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Article

The Design of Noah's Ark and Its Significance for Biblical Faith

Alan Dickin

This article reexamines the design of Noah's ark based on a combination of biblical and Mesopotamian sources. Although the biblical description of Noah's ark is considered to be divinely inspired, it seems questionable whether it could have been built to the size and design that is popularly conceived. The Genesis account lacks detail about the method of construction, but since it shows evidence of a common source with ancient Mesopotamian versions, these can provide additional information to constrain our interpretation of the Bible. For example, the very large amounts of bitumen specified in the Mesopotamian sources suggest that this was used as a structural component, to reinforce a raft-like ark and create a smooth and durable platform for large numbers of animals. On this platform, a reed-built hut could have been securely fastened to provide a dry shelter for human habitation and food storage; that being the case, and using readily available materials, it was possible to construct a large and sea-worthy ark of the dimensions specified in Genesis, using primitive ancient tools.

Keywords: Noah's ark, Mesopotamia, Ark Tablet, Neolithic, bitumen, mudhif

The account of Noah and his ark is one of the foundational stories of the Bible. Many modern commentators argue that it reads more like a parable than a description of real events, but this may be because they have misunderstood its ancient setting.[1] In contrast, the biblical book of Hebrews cites the faith of the ancient patriarchs as inspiration for contemporary belief in God. Prominent in the list of these ancient heroes is the patriarch Noah, who is commended for his faith in building the ark in obedience to God's command (Heb. 11:7).

The significance of this story for Christian faith is demonstrated by its endless recitation in Sunday school. But if children, thus instructed, later discover that the story was an exaggeration of the truth, it is apt to have the opposite effect from the one intended, causing them to lose their faith in the reliability of the Bible as a guide to faith. Creationists take this threat seriously, as demonstrated by the reported $100 million that Answers in Genesis spent to build the Ark Museum in Tennessee.[2] But do other Christian organizations give the story of Noah's ark the serious attention that it merits?

Some might argue that even if the historicity of Noah's ark is an important question, there is little we can do about it, because there is no new evidence to bring to bear and therefore no merit in further discussion. Claims to find actual remains of the ark on Mount Ararat (Northeast Turkey) have been definitively rejected, and these so-called remains have been shown to consist of a folded rock formation with no connection whatever to the flood.[3] However, there is a substantial amount of new literary evidence from

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ancient Mesopotamia that can shed further light on the design of the ark, thus prompting the present contribution.

It is important to note that among the figures of faith listed in the book of Hebrews, the flood hero (a generic name for Noah) is by far the most well-attested person outside the Bible. His experience is described in three distinct Mesopotamian traditions: the Sumerian flood story (ca. 1700 BC); the Atrahasis Epic (ca. 1700 BC, written in Akkadian cuneiform); the Gilgamesh Epic (ca. 700 BC, also in Akkadian); and several fragments from outside Mesopotamia.[4] In contrast, several other heroes of faith mentioned in Hebrews—Abraham, Isaac, Jacob, Joseph, and Moses—are not attested in any ancient source outside the Bible and its derivative Jewish literature. This makes the testimony of the flood hero particularly important among claimed ancient eyewitness sources.

Specific events described in the biblical and Mesopotamian flood stories provide good evidence that these accounts were all ultimately derived from a common source. For example, it has been known, since the late nineteenth century, that both the Bible and the Gilgamesh Epic describe how the flood hero sent out a series of birds to test for the abatement of the floodwaters.[5] This commonality suggests that the Mesopotamian sources contain important information that could help us to better interpret the account of the flood given in Genesis. There are many aspects of this account that are historically important, but the principal one of interest here is the reported size and design of the ark.

Until recently, the only Mesopotamian source that gave a detailed description of the ark itself was also the youngest, the flood story in the Gilgamesh Epic. However, this situation changed when Irving Finkel deciphered a small but nearly complete tablet that was brought to him for examination at the British Museum.[6] This tablet shows strong stylistic evidence of being an excerpt from the early second-millennium BC Atrahasis Epic, and it happens to fill a large gap of missing lines in the previously known cuneiform account. Finkel published this "Ark Tablet" in 2014, and it has the potential to influence our interpretation of the biblical account of Noah's ark. Since then, a critical reevaluation of all of the flood stories written in Akkadian was carried out by Nathan Wasserman, but he did not reassess Finkel's interpretation of the design of the ark.[7] This prompts a detailed re-examination here of the design of the ark.

The Biblical Description of the Ark

Some people might argue that Mesopotamian sources have nothing useful to add to a description of the ark, relative to the information we already have in the Bible. However, this opinion overlooks important evidence about the history of interpretation of Noah's ark in Genesis, which is highly pertinent to our modern approach to the story. For example, the very word "ark" embodies a particular interpretation of the Hebrew text that is not necessarily obvious or even correct. Specifically, the English word ark is a direct transliteration of the Latin word *arca*, meaning a box. But this interpretation of the ark as a box is not based on the Hebrew text of Genesis, but on the Greek Septuagint translation.

In the Hebrew scriptures, the word used for the ark (*tevah*) is unique to the stories of Noah's flood and the birth of Moses. The latter story (Exod. 2:3) describes how Moses's mother placed him in a basket of papyrus covered in bitumen. In the Septuagint, Moses's basket is translated by the rare Greek word θιβις (*thibis*), used in Egyptian Greek to mean a "basket made of papyrus." On the other hand, the Septuagint translates Noah's *tevah* as a κιβωτός (*kibotos*), meaning a "wooden chest." This is the same word used in the Septuagint for the Ark of the Covenant, despite the fact that this ark is represented by a completely different Hebrew word, *arown*. Of the 202 usages of *arown* in the Hebrew scriptures, 196 refer to the Ark of the Covenant, five refer to a money chest set up by King Joash for temple offerings (2 Kings 12:9), and one is used to describe Joseph's coffin (Gen. 50:26).

It is clear from its description in Exodus 25:10 that the Ark of the Covenant really was a wooden chest. And the usages of the word *kibotos* in Attic Greek confirm that this is exactly what the word normally means: a money chest, a coffer, a case for apples, or a box of scrolls.[8] On the other hand, there is no basis in the Hebrew text of the flood story for thinking that Noah's enormous boat was a wooden chest. Therefore, the translators of the Septuagint may have been influenced to use this expression by the Greek flood myth, whose hero Deucalion was reputed to

have survived the flood with his wife Pyrrha in a wooden chest.[9]

The word used in Greek mythology for Deucalion's ark is actually λάρναξ (*larnax*), but this has a very similar range of meanings to *kibotos*: a coffer, box, or chest. However, the word *larnax* is also used to describe a chest used in the well-known trope of "exposure," in which a victim (usually a child but sometimes a pregnant woman) is locked in a chest, which is then thrown into the sea to drown them. Typically in myth, the intended victim nevertheless survives by being washed up on a beach.

