

## **Archaeoacoustics and the Fall of Jericho**

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### **Abstract**

The conquest of the Canaanite city of Jericho by Joshua's forces, as famously narrated in the Hebrew Bible, was a fascinating archaeoacoustic event. There were horns blowing, feet marching, shouts, the sounds of the wall falling, a fierce battle, and a great fire. Bible believers do not doubt that the conquest of Jericho took place as described in the historical account, and that the wall fell by Divine action. Skeptics say that archaeology proves there was no destruction of Jericho at the time in history when it should have occurred. Discussion of these issues shows that one's worldview will ultimately determine acceptance or rejection of the Jericho event as real history.

### **Introduction**

Ancient warfare was tumultuous, and attacking forces were ruthless in their destruction. In this, the conquest of the Canaanite city of Jericho by Joshua's forces, as narrated in the Hebrew Bible in Joshua 6, was not unusual. A parallel example of this event is found in the annals of the Assyrian king Tiglath-Pileser I, who describes (we might say with relish) how he burned, razed and destroyed enemies' cities, made them into ruin hills and heaps, cut off the inhabitants' heads and made the blood flow into the hollows and plains of the mountains (Younger 1990, pp. 80–81).

However, Jericho's defeat by Joshua's forces was distinguished by some unusual features that included a Divine miracle in making the city's wall fall. This latter aspect has naturally raised skepticism from those who do not accept the biblical narrative literally.

Many scholars deny that the Exodus of the Children of Israel from Egypt and their conquest of Canaan really happened, and claim that the stories are merely traditions and myths (see, for example, Rogerson 2014, pp. 21–22). On the other side are those who believe that these events happened exactly as the Bible narrates. Nobody denies that there is a ruined tell (Tell es-Sultan)

on the Jericho plain where successive walls fell and fierce fires destroyed the city repeatedly during the third and second millennia BC (Nigro 2006).

### **Background of the Story**

The Bible relates in the book of Exodus that in Egypt the Children of Israel, Jacob's descendants, had been under heavy bondage to a tyrannical pharaoh who forced them to do extremely hard labor under cruel taskmasters. God raised up Moses to deliver his people from the Egyptians and lead them to their promised land of Canaan. The pharaoh finally allowed them to leave after God sent ten plagues to destroy Egypt: all surface water turned into blood, frogs, biting insects, wild animals, livestock disease, boils, fiery hail, locusts, darkness and finally, deaths of all the firstborn of people and animals in the land. (The Israelites, who were living in Goshen, were exempt from all these afflictions.) This miraculous deliverance out of Egypt is commonly called the Exodus.

With Moses as their leader, the people headed en masse for their promised land, Canaan, to conquer and inhabit it. God forced them to wander in the wilderness between Egypt and Canaan for 40 years as punishment, because they had made Him angry. Finally they arrived at the Jordan River, the eastern border of Canaan, with Joshua now their leader. The first city they had to conquer was Jericho, located strategically on the eastern edge of Canaan, near the Jordan River (see Figure 1). The fame of the Exodus and related events had preceded them, and fear of the Children of Israel had spread far and wide (Joshua 2: 9–11).

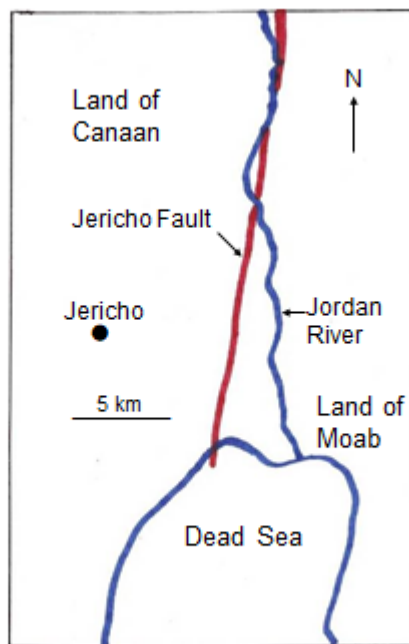


Figure 1. Map of the north end of the Dead Sea, showing the position of Jericho relative to the Jordan River and the Jericho Fault. The Children of Israel crossed the Jordan River from the east to the west and camped between Jericho and the river before conquering the city. (Habermehl 2017, after Al-Zoubi et al. 2007)

