*.

Contra these arguments the following points must be stressed:

1. The Bible describes the *nēḫel* as a vessel for carrying/storing liquids and not as a tool for measuring. In the Book of Samuel the *nēḫel* is described as a supply vessel to be used on journeys, and in the prophecies it is a pottery vessel for storing liquids. Unlike the *bath*, the *hîn,* or the *lōḡ*, the *nēḫel* is never mentioned in analogy to other vessels or measurements, making it even more difficult to place it within a system of units, as some scholars have attempted to do in reconstructions.
2. St. Jerome and Epiphanius were church fathers who lived and wrote a thousand years after the destruction of the First Temple. Their texts describe the reality of the Byzantine period and not the Iron Age. Using the measurement system they reconstructed in order to understand the First Temple reality suffers from anachronism and is riddled with inaccuracy.
3. The find of the jars from the sunken ship near Ashkelon, important as it may be, is not evidence of the liquid volume measurement system in Phoenicia. Heltzer (2008, 72*–73*) pointed out that the volume of the jars is not uniform and therefore one may wonder about the selection of a single jar, just because it is closest to the speculated Phoenician *kd*. Is it the exception that testifies to the rule? And what of the dozens of other jars? Do they fit the "Standard liquid volume measurement system" of Phoenicia?

In light of the above, we suggest abandoning the assumption that the *nēḫel* was a liquid volume measurement and accept the previous, common, view of it described in the Bible: a vessel for storing and transferring liquids.

The *kaḏ* is mentioned 18 times in the Bible, in several connections: in Genesis 24 (14, 15, 16, 17, 18, 20, 43, 45, 46) and in 1 Kings 18:23, it is used for drawing water from a well and to transfer it from place to place; in 1 Kings 17 (12, 14, 16) it is used for storing flour; while in Judges 7 (16, 19, 20) it is described as a pottery vessel used to hide the torches of Gideon's warriors, and in Ecclesiastes (12:6) it is just a vessel. In parallels from the ancient Near East, the Ugaritic *kd* is kind of a jug (Koehler/Baumgartner, 1995, 460), and in Akkadian the west-Semitic loanword *kandu* had the same meaning (CAD K, *kandu*).

Unlike other scholars (cf. Heltzer, 2008, 72*), there is no evidence that the biblical *kaḏ* was used as a fixed liquid volume measurement. There is no evidence for the assumption that the *kaḏ* had any connection whatsoever to a liquid volume measurement system. We may speculate that it was used by individuals and families, and that its shape was fixed (including a spout for pouring), and that its size was related to the distance from the water source, the size of the family using it, and the physical ability of the one who would carry it.

Summary

The study of ancient periods has always carried the potential risk of anachronism, means reflecting backwards the reality of late, and even modern, periods. The anachronism may create a historical reconstruction, that its "characters" and "background" are from the Iron Age, but their relationship, nature and description are based on more recent periods. Thus, for many years, scholars tended to reconstruct the ancient liquid volume measurement system according to the characters of modern systems. Furthermore, by doing so they 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, and they projected their interpretations on the archaeological and epigraphic finds.

A system of liquid volume measurements, which includes the *bath, hîn, lōḡ, ʿiśśārôn,* and *ḥeṣy*, *kaḏ* and *nēḇel* is a *shatnez,* that is foreign to the First Temple period. The *hîn* and the *lōḡ* were used for the Second Temple cult; the *ʿiśśārôn* and the *ḥeṣy* were used for dry capacity and never for liquid; the *bath*, the *kad* and the *nēḇel* are mentioned separately, never together or with any other vessels, and always by units. Therefore, the connection of these three vessels, or any other vessel, to one system, does not reflect the reality of the First Temple period.

Another projection of the modern mind backwards, and the imposing of it on the ancient reality, is the use of mathematical formulae as a response to the "need for accuracy" of the central administration jar capacity. This reconstruction is based on the assumption that the accuracy was necessary to the administration system, but this concept is difficult to accept. The hundreds of jars manufactured and used by the administrative system cancel the variation of 10% between the individual jars. Furthermore, there is no evidence, in the Bible or the epigraphic finds that teaches about this accuracy, while it is on this assump-

tion that the entire hypothesis of the liquid volume measurement system is based.

Scholarship should focus on the evidence of the biblical text and the epigraphic finds. *Bath* appears as a storage vessel for liquids in both these sources. This vessel, which held wine and oil, is identical to the common Judahite storage jar, and support for this can be found in the two Lachish jars that have their names inscribed on them.

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