The translators of the Septuagint may have chosen not to use the word *larnax,* because Noah's ark was intended to preserve life, rather than to dispose of the victim. Instead, the Septuagint uses the same word as for the Ark of the Covenant, perhaps to emphasize the life-preserving aspects of Noah's ark and disguise a direct link with Deucalion's chest. However, by describing Noah's ark as a chest rather than a boat, the Septuagint is nevertheless implying a link between the biblical and Greek flood stories.

These links were made more explicit by first-century Hellenistic Jews and second-century Christians.[10] For example, Philo of Alexandria specifically identified Noah as the Hebrew equivalent of the Greek Deucalion in his *De Praemiis et Poenis*.[11] On the other hand, Flavius Josephus re-told the biblical flood story in his *Antiquities*, but used the word *larnax* for the ark, arguably in an attempt to "synthesize Jewish and Hellenistic culture."[12] Later, the Church Father Theophilus of Antioch made a comparison of the Greek and biblical flood stories in his *Ad Autolycum*.[13] His objective was to show the greater reliability of the biblical story, but the need for the apologetic suggests that the link between these accounts was already well known.

The Septuagint was the principal version of the Old Testament available to the New Testament writers.[14] Therefore, it is not surprising that the translation of Noah's boat as a *kibotos* was perpetuated in New Testament quotations of the sayings of Jesus (Matt. 24:38 and Luke 17:27), the letter to the Hebrews (Heb. 11:7), and the first letter of Peter (1 Pet. 3:20). Similarly, the earliest Latin translations of the Old Testament were derived directly from the Septuagint.[15] Therefore, they translated Noah's boat using the Latin word for a wooden chest (*arca*). And even when Jerome revised the Latin Bible, consulting the Hebrew originals to create the Vulgate, it was inevitable that he was constrained by the New Testament usage of *kibotos* to retain the Latin word *arca* to describe Noah's boat in Genesis. This in turn led to the English word "ark." However, it has always been evident that the giant size of Noah's boat described in Genesis would have been very improbable as an ancient box-like vessel. This causes a dilemma. One can accept the size of the ark described in Genesis and reject its box-like form, or one can accept the box-like shape implied by the Septuagint, and regard the dimensions as schematic or symbolic.

Artistic Depictions of Noah's Ark

In approaching problematical issues in Genesis, such as the days of Genesis 1 or the shape of the ark, the early church fathers had a long history of allegorical interpretation.[16] Therefore, it is not surprising that depictions of Noah's ark in the Roman era focused on its symbolic character as a box and ignored the massive size described in Genesis. The earliest known example is a coin from the reign of Septimius Severus (ca. 200 AD), which shows Noah's ark on the reverse (fig. 1a).[17] The ark is shown as a wooden chest containing the flood hero and his wife, as described in the Greek flood myth. However, the label "Noe" shows that this was actually intended as a depiction of the biblical flood story. Two birds are shown, one of which is clearly the dove sent out by Noah, since it carries an olive branch. To the left, Noah and his wife are shown on dry land after emerging from the ark.

The choice of the ark motif for the reverse side of this coin is believed to derive from the city where it was minted, Apamea in Asia Minor (modern Turkey). This city had apparently been given the nickname of Kibotos, based on the prevalent use of wooden chests for transporting trade goods. Local Jewish merchants therefore chose this illustration for a coin struck in their city as a play on the name of the city and the flood tradition.[18] The minting of this coin shortly after Bishop Theophilus wrote *Ad Autolycum* seems to confirm that the Deucalion and Noah flood stories had become significantly conflated in the ancient Greek-speaking world.[19]

A similar box-like ark can be seen in several third- and fourth-century frescoes from Christian

catacombs near Rome (not shown here).[20] These frescoes typically show Noah alone, standing in a small floating chest and accompanied by a dove. This depiction therefore suggests that the Greek conflation of the Noah and Deucalion traditions had now reached the Western church. However, this is not surprising, since we noted above that the Latin Old Testament was derived from the Septuagint.

A very different portrayal of the ark is found in the *Vienna Genesis*, an early illuminated manuscript of the Septuagint, dated to the sixth century AD.[21] This manuscript contains two paintings of the ark, during and after the flood, but the ark now has the appearance of a stepped three-story building.[22] Andreina Contessa suggested that this depiction was based on Origen's *Homilies on Genesis*, which describes the ark as having the shape of a stepped pyramid.[23] The approximate size of the ark can be judged in comparison with a horse which leads a series of billowing waves (fig. 1b). The ark is also surrounded by many drowning bodies, not shown in figure 1b. It is listing at a drunken angle, as if on the point of sinking, but its survival is demonstrated by the emergence of the animals from the same "ark building" after the flood (not shown here).

Perhaps a few decades later, the Ashburnham Pentateuch is the earliest surviving manuscript of the Vulgate (Latin) Pentateuch, recently dated to around

