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Article

New Historical and Geological Constraints on the Date of Noah's Flood

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This article proposes a revision of the most likely date of Noah's Flood from ca. 2900 to 5700 BC. A date around 2900 BC cannot be reconciled with the Genesis text as an eyewitness account of a real flood that devastated the Mesopotamian plain, killing all of its known inhabitants except those on the Ark. On the other hand, a devastating flood at 5700 BC could have had this effect, and is much more consistent with geological evidence for the date of severe flooding episodes in the ancient Middle East. In this article, a Neolithic date for the Flood is examined in the light of ancient literary accounts and geological evidence, and the implications for the construction of the Ark and for the origins of Sumerian religion are briefly examined.

Noah's Flood is one of the most important cosmic events in biblical history,[1] but current views remain highly polarized between "literal" interpretations of a global flood[2] and interpretations that see the account as largely nonhistorical, perhaps in the form of a parable.[3] The concept of a global Flood is unscriptural, because ancient peoples had no knowledge of the earth as a globe (Ps. 93:1). On the other hand, viewing the Flood as a parable implies that God did not actually save Noah (Heb. 11:7).

There have been many searches for a "middle way" between these extremes, generally attributing the Genesis account to the flooding of the plain of Mesopotamia. Based on Calvin's doctrine of "divine accommodation,"[4] such an interpretation would represent the flooding of the entire earth *as it was then known*.[5] In a series of papers on this question, Carol Hill and Alan Hill showed that the biblical account of the Flood is consistent with climatic, geological, and hydrological factors that have repeatedly led to catastrophic flooding of the Mesopotamian plain.[6] Specifically, Carol Hill argued that a real flooding event around 2900 BC could have led to the Genesis account, when told from the "worldview perspective" of Noah.[7] However, Paul Seely cited archaeological evidence that the relatively minor flood of 2900 BC was not adequate to annihilate the inhabitants of Mesopotamia, and was therefore not consistent with an eyewitness account of a cataclysmic flood.[8]

The claim that the Flood killed all of the known inhabitants of the world except those on the Ark (Gen. 6:13,17; 7:23) is significant, because it leads to the biblical belief that the ancient world's known people groups were all descended from Noah (Gen. 10:32; 11:1). For this claim to be credible, it is necessary that the descendants of Noah were isolated for some period of time after the Flood, and some indication of the duration of this isolation can be obtained from the genealogies in Genesis 10–11 (table 1).

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Table 1. Lineages of the Descendants of Noah through Different Family Branches*

Shem	Shem	Shem	Ham	Ham	Japheth
Arphaxad	Arphaxad	Aram	Cush	Canaan	Gomer
Shelah	Shelah	Uz	Raamah	Sidon	Ashkenaz
Eber	Eber		Sheba		
Peleg	Joktan				
Reu	Almodad				
Serug					
Nahor					
Terah					
Abraham					

*Only the first-born of the final generation is listed

Compared with the line of the elect in column 1 of table 1, the limited depths of the nonelect lineages (columns 2–6) give an idea of the perceived length of family memories among the descendants of Noah. These lineages attempt to explain the origins of world people groups within the limits of anthropological understanding at the time when the Table of Nations (Genesis 10) was compiled. Assuming a typical generational cycle of 30 years (Genesis 11), the data suggest that decades of isolation occurred. After that time, alien peoples would not have been distinguishable from distant family members.

The proposed flooding event at 2900 BC directly preceded the Early Dynastic period in Mesopotamian history (table 2). This was a time when great cities with walls were being built for defense against attack by other city states.[9] Hence, this is definitely not a period when the Mesopotamian descendants of Noah's family could have believed themselves to be the only survivors of a great flood. However, this conundrum can be solved by postulating an earlier date for the Flood. At such an earlier time in human history, humankind's horizons would have been smaller, and hence it is more credible that Noah's family could have believed themselves to be the only survivors of the Flood. Geological evidence can place paleo-environmental constraints on the possible timing and extent of catastrophic ancient flooding events in Mesopotamia, and thus identify the most likely date of Noah's Flood. A reexamination of the problem is therefore warranted.

Ancient Flood Stories

It has long been known that the biblical Flood story has very close parallels to the three Mesopotamian

Table 2. Summary of Major Mesopotamian Periods

C-14 Age BC	Name of Period in Mesopotamia		General Name of Period
1600 ~~~~~~	~~~~~~	~~~~~~	~~~~~~
	Old	Babylon	
	Babylonian	Larsa	Middle Bronze
	Period	Isin	
2020 ~~~~~~	~~~~~~	~~~~~~	
	3rd Dynasty of Ur		~~~~~~
2200	Gutian Period		
	Akkadian Dynasty		
2350 ~~~~~~	~~~~~~	~~~~~~	
		III	
2600	Early		
	Dynastic	II	Early Bronze
2750	Period		
		I	
2900 ~~~~~~	~~~~~~	~~~~~~	
	Protoliterate (Jemdet Nasr)		
3200 ~~~~~~	~~~~~~	~~~~~~	~~~~~~
		Late	
3600	Uruk		
		Early	
4000 ~~~~~~	~~~~~~	~~~~~~	Chalcolithic
		Late	
4500	Ubaid		
		Early	
5500 ~~~~~~	~~~~~~	~~~~~~	~~~~~~
		Late	
5800	Halaf		Neolithic
		Early	
6200 ~~~~~~	~~~~~~	~~~~~~	

accounts of the deluge contained in works often referred to by modern scholars as the Atrahasis Epic, Gilgamesh Epic, and Sumerian Flood Story. The closest biblical parallel is found with tablet 11 of the Gilgamesh Epic, on which the Flood Hero (Utanapishtim) is referred to as "man of Shuruppak." This ancient city is mentioned in both the Sumerian Flood Story and the Sumerian King List as the location of the last dynasty before the Flood. A summary of the relevant parts of the King List is shown in table 3.

This summary shows that according to the King List, there were five dynasties that ruled over Mesopotamia before the Flood, comprising a total of eight kings. However, this part of the King List is not historically reliable, because it omits the city of Uruk, which is known from archaeological evidence to be the principal city of Mesopotamia at that time.[10] In contrast, the postdiluvian section is in relatively good accord with archaeological evidence, and records the

Table 3. Summary of the Sumerian King List (WB444)

Name of Dynasty	Number of Kings	Total length of reigns, yr
Eridu	2	64,800
Badtibira	3	108,000
Larak	1	28,800
Sippar	1	21,000
Shuruppak	1	18,600
~~The Flood~~~~~~~~~~~~~~~~~~~~		
Kish 1	23	24,510
Uruk 1	12	2,310
12 more dynasties	45	5,332

dominance, first of the city Kish, and then of Uruk, followed by twelve more dynasties in total (locations of important ancient sites are shown in fig. 1). The penultimate king of the dynasty of Kish was En-Mebaragesi, who is attested in two of the earliest contemporary royal inscriptions,[11] one of which was excavated from a level dated to around 2500 BC at Khafajah (ancient Tutub). These records allow the beginning of the Kish dynasty to be placed around 2900 BC.

In a detailed analysis of the date of the Flood, Max Mallowan compared the literary accounts with archaeological evidence of possible flood deposits in excavation sections at several ancient cities.[12] Three deposits had been found at Kish, of which the thickest (0.4 m) was however too young, since it occurred near the end of the Early Dynastic period (ca. 2400 BC), and after the reign of Gilgamesh. However, the earliest deposit, around the beginning of the Early Dynastic period (2900 BC) appears consistent with the literary evidence.

Although this flood left visible deposits within some city streets, it evidently did not wash away the (mud-brick) walls of adjacent houses. A similar deposit, around 0.6 m thick and consisting of a mixture of sand and clay, was found at the base of the Early Dynastic stratigraphy in Shuruppak (Tel Fara).[13] This was unequivocally identified by the excavators as a flood deposit, and was possibly of the same age as the oldest Kish flood stratum, but was not subjected to any further archaeological investigation.

