

Steadying the storm in the *kiddush* cup: a solution to the halachic *shiur* crisis

The difficulty with halachic *shiurim* for volume is well known and many different resolutions to the problem have been offered. While these resolutions differ in their premises and implications, they are all *generically* similar in that they start by assuming consistency between all the talmudic sources, and seek to solve the discrepancy that arises from applying these sources to observable reality by using forced arguments to modify one or another aspect of said observable reality. In this piece, I shall present a different way of resolving the problem, which both affirms traditional Jewish *shiurim* used until the modern era and avoids the need for forced arguments or untenable claims. Before doing so, I shall, at the risk of boring some readers, once more recapitulate the difficulty in calculating volume *shiurim* used in *halacha* and how the different approaches to addressing it arose. I shall take the *revi'it* as my locus of the discussion because this is where the daily life of every Jew has been most affected.¹

The problem and its discovery

There are two main ways of calculating the volume of the *revi'it*.² The first, which was favoured by the *Geonim*, and was relied upon in practice by Jewish communities for at least a millennium, is to express it in terms of eggs. The Talmud Bavli in [Eruvin 83a](#) tells us that a *se'ah* is equivalent to 144 eggs. Since we know that there are 4 *revi'ot* in a *log*, 4 *login* in a *kav*, and 6 *kabin* in a *se'ah*, we can calculate the volume of a *revi'it* in terms of eggs through the sum $144 \div 6 \div 4 \div 4 = 1.5$; it therefore follows that a *revi'it* is equivalent to the volume of one and a half eggs. Using a generous estimate of the egg as 50ml, we arrive at an estimate for the *revi'it* of 75ml.

The second way of calculating the *revi'it* is stated explicitly in [B Pesahim 109a](#) in the name of Rav Hisda:

אמר רב חסדא רביעית של תורה אצבעים על אצבעים ברום אצבעים וחצי אצבע
וחומש אצבע. כדתניא ורחץ במים את כל בשרו שלא יהא דבר חוצץ בין בשרו
למים. במים במי מקוה את כל בשרו מים שכל גופו עולה בהן וכמה הן אמה על
אמה ברום שלש אמות, ושיערו חכמים שיעור מי מקוה ארבעים סאה.

Rav Hisda said, the *revi'it* of the Torah is two *etzba'ot* by two *etzba'ot* by 2.7 *etzba'ot*. As it was taught 'and he will wash in water all of this flesh' - [this shows that] there will not be anything separating his flesh from the water. 'in water' - [this means] in the water of a *mikveh*. 'all of his

¹ Many readers will object that a better candidate is the *kezayit*, but, here, the doubling of *shiurim* in the modern era is only relevant as a side effect of the more fundamental development of defining olives in terms of eggs.

² Two additional ways are provided in the [Pesahim 109a](#), namely a quarter of a vessel used for measuring *muryas*, and the difference between the old and new versions of a certain vessel used in Teverya. To my knowledge, no-one in the modern era has been able to reconstruct either method.

flesh' - [this means] water in which all of his flesh can get into them. And how much is that? 1 *amah* by 1 *amah* by 3 *amot*, and the sages measured the water of a *mikveh* as 40 *se'ah*.

Rav Hisda's definition is based upon a tradition that states an equivalence between the minimum volume of a *mikveh* expressed as a cubic function of its dimensions measured in *amot* (cubits), and its volume as measured in the conventional large volume measurement, the *se'ah*. Rav Hisda's mathematical argument is not spelled out in the *Gemara*, but the gaps are filled in by the *Behag*, *Rabeinu Chananel* and the *Rif*.³ Though their calculations are without error, their methods for deriving the volume of a *revi'it* from a *se'ah* are extremely confusing for someone trained in modern mathematics. It is far easier for the modern reader to understand the proof as follows.