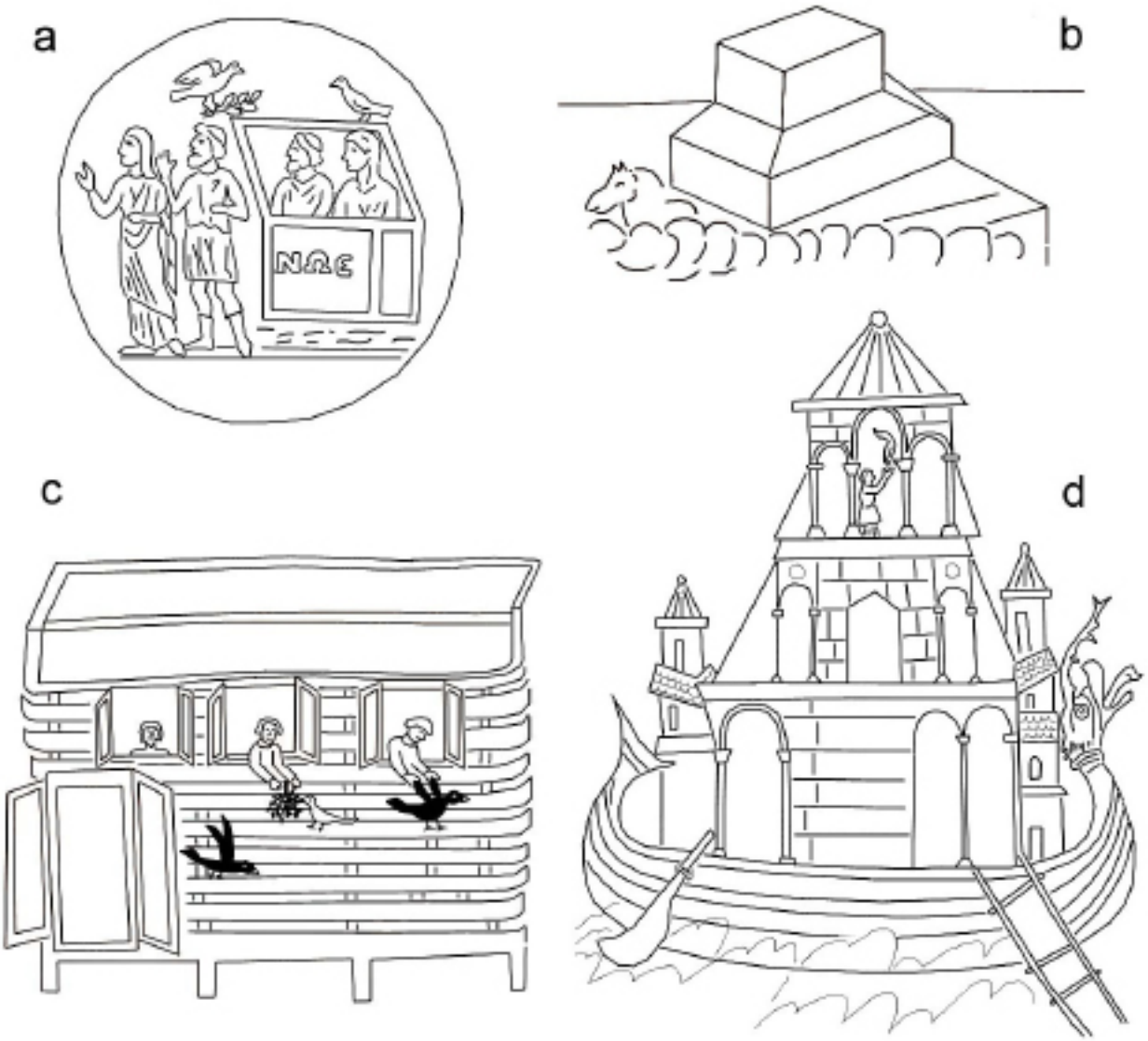

Figure 1. Depictions of Noah's ark during the first millennium AD. (a) reverse side of a coin of Septimius Severus showing Noah's ark as a chest; (b) the floating ark in the *Vienna Genesis* (drowning bodies omitted); (c) the ark after the flood in the Ashburnham Pentateuch (all figures except Noah omitted); (d) the ark in the *Junius Manuscript* (all figures except Noah omitted).

600 AD.[24] This manuscript also has two illustrations of the ark, during the flood and in its immediate aftermath.[25] The ark is again represented as a kind of three-story building, whose size is indicated by the figure of Noah in each of the upper windows, with a succession of birds (fig. 1c). However, the legs underneath the ark and the open lid suggest an origin as a wooden chest, which nevertheless also has the appearance of a giant basket. Bezalal Narkiss argued that the iconography in the Ashburnham Pentateuch was inspired by Syrian Jewish manuscripts of Genesis.[26] Hence, this may explain how a Vulgate Bible contains an illustration of the ark as a combination of chest, basket, and building.

A few centuries later, several images of the ark are found in late Saxon biblical manuscripts dating to near the end of the tenth century AD. The *Junius Manuscript* (fig. 1d) continues the motif of a stepped three-story building, and Noah is seen releasing a bird from the top story (fig. 1d).[27] However, this structure is now carried securely by what looks like a Viking longship, complete with a pagan-looking figurehead. This image of a building carried on a ship establishes the appearance of the ark in most subsequent art. For example, the late fifteenth-century *Nuremberg Chronicle* (not shown here) depicts the ark as something like a small galleon.[28] Similar images continue up to the present day, with the common depiction of the ark in children's Bibles as a wooden cargo ship, and with the full-sized but nonfloating replica of the ark recently constructed by Answers in Genesis.[29]

Difficulties in Building Large Wooden Ships

The box-shaped form of the ark described above creates a fundamental shipbuilding problem, because it constitutes a large displacement vessel. This type

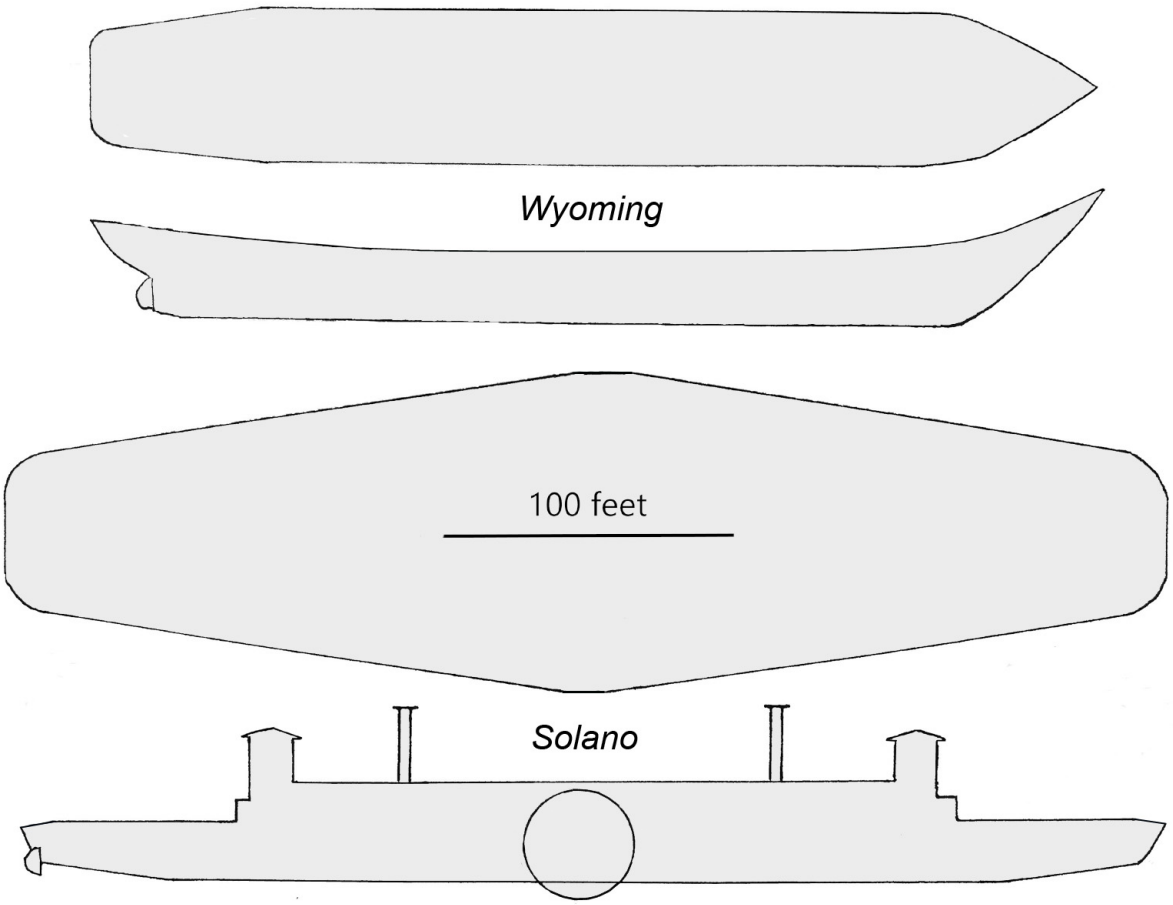

Figure 2. Comparison of the profile and deck area of the *Wyoming* and *Solano* wooden ships, shown to the same scale.

of ship relies for its buoyancy on the volume of air that fills its hull. If the hull leaks, the buoyancy is lost and it becomes a waterlogged wreck. Furthermore, as the tonnage of such a vessel is increased, it draws more water, so that the water pressure at the keel is increased. This requires more perfect fitting of the planks to create a watertight hull than is necessary for a small vessel, and would have been relatively impossible using the primitive tools available at the most likely date of Noah's flood.

