THE CUBIT, BATH, HANDBREADTH, AND SEA:
A LAYMAN’S ANALYSIS OF 1 KINGS 7:23 ; 7:26 AND 2 CHRONICLES 4:2; 4:5

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Presupposition

“All Scripture is given by inspiration of God, and is profitable for doctrine, for reproof, for correction, for instruction in righteousness, that the man of God may be complete, thoroughly equipped for every good work (2 Timothy 3:16-17; NKJV).”

Motivation

“It is the glory of God to conceal a matter, but the glory of kings is to search out a matter (Proverbs 25:2).”

Introduction

Examination of the parallel accounts of the “Sea” in 1 Kings 7:23; 7:26 and 2 Chronicles 4:2; 4:5 yields numerous questions about the inspiration of the text, as well as of the credibility of contemporary translators. First, a direct comparison of 1 Kings 7:26 and 2 Chronicles 4:5 indicates an apparent discrepancy between the recorded volume of the Sea. Second, the written dimensions of the Sea indicate an apparent value for \( \pi \) of 3, in considerable error in comparison with the actual value of \( \pi \) (3.1415926...) and estimates obtained by other mathematicians since the second millennium before Christ. Third, mathematical analysis indicates an intra- and inter-source inconsistency concerning the contemporary volumetric equivalent of the unit translated into English as “bath.” The first and second problems deal directly with the inerrancy (or errancy) of Scripture (depending on your paradigm), while the third problem indicates the fallibility of contemporary translators. Herein, each problem is discussed, and possible although not definitive resolutions are proposed.

Scripture

<table>
<thead>
<tr>
<th>1 Kings 7:23; 7:26</th>
<th>2 Chronicles 4:2; 4:5</th>
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</thead>
<tbody>
<tr>
<td>23 And he made the Sea of cast bronze, ten cubits from one brim to the other; <em>it was</em> completely round. Its height <em>was</em> five cubits, and a line of thirty cubits measured its circumference.</td>
<td>2 Then he made the Sea of cast <em>bronze</em>, ten cubits from one brim to the other; <em>it was</em> completely round. Its height <em>was</em> five cubits, and a line of thirty cubits measured its circumference.</td>
</tr>
<tr>
<td>26 <em>It was</em> a handbreadth thick; and its brim was shaped like the brim of a cup, <em>like</em> a lily blossom. <em>It contained</em> two thousand baths.</td>
<td>5 <em>It was</em> a handbreadth thick; and its brim was shaped like the brim of a cup, <em>like</em> a lily blossom. <em>It contained</em> three thousand baths.</td>
</tr>
</tbody>
</table>
The First Problem: The Volume of the Sea

A direct comparison of 1 Kings 7:26 and 2 Chronicles 4:5 indicates an apparent discrepancy between the recorded volume of the Sea. That is, the two verses are effectively identical in all respects except regarding the volume of the Sea, which is described as 2000 baths in 1 Kings 7:26, and 3000 baths in 2 Chronicles 4:5. Therefore, which value, if either, is correct? Are the current manuscripts correct (inerrant), or corrupted (errant)? Herein, only three options are considered:

1. Neither of the values is correct in the current manuscripts;
2. Only one of the two values is correct in the current manuscripts; or
3. Both of the values are correct in the current manuscripts.

Acceptance of the “first option” (subject to the stated presupposition of this manuscript) that neither of the values in the current manuscripts are correct requires evidence that both 1 Kings and 2 Chronicles were uniquely corrupted as a consequence of scribal error. In this case, the only viable hypothesis is that the original Hebrew letter in the original texts (which later became either 2 or 3 due to error) is similar in appearance to characters used for both 2 (ד) and 3 (ג). However, there is none. The only Hebrew letter that looks similar to that used for 2 is (ד), which symbolizes the number 20 [2]. In addition, the only Hebrew letter that looks similar to that used for 3 is (ג), which symbolizes the number 50 [2]. Considering that no known manuscript copies of 1 Kings 7:26 and 1 Chronicles 4:5 contain either “20,000 baths” or “50,000 baths” as the volume of the Sea, it is unlikely that this hypothesis, and thus the first option, is valid.

Acceptance of the “second option” requires evidence that either 1 Kings or 2 Chronicles became corrupted during the copying process. The history recorded in 1-2 Kings ends with a reference to Evil-Merodach as king of Babylon (2 Kings 25:27). Extrabiblical records indicate that the reign
of Evil-Merodach was limited to 561-560 B.C.; thus, 1-2 Kings was likely completed in ca. 560 B.C. [3,4]. However, it is evident to scholars that the book of 1 and 2 Chronicles was completed between ca. 515 and 331 B.C., in which case 1-2 Kings was likely used as a source document [5]. Therefore, if this “second option” is valid, then, from a chronological perspective, it can be inferred as most probable that a scribe with the responsibility of copying the book of Chronicles somehow mistook the letter for 2 (ב) in 1 Kings 7:26 for the letter 3 (ג), thus (via propagation) resulting in a corruption of the original text.