The minimum volume of a *mikveh* is 1 *amah* x 1 *amah* x 3 *amot*. There are 6 *tefahim* (fists) in the standard *halachic amah* and 4 *etzba'ot* (fingers) in a *tefah*. There are therefore $6 \times 4 = 24$ *etzba'ot* in an *amah*. The cubic volume of a *mikveh* can therefore be defined as $(24 \times 1) \times (24 \times 1) \times (24 \times 3) = 41,472$ cubic *etzba'ot* in a *mikveh*. There are 40 *se'ah* in a *mikveh*, 6 *kabin* in a *se'ah*, 4 *login* in a *kav* and 4 *revi'yot* in a *log*. We can therefore divide the volume of a *mikveh* using the sum $41,472 \div 40 \div 6 \div 4 \div 4$ to show that a *revi'it* 10.8 cubic *etzba'ot*. This is expressed by Rav Hisda as $2 \times 2 \times 2.7 (=10.8)$.

This formula is not only explicitly stated in the *gemara*, but also canonised as practical *halacha* by *Geonim* and *Rishonim* including the *Behag*, *Rif*, *Rambam*, *Rosh* and the *Tur*.⁴ All the above authorities, with the exception of the first, explicitly stipulate that the *etzba* in question is actually a *godel*, that is to say a thumb. The rule that an *etzba* used in measurement means a thumb is explicitly stated by Rav Papa in [Menahot 41b](#), and also follows from a *baraita* in [B Bechorot 39b](#), which states that *etzba* always refers to a quarter of a *tefach*, something that can only be true of a thumb.

However, while a measurement in terms of cubic *etzba'ot* is an apparently very precise way of defining a *revi'it*, it was not, before the modern age, a very practical way of doing it either for the ordinary person or for a scholar. It was therefore not for nearly a thousand years - and perhaps not coincidentally shortly after the invention of the metric system - that the *poskim* came to appreciate a very serious problem. Human thumbs vary in width, but a reasonable average is 2.3cm. If we plug that into Rav Hisda's formula, we get $(2 \times 2.3) \times (2 \times 2.3) \times (2.7 \times 2.3) = 131$ ml, close to double the volume of the *revi'it* calculated in terms of eggs.

This general problem was observed already in the period of the *Rishonim* by the *Tashbetz*, who, writing about the volume of the *mikveh*, observed that 3 cubic *amot* is a great deal larger than 5760 (= 144 x 40) eggs, and therefore, endorsed using the larger measure to avoid the possibility of the *mikveh* being

³ Many MSS of the *gemara* do provide a step by step calculation, but this appears to be a later interpolation.

⁴ משנה תורה, הלכות תפילה ט"ו:ד; טור, א"ח תעב; בה"ג סוף הלכות חלה/כלאים; רי"ף פרק ערבי פסחים כג ב, ורא"ש פרק ערבי פסחים כג.

invalid.⁵ However, in practice, *mikveot* were always built with significant extra space, and those who noticed that there was a problem did not apply their observation to the smaller *shiurim* of the *revi'it* and the *shiur* for *hallah*, but instead stuck with traditional calculation based on eggs. The first raise to this problem as a practical issue was the *Noda BiYehuda*, R. Yehezkel Landau זצ"ל, who made two vessels for an *asirit haephah*, the minimum *shiur* for *hallah*, one using an egg-based measurement derived from *Eruvin* 83b, and the other from cubic dimensions derived from *Pesachim* 109b. His thumb seems to have been around 2.4cm, and, accordingly, he found that the latter vessel was fully twice the size of the former. This discovery threw the halachic system of *shiurim* into conceptual crisis, one that demanded, and still demands, a resolution.

Solutions to the Problem

The *Noda BiYehuda* himself was the first to offer a resolution. Since the problem essentially boils down to an irreconcilability between the measure based on thumbs and the measure based on eggs, there must, he reasoned, be something wrong either with our estimate of the width of a thumb or the volume of an egg. The *Noda BiYehuda* opted for the latter, and concluded that, in the time of the *Gemara*, eggs must have been twice the size they were in his own day. The practical ramification was that all *shiurim* that had hitherto been based on the volume of eggs (which was, in fact, all volume *shiurim* except for *mikveot*, where it was essentially a theoretical matter) now had to be doubled.⁶