Taken together, the Mesopotamian literary and archaeological evidence was seen to imply an association of the Mesopotamian Flood stories with a significant inundation that occurred around 2900 BC. However, both the Mesopotamian and biblical Flood accounts speak of cataclysmic devastation and

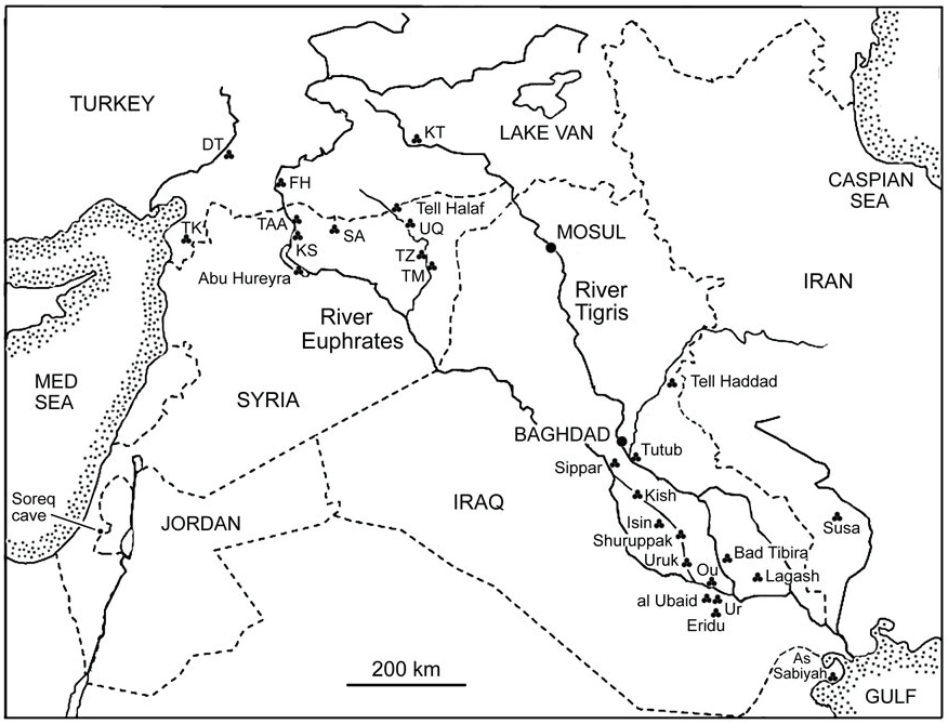

Figure 1. Map of the Middle East showing the location of ancient sites and other features mentioned in the text. Acronyms = ancient sites mentioned in figure 7. Ou = Oueili.

human annihilation that is quite at odds with the archaeological evidence. For example, Genesis 7:21–23, NIV claims that

> *Every living thing that moved on the earth perished – birds, livestock, wild animals, all the creatures that swarm over the earth, and all mankind. Everything on dry land that had the breath of life in its nostrils died. Every living thing on the face of the earth was wiped out; men and animals and the creatures that move along the ground and the birds of the air were wiped from the earth. Only Noah was left, and those with him in the ark.*

According to the Documentary Hypothesis, these verses actually come from two different source traditions, P (v. 21) and J (vv. 22–23).[14] Therefore, these can be considered as two semi-independent attestations of the same event. Furthermore, the three separate Mesopotamian sources tell the same story. For example, after the waters have receded, the Flood Hero of the Gilgamesh Epic describes the scene as follows:

> *I looked at the weather; silence reigned;*
> *For all mankind had returned to clay*
> *The flood-plain was flat as a roof.*[15]

Mallowan suggested that the flood deposit separating the Protoliterate (Jemdet Nasr) and Early Dynastic levels at Fara may have caused social upheaval and led to changes in building and pottery styles, but he also argued that "no flood was ever of sufficient magnitude to interrupt the continuity of Mesopotamian civilization."[16] Therefore, Mallowan concluded that the biblical Flood story was based on a real event that probably occurred around 2900 BC, but was "written down for a didactic purpose and given the appearance of a world-wide catastrophe."[17] However, since the work of Mallowan, historians have completely reevaluated the evidence from the Sumerian King List, based on the publication of new Sumerian texts. This, therefore, requires a complete reassessment of the evidence.

Reassessment of the Sumerian King List

As noted above, the Sumerian King List is pivotal for dating the Flood, by placing it before the first dynasty of Kish around 2900 BC. There are several versions of the King List, of which the most complete is the Weld-Blundell prism (WB444), hence often taken to be the definitive version. More than half of the extant fragments of the King List derive from the Old Babylonian period in the city of Nippur (ca. 1700 BC). Most of these copies are broken, but some of them have a summary at the end which can be used to assess the overall structure. Significantly, this summary does not mention the antediluvian section. This observation led Thorkild Jacobsen to suggest that the antediluvian section was a "prequel" added to the beginning of the King List after its original composition.[18] Additional evidence for this theory was given by Jacob Finkelstein and William Hallo.[19] For example, the wording used to indicate a transition between dynasties is different in the antediluvian and postdiluvian sections, and the antediluvian section also has more variability in the order of cities in different versions.

Evidence supporting this view came from a new version of the King List discovered in Ur, published in 2003.[20] This tablet is dated to the third dynasty of Ur (ca. 2100 BC) and is therefore the earliest known form of the King List. Not only does this version lack the antediluvian section, but it does not mention the Flood at all. This discovery confirmed a theory that was previously held by many historians of ancient Mesopotamia, that the original composition of the King List began with the cuneiform signs "nam lugal" (kingship), hence translated, "When kingship descended from heaven, the kingship was in Kish."

This claim is supported by archaeology, since the dynasty of Kish saw the first architectural development of the royal palace. The palace was characterized by three new defensive features that are not seen in earlier temple-related architecture: a double-walled enclosure, entrance through a labyrinth, and a royal audience hall.[21] This development shows that the original version of the King List was correct in presenting the Early Dynastic period as an era when secular kingship was first instituted, involving hegemony over the Mesopotamian plain that moved from one city state to another. However, it said nothing about the Flood.

From this position, it was a fairly small step for secular historians to conclude that the deluge, like the antediluvian kingship, was largely fictitious. Their conclusion was based on examination of the cuneiform signs used to write the Flood, pronounced a-ma-ru. This word sounds very similar to the Sumerian and Akkadian names for the Amorite peoples (mar-ru and amurru respectively).[22] The

similarity was observed by several scholars, and led William Hallo to suggest that the cosmic Flood was merely a cultural motif, inspired by devastating Amorite invasions of Mesopotamia.[23] These invasions began at the end of the third millennium and led to the fall of the Ur III dynasty around 2000 BC.

This argument was more recently championed by Y. S. Chen, who suggested, from the absence of earlier Flood texts, that these stories could not have existed in the third millennium:

> With the Flood being such a pivotal mythological and historiographical motif, it would be unthinkable for it not to be reflected in textual traditions soon after it came into circulation orally.[24]

However, if the writing of literature did not *exist* near the time of the Flood, the story could not have been written down at that time. And in fact, there are very few extant literary works from the third millennium. So, the writing of flood myths in the Old Babylonian period says more about the changing interests of kings and scribes than the actual prehistory of Mesopotamia.

Recent studies on the development of Sumerian literature suggest that the original motivations for the development of Sumerian textual traditions were quite different from the motivations of later times. Although most Sumerian literary texts come from the Old Babylonian period, an examination of tablet find-sites shows that they are not in libraries (as in later times) but in scribal schools.[25] Thus, Piotr Michalowski suggested that the motive for writing Sumerian literary texts was the opposite of that behind a modern musical score.[26] A score is the permanent record, from which ephemeral musical performances are created. In contrast, it appears from the variation of individual tablets that literary texts were written as "ephemeral" practice pieces, from an oral tradition that was handed down as the "permanent" record. The very sparse literary record surviving from Early Dynastic times supports this view.[27]

Given this background, it is important to review the evidence for the earliest attestation of the Flood tradition, which is also linked to the Gilgamesh epic tradition.