### **About Jericho**

Situated in a key location north of the Dead Sea at 258 m (846 ft) below sea level, the ancient city of Jericho was founded about 11,000 years ago on the standard timeline of history (Kenyon 1998), making it nearly as old as Göbekli Tepe in southern Turkey. Its name most likely comes from the ancient Canaanite moon god Yarikh (also spelled Yerach); Jericho was an early center of worship of this god (Noll 2013, p. 337). It was called the city of palms because a copious year-round spring watered the area and many palms grew there. Over the millennia it had been destroyed and rebuilt many times, and had built up into a tell that is today called es-Sultan (Nigro 2006). (The modern city of Jericho is situated nearby.)

In Joshua's day, the wall probably enclosed about 3 ½ hectares (8.5 acres) (Gabriel 2003, p. 121). Clearly some of those ancient cities were quite small by today's standards. The Jericho that Joshua and his forces encountered was well fortified by a wall with towers at intervals. Rahab, the harlot, helped Joshua's spies escape by secretly letting them down outside the city wall on a cord through a window (Joshua 2:15) to avoid the pursuing soldiers of the king of Jericho.

As shown in Figure 1, the ancient tell sits almost directly on a geological fault (called the Jericho Fault) that runs north from the Dead Sea (see Al-Zoubi et al. 2007, p. 57). Because of this fault, and the geological structure of the area, Jericho has seen many earthquakes throughout its history.

### **Acoustics of the Event**

According to the Hebrew Bible, God told Joshua how he was to conquer Jericho (Joshua 6). A procession of warriors, followed by seven priests blowing rams' horns, priests carrying the sacred Ark, and a rear guard, was to march around the city once a day for six days, and seven times on the seventh day. The mass of people was to surround the city (outside the circuit of the procession) as onlookers each day. For six days the people were to remain quiet. After the seven circuits on the seventh day, the priests were to blow a long blast on the horns and all the people were to shout loudly. God promised that the wall would immediately fall flat—which it did, no doubt with loud sounds of tumbling masonry. This was followed by the sound of the battle on top of the tell (mound), in which all human and animal occupants of the city were killed by sword (except Rahab and her family). Last of all was the roaring sound of the fire that destroyed the city. We will look at these elements individually.

**The Shofar** is a hollow animal horn, the traditional trumpet of the Jewish people from early times to this day. The shofarot (plural of shofar) in the Bible were rams' horns (Montagu 2015,

pp. 3,4), and therefore those blown at Jericho would have been from rams. (The shofar had to be specified because there were also silver trumpets used in the tabernacle rituals (Numbers 19:1,2)). The shofar could be compared to a bugle because its pitch could be changed by the embouchure of the player. Although it was prescribed for use at different times in Jewish rituals, it was an important instrument for war; see Adler (1894, pp. 444–446) for a list of 19 biblical instances of blowing the shofar for war. It appears from these biblical citations that it was a loud instrument, and seven of them were blowing simultaneously at Jericho. In Egypt in the time of King Tutankhamun, trumpeters blew short notes to time the steps of the marching soldiers (Williams 2003); we might expect that the Children of Israel, who had lived in Egypt for 215 years, would have followed a similar military tradition. According to Goldman (1999, pp. 220–221), the blowing of these horns would not have contributed to making the wall fall because the horns' vibration frequency range was too high.

**Marching.** The march around Jericho was possibly not a strange custom to the inhabitants of the city. As Waltke (2007, p. 519) says: “The royal march around the city is based on widespread custom in the ancient Near East of laying claim to territory by tracing out its bounds.” The number of soldiers that Joshua would have commanded, and who would have marched in the procession around Jericho, is estimated by Gabriel (2003, pp. 113–114) to have been about 8,000 men. How loud a sound their marching feet would have made on the ground around Jericho with the footwear of that time is difficult to say. They would most likely have worn leather sandals as sandals are mentioned in scripture as footwear of the Children of Israel during their trek from Egypt (e.g., Deuteronomy 29:5).