If the third “option” is correct, i.e., if both 1 Kings 7:26 and 2 Chronicles 4:5 are correct in the current manuscripts, then evidence is required to support the hypothesis that 2000 baths = 3000 baths. At first glance, this notion seems absurd. Nevertheless, defense of this hypothesis is possible if it can be demonstrated that 1 bath in 1 Kings 7:26, hereafter denoted as \( b_K \), is equal to 1.5 baths in 2 Chronicles 4:5, hereafter denoted as \( b_C \):

\[
b_K = 1.5 b_C \tag{1}
\]

The books of 1 Kings and 2 Chronicles were not completed in the same century; therefore equation (1) could be valid if the accepted volume associated with the word bath changed over time. Although no direct evidence has been found to support this statement, there is evidence to indicate that some accepted numerical values associated with Hebrew units of measure have changed with time. Specifically, according to Prof. Leo Levi and Avi Polak of the Jerusalem College of Technology, the values for all Hebrew units of measure have undergone changes since their original use in the Torah [6]. Therefore, although no precise data are available to verify this hypothesis, there is evidence to indicate, at least in principle, that the hypothesis is possible, and thus worthy of further inquiry.

In conclusion, three options have been presented to address the apparent discrepancy in 1 Kings 7:26 and 2 Chronicles 4:5 regarding the recorded volume of the Sea. Simple arguments are presented to indicate that while attribution of the apparent discrepancy in 2 Chronicles 4:5 to a scribal error is probable, there remains a possibility that both texts as they exist today are actually correct.

**The Second Problem: π**

Both 1 Kings 23 and 2 Chronicles 4:2 state that, from an areal vantage point, the top of the Sea was circular, with a measurement from brim-to-brim of ten cubits, and a circumference of thirty cubits. If it is inferred from the text that the ten cubit measurement is from the outside edge of each brim (and thus equivalent to the outside diameter), and that the circumference measurement along the outside edge of the brim is thirty cubits, then, via simple geometry, it is possible to calculate a value of π from these measurements:

\[
π = \frac{C}{D} = \frac{30 \text{ cubits}}{10 \text{ cubits}} = 3 \tag{2}
\]

where C is the circumference and D is the diameter. However, this value of π inferred from 1 Kings 23 and 2 Chronicles 4:2 is in gross error with the actual value of π (3.1415926...), as well as with estimates for π obtained by mathematicians in other nations since the second millennium before Christ (see Table 1). Herein lies the problem. If “all Scripture is given by inspiration of God (2 Timothy 3:16-17),” and God is perfect (2 Samuel 22:31; Psalm 19:10; Matthew 5:48), then how can Scripture contain (by inference) an errant value for π?
Table 1. An abridged chronological history of estimated values for $\pi$ [7].

<table>
<thead>
<tr>
<th>Approximate Date</th>
<th>Estimated Value for $\pi$</th>
<th>Person or Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000 B.C.</td>
<td>3.125</td>
<td>Babylon</td>
</tr>
<tr>
<td>2000 B.C.</td>
<td>3.1605</td>
<td>Egypt</td>
</tr>
<tr>
<td>1200 B.C.</td>
<td>3</td>
<td>China</td>
</tr>
<tr>
<td>560 B.C.</td>
<td>3 (?)</td>
<td>1 Kings 7:23</td>
</tr>
<tr>
<td>515 - 351 B.C.</td>
<td>3 (?)</td>
<td>2 Chronicles 4:2</td>
</tr>
<tr>
<td>300 B.C.</td>
<td>3.14163</td>
<td>Archimedes</td>
</tr>
<tr>
<td>139-167 A.D.</td>
<td>3.14167</td>
<td>Ptolemy</td>
</tr>
<tr>
<td>263 A.D.</td>
<td>3.14</td>
<td>China</td>
</tr>
<tr>
<td>500 A.D.</td>
<td>$3.1415926 &lt; \pi &lt; 3.1415927$</td>
<td>China</td>
</tr>
<tr>
<td>1593 A.D.</td>
<td>3.141592653589793</td>
<td>Adriaen van Roomen</td>
</tr>
<tr>
<td>1962 A.D.</td>
<td>3.141592653589732384626433...</td>
<td>IBM</td>
</tr>
<tr>
<td></td>
<td>(Accurate to 100,265 decimal places)</td>
<td></td>
</tr>
</tbody>
</table>

Skeptics, who glory in exposing possible errors in the current Biblical manuscripts as a justification for atheism (i.e., disregard of God) and intolerance of Christianity [8], pose this issue regarding $\pi$ as a problem for apologists. Therefore, in the spirit of 1 Peter 3:15, can a viable explanation be provided (to anyone who inquires) that resolves this apparent error regarding the value for $\pi$ inferred from 1 Kings 7:23 and 2 Chronicles 4:2?