Relationship between the Gilgamesh and Flood Traditions

The late-third-millennium Ur III dynasty shows the first development of a significant literary tradition, with short stories emerging about three Early Dynastic kings of Uruk: Enmerkar, Lugalbanda, and Gilgamesh. In fact, Gilgamesh was already attested by the end of the Early Dynastic period as a deified figure. He is named with the divine designator (dingir) in an archaic inscription on a mace head,[28] and also in god lists from this period.[29] Therefore, Gilgamesh, the archetypal hero, was evidently already a powerful symbolic figure by the end of the Early Dynastic period. This may have encouraged Shulgi, second king of the Ur III dynasty, to co-opt Gilgamesh as a pattern for his own deification.[30] This is a reasonable theory, since Shulgi's dynasty traced its own ancestry to the city of Uruk. And by establishing the Gilgamesh stories as canonical pieces, Shulgi could mandate this material for training the next generation of scribes. However, only fragments of these epic stories are preserved from the third millennium. To study their detailed content, it is necessary to examine second-millennium copies.

Five Gilgamesh stories are known from the Old Babylonian period, but some of them were quite incomplete before a new trove of literary texts was discovered at Tell Haddad, northeast of Baghdad.[31] One of these stories is the Death of Gilgamesh, whose text had been very incomplete before the Tell Haddad discovery. This story contains a speech by Enki, god of wisdom, which begins with an "introduction formula" first seen in the Early Dynastic period:[32]

> [In those days,] *in those far-off days,*
> [in those nights,] *in those far-off nights,*
> [in those years,] *in those far-off years,*
> *after* [the assembly] *had made the Deluge sweep over,*
> *so we could destroy the seed of mankind,*
> *in our midst a single man still lived,*
> *Ziusudra, one of mankind still lived!*
> *From that time we swore by the life of heaven and the life of earth,*
> *from that time we swore that mankind should not have life eternal.*
> *And now we look on Gilgamesh:*
> *Despite his mother* (a goddess) *we cannot show him mercy!*[33]

The tradition of a devastating Flood is an integral part of this story, since it explains why Gilgamesh

must die. And since the Death of Gilgamesh is an important part of the Gilgamesh cycle, it seems almost certain that the account originated in the third millennium, even though the tablet translated above is of Old Babylonian age. Hence, this contradicts the idea of Hallo and Chen cited above, that the cosmic Flood was an invention of the Old Babylonian period. Instead, it suggests that the Flood was a much older tradition, but only added to the beginning of the King List in the Old Babylonian period. Therefore, although the King List provides evidence that the cosmic Flood preceded the first dynasty of Kish, it provides no information on how *much* earlier it occurred.

Gilgamesh the king is placed in the first (postdiluvial) dynasty of Uruk by the King List and the Tummal Chronicle.[34] This evidence dates Gilgamesh to around 2700 BC. On the other hand, the Flood hero is regarded as an almost-mythical figure in the Death of Gilgamesh and the Gilgamesh Epic, since he was unique in having attained immortality. This therefore implies that the Flood occurred long before the time of Gilgamesh, rather than just 200 years earlier. And the earlier setting is consistent with the belief that the Flood annihilated the whole (known) human race outside the Ark.

This "primitive" setting is not consistent with any date for the Flood after the ascendancy of Uruk in the mid- to late-fourth millennium, when Sumer had a huge influence on world culture, well outside the Mesopotamian plain. The cultural influence of Uruk on Egypt is demonstrated by the presence of Sumerian cylinder seals in predynastic Egyptian graves.[35] On the other hand, the influence on Susa in Iran was even greater, with almost-identical copies of Mesopotamian pottery, cylinder seal iconography, administrative tablets, and architecture being discovered there.[36] And sites in Syria and southern Turkey (Anatolia) also show a pervasive cultural influence, as summarized by Hans Nissen: "Syria in its entirety appears to have adopted the southern Mesopotamian Uruk-Warka set of artifacts and ideas."[37] Hence it has become commonplace among secular archaeologists to use Guillermo Algaze's term "the Uruk World System" to refer to the Middle East of the late fourth millennium, without any sense of exaggeration.[38] Therefore, it is simply not credible that a moderate-sized flood in Mesopotamia around 2900 BC could have been seen as annihilating the whole human race.

Excavation records from the ancient city of Eridu, attested by both literary and archaeological sources as the oldest city in southern Mesopotamia, place the earliest mud-brick buildings at Eridu in the late sixth millennium.[39] However, a devastating flood that wiped out all of the known inhabitants of Mesopotamia would have severely damaged the early mud-brick architecture of Mesopotamia. Therefore, it seems most likely that the cosmic Flood predated the founding of Eridu. Such an early date is also more consistent with the biblical impression that the Flood was so far back in prehistory that it was believed that all humanity was descended from a single family of survivors. On the other hand, the Flood must have postdated the agricultural revolution (during the ninth millennium BC[40]) since the story of Cain and Abel is set in a Neolithic agricultural context (Gen. 4:2).

Geological Evidence for the Date of the Flood

Lower Mesopotamia is a delta plain built up by sediment deposition from the Tigris and Euphrates Rivers. It is one of the flattest places on Earth, covering an area of more than 100,000 square km with less than 50 m of vertical relief (fig. 2). In particular, the very low gradient of these rivers (around 6×10^{-5} between Baghdad and the sea) causes the flow to back up very readily and breach the levees. Hence, this is one of the few areas in the world where a catastrophic river flood in prehistory could have appeared to destroy all of the known earth. In that case, evidence for such a flooding event may be preserved in geological records.

Before the completion of major dams over the past 50 years, the Tigris and Euphrates often flooded due to spring snow-melt in their headwaters in southeast Turkey (fig. 1). Furthermore, the peak springtime discharges of these rivers were often ten times the autumn discharge.[41] The peak flow of the Tigris normally occurred in April, whereas the Euphrates peaked in May. This seasonality accords well with the biblical description of the Flood beginning on the seventeenth day of the second month (ancient Middle Eastern calendars dated the new year from the first new moon after the spring equinox).[42]

To date wet climatic periods that may have caused catastrophic flooding in Mesopotamia, we can study ancient sediment records from Lake Van, which lies

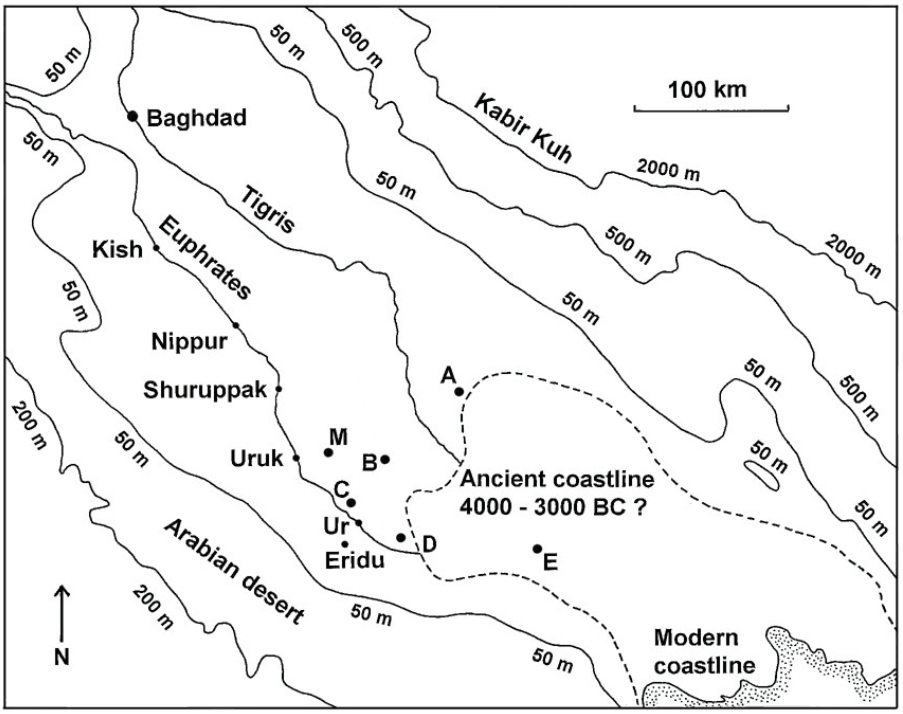

Figure 2. Topographic map of the Mesopotamian Plain showing contour lines, borehole locations, and ancient city sites relative to ancient courses of the Tigris and Euphrates Rivers.

between the headwaters of the Tigris and Euphrates in southeast Turkey (fig. 1). Because Lake Van lies in a closed watershed, it forms a "terminal lake" which is fed by rivers but has no outflow. The levels of such lakes are determined by a balance between river influx and water loss by evaporation, and they are therefore very useful as monitors of past climate. During wet periods the lake level rises, whereas in dry periods the lake level falls and salinity increases to the point at which salt deposits may form. Such processes are seen at another well-known terminal lake, the Dead Sea.