An early date for the flood is implied by the claim in the Table of Nations (Genesis 10) that all Middle Eastern peoples were descended from Noah. This requires that the flood occurred relatively soon after the Agricultural Revolution allowed the colonization of the plain of Mesopotamia. Detailed arguments for a late Neolithic date for Noah's flood were presented in this journal by Dickin.[30] That paper cited various lines of paleoclimate evidence pointing to a late Neolithic date. These included geochemical records from cave stalactites near Jerusalem that suggested that a "deluge period" of intense river flooding occurred around 5600 BC.[31] However, such a late Neolithic date for the flood implies that the tools available to build the ark were relatively primitive.

Even in modern times, building a sea-worthy wooden ship with a hull the size of the ark has proved impossible. The largest commercial wooden ship ever built was the schooner *Wyoming*, with a deck area around 16,500 square feet, about half of the reported size of Noah's ark (33,750 square feet).[32] The *Wyoming* was strengthened with wrought iron cross-bracing to increase her rigidity, but the size of her hull caused excessive flexing of the planking in stormy weather.[33] She leaked habitually, and sank in a storm with the loss of all hands.

A closer comparison can be made with the largest wooden paddle-steamer ever built, the rail ferry *Solano*.[34] This ferry was built to transport trains across the one-mile-wide Carquinez Strait in California, and was therefore designed for sheltered water only. She is shown in elevation and plan form in figure 2, in comparison with the *Wyoming*. This comparison shows that the *Solano* had a much larger deck area than the *Wyoming*, and quite close to the stated dimensions of Noah's ark. However, her hull was only about 60 feet wide, the rest of her width accommodating the paddle wheels.

The height of the *Solano*'s hull was only 18 feet, but the height from her keel to the top of her bridge was 56 feet, which is considerably more than the reported height of the ark (45 feet). This comparison suggests that it would be quite wrong to interpret the reported size of the ark as the size of her hull, since we have little indication from the Hebrew text that she had a hull at all. On the contrary, it was shown above that the idea that the ark had a hull is derived from the Septuagint and early iconographic depictions, which were clearly influenced by Greek mythological thinking. On the other hand, it was demonstrated that the biblical account of the flood shares a common origin with (early) Mesopotamian sources. These sources clearly provide much more reliable evidence for the design of the ark than much later Greek mythology.

Evidence from Mesopotamian Sources

It was mentioned above that the Gilgamesh Epic contains the most-detailed Mesopotamian account of the flood, with the closest similarities to the Bible. However, it is also well established that the Gilgamesh Epic was derived by combining several older Sumerian myths, most of which are known independently.[35] Since the main theme of the epic is the quest of the hero Gilgamesh for the lost secret of eternal life, the flood story was included in the epic on the pretext that the flood hero was the only person ever to receive eternal life from the gods. Consistent with this role, the flood hero is introduced into the epic under the name "Uta-napishtim," meaning "he found life."

Uta-napishtim recounts the story of the flood to Gilgamesh in order to explain how he received eternal life from the gods. However, when the gods are "overheard" in the story arguing about who warned any man about the impending flood, the god Enki (Ea in Assyrian) refers to the flood hero as Atrahasis ("extra-wise"), the name used in the older (1700 BC) Atrahasis Epic.[36] This evidence from the name of the flood hero shows clearly that the flood story of the Gilgamesh Epic is derived from the Atrahasis Epic. It follows also that the biblical story of the flood comes from a source that is largely in common with the early second-millennium BC Atrahasis Epic. Most importantly, the newly discovered Ark Tablet also refers to the flood hero as Atrahasis, and also begins with a very well-known line from the Atrahasis Epic,

in which the god Enki is whispering like the wind through the walls of a reed hut, to tell Atrahasis to build a boat to save his family:

> *Wall, listen constantly to me*
> *Reed hut, make sure you attend to all my words*
> *Dismantle the house, build a boat …*[37]

Based on this evidence that the Ark Tablet has a common source with the most complete and oldest extant Mesopotamian text of the flood, the Ark Tablet should be given serious attention to elucidate the meaning of the less detailed description of the ark in Genesis.

The Ark Tablet

The Ark Tablet describes the deck area of the ark as one Sumerian field (120 cubits on each side), an area of approximately 32,400 square feet. Importantly, this is in excellent agreement with the Genesis ark, whose area was quoted above as 33,750 square feet (assuming a cubit of 18 inches). However, the Ark Tablet also specifies that her shape should be circular, and confirms this by stating that her length and breadth should be equal. The Gilgamesh Epic agrees that the area of the ark should be one field, and her length and breadth equal. However, the two sources disagree regarding the height of the ark. Here the Gilgamesh Epic claims her height to be equal to her length and breadth (10 nindan or "poles" = 120 cubits = 180 feet), whereas the Ark Tablet specifies a height of only 1 nindan (18 feet). In this case, it appears that the height of the ark in the Gilgamesh Epic was modified for the sake of grandiloquence. However, this has tended to undermine the credibility of the Gilgamesh Epic as a serious account of the design of the ark.

Here, the evidence from the Ark Tablet is crucial.[38] Because it agrees closely with the deck area of the ark given in Genesis, it suggests that we should take these measurements seriously as approximations to the real dimensions of Noah's ark, rather than as symbolic or hyperbole, as many scholars have proposed.[39] An ark the size of a Sumerian field seems quite reasonable to accommodate the large number of domesticated animals to be taken on board. This probably included seven pairs of each species (Gen. 7:2), since some of these animals were sacrificed immediately after the flood (Gen. 8:20). However, during the evolution of the flood story from an oral source, the original dimensions of a Mesopotamian field may have gained a precision that was never intended.