On one extreme, Chuck Missler has reported a method based on alphanumerics that “permits” a mathematical correction to the stated circumference, yielding a value for $\pi$ of 3.14151 [2]. According to Missler, an extra letter (heh) is present in the manuscripts added to the word for circumference (qav), yielding qaveh. The significance of this addition, according to Missler, is that it permits the stated value in the text for the circumference (30 cubits) to be multiplied by the ratio of the numerical values for qaveh (111) and qav (106). Although Missler’s “corrected” value for $\pi$, 3.14151, is more accurate than any other known estimate prior to 500 A.D. (see Table 1), it is still not exact. In addition, there are two reasons to believe that Missler’s result is based on eisegesis:

1. His method, numerology, is not based on any known orthodox hermeneutic; and
2. Missler is known for providing factually deficient material to support his interpretations [9].

On the other extreme, Geisler and Howe have suggested that the discrepancy be treated merely as an approximation. According to them [10]:

The biblical record of the various measurements of the different parts of the temple are not necessarily designed to provide precise scientific or mathematical calculations. Rather, the Scripture simply provides a reasonable approximation. The rounding of numbers or the reporting of approximate values or measurements was a common practice in ancient times when exact scientific calculations were not used.

However, disregard for the apparent error based upon the inference that the Scripture is not necessarily exact has the appearance of avoiding rather than addressing the issue. That is, if, as
Christ Himself stated, every ιωτα [11] and κεραια [12] of the Scriptures will not pass away until all is fulfilled (Matthew 5:18; Luke 16:17), then there should exist in principle some plausible argument to support the veracity of the 1 Kings and 2 Chronicle texts.

In this regard, Rabbi Nehemiah, the author of the Hebrew geometry text entitled “Mishnat ha-Middot,” presented a resolution to the “π problem” in ca. 150 A.D. [13]. Simply, rather than inferring from the text that the stated circumference of 30 cubits is the measure along the outside edge of the brim, Nehemiah suggested that the circumference is that of the inside edge of the brim. Clearly, linguistic evidence beyond the scope of this brief manuscript is required to support either the common inference (that the outside edge is implied in the text) or Nehemiah’s inference (that the inside edge is implied in the text). Nevertheless, if the outside diameter of the Sea is equal to ten cubits, and the inside circumference is equal to 30 cubits, then, via simple geometry, it is possible to directly calculate the wall thickness ($t_{wall}$) of the Sea:

$$t_{wall} = 5 - \left(\frac{15}{\pi}\right) = 0.22535 \text{ cubits}$$

Although a majority of contemporary Bible editors accept a value of 18 inches per cubit, scholars continue to debate values for the cubit between 17.5 and 22 inches [6]. In this regard, evidence indicates that the original Hebrew cubit was equivalent to 17.5 inches [6], in which case, according to the argument presented by Nehemiah, the exact wall thickness of the Sea was 3.90 inches. According to 1 Kings 7:26 and 2 Chronicles 4:5, the wall thickness of the Sea was a “handbreadth.” However, this value for a handbreadth derived from the assumption of Nehemiah (3.90 inches) exceeds the commonly accepted value for the handbreadth (3.00 inches --- [14])! Nevertheless, considering the apparent great uncertainty in all ancient Hebrew units of measure [6], as well as the observation that the author of this manuscript has a handbreadth between 3.5 and 4.0 inches (depending upon the method of measurement), it is at least possible that the handbreadth was indeed once equivalent to a length of 3.90 inches.

In conclusion, a hypothesis has been presented to resolve the apparent error in the numerical value for π commonly inferred from 1 Kings 7:23 and 2 Chronicles 4:2. Specifically, if Nehemiah’s hypothesis (that the circumference measurement refers to the inner edge of the brim of the Sea) is true, then an exact value for the handbreadth (0.22535 cubits) can be calculated. It is suggested that two additional pieces of evidence are required to either support or invalidate this hypotheses. Specifically, linguistic evidence is needed in order to justify application of the circumference measurement to the inner edge of the brim. In addition, accurate data regarding the historical value for the handbreadth are required.