Water-level variations of about 0.5 m occur on a seasonal basis in Lake Van, with a marked rise in May from a combination of snow melt and spring rains, followed by a drop over the summer due to evaporation. Lake-level variations of over 1m also occur between wet and dry years. However, sediment records from the floor of the lake record changes in lake level of over *400 meters* over the past 15,000 years. These records can be precisely dated, because the bottom sediments in Lake Van often preserve annual deposition layers (varves) whose ages have been verified by radiocarbon dating.[43]

By combining the record of past lake levels with the underwater shape of the lake, the varve data can be translated into a model of relative precipitation in the headwaters of the Tigris and Euphrates from 13,000 to 2000 BC (fig. 3). This model shows evidence of three periods of very high precipitation around 11500, 8500, and 6000 BC, but the most recent of these was the wettest. Within this wet period, the most intense episode of precipitation is constrained by the time when one of the core locations was first flooded by rising lake level (point x in fig. 3) around 6100 BC.[44] However, due to a lack of cores at slightly shallower depths in the lake, the data do not yet allow the wettest individual years after 6100 BC to be pinpointed. This therefore requires us to look

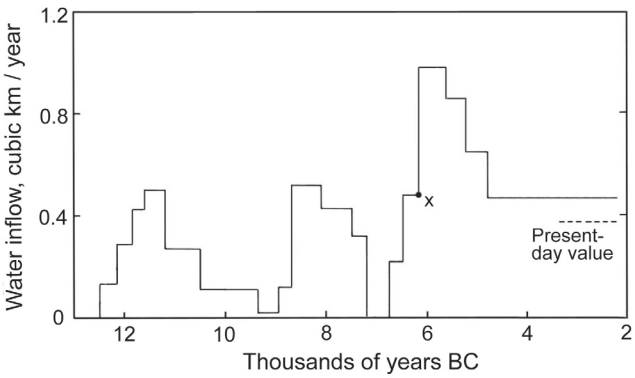

Figure 3. A reconstruction of past water inflow to Lake Van from precipitation. For discussion of point "x" see text.

for other records of ancient rainfall in the Middle Eastern region.

Climatic evidence suggests that Mesopotamia is part of a regional weather system that affects the whole Fertile Crescent.[45] Therefore relevant evidence of the ancient rainfall history of Mesopotamia can also be derived from stalactites and stalagmites in Soreq Cave near Jerusalem. Calcite growth layers were sampled at intervals of 1 mm, and were dated by the uranium-series method.[46] Stable oxygen and carbon isotope measurements were then used to obtain paleoclimate information. For example, low delta O-18 ratios are indicative of a wet climatic period between 6500 and 5000 BC, with a maximum intensity at 5700 BC. Similar delta O-18 signatures for Lake Van and for Lake Mirabad in the Zagros Mountains suggest that high rainfall affected much of the Fertile Crescent at that time.[47]

More specifically, carbon isotope measurements on Soreq Cave deposits provide a record of ancient flooding events during the same period (fig. 4). During this time interval, high delta C-13 signatures were observed that are unique in the past 100,000 years.[48] These signatures were attributed to enhanced weathering of bedrock and a lack of equilibration between groundwater and soil organic matter, due to extreme summer rainfall events. Furthermore, these signals were accompanied by unusual iron-rich coloration and large detrital fractions in the deposited calcite, indicative of floodwaters entering the cave.[49] Although these records do not allow individual flooding events to be isolated, they show that the intensity of flooding during the interval 6500–5000 BC was never subsequently repeated (fig. 4).

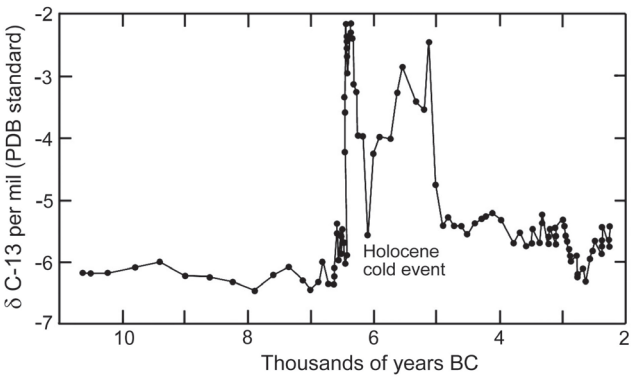

Figure 4. Record of carbon isotope ratios relative to the PDB standard for a stalactite from Soreq cave near Jerusalem. Data from Bar-Matthews et al.[50]

The wet period was itself interrupted by a briefer period with low delta C-13 signatures at 6200 BC. This is attributed to a brief period of cold, dry weather that is recognized throughout the northern hemisphere[51] and has been precisely dated in Greenland ice cores.[52] This event provides a precise reference point for the stalactite cave record in figure 4, demonstrating the accuracy of the age calibration.

The very wet climatic interval in Soreq Cave is also marked in Mediterranean sediment cores of this age as a widely observed "anoxic sapropel" layer enriched in organic matter.[53] This layer is called "Sapropel 1" because it is the youngest of a series of such deposits spanning the last glacial cycle. It is attributed to a massive injection of fresh water into the Mediterranean due to extreme flooding of rivers such as the Nile.[54] This freshwater incursion led to the development of anoxic conditions, which caused enhanced preservation of organic matter. The phenomenon probably does not date a single great flood, but it does indicate a period of unusually severe summer rainfall events. Taken together, the evidence suggests that the early sixth millennium BC was a period of intense flooding in the Middle East that was never again repeated. Therefore it represents the most likely period for extreme flooding events in the sedimentary record of Mesopotamia.

The Flood in the Sedimentary Record

As discussed above, there have been many attempts to locate the sedimentary deposit left by Noah's Flood. One issue inhibiting this search has been a misunderstanding of the type of deposit to be expected from flooding of a delta plain such as Mesopotamia. However, a detailed study based on over 200 auger sections drilled in the 1970s has clarified the distinct types of sediment to be expected on the Mesopotamian delta plain.[55] The study area was in the vicinity of the ancient city of Sippar, about 40 km south of Baghdad. The results are summarized in figure 5 on a cross-section through 16 auger holes.

The most common deposits were homogeneous (poorly banded) grey-brown silty clays with few remains of vegetation or shells. These are identified as flood-plain deposits, consisting of repeated fine-sediment deposition from standing water, due to minor flooding events. The brownish coloration is evidence of exposure to air, implying small sediment

accumulations that dried out before subsequent flooding events. In contrast, coarser greenish-grey silty to sandy deposits are interpreted as channel-belt and crevasse-splay deposits. The greener color indicates more rapid sedimentation, preventing oxidation. Crevasse-splay deposits are coarse-grained flood deposits that form near the river channel when it overflows its banks. Over time, these deposits can build up natural levees on either side of the channel. A third type of material, comprising the upper 1–2 m of each auger section, consisted of grey-brown fine sand and silt, attributed to wind-blown sand and dust.