The *Noda BiYehudah's* solution to the problem has been accepted, at least *lechatchila*, by the bulk of Orthodox Jewry, though later than most people likely assume, partly because he was the first to provide an answer, partly because of his justified reputation as a top-tier *posek* and *talmudist*, and partly because it was endorsed, though, again, more tepidly than most people likely realise, by the *Mishnah Berurah* and *Chazon Ish*.⁷ However, the fact is that this is not a possible solution to the problem. The largest eggs that can be produced commercially today after generations of intensive breeding for egg size have a volume of not much more than 60 ml. Occasionally, eggs significantly larger than this are laid, so it is strictly biologically possible, but there is precisely no evidence to indicate that in the time of the *Gemara*, the period of the *Rishonim*, or at any other time, chickens were ever routinely laying eggs with a volume of 90 or 100ml. To the contrary, [numerous different strands](#) of evidence from archaeology and the Rabbinic sources all point to the conclusion that chicken eggs a thousand or two thousand years ago were slightly smaller, and at any rate certainly no larger, than those today. The arguments have been made at length by others, so it will suffice here to say that the resolution of a contradiction in the *Gemara* cannot justify such a far-reaching and unlikely claim about the world around us with so much contrary, and a total lack of supporting, evidence.

⁵ ספר תשב"ץ, חלק ג:לג

⁶ חידושי הצ"ח, פסחים קטז ב

⁷ See the famous remarks of Prof. Hayyim Soloveitchik in [Rupture and Reconstruction](#), pp. 323-5

If we reject the option of adjusting *up* the size of eggs, what remains is to adjust *down* the size of thumbs. This option was taken by R. Chaim Naeh זצ"ל, who worked backwards from the volume of a *revi'it* to find the length of a talmudic *etzba*. R. Naeh calculated the *revi'it* as 86 ml, by measuring the amount of water that weighed 27 *dirhams*, a coin used in the Muslim world, employing a method for practically measuring a *revi'it* found in Rambam's commentary on the Mishnah ([Eduyot 1:2](#)). Working backwards from this definition, R. Naeh estimated the size of a Rabbinic *etzba* as 2 cm $[(2 \times 2) \times (2 \times 2) \times (2 \times 2.7) = 86.4\text{ml}]$. His estimate of *revi'it* is widely cited today as the 'lenient *shiur*' for a *revi'it* that can be relied upon in cases where an obligation is *d'rabanan* or extenuating circumstances apply.

The first problem with R. Naeh's *shiur* for the *revi'it* is that, while it is much smaller than the *Chazon Ish shiur*, it is still too big. This is so, first, because it implies an egg size of 57ml, which is bigger than the average size of an egg today, and even more so than an egg in the time of *Hazal*. Perhaps more importantly, though, it has subsequently been shown that the *dirham* used by R. Naeh to calculate a *revi'it* was larger than those in circulation during the era of the *Rambam*. As Rav Beinush Finkel זצ"ל found, if we use the coin *Rambam* was referring to, we arrive at a *shiur* of 75ml, more or less exactly what we could calculate using modern eggs. Though the figure of 86ml is still widely quoted as the lenient opinion, it is generally recognised by those who understand the *sugya*, that the actual *shiur* according to the logic of R. Naeh's way of reconstructing the sources is 75ml.⁸

This, however, intensifies the second, more serious, problem with R. Naeh's *shiur*. If we plug 75ml into Rav Hisda's formula and work backwards, we arrive at an estimate for the *etzba* of 1.9cm. 2cm is at the lower boundary for the width of an adult thumb, and 1.9cm is below it. Neither is a plausible estimate of what *Hazal* intended to be understood by the measure *etzba*, which, as we have seen, is defined by the width of the thumb, and is equal to $\frac{1}{4}$ of a *tefach*.