Finkel suggested that before his translation of the Ark Tablet, no one would ever have imagined a circular ark.[40] But in fact, Stephanie Dalley had already interpreted the description of the ark in the Gilgamesh Epic as probably inspired by a coracle-like vessel, variously called a quffah or guffa.[41] Finkel likewise interpreted the ark as a "scaled-up" coracle, made by winding a rope of palm fiber into a giant mat, attaching this to a wooden frame, and then waterproofing it with a liberal coating of bitumen. Inspired by Finkel's interpretation, a TV company financed an attempt to build a partially scaled-up version of a coracle-type ark, and made a documentary of the attempt.[42] This "TV-Ark" was about 20% of the diameter reported in the Ark Tablet, meaning nearly 50 feet across. It was waterproofed underneath with bitumen, but leaked very badly, and was only made to float by using a high-powered mechanical pump.

Although Finkel claimed that the "TV-Ark" vindicated his interpretation of the design specified in the Ark Tablet, he admitted that a coracle of the size described in the Ark Tablet could never actually be built. He argued that the design specified in the Ark Tablet was a *conceptual* scaling up of an ancient coracle, rather than an eye-witness description of Noah's ark. But is this a credible interpretation? I suggest that with their practical experience of coracle-like vessels, ancient scribes and/or listeners to the Atrahasis Epic would have known very well that a conceptually scaled-up coracle was a bogus design for the giant ark of the ancient tradition. This prompts us to ask whether there is an alternative interpretation of the Ark Tablet that would be both feasible to build, capable of surviving a storm, and consistent with the description of the ark given in Genesis.

Structural Details in the Ark Tablet

To understand the structure of Atrahasis's ark in detail, I quote from Finkel's translation of lines 13–16 of the Ark Tablet:

> *I set in place 30 ribs,*
> *which were one parsiktu-vessel thick, ten nindan long;*
> *I set up 3600 stanchions within her* (to make her heart firm)
> *that were half* [a parsiktu vessel] *thick, half a nindan long.*

From these measurements, we can see that the structure of the vessel was based on 30 major ribs, each 180 feet long, with a thickness similar to a bushel basket (about 18 inches). As proposed by Finkel, these ribs were divided into two sets of 15 ribs each. One set is placed in the horizontal plane, the 15 ribs parallel to each other, spaced 12 feet apart. The second set is laid directly over the first set but at right angles to the first set, again with the 15 ribs parallel and spaced 12 feet apart. These were fastened together, forming a square grid. Note that the spacing of 12 feet would frame a hull with an area of one Sumerian field (32,400 square feet).[43] However, this spacing is far too great to adequately support a hull made from a palm-rope basket.

The word translated "stanchion" by Finkel is the Akkadian word *imdi*. He inferred that these "stanchions" were vertical posts that supported a major deck half-way up the total height of the coracle's hull. However, with only 30 major ribs, these 3,600 posts (with a thickness of about 10 inches each) would have to be set every 18 inches along each rib. This leaves only 8 inches between individual verticle stanchion along the ribs, thus forming an almost continuous row of vertical posts along the ribs. However, with 12-foot gaps between the ribs, the stanchions are 8 inches apart in one direction and 12 feet apart in the other (i. e., at right angles). This is a highly uneven and unlikely spacing. Furthermore, the Ark Tablet does not specify any timber for the decking to be built on these stanchions, or for a roof over the ark, which would have been necessary to prevent it from filling with rainwater. This interpretation seems very unsatisfactory.

To test Finkel's translation of *imdi* as a vertical stanchion, we need to examine other uses of the word in Assyrian/Babylonian sources. These usages indicate that *imdi* has a basic meaning of "support," commonly to do with the foundations of walls. However, vertical posts are not necessarily implied. For example, a royal inscription of Nebuchadnezzar II (ca. 600 BC) describes how he reinforced the city wall of Babylon as follows:

> In order to strengthen the area outside the (double inner) wall I made a third (wall): I built as an "imdi" a large "assure" up against the base of a baked-brick wall. I built it on the breast of (the underworld) and made its foundation platform solid.[44]

In other records of this work, the nature of the *assuru* is explained: it was made of bitumen and baked brick.

This example shows that *imdi* can mean a general type of support, with no implication of a vertical post. A quite different type of structure can be inferred. Rather than seeing the *imdi* as supporting a middle deck which is otherwise not described at all, we could see the *imdi* in the Ark Tablet serving as horizontal supports for the *bottom* floor of the ark, in the same plane as the floor. The way that this could work is shown in figure 3. The *imdi* are wooden logs about 9 feet long and 10 inches thick (2), which are laid across the main ribs (1) in order to support the floor of the ark. Because the floor supports are at right angles to the main ribs, the latter need to be laid in one direction only, and can therefore be set only 6 feet apart. By staggering the cross supports, they hold the main ribs together in a rigid framework.

The Ark Tablet also specifies the use of a very large quantity of palm-fiber rope. As noted above, Finkel believed that this rope was intended to make a basket-like hull. However, since he also admitted that this design could never be scaled up to the size of the ark, it seems more likely that the large quantity of rope was to be used to bind together the main ribs and the floor supports. Based on the substantial size of the wooden components, very large amounts of rope would have been needed to construct an ark that was one field in area.

The plan view in figure 3 shows that when a platform is made in this way by binding together rough

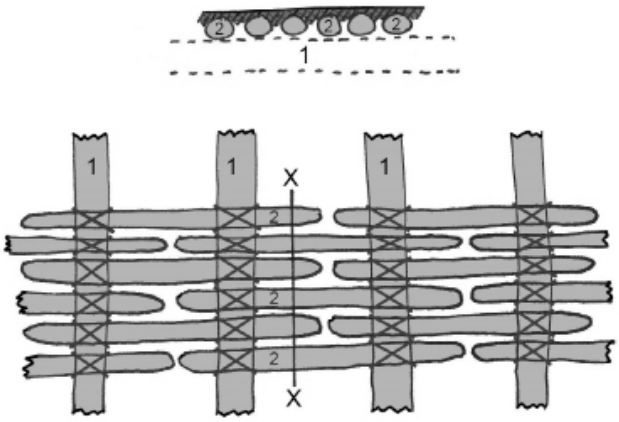

Figure 3. Plan showing the main ribs (1) and cross supports (2) of the floor of the Ark. X—X is the line of the cross-section shown above. Medium grey = wood; dark grey (hatched) = bitumen.

tree logs with palm rope, it is inevitable that significant gaps would have occurred between the logs that represent the "supports." These gaps result from the space taken up by the lashings, as well as by the expected irregularity of the logs. If the gaps were 2 inches on average, then based on the size and number of supports specified in the Ark Tablet, the resulting deck area would be 32,400 square feet, exactly as specified.

Significance of Bitumen in the Construction of the Ark

A raft made from two layers of logs, laid perpendicularly, was previously proposed by Dickin to explain how an ark with the size of a Sumerian acre could have been constructed in the Neolithic period.[45] However, the Ark Tablet describes the second layer of logs as "supports" rather than planking. This implies that the second layer of logs was intended to support the deck of the ark, rather than being left unfinished. And indeed, such an unfinished surface would have been largely unusable for animals, since their hooves would have become stuck in the gaps between the logs.