An important feature of the river systems of Mesopotamia is avulsion, meaning a change in the course of the river that results from a major flooding event. The process of avulsion has occurred many times over the history of the plain, and causes the lateral movement of channel-belt deposits with depth through a section (fig. 5). Avulsion can cause the development of a new channel where none existed before, and is most likely what led to the 3 m thick "Flood stratum" identified by Leonard Woolley on one side of the city of Ur.[56] Most major cities were built on the banks of one of the major channels of the Euphrates River, and were therefore highly susceptible to avulsion events.

The conclusion that we reach from this evidence is that flooding events do not necessarily lead to the expected types of sedimentary deposit in the geological record. This was already noted by Carol Hill, who pointed out that major flooding events can cause erosion just as much as sediment deposition.[57] When the river bursts its banks, it may cause (local) proximal development of crevasse-splay deposits. However, the distal effects of prolonged submergence lead to organic-rich deposits over a much wider area. Therefore, the best indicator of a major flooding event is likely to be an organic-rich sapropel layer similar to the one developed in the Mediterranean by catastrophic flooding of the Nile River.

Borehole Sections from Southern Mesopotamia

Most borehole sections in Mesopotamia do not reach the depths of around 10 m needed to search for flood deposits around 6000 BC. However, around 1980, eight boreholes were drilled through the postglacial alluvium in the southeast part of the plain, and their stratigraphy was analysed by Adnan Aqrawi.[58] Of particular interest for the present investigation is borehole C, near the ancient city of Ur on the southwest side of the plain, and borehole B, located 40 km to the northeast, near the central axis of the plain (fig. 2). At certain horizons, organic-rich sediments were found that allowed these sections to be calibrated by radiocarbon dating.[59]

The postglacial sedimentary record of Mesopotamia must be seen within the context of sea-level rise since the last glacial maximum (around 20,000 years BC). At that time, sea level was about 125 m below its present-day level, and it rose over the following 15,000 years at just under 1 cm per year as the ice sheets melted.[60]

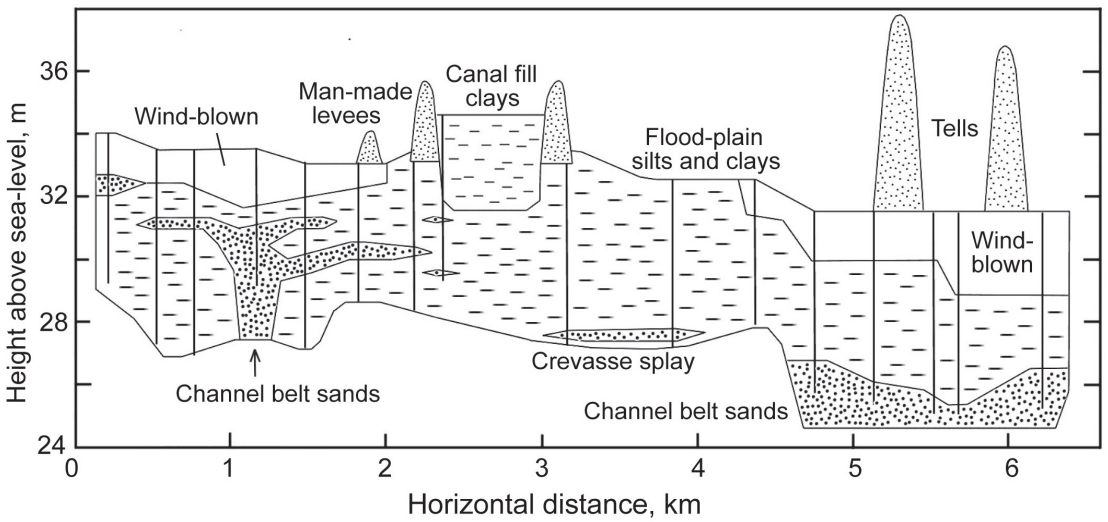

Figure 5. Cross-section of flood-plain deposits in the region of Sippar based on 16 auger sections. Note the 200 times vertical exaggeration. Redrawn from Heyvaert and Baeteman.[61]

As global sea level rose, it would have overtopped any natural rock ridges in the dried-up seafloor, causing local flooding of some low-lying areas. This observation led William Ryan and Walter Pitman to propose that the Genesis Flood occurred when sea level overtopped the Bosphorus Straight between the Mediterranean and the Black Sea at the end of the last ice age.[62] Based on the premise that the Black Sea had partially evaporated due to low rainfall in the previous millennium, they argued that sea-level rise created a massive waterfall, rapidly refilling the Black Sea and giving rise to the biblical and Mesopotamian flood stories. However, this theory has a fatal flaw. The water level in the Black Sea never fell again after the influx stopped, whereas both biblical and Mesopotamian sources give detailed accounts of the ebb of the Flood, including the release of birds to test the reappearance of land. This shows that the "Black Sea Flood" can have no connection with the biblical Flood story. Instead, Genesis is clearly describing a catastrophic river flood, of the type that frequently devastated Mesopotamia before the construction of major dams on the headwaters of the Tigris and Euphrates Rivers.[63]

Nevertheless, postglacial sea-level rise would still have had a critical effect on flooding conditions in Mesopotamia. For example, the huge drop in sea level during the last glacial period allowed rivers to cut small gorges in their earlier flood-plain deposits, thus confining the river to these gorges and severely limiting flooding events.[64] However, when rising sea level impinged on the preglacial delta plain around 6000 BC, it quickly flooded these gorges, backing up the river flow and preventing subsequent river floods from easily draining away. The effect of this sea-level rise is most clearly seen in boreholes B and C, comprising 15 m sections spanning most of the Holocene period (the last 10,000 years).

The stratigraphic logs are shown in the form of a "fence diagram" in figure 6, describing the lateral distribution of sediments according to grain size and type.[65] This sedimentological evidence was combined with an analysis of microfossils and the carbonate content of the core to determine salinity conditions at the time of sediment deposition.

Holocene sedimentation began with mixed deposition of sand and silt containing significant amounts of gypsum and dolomite. These are indicative of evaporitic conditions in short-lived lakes (playa), formed on flat-lying land above sea level. Rising sea level caused a flooding event (marine transgression) at 11 m depth in drill-core C, marked by a sharp increase in the carbonate content of the core and a

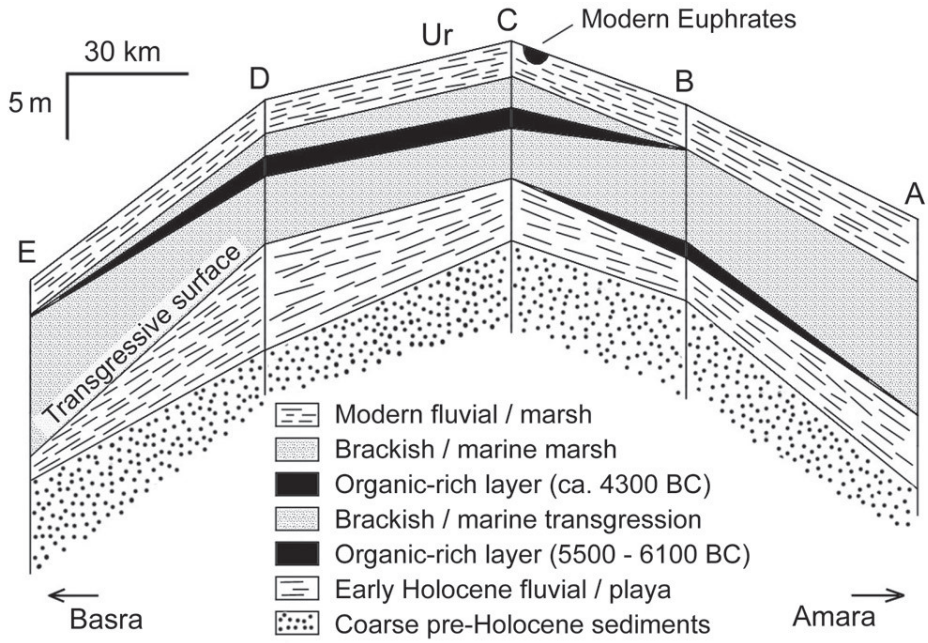

Figure 6. "Fence diagram" showing sedimentary borehole sections in southern Iraq, looking along the course of the Euphrates from the east. Localities are shown in figure 2. Data from Aqwari.[66]

change in the isotopic composition of carbonates.[67] The date of this event is given by radiocarbon dating of organic-rich sediment from immediately below the transgressive horizon in borehole B (fig. 6). Two samples gave calibrated radiocarbon ages of 6150 and 5550 BC, sampled from the lower and upper halves respectively of a 1 m thick layer (from 11 to 12 meters depth).[68] The age of this organic-rich layer therefore suggests it to be a lateral equivalent to Sapropel 1 in the eastern Mediterranean.