R. Naeh addressed this issue by pointing to the difficulty of accurately measuring the width of the thumb, which varies from person to person, and relied upon the testimony of the *Rambam* who claimed to have calculated the *revi'it* himself using thumbs and arrived at a volume equal to 1.5 eggs.⁹ Neither argument, however, is convincing. It is true that, if pressed, we would have trouble, based on the sources in the *gemara*, in determining whether 2.2cm, 2.3cm or 2.4cm was a better estimate of an *etzba*, but we can be confident of the *range* of plausible answers. 2cm and, still more so, 1.9cm are simply outside that range. The *Rambam's* testimony certainly requires analysis, but it cannot change the width of the human thumb or fist. To put the matter in Yeshivish terms, it's a *kasha* on the *Rambam*, not a *ra'aya* for a definition of the *etzba*.

Various answers have been given to this problem by defenders of traditional *shiurim* and what we might loosely call rationalists. One popular argument is that human hands used to be smaller because

⁸ For example, [פניני הלכה](#) and [Rav Kaganoff](#)

⁹ [שיעורי תורה](#), ו:א-ב

of worse nutrition.¹⁰ This argument is often paired with the claim that the *Noda BiYehuda* was unusually tall and long limbed.¹¹ Neither of these are true to the extent necessary to solve the problem. More serious arguments include the claim that the *etzba* should be calculated by the thickness, not the width, of the thumb,¹² and that ancient workmen pressed their thumbs very closely together when measuring.¹³ Aside from the inherent implausibility of such claims, they all founder on the rock of modern archaeology. [Careful studies](#) of pots from ancient Israel have found that a *tefach* measure was used with great consistency and that it was between [8.85 and 8.97cm](#). If we take the middle of this small range, and divide by 4, we get an estimate of 2.2275cm for an *etzba*, which, using Rav Hisda's formula, yields a *revi't* of 119ml, smaller, it is true, than the *Chazon Ish shiur*, but far too large to be 1.5 eggs.¹⁴

If we accept the evidence of biology, archaeology, and our own eyes, we are left with no choice but to admit that the incompatibility between the two measurements of the *revi't* cannot be explained away by reference to larger eggs or smaller thumbs, but rather *exists within the gemara* itself. This suggests a totally different approach to addressing this problem. Sometimes, it is true, an apparent difficulty in a Rabbinic text can be resolved by reference to context or *realia* known to the author but not immediately apparent to the reader. Our usual approach, however, to a Talmudic problem is to delve further into the sources and see if additional information *in the gemara itself* or close textual analysis can shed new light. I will now attempt such an analysis.

A New Approach to the Problem

Once we approach this issue as a contradiction within the *gemara* itself, rather than a contradiction between the *gemara* and observable reality, we need to start by defining precisely where the difficulty

¹⁰ For example, R. Natan Slifkin [states](#) 'First, we know that thumbs have indeed grown'

¹¹ Cited [here](#).

¹² This has been extensively and ably argued by [Prof. Avraham Greenfeld](#)

¹³ See the editorial note at the end [here](#).

¹⁴ A different type of solution was suggested by [J.J. Ajdler](#), who proposed that the *gemara's* definitions of the three types of *se'ah* in terms of eggs referred not to multiples of the volume of a standard egg, but rather how many actual eggs could be placed in these measures. Because eggs are egg-shaped, a vessel that can hold 144 eggs has a liquid volume equivalent to around 275 eggs. The *Geonim*, on this argument, simply misunderstood the *gemara* and the contradiction between the volume of eggs and the lengths of thumbs never existed. Filling a large basket with eggs sounds like quite a bad, not to say messy, way of measuring its volume. The conclusive refutation, however, of this claim comes again from archaeology. In Eruvin 83a, after giving the measurements of the three types of *se'ah* in terms of eggs, the *gemara* also describes *Rabi* as measuring a certain vessel, the מודיא, as 217 eggs. The [modius](#) was 8.73 litres, which divided by 217 gives us 40.2ml. This clearly proves the *gemara* is not talking about how many eggs could be fitted into the vessel, but rather how many multiples of the volume of a standard egg it contained. The most likely method used to make this calculation was simply to crack eggs into a *se'ah* measure until it was full. This explains why it is only the *se'ah* that is calculated in such a way, because for a small measure, like a *revi't*, trying to do so with any accuracy would be impossible. The other arguments made by J.J. Ajdler for larger measurements can be explained simply by the observation that the Mishnah, and early sources generally, by default employ *Tzipporean* volume measurements, also using *Yesuhalmi* measures in some cases.