For a modern raft, the floor supports would normally be covered with planking or small spars to make a smooth platform. For example, the Kon-Tiki balsa-wood raft was decked with bamboo spars, covered with matting.[46] However, bamboo is not native to Mesopotamia,[47] and it would not have been possible to cut wooden planks in the Neolithic period with stone tools. Nevertheless, boat-building practices observed in nineteenth-century Mesopotamia show that an alternative approach was possible (fig. 4). This involved making a platform of rough logs, caulking it with reeds and palm-fiber, and then impregnating the whole structure with molten bitumen. This crude but effective method of boat-building was quoted by Finkel from an eye-witness report by Lt. Col. Chesney:

> A remarkable kind of boat is constructed at Tekrit and in the marshes of Lamlum, but more commonly near the bituminous fountains of Hit. At these places the operation of boat building is an everyday occurrence, and extremely simple …
>
> The first step in this primitive mode of shipbuilding is to choose a level piece of ground of suitable size, and sufficiently near the edge of the water; on this the builders trace out the size of the vessel's bottom, not with mathematical precision it is true, still a line is used, and a certain system followed, the floor or bottom of the boat being the first object. In the space marked out a number of rough

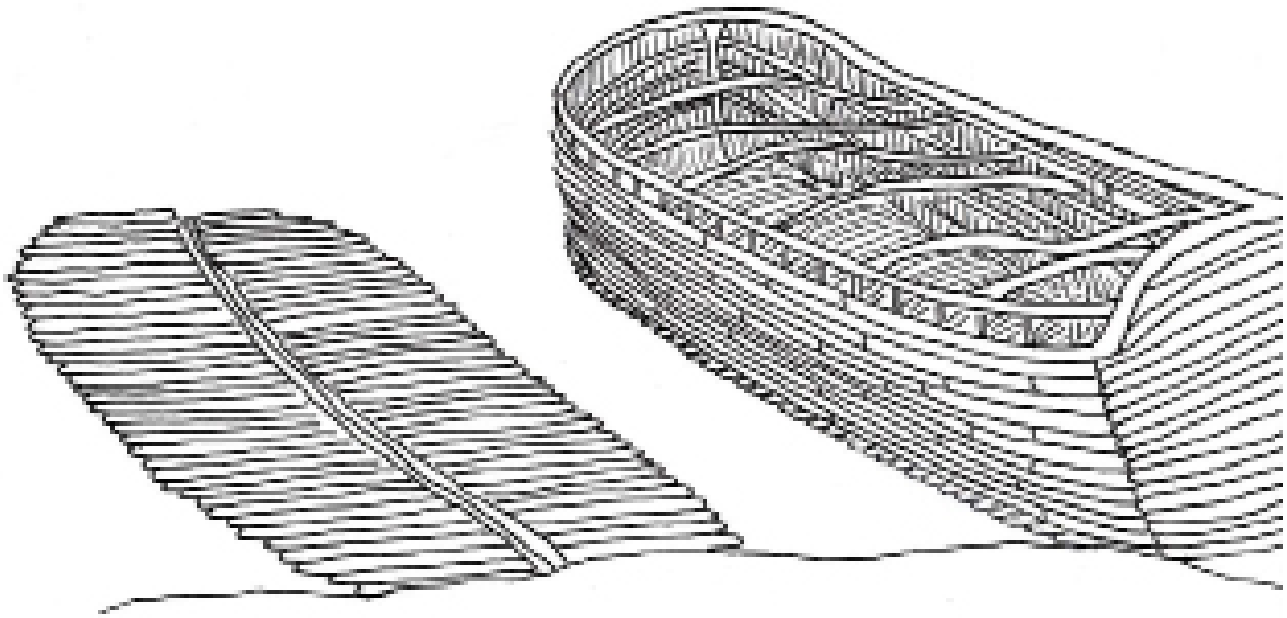

Figure 4. Two stages in the construction of a forty-foot-long boat from rough logs (before caulking), based on an 1888 photograph of an "ark shipyard" at Hit by John Peters in Irving Finkel, *The Ark before Noah: Decoding the Story of the Flood* (London, UK: Hachette, 2014), 152.

> branches are placed in parallel lines, at about a foot distance; other branches are placed across them at similar distances, and interlaced. These, with the addition of a sort of basket-work of reeds and straw, to fill up the interstices, form a kind of rough platform …
>
> All parts are then coated with hot bitumen, which is melted in a hole close to the work, and reduced to a proper consistency with a mixture of sand and earth.[48]

The importance of bitumen in the construction of the ark is demonstrated by its mention in all of the Akkadian accounts of the flood, in addition to the Genesis text. The Hebrew text uses the word *kopher*, translated in most English Bibles as "pitch" or occasionally "tar." Tremper Longman III and John Walton suggest that *kopher* is a loan-word from Akkadian *kupru*, which refers to bitumen of the type that oozes naturally from the ground near Hit.[49] Since the Vulgate also uses the word "bitumine," this seems more appropriate as an English translation of the Hebrew than "pitch."

The other materials mentioned in building Noah's ark (Gen. 6:14) may also be Akkadian loan-words. For example, "gopher" wood is unknown elsewhere in the Hebrew Bible. It is translated as "squared timber" in the Septuagint, but this appears to be another example of Greek cultural influence. Certainly, squared timber would have been impossible in the Neolithic period when the ark was probably built. A more likely explanation is that gopher is related to *kopher*, but here refers to pitch, in the sense of resinous wood.[50] Hence, the translation of Genesis 6:14 in the New Jerusalem Bible:

> *Make yourself an ark out of resinous wood.*
> *Make it with reeds and caulk it with pitch*
> *inside and out.*

The Hebrew word here translated "reeds" (*qinnim*) literally means "nests." In other English versions it is generally translated as rooms, but there is no basis for describing the rooms or compartments of a wooden ship as "nests." Therefore, many scholars now support the translation in the New Jerusalem Bible, assuming that the original Hebrew word intended was *qanim*, meaning reeds.[51] This word is distinguished from *qinnim* only by its different pointing, and is another loan-word from Akkadian *qanuu* (reeds).[52] Longman and Walton suggested that these reeds were used for caulking between the wood and then covered with bitumen, as described in the Gilgamesh Epic.[53] However, they did not speculate about the overall shape of the resulting ark.

It has always been assumed that the function of the bitumen was simply for waterproofing. However, both the Ark Tablet and the Gilgamesh Epic describe enormous quantities of bitumen that seem excessive for waterproofing alone. In fact, the total amount of bitumen specified in both accounts is 9 *sar* (9 x 3600 *sutu*), which Finkel equates to 272 cubic meters (9600 cubic feet).[54] Dalley quotes one *sar* as 8,000 gallons, which is equivalent in volume, assuming American gallons.[55] Based on a deck area of 33,000 square feet, this implies an average thickness of about 3.5 inches of bitumen over the entire deck area of the Ark. However, since the bitumen was being poured onto a raft made of 10-inch logs, we can see that most of the bitumen would be used to impregnate the reed caulking between the logs. Therefore, the thickness of bitumen over the tops of the logs would only be a finger or so, as described in the Ark Tablet.