But audible sound is not the only result of the marching. Experts include infrasounds (cycles per second in the range below what the human ear can hear) in the science of acoustics. Goldman (1999, pp. 220–221), a mechanical engineer who specializes in vibration analysis and pulse theory, says that it was likely the marching feet of the soldiers in the procession that would have caused the low-frequency vibrations needed to make the wall fall. His reason was that the wall would have had a natural frequency close to that produced by the marching feet. Jones (2001, p. 2), an expert in viscoelastic vibration damping, also mentions that the vibrations of Joshua's marching soldiers supposedly are what made the wall fall. He cites the failure of the Tacoma Narrows bridge in 1940 in the State of Washington as an example of vibrations that became excessive; in that case the wind (64 km/hr) caused the damaging vibrations. However, if marching could cause city walls to fall, we might wonder why we do not have reports of the walls of other cities falling down from marching as well.

**Shouting.** After the 7<sup>th</sup> circuit on the 7<sup>th</sup> day, all the people were to shout at the same time as the trumpets blew. How many people were there, and how much noise did they make? According to Gabriel (2003, pp. 113–114), the number of the Children of Israel of all ages would have been about 35,000. Goldman (1999, pp. 220–221) says that the shouting would have served mainly to

terrify the inhabitants of Jericho, but would not have contributed to making the wall fall because the frequency of the vibrations produced from the voices was too high.

**Earthquake:** Because Jericho sits almost on top of a geological fault (as noted earlier), an earthquake could have caused its wall to topple; this quake would have been accompanied by low rumblings or various other noises from the ground's movement (Hill 2011). If an earthquake caused Jericho's wall to fall, believers consider that its timing just at the moment of the 7<sup>th</sup>-day shofar blowing and the people's shouting had to have been a Divine action. Doubters, who do not accept the historicity of the biblical account, prefer to say that earthquakes may have destroyed the city at some not-specified time or other. Rucker and Niemi (2010, p. 103) warn about circular reasoning in claiming that an earthquake happened at a certain date in ancient history, and then tying specific earthquake damage to that date. (We will not consider the possibility that aliens made the wall fall, as promoted in the Ancient Aliens 2017 TV episode.)

**Falling of the wall:** How much sound this would have made cannot be estimated with any certainty. We do not know what the wall was built of (whether only mudbrick, or mudbrick on a stone foundation), and what its height and thickness were. Which fortifications from what era are also in question, as it is possible that archaeologists have been looking at the wrong set of walls in their discussions. They believe that there was a set of two walls in place, one around the top of the tell and one around the bottom, although the biblical account consistently says "wall," singular. (For a description of this set of walls, see Wood 1999.) Further discussion of this is in the section below on dating the walls.

**Battle Sounds:** After the wall fell, the soldiers were instructed to go straight up the mound into the city and kill all the inhabitants (except Rahab and her family) and all animals (Joshua 6:5). We would expect that this part of the conquest of the city would have entailed considerable sounds of terror from the occupants.

**Fire.** The Jericho city structures would have been made of mudbrick, as most buildings in the Near East have been since Neolithic times right up to the present day (Forget and Shahack-Gross 2016). These authors did research on heating mudbricks, and determined that ancient cities may have burned a lot faster than had previously been believed, in as little as 2–3 hours. As anyone knows who has burned wood in a fireplace, the faster the fire burns, the louder it roars. The fire that burned Jericho may have been a loud conclusion to the city's conquest.

### **Did This Event Really Happen? If So, When?**

Today many theologians deny that the biblical stories of the Old Testament are real history. These scholars do not care whether there ever was a Joshua, let alone a conquest of Canaan.

According to them, the narrative of the fall of Jericho should not be taken literally (e.g., Thompson 1999, pp. 34–44) and therefore this event did not happen.