The organic-rich layer may once have been more widely extensive, but was probably eroded by the subsequent marine transgression. After this event, brackish conditions persisted for about 1500 years, followed by another organic-rich layer. This horizon was dated to around 4300 BC in borehole C, near Ur (fig. 6). This material occurs within a 1 m thick clay-rich layer that is the correct age to be correlative with the probable avulsion flood deposit excavated by Leonard Woolley at Ur.

More recently, a new borehole penetrating to similar depths was drilled about 20 km east of Uruk (borehole M, fig. 2), and about 20 km upstream of borehole B.[69] This borehole log also contains organic-rich horizons, but unlike the downstream boreholes studies by Aqwari, there was no evidence for marine incursion. Instead, the section contained freshwater diatom species throughout. This evidence suggests that the marine transgression on the seaward end of the Mesopotamian plain was not directly responsible for Noah's Flood. Nor is there any evidence of other types of marine incursion such as tsunami. However, the marine transgression played a critical role in the flooding history of Mesopotamia by backing up the river flow and preventing river-floods from rapidly draining away.

The timing of the marine transgression is more precisely constrained by sediment sections in the nearby Karun River of southeast Iran.[70] Organic-rich sediments immediately below the marine incursion date this event to 5600–5900 BC, coinciding with the minimum in the delta O-18 records that marks the peak in rainfall intensity. This therefore created the conditions for a "perfect storm" with the greatest flood risk. However, after this period, the rate of sea-level rise dropped by a factor of ten (around 5000 BC)[71] so that after that time, the risk of catastrophic flooding was reduced.

The effect of marine transgressions backing up river floods in the mid-Holocene wet period can explain why deluge accounts seem common around the globe. The flooding of the Black Sea provides an example of such a scenario, since it apparently occurred around the same time as the Mesopotamian flood. Although it cannot explain the biblical Flood story, it provides an example of how sea-level rise may have given rise to similar stories in other cultures.[72]

Evidence for a Cultural Gap

If river flooding caused by heavy rainfall events between 6000 and 5500 BC was exacerbated by sea-level rise, this prompts us to ask whether there is any archaeological evidence for cultural disruption in Mesopotamia in this time period. Although the evidence remains incomplete, there is a significant cultural break within this interval, between Late Neolithic (Halaf) and Early Chalcolithic (Ubaid) settlements.[73] For example, in northern Mesopotamia and environs, there is a gap of over 500 years between the end of Halaf occupation at several well-dated sites and the beginning of Ubaid occupation at others (open boxes in fig. 7). On the other hand, the site of Domuz Tepe, whose occupation continued until 5500 BC, is located to the west, outside the Euphrates watershed (DT on map, fig. 1).

It is notable that the majority of the Neolithic sites in northern Mesopotamia were active either before or after the Halaf-Ubaid transition, but very few early sites were resettled after the transition. The disappearance of these settlements followed an episode of mass human emigration from Eastern Anatolia into Europe (deduced from genetic evidence).[74] Therefore, although the Flood evidently did not annihilate these peoples on the upper reaches of the Euphrates, extreme variations in the amount of precipitation during the early sixth millennium BC may have disrupted agricultural production, encouraging migration toward areas of greater climatic stability to the northwest.

Around the same time as this major human migration to the northwest, other migrations also occurred: southward along the Mediterranean coast into Egypt, northward from the Caucasus into the Eurasian steppe, and eastward from the Zagros Mountains into Asia.[75] This massive outward migration from northern Mesopotamia would have increased the

isolation experienced by Noah's descendants after the Flood, leading them to believe that they were the only survivors of the catastrophe. It also explains their belief that they were the ancestors of all the nations, which evidently spread out after the Flood much as described in Genesis 10.

Unlike northern Mesopotamia, it is particularly notable that no settlement sites are known in southern Mesopotamia before 5500 BC. Although this area currently requires irrigation for large-scale farming, the immediate banks of the Euphrates have always been habitable, even in dry periods. Hence, there is no reason to believe that the river banks of the Mesopotamian plain were unoccupied during the Halaf period. The most logical explanation is that there *were* Halaf-age settlements along the rivers of southern Mesopotamia, but they were wiped out by the Flood.

The earliest known settlement in southern Mesopotamia is Oueili, an Early Ubaid site that was apparently abandoned at the end of the Ubaid period and therefore never developed into a major city.[76] Two charcoal samples from Phase I of the occupation give calibrated radiocarbon ages of ca. 5360 and 5600 BC (based on analyses by Valladas et al.,[77] recalibrated by Hritz et al.). Unfortunately, the error bars are relatively large, partly because this is a nonideal part of the radiocarbon calibration curve that causes some magnification of analytical errors.[78] Another very early Ubaid site, As-Sabiyah in Kuwait, has yielded charcoal dating to 5430 BC.[79] In comparison, the oldest dated organic material at Uruk, from a deep sounding of the Eanna temple complex, gave a calibrated age of ca. 5000 BC (fig. 7).

Shell material has been radiocarbon dated from both Oueili and Eridu, the latter from samples of clay bricks near the base of the mound. This material gives ages as old as 6300 BC from Oueili and 5700 BC from Eridu.[80] However, these ages cannot be used to date the occupation. They almost certainly represent shells that were incorporated into clay deposits used by later settlers to make clay bricks. The younger of these clay deposits may even have been laid down by Noah's Flood itself.

It is concluded that the Flood most likely occurred around 5700 BC, before the settlement of Oueili, corresponding to the radiocarbon age of the upper part of the sapropel layer dated by Aqwari. This early date makes the extreme effects described in the Flood narratives much more credible. At this time, lower Mesopotamia had only recently been colonized by people migrating southward from the villages of

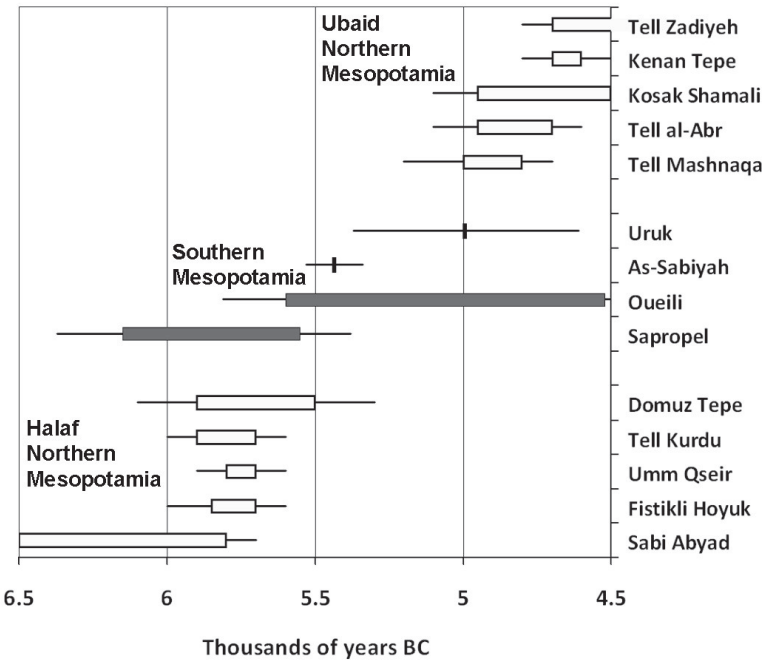

Figure 7. Calibrated C-14 dates on well-constrained dating material from different sites. Wide bar = range between oldest and youngest reliable ages, thin bars = 95% confidence limits on ages.

northern Mesopotamia where the agricultural revolution began. These people would have been living in small settlements on the immediate banks of the Euphrates, and their nascent civilization would have been completely overwhelmed by the greatest flooding event that Mesopotamia has ever seen. In such circumstances, it is not hard to see how the devastation of the Flood would have seemed like a return to cosmic chaos.