in the *gemara* is located. Our first step, then, is to note that the *gemara* does *not* define the volume of a *revi'it* in terms of eggs, but rather this definition is inferred from what *gemara* says explicitly about the volume of a *se'ah*. The next observation is that while the *gemara* does explicitly provide a measurement for the *revi'it* in terms of cubic *etzaba'ot*, this is an amoraic derivation from a primary source that, once again, describes the volume of a *se'ah*, or, more precisely, forty of them, this time in terms of cubic *amot*.

We can therefore re-describe the problem as follows. A *baraita* that appears in four places in the Talmud Bavli, as well as *Sifra*,¹⁵ defines the minimum volume of a *mikveh* as 3 *amot* by 1 *amah* by 1 *amah* and states that this is equivalent to 40 *se'ah*. The Talmud Bavli also states that the volume of one *se'ah* is 144 eggs. However, these two formulae do not appear to match. The first yields the following calculation: 6 [*tefahim* in an *amah*] × 4 [*etzba'ot* in a *tefach*] × 2.2275 [the width of a thumb] = 53.46 × 53.46 × 53.46 × 3 = 458,362ml or 458.3 litres. However, if we divide this figure using the second formula we get 458,362 [ml in a *mikveh*] ÷ 40 [*se'ah* in a *mikveh*] ÷ 144 [eggs in a *se'ah*], yielding an impossible volume of an egg as 79.6 ml.

This leaves us in apparently exactly the same position as we started, but now with different options. When the problem was expressed in terms of the volume of a *revi'it* (or, as it was by the *Noda BiYehuda*, the *shiur* for *hallah*), the variables were eggs and thumbs, and so the only means for solving the problem were to look outside of the *gemara* and redefine the size of either eggs or thumbs, both of which prove to be untenable. However, when we focus on the problem as it manifests itself in the *gemara*, we introduce two different variables, the length of the *amah*, and the volume of the *se'ah*, both of which allow us to look within rabbinic sources for a resolution to the problem. We shall now look at each option in turn.

The first method involves revisiting our assumption about the length of the *amah*. Our calculation of the volume of a *mikveh* above started with the assumption of all modern *shittot* that the *amah* contains 6 *tefahim*. However, two *amot* were in use by ancient Jews, one five *tefahim* long and the other six.¹⁶ The length of the *amah* used to construct King Hizkiyahu's tunnel that brought water to Jerusalem [has been shown](#) to be 44.4cm, corresponding to a 5-*tefach amah*, based on an *etzba* of 2.22 cm. If we find an *amah* measurement in the Talmud, there are certainly strong grounds for considering the *possibility* that the *amah* referred to was made up of 5, not 6, *tefahim*.

If we do so for the *baraita* which states that the minimum *shiur* of a *mikveh* is 3 cubic *amot* we get the following calculation: (2.2275 [cm in an *etzba*] × 4 [*etzbaot* in a *tefach*] × 5 [*tefahim* in an *amah*])³ × 3 =

¹⁵ חגיגה יא:ב; יומא לא:א; עירובין ד:ב; פסחים קט:א; ספרא פרשת זבים ו:ג

¹⁶ See [מנחת צניא](#). Note that, in the wider Middle East, there were two cubits, the standard one, and the longer 'royal' cubit. It is [widely stated](#) that the first was six, and the second seven, fists, but there does not appear to be much evidence for this, and their estimated lengths actually correspond to five and six fists, retrospectively. Bizarrely, [Wikipedia](#) as of 21/05/23 cites Leonardo Da Vinci's drawing of Vitruvian man and a book by apparent crank, [Steven Skinner](#), as well as [sic!] 'many other sources'.