**The Third Problem: The Volume of a Bath**

Perusal of various study Bibles and resources indicates a reported variance in the value of a bath (Table 2). Although the volume of a bath is most commonly stated as roughly 6 gallons, reported values range from 2.67 to 10 gallons. Presumably, this variance is due in part to uncertainty in the understanding of available archaeological and historical evidence. Nevertheless, sufficient information is provided within 1 Kings and 2 Chronicles to estimate the volume of a bath in terms of the cubit.
Specifically, it is stated in 1 Kings 7:26 and 2 Chronicles 4:5 that the shape of the Sea was like that of a lily blossom. However, the lack of a mathematical formula that describes the precise shape of a lily blossom prevents making an exact calculation of the Sea volume. Nevertheless, based on arguments presented in the preceding section, it is reasonable to assume for the sake of simplicity that the shape of the inner volume of the Sea is similar to that of an ellipsoid. A lower-limit estimate of the Sea volume can be obtained assuming a conical shape, and an upper-limit estimate of the Sea volume can be obtained assuming a cylindrical shape. Therefore, the Sea volume can be calculated from the inside diameter (9.549 cubits) and depth (5 cubits), via [23]:

\[ V_{\text{cone}} = \pi D (\text{ID})^2 \div 12 = 119.36 \text{ cubits}^3 \]  
\[ V_{\text{ellipsoid}} = \pi D (\text{ID})^2 \div 6 = 238.72 \text{ cubits}^3 \]  
\[ V_{\text{cylinder}} = \pi D (\text{ID})^2 \div 4 = 358.08 \text{ cubits}^3 \]

where ID is the inside diameter, and D is the depth of the Sea. Substitution of the length of the cubit (17.5 inches), as determined from measurements at the Tunnel of King Hizkiyahu [6], with an appropriate unit conversion for in\(^3\) to gallons (1 gallon = 231 in\(^3\) --- [24]), yields Sea volumes of \(V_{\text{cone}} = 2769\) gallons, \(V_{\text{ellipsoid}} = 5538\) gallons, and \(V_{\text{cylinder}} = 8307\) gallons (or \(<V_{\text{Sea}}> = 5538 \pm 2769\) gallons). In this case:

\[ b_K = \frac{V_{\text{Sea}}}{2000} = 2.77 \pm 1.38 \text{ gallons} \]  
\[ b_C = 2 b_K \div 3 = 1.85 \pm 0.92 \text{ gallons} \]

These values for \(b_K\) and \(b_C\) are considerably lower than a majority of values reported in contemporary sources (Table 2); however, they are mathematically consistent with the other stated dimensions of the bath, as well as with the “cubit” and the “handbreadth.” Therefore, based on the limited survey shown in Table 2, it is concluded that the unit translations provided for “bath” in most contemporary resources are incorrect.
Summary

Three problems associated with the description of the Sea in 1 Kings 7 and 2 Chronicles 4 have been presented and briefly discussed. The first problem, i.e., an apparent textual discrepancy between the stated volume of the Sea, is typically explained in terms of a propagated scribal error; however, it is suggested that the discrepancy may have been intentional due to a change in the volume-equivalent of a bath with time. It is also suggested that the second problem regarding π can be resolved if Nehemiah’s hypothesis is valid, and if the true value for the handbreadth is slightly larger than the commonly reported value. In addition, simple geometric analysis demonstrates that the actual volume-equivalent of a bath is considerably lower than that commonly reported in contemporary sources. As a result of this preliminary analysis, a revised system of Hebrew units is suggested (Table 3). Unless further information is obtained that refutes the conjecture contained herein, these values will be considered adequate to reconcile the apparent differences between the 1 Kings and 2 Chronicles texts.

<table>
<thead>
<tr>
<th>Table 3. Suggested values for common Hebrew units of measure based on the analysis herein.</th>
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<tbody>
<tr>
<td><strong>Unit of Measure</strong></td>
</tr>
<tr>
<td>Handbreadth</td>
</tr>
<tr>
<td>Cubit</td>
</tr>
<tr>
<td>Bath (ca. 560 B.C.)</td>
</tr>
<tr>
<td>Bath (ca. 515-331 B.C.)</td>
</tr>
</tbody>
</table>

References

[2] Note that alphanumerics, i.e., the use of the alphabet to symbolize numbers, were employed in the Hebrew language. See, e.g., C.Missler, “Hidden Treasures.” Koinonia House, Coeur d’Alene, 2000, p.33-36.
[8] For example, see “The Skeptical Review,” published bimonthyl by Skepticism, Inc. (Farrell Till, Editor).
[12] Strong, Greek # 2762.