Archaeologists, however, look to the results of their excavations for verification or denial of biblical events. One of the reasons most often given by archaeologists for disbelieving the literal conquest of Jericho as related in the Bible is that there was no walled city of Jericho in place at the time of the claimed biblical conquest; therefore they claim that the biblical account is not historical. Kathleen Kenyon, whose excavations at Jericho earned her great renown, discusses some aspects of this problem (Kenyon 1970, pp. 208–212).

This raises the important subject of dating the ruins, and it is a hotly debated topic. According to the Hebrew Bible, the destruction of Jericho occurred 40 years after the Exodus from Egypt; this was the length of time that the Children of Israel wandered in the wilderness between Egypt and Canaan as a punishment from God because they had displeased Him (Numbers 32:13). The Exodus is generally considered by bible-believing scholars to have taken place at about 1450 BC (Habermehl 2013), making the conquest of Jericho about 1410 BC.<sup>1</sup> Secular scholars say that Jericho was in ruins at that time because carbon 14 dating of the top ash layer shows the destruction earlier, around 1550 BC (Howard 1993, p. 97).

But the biblical and secular timelines do not mesh, as shown by Habermehl (2015) at the Archaeoacoustics II conference in Istanbul. The divergence of these two timelines is about 350 years (counting back to the end of 12<sup>th</sup> Dynasty) or 750 years (counting back to the end of 6<sup>th</sup> Dynasty) at the time of the Exodus (Habermehl 2013); this is based on these two dynasties running concurrently and ending at the same time when Egypt collapsed because of the ten plagues. This means that the conquest of Jericho should show up on the secular timeline as early as 1750 BC or 2150 BC, or even earlier, using standard dating methods. This throws confusion into the dating because Kenyon's date is not early enough (as noted above).

I believe that it is highly possible that the dating argument is over the wrong set of walls. Like Garstang, who excavated earlier from 1930–1936 (John Garstang 1998), everyone believes that the fourth set of destroyed walls is the one that fell in Joshua's conquest (the destructions are numbered from the bottom up at Jericho, and the fourth destruction is the top one). This double set of walls looks as if it could have been destroyed by an earthquake, and there is a thick layer of ash from a fierce fire (Kenyon 1970, pp. 197–198). It seems to fit the biblical story enough to satisfy uncritical believers. However, it is overlooked that these walls do not actually fit the biblical account (Joshua 6:20–25) because Joshua's wall was singular in the Bible (not "walls"). There are also difficulties in working out how the spies were let down on the rope by Rahab, if there was a wall around the crown of the mound as well as another at the foot of the mound. (The explanation commonly given is that Rahab's house was located inside and against or on top of the lower wall, and that she did not live in the city proper).

But according to the Bible, after Joshua's conquest Jericho's fortifications were rebuilt some hundreds of years later by a man called Hiel in the time of King Ahab of Israel (I Kings 16:34), who ruled for 22 years from 918–896 BC (Jones 2007, p. 279). It is most likely Hiel's double wall that everyone mistakenly believes is the wall that fell in the biblical account, while the wall that actually fell in Joshua's time would have been an earlier one. This would solve the dating problem all around. We cannot go into further detail on this here.<sup>2</sup>

## Conclusion

Believers will consider this story to have happened as narrated in the Bible, and will be certain that God made the walls fall at the moment of the shouting and shofar blasts. For them, questions of dating will be secondary. On the other side, skeptics will look for natural reasons like an earthquake or possibly even marching feet to account for the tumbling of the walls that have been excavated at the tell es-Sultan. For them, the question of whether the capture of Jericho happened as the Bible claims is secondary. Whatever, it is doubtful that Jericho's conquest was an incidence of sonic warfare.

Which walls were the ones of Joshua's time, and whether the biblical and secular timelines diverge, are controversial matters. The question of whether or not there was a fortified city of Jericho in place at the right time remains. Ultimately it is one's worldview that will determine whether to accept or reject the literal biblical Jericho event as real history.

## Footnotes

1. Some scholars believe that the Exodus and conquest took place as late as the 13<sup>th</sup> century BC. For an excellent discussion on this, see Heater (2014, pp. 77–84).
2. A paper on this subject will be published in the future, in which I will propose that Joshua's wall was actually an earlier one, based on timeline and other considerations.

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