265,255ml. If we divide that volume by 40 [*se'ah* in a *mikveh*] and 144 [eggs in a *se'ah*], we get a volume of 46ml, which fits with estimates of average egg size at the time of *Hazal*.¹⁷ The contradiction between the primary sources can therefore be completely resolved by assuming that the *amah* used to calculate the minimum size of a *mikveh* is the smaller *amah* of 5 *tefahim*.

This is not, however, the only possible approach to addressing the problem, because, in addition to the *amah*, there are also multiple definitions of the *se'ah* found in the [gemara](#):

הא סאה דהיכא אי דמדברית מאה ארבעים וארבע הויא ואי דירושלמית מאה
שבעים ושלש הויא ואי דציפורית מאתים ושבע הויין ... תנו רבנן סאה
ירושלמית יתירה על מדברית שתות. ושל ציפורית יתירה על ירושלמית שתות.
Which *se'ah* is referred to [in the preceding discussion]? If it is a *midbar se'ah*, that is 144 eggs.
If it is a *Yerushalmi se'ah*, that is 173 eggs. If it is a *Tzipporean se'ah*, that is 207 eggs ... It was
taught, the *Yerushalmi se'ah* is bigger than the *midbar se'ah* by a sixth, the *Tzipporean se'ah* is
bigger than the *Yerushalmi se'ah* by a sixth.

The system of volume measurements used by *halacha* was not static. On two occasions, an additional $\frac{1}{5}$ ¹⁸ was added to the original *midbar* measures, resulting first in the *Yerushalmi* measures and, then, in the *Tzipporean* system. In the latter of these, a *se'ah* is defined as 207 eggs, which, with a 50ml egg, gives us a *Tzipporean se'ah* of 10,350ml. Calculating a *se'ah* using cubic *etzba'ot* of 2.2275cm and *amot* of 6 *tefahim* gives us 11,519ml, a discrepancy of just over 10%. The equivalents for the *revi'it* are 107.8ml and 120ml, respectively.

In order to resolve this discrepancy, we are once again forced to resort to the solution of larger eggs and/or smaller thumbs. However, we can do so within the realm of the plausible. An egg of 52ml gives us a *Tzipporean revi'it* of 112ml, and an *etzba* of 2.125cm - the minimum value found by archaeologists investigating the *tefach* - with an *amah* of 6 *tefahim* gives us 117ml. I leave it to the discretion of the reader to judge how far it is reasonable and necessary to go in pushing these figures closer together.

Choosing between our two options

It is now time to state clearly what the perceptive reader will likely have already observed. Either of these solutions to the problem of the incompatibility of the two definitions of *se'ah* necessarily implies that Rav Hisda's way of deriving the volume of a *revi'it shel Torah* is mistaken. To be specific, either Rav Hisda correctly assumed that the definition of a *mikveh* as 40 *se'ah* refers to the original *se'ah* of the *midbar*, but incorrectly assumed that the definition of three cubic *amot* referred to a 6-*amah tefah*, or he correctly assumed that the *amah* referred to was 6 *tefahim* long, but incorrectly assumed that that

¹⁷ See [recent research](#) by Prof. Zohar Amar. In fact, 46ml is still slightly too big, though it is very close to the 45ml that has been found by measuring the [amphora](#).

¹⁸ The *baraita*, as is common in Rabbinic sources, refers to it as a sixth, because a fifth of the original total is a sixth of the increased total.

the 40 *se'ah* referred to the smaller *se'ah* of the *midbar*. In the first case, his formula does not correspond to any recognised measurement, except perhaps incidentally; in the second, it is a way of deriving a *Tzipporean revi'it*. If we accept that Rav Hisda's formula must be mistaken in some way, we have to determine which specific mistake is more likely. This substantially hinges on two questions:

- (1) Is it more likely that the primary tannaitic source cited in the Talmud *Bavli* and *Sifra* refer to *midbar* measurements and a 5-cubit *amah*, or to *Tzipporean* measurements and a 6-*tefach amah*?
- (2) Is it more likely that Rav Hisda made a mistake about what *amah* was being referred to or what *se'ah* was referred to?