The result of this procedure was a composite material of enhanced strength and excellent buoyancy. In fact, such a platform has so much intrinsic buoyancy that when empty, a 45-foot long "ark-boat" of the type seen in figure 4 was reputed to have drawn only 6 inches.[56] This method of construction also explains the instruction in the Atrahasis Epic that the bitumen must be "strong," to "give strength" to the ark.[57] We note that by mixing the bitumen with sand, a primitive asphalt could be created, which would have formed a durable surface for the flocks and herds of animals to be taken onto the ark. According to this design, the bitumen was not just waterproofing, but an integral part of the structure.

The Superstructure of the Ark

So far, we have seen how the crude yet effective shipbuilding process practiced at nineteenth-century Hit could be used to make a large and buoyant raft-like platform of whatever horizontal dimensions were required. But how does this correlate with the vertical size of the ark described in Genesis? The key point, based on our examination of the *Solano*, is that the reported height of the ark refers to its superstructure, not its hull. In fact, the ark had no need of a hull at all, because the animals could be accommodated on the platform made of bitumen-reinforced timber and reeds. In other words, the ark was scaled up

horizontally from the design of the Hit barges, but not vertically.

A fence could have been added round the edge of the ark, by forcing vertical stakes into the horizontal mesh-work platform. For the "ark shipyard" described above, these stakes were turned into a "wattle" fence that was waterproofed with bitumen to form the hull. However, there would be little advantage in waterproofing the wattle walls of the original ark fence with bituminous "daub." By leaving the wattle open, this would allow spray or rain falling on the bitumen-covered platform to quickly drain away, allowing a relatively dry resting place for the animals. Such a design would have been aptly described, as in the Hebrew text, as an enormous basket.

In contrast to the stock animals, a dry shelter was required on the ark for human habitation and for the dry storage of food and animal fodder. Indeed, we could say that in many ways, the dry shelter *was* the ark (in the sense of the preserver of human life). And here, the introduction to the Ark Tablet makes it clear how this worked:

> *Dismantle the house, build a boat …*

In other words, the reed-walled hut through which the god of wisdom had whispered his instructions was to be torn down and rebuilt on the bitumen-reinforced platform. Such reed-built huts (called "mudhifs") are still built at the present day by the Marsh Arabs of southern Iraq, and an example of an interior is shown in figure 5. The structure consists of a framework of huge arches, each consisting of a large bundle of reeds that is also bound together with reeds. Typically, larger mudhifs also have four reed pillars at each end, creating an imposing entrance-way. These pillars can be over 30 feet high, with their lower ends buried in the soil. Therefore, if these pillars were pulled up and re-erected on the platform, they would create an ark around 40 feet high.

For a mudhif of the type seen in figure 5, the burial of the reed-pillars and arches in the ground clearly contributes to its overall rigidity. Therefore, when the reed hut was re-erected on the ark, additional reinforcement would have been necessary to compensate. This reinforcing was probably provided by three sets of horizontal reed bundles, attached to the main arches and pillars using reed hoops (fig. 6). Although modern mudhifs do not have this reed-hoop feature, it is an important component of the

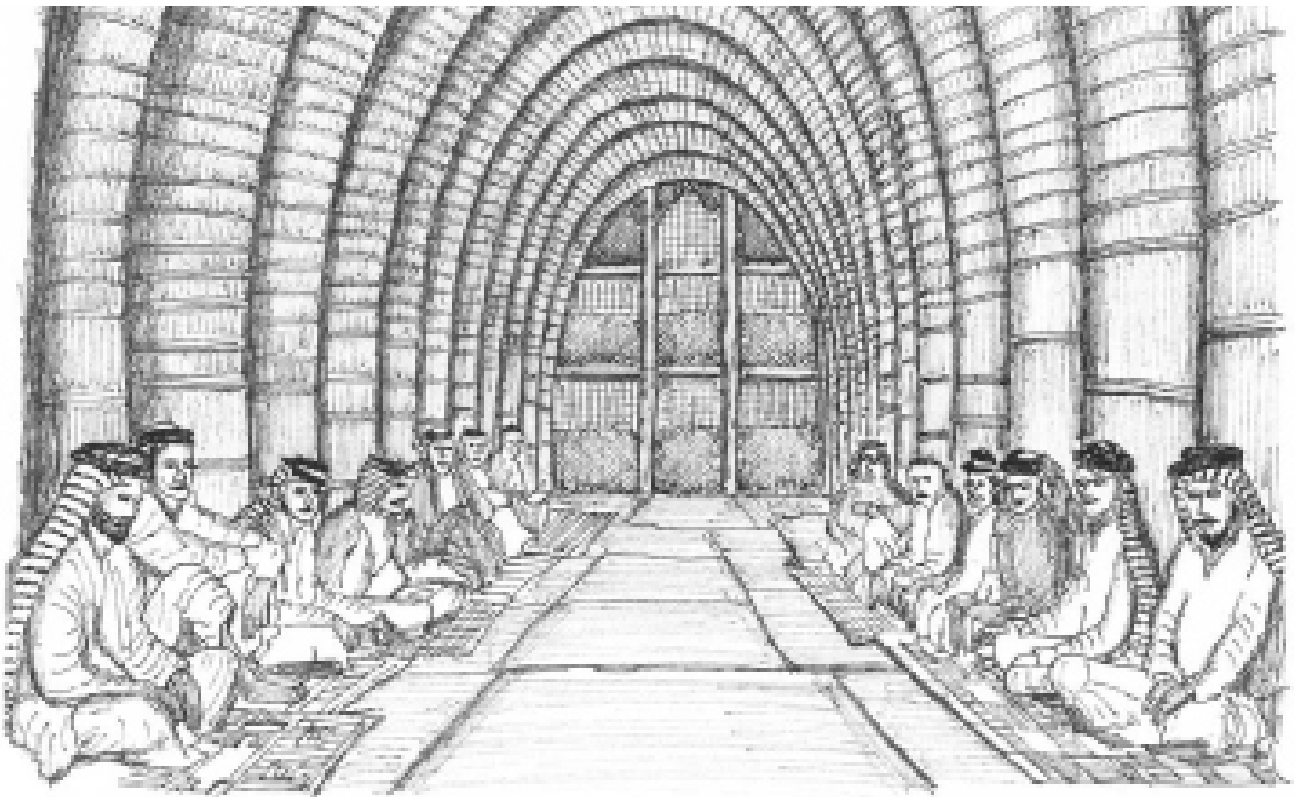

Figure 5. Typical view of the interior of a modern Marsh Arab mudhif.

reed huts that formed ancient sacred space, as seen in Sumerian cylinder seals and their impressions.[58] This reed-pillar iconography can be traced back to the reed hut sanctuary on the ark.[59]

The key to making the reed hut an integral part of the ark's structure would have been the use of large quantities of bitumen as reinforcing for the reed-built framework and as waterproofing for its reed-mat covering. Both the Ark Tablet and the Bible speak of coating the ark with bitumen both inside and out. This has tended to give the impression of a hull that needed to be waterproofed, as interpreted by Finkel. However, by seeing the ark as a mudhif on a platform, we can now see that "inside" and "out" refer to inside and outside the mudhif.