Construction of the Ark

A question that arises from a Late Neolithic date for the Flood (nearly 3,000 years earlier than the widely accepted date) is whether the pre-Chalcolithic peoples of Mesopotamia would have been capable of constructing the Ark described in Genesis. The quoted dimensions of 300 cubits long, 50 cubits wide, and 30 cubits high, when translated into the form of a ship, would make the Ark the largest wooden vessel ever to float, with a size equivalent to a small container ship.

The largest commercial wooden ship ever built was the schooner Wyoming, launched in Maine in 1909 and weighing 3,400 tons.[81] The hull was 330 feet long, making her 120 feet shorter than Noah's Ark, and she was also strengthened with iron cross-bracing. Nevertheless, the size of her hull caused excessive flexing of the planking in heavy weather, causing her to habitually leak and eventually to sink in a storm. This experience suggests that a wooden ship of the size and type commonly illustrated in children's Bibles is unlikely to have survived the Flood, even if it could have been built. But, in fact, the popular conception of the Ark as a wooden "cargo ship" is not biblically based. A literal translation of the relevant verses in Genesis 6:14 and 6:16 reads as follows:

> *Make for yourself a basket-vessel of building-wood; nests you shall make together with the basket-vessel; and you cover inside the house with pitch and outside with pitch.*
>
> *Noon-day you shall make for the basket-vessel, and to a cubit you shall end it above, and a door of the basket-vessel in the side you shall put; lower, second and third you shall make.*

This translation is somewhat opaque, but it is based on Hebrew word usages elsewhere in the Old Testament. For example, the Hebrew word for the Ark is unique to the Flood story and the story of Moses's birth, when his mother places him in a basket of papyrus covered in pitch. In contrast, the Hebrew word used for the Ark of the Covenant is the same as for a money chest. Therefore, Noah's Ark was not a wooden box. On the other hand, a better understanding of the nature of the Ark can be gained by comparing the biblical account with Mesopotamian descriptions of its building.

In the Atrahasis and Gilgamesh epics, the Flood Hero is given a dream or vision in a reed hut, where he receives the instruction, "Dismantle your house, build a boat." This type of reed hut can still be seen in modern Iraq,[82] where the Marsh Arabs construct communal buildings up to 100 feet long and 30 feet high called mudhifs. These structures are based on a framework of giant reed bundles, covered with reed matting and waterproofed with pitch.

The dimensions of the Ark in the Gilgamesh Epic seem to approximate a giant cube. However, Stephanie Dalley suggested that what was actually intended was a scaled-up version of a tub-shaped craft called a quffah, usually made by covering a wooden frame with bitumen-coated reed matting.[83] Unfortunately, this description is missing from the Atrahasis Epic, due to damaged areas of the tablet. However, a small tablet that appears to fill this gap was recently described by Irving Finkel.[84] This so-called "Ark Tablet" is dated to around the same time as the Atrahasis Epic (ca. 1700 BC), and uses the same name for the Flood Hero (Atrahasis, meaning extra wise). The tablet gives detailed instructions for building the Ark, describing it as circular, with a diameter of about 230 feet (70 m). It was apparently to be constructed like a giant basket, by winding a thick "rope" made of palm fiber into an enormous spiral mat, and attaching this to a wooden frame before covering it with pitch. Hence the craft is clearly a giant quffah, of the type previously proposed by Dalley.

A scaled-down version of the "Atrahasis Ark" with a diameter around 50 feet was constructed in 2014 as part of a TV documentary about the Ark Tablet.[85] Although scaled down from the dimensions in the tablet, the "TV Ark" was about three times the diameter of the largest known quffahs from Iraq (which have a diameter of 15 to 20 feet). The experiment showed that scaling up a design in this way is impractical, because when launched, the vessel leaked badly and was only made to float with the assistance of a high-powered pump. This

suggests that the design of the Ark described in the Mesopotamian accounts was a *conceptual* scaling-up of later commercial vessels, rather than an eyewitness description of the actual Neolithic Ark.

The type of vessel described in the Ark Tablet is quite similar to the idea of a giant basket, as implied by the Hebrew word for the Ark. A waterproof basket can be made of reeds or papyrus covered in pitch, but like the TV Ark, this cannot be scaled up to the reported size of Noah's Ark and still be seaworthy. In addition, the biblical instructions for building the Ark imply that it was made primarily of the type of wood normally used for building houses. This type of material does not lend itself to basket making. However, it is inherently buoyant, and can therefore be used to make a giant raft.

Most wooden rafts are made by tethering together a bottom layer of large spars or tree trunks, and then lashing a second layer of spars across them at right angles to make a floating platform on which a shelter can be erected. This type of design is used at the present day to ship rafts of teak or bamboo down the Irrawaddy River.[86] The raft would also have needed a fence round it to keep the animals from falling off, forming a kind of stockade. Hence, such a vessel could have had the appearance of a giant basket.

Another basis for comparing the Ark with a giant basket arises from the Hebrew word used for the habitations on the Ark (*qnen*), the singular of which is translated *nest* in other biblical occurrences. Jason McCann has argued that the Hebrew root of this word relates to construction from material like reeds,[87] and his theory is supported by the New Jerusalem Bible, which translates Genesis 6:14 as follows:

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

As pointed out by McCann, this translation of Genesis 6:14 is consistent with the Atrahasis and Gilgamesh accounts, both of which describe three components used to build the Ark: wood, reeds, and pitch. Therefore, this also implies the building of a typical Marsh Arab mudhif on a raft.

Mudhifs are constructed with a framework of large reed-bundle arches, the ends of which are usually buried in the ground. However, the same framework could easily be built into the structure of a raft (fig. 8). To complete the mudhif, the framework is covered in reed matting, which must be waterproofed with pitch to repel rain. Therefore the use of pitch in Genesis 6:14 may refer to covering one or more mudhifs with pitch rather than the raft itself. Similarly, the reference to making "noon-day" for the Ark, usually taken to mean a window, probably refers to the lattice-work that forms the end of a typical mudhif to admit light to the interior. Genesis 8:6 reports that Noah opened this window to release the raven after the Flood.

One of the reasons why the Ark has traditionally been identified as a wooden ship is the reference in Genesis 6:16 to it having three decks. However, the Hebrew text does not contain any mention of decks, but simply gives instructions for building the Ark, with "lower, second and third." These instructions more likely refer to the horizontal reed bundles that complete the framework of the mudhif, and are anchored to the vertical bundles by large hoops or rings also made of bundles of reeds (fig. 8). These hoops form an essential part of the structure, and became an important symbol in later Sumerian iconography. The horizontal bundles have the *appearance* of deck-beams, although mudhifs do not normally have internal floors. The lowermost of these horizontal bundles would have been critical in anchoring the reed framework to a raft (fig. 8), since the vertical reed bundles could not be buried in the ground like a normal mudhif.