My personal answers to these questions are as follows:

- (1) It would seem logical that a tannaitic source referring to a *se'ah* without further specification intends the *Tzipporean* measure, since this was the measure in use during the period.¹⁹ It is also more likely that a source that refers to an *amah* without specification refers to an 6-*tefach amah*, since this rule is stated clearly in [Eruvin 3b](#) (even though, according to *Abaye*, it applies only to *amot* in *hilchot kilayim*)
- (2) It is clear that Rav Hisda was trying to calculate the *midbar revi'it*, to the exclusion of the *Tzipporean revi'it*.²⁰ It seems logical that he would be careful to ensure that the source he was using as a basis for his measurements would be a *midbar* measure, but he would be more likely to make a mistaken assumption about the meaning of the term *amah* within the source. In addition, since there was apparently a tendency over the course of the Amoraic period to make the 6-*tefach amah* the normative default *amah*, it is plausible that Rav Hisda would mistakenly interpret an earlier source used when the 5-*tefach amah* was more common.

In other words, *a priori* logic here points in opposite directions. However, one way of resolving the problem is much more convincing from the mathematical perspective. A 5-*tefach amah* and a *midbar se'ah* correspond to an egg volume that matches neatly to archaeological evidence. Conversely, a *Tzipporean se'ah* and a 6-*tefach amah* force us to push both the volume of an egg and the width of a thumb to the limits of what is plausible, unless we are willing to entertain the possibility of substantial inaccuracy in the primary *halachic* sources.

Concluding Remarks

¹⁹ See, for example, ערויות אב, which uses the *Tzipporean kav* without explanation or warning. Of course, this question hinges on one's views about the antiquity of the *baraita*. If it is either much older than the *Mishnah* or much younger the probability that it is using *Tzipporean* measurements decreases. In cases such as this, however, source criticism is not much more useful than guessing.

²⁰ The words רביעית של תורה appear in all MSS of the *gemara*.

The most convincing resolution to the *shiur* crisis is that the *baraita* that describes the minimum dimensions of a *mikveh* refers to *amot* of five *tefahim*, and that, therefore, the correct measure of a *revi'it* in terms of cubic *etzba'ot* is not 10.8 ($= 2 \times 2 \times 2.7$), but rather 6.25,²¹ corresponding to a volume of around 71ml. This solution maintains the absolute validity and accuracy of the tannaitic sources, and also the *Geonic* tradition for calculating *shiurim* by world Jewry until recently, while corresponding perfectly with archeology, biology, history and basic rationality. However, there is no avoiding the fact that it entails asserting that one of the greatest *Amoraim* made a mistake, that this mistake was given authoritative status by the editors of the *gemara*, and that this mistake was then ratified by the greatest *Rishonim* and *poskim*, until, eventually, this codified halacha became paramount over the authentic traditional measure.

This is not the solution I was looking for when I began researching the topic, and I suspect most readers will feel similarly. While the thesis can be stated less baldly than I have above, the probability that, however presented, it will be accepted by any significant proportion of Orthodox Jewry is vanishingly small. Most will simply reject the possibility that Rav Hisda's formula is based on an error out of hand. Others will argue that regardless of its origin, its codification in classic *sifrei halacha* makes it authoritative. For practical purposes, it is probably wise for supporters of the traditional authentic *shiurim* to rely on a mixture of *mesorah*, the authority of R. Chaim Naeh, and the lack of popular appreciation of the insurmountable difficulties of the smaller-thumbs hypothesis. However, the truth also has, if not a veto, at least a voice with a right to be heard by those who seek it.²²

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²¹ The volume of 40 *se'ah* in terms of *etzba'ot* (4 [*etzba'ot* in a *tefah*] $\times 5$ [*tefahim* in an *amah*])³ $\times 3 = 24,000$. If we divide this by 40 [*se'ah* in a *mikveh*], 6 [*kabin* in a *se'ah*], 4 [*login* in a *kav*] and 4 [*revi'yot* in a *log*] we get 6.25

²² After finishing this essay, I came across [this shiur](#) by R. Asher Weiss where he concludes that the *shiurim* problem is actually insoluble, and we shouldn't try to solve it.