The mudhif would also have needed a drainage system, so that any rain penetrating the structure could be removed, to keep the people, their food, and their animals' fodder dry. This drainage function is suggested by the detailed account of the ark's construction in the Gilgamesh Epic, which describes how the flood hero "*Drove water pegs into her middle.*"[60] Finkel suggests that the same expression may be found on the reverse of the Ark Tablet, but it is badly damaged. He observed that other scholars have identified the "water pegs" as bilge plugs.[61] These are normally removed to drain water leakage from the hull of a boat by beaching it at low tide. However, this procedure would be quite useless for the ark, which was never to be reused once

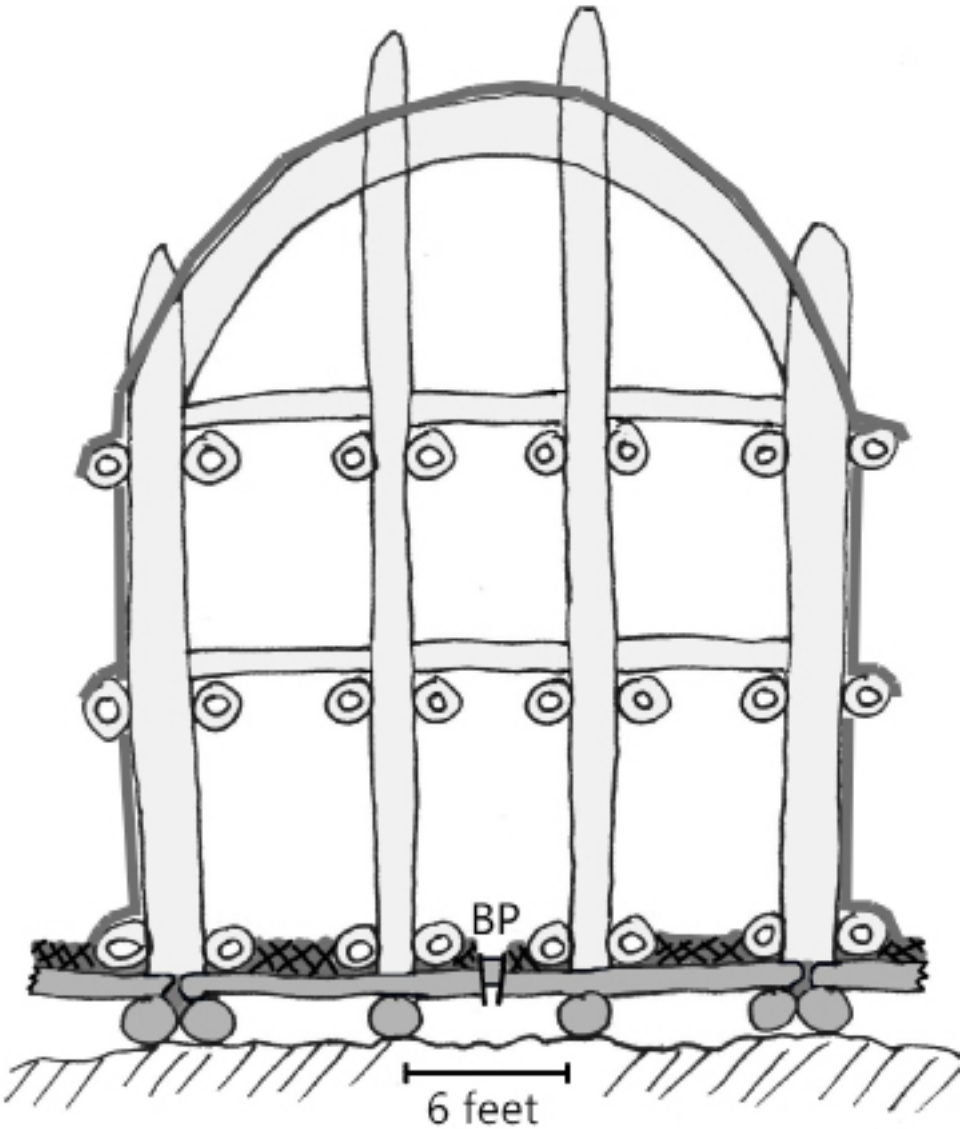

Figure 6. Schematic cross section of a reed hut re-erected on the ark platform. Vertical pillars support the end wall of the hut, whereas the reed-pillar arch supports the interior along its length. Pale grey = reeds; medium grey = wood; dark grey = bitumen; BP = bilge plug.

it was beached after the flood. In fact, bilge plugs are the last thing that would be wanted for a hull-like ark, since their only effect would be to sink the ark if they ever leaked. On the other hand, drainage holes might be very useful for a raft-like ark with integral buoyancy. In case of any rainfall leakage into the superstructure of the ark, they would allow this water to be drained away.

Conclusions

Nothing is gained in understanding the lessons of faith if we adhere to an interpretation of Noah's ark that is intrinsically improbable. Therefore, we should seek interpretations of Genesis, enlightened by comparison with Mesopotamian sources, that would actually have been feasible to carry out in the ancient world. For example, the belief in Genesis that all peoples of the Middle East were descended from Noah implies a Neolithic flood, relatively soon after the Agricultural Revolution. This in turn implies that the ark was constructed using relatively primitive stone tools.

The epitome of good design of any structure is physical toughness and simplicity of construction. The new interpretation of the Ark Tablet proposed here would have used readily available materials to construct the ark with minimal processing. Indeed, the banks of the rivers have always been lined with a fringe of forest, due to "natural irrigation," even where rainfall alone is inadequate to support agriculture. In the nineteenth century, after millennia of deforestation and bitumen extraction, raw materials were still sufficiently plentiful to churn out "mini arks" in large numbers; therefore, we can surmise that in the ancient world, when large quantities of timber and bitumen would have been available at natural tar seeps near the Euphrates River, it should have been possible to build one large ark.

I conclude that the building of any kind of hulled ship in the Neolithic period would have been a near impossibility. In contrast, the bitumen-reinforced platform described here would easily have been scaled up to the size described in Genesis, and could indeed have been built in the late Neolithic period.◀

Notes

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