A critical feature which the Genesis text shares with the Mesopotamian accounts is the reported deck area of the vessel (Gen. 6:15). In the Gilgamesh Epic, the

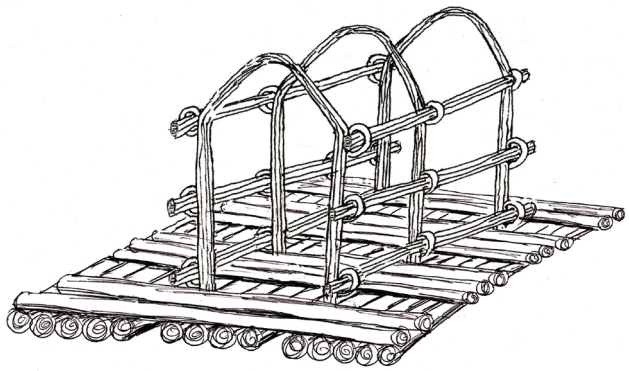

Figure 8. Schematic drawing of the framework for a reed-built mudhif installed on a wooden raft. Note that the overall size of the raft was larger than this. Modified after Jacobsen.[88]

Flood Hero specifically describes the construction as follows:

> *By the fifth day I had set her hull in position, one acre was her area.*[89]

In the Ark Tablet, Enki gives instructions that are identical in size:

> *Draw out the boat that you will make on a circular plan,*
> *Let her length and breadth be equal, Let her floor area be one field.*[90]

The words "acre" and "field" are alternative translations of the Akkadian ideogram IKU,[91] a standard unit of area that seems to be derived from the Sumerian word for a dyked (one acre) field.[92] A Sumerian acre was defined as a field measuring 60 feet by 600 feet (smaller than an English acre). And although the biblical instructions for building the ark have different proportions, it is significant that the surface area (ca. 34,000 square feet) is almost exactly the same.[93] So, rather than seeing these as the dimensions of an impossibly large ship, we should view the Ark as a "floating field." In fact, the Marsh Arabs still build artificial islands in the marshes of southern Iraq by laying down a reed-mesh framework and filling it with mud, to build a platform for their reed huts and a dry resting place for their water buffalo. In comparison, we can conceive that the original Ark was a giant floating raft made of logs on which the animals lived, with one or more mudhifs for human habitation.

The timber required for a raft of this size might amount to a few thousand tree trunks. Although timber was scarce in later historical times, this number of trees would have been available from the riverbanks of ancient Mesopotamia, the principal site where mature wilderness would have existed. Similarly, the pitch necessary for waterproofing probably came from near the Euphrates River at Hit, 150 km west of Baghdad.[94] Hence, both these materials could have been transported by water to the construction site of the Ark on rafts.

In the absence of metal tools for felling trees, the Late Neolithic peoples of Mesopotamia would have used implements made from flint, obsidian, or highly fired clay. The latter type of implement has been found in the Ubaid-period ruins at Oueili.[95] Therefore, when we shed some of our modern preconceptions, the ancient description of the Ark may not be as far-fetched as it initially seems. Such a craft could indeed have been built in the Late Neolithic period.

Implications for Primeval History

The proposed Neolithic date for the Flood has major implications for how Genesis is read as a record of the real experiences of ancient Middle Eastern peoples. Based on Old Babylonian versions of the Sumerian King List, a 2900 BC Flood would have been a comparatively late event in the Mesopotamian prehistory of Genesis, nearer to its end than its beginning. However, given the biblical setting of Cain and Abel in the Neolithic period (after the agricultural revolution around 8500 BC), the proposed new date for the Flood places it much nearer to the time of Adam than of Abraham.

A well-known feature of the Priestly Flood story in Genesis is the idea that the Flood was a return to cosmic chaos.[96] This idea seems far-fetched from a modern perspective, especially given the view discussed above that the Flood story was more of a parable than a real event. However, if the Flood occurred only a few hundred years after God's first revelation to humankind in southern Mesopotamia, the catastrophic flooding of the whole Mesopotamian plain for a whole year could indeed have seemed like a return to the beginning of creation. Hence, the view of Noah as a new Adam (Gen. 9:1) seems quite reasonable.

Since Noah offered sacrifices after he emerged from the Ark, it seems inevitable that the Ark would have been preserved for many years as a shrine. It would have had huge religious and cultural significance as the preserver of human life during the cosmic disaster. Most likely it would have been repaired for many decades *in situ*, and the enclosing fence may have made it look more like a holy enclosure than a raft, prompting later observers to think that it floated like a giant basket. On the other hand, the mudhif on the Ark probably become the archetypal Holy of Holies, representing the place where God spoke with Noah.

It has been pointed out before that Mesopotamian temple architecture often refers back to a primeval reed hut as the archetype of the sacred shrine.[97] This motif was used in an Early Dynastic dedicatory inscription, in which King Ur-Nanshe of Lagash invoked the "pure reed" of the primeval shrine as a blessing on a new brick-built temple.[98] This inscription (ca. 2500 BC) gives one of the earliest written descriptions of the reed-built shrine, and it specifically describes the pillars of the shrine built from reed bundles, including the hoops that held the

structure together (fig. 8). By the end of the Late Uruk period (ca. 3300 BC), these reed pillars with hoops attached, forming the "ring-pole standard," had become emblematic of Sumerian sacred architecture, as shown on an early cylinder seal (fig. 9a).

The ring-pole standard also gave rise to the cuneiform sign for temple cities such as Ur (fig. 9b).[99] On this fragment of a clay tablet, the city of Ur is indicated by the first panel on the right-hand side. Here, the ring is simplified into a triangle to facilitate drawing with a stylus, and the standard is combined with a simplified picture of a ziggurat temple. Finally, on another cylinder seal, ring-pole standards with three pairs of rings are shown on either side of a brick-built temple (fig. 9c). In this detailed image, the origin of the ring-pole as a bundle of reeds is indicated by the horizontal bindings at intervals along its length.

The ring-pole emblem runs through the whole history of Mesopotamian religion, linking the monumental temple architecture of the fourth, third, and second millennia with their earliest forerunners after the Flood, consistent with Noah's Ark being the primeval shrine of Sumerian religion. However, the long duration of Mesopotamian civilization gives more than enough time for the early true religion of Noah to be corrupted into the polytheistic pagan culture that Abraham was called to leave. ✧

Notes

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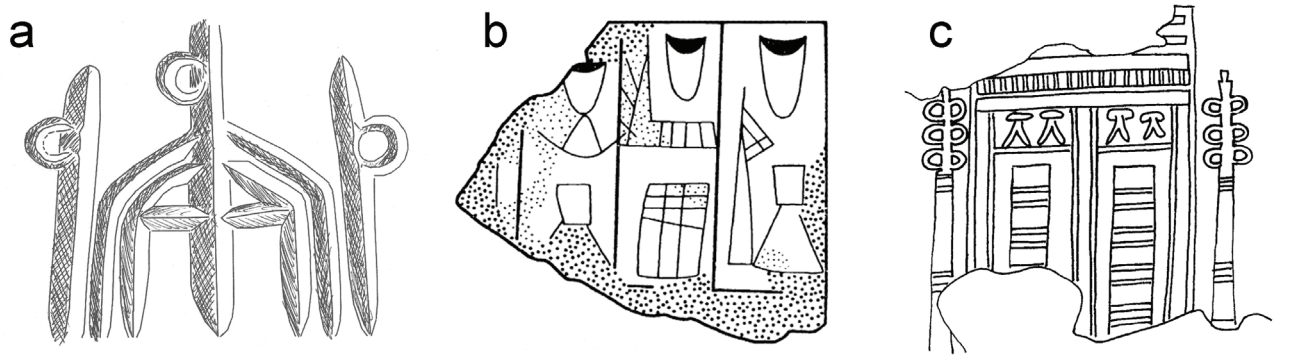

Figure 9. Drawings showing the ring-pole standard in early iconography: (a) Uruk-age cylinder seal showing a reed-built shrine,[100] (b) Protoliterate-age tablet showing cuneiform signs (right) for the city of Ur,[101] (c) Uruk-age cylinder seal showing a reed pillar next to a brick-built temple.[102]

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