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Research Article

The Science Behind Supernatural Phenomena: A Critical Assessment of Jericho's Walls Devastation

Gastón Sanglier Contreras [1], Roberto Alonso González-Lezcano [2*], Eduardo José López-Fernández [3]

[1] Escuela Politécnica Superior, Department of Architecture and Design, Montepríncipe Campus, Universidad San Pablo-CEU, Madrid, Spain
[2] Escuela Politécnica Superior, Department of Architecture and Design, Montepríncipe Campus, Universidad San Pablo-CEU, Madrid, Spain
[3] Escuela Politécnica Superior, Department of Architecture and Design, Montepríncipe Campus, Universidad San Pablo-CEU, Madrid, Spain
* **Corresponding Author:** rgonzalezcano@ceu.es

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ABSTRACT

This study delves into the fascinating history of the destruction of the walls of Jericho as described in the biblical account in the book of Joshua. Over the last century, prominent archaeologists such as Carl Watzinger, John Garstang, Kathleen Kenyon, and Bryant Wood have excavated the site, confirming the existence of the ancient city and its fortified walls during the approximate period of the event.The study explores the possibility that the destruction of Jericho's walls could have a scientific explanation based on natural phenomena. The theory of resonance is proposed, suggesting that sound waves generated by the human shouting might have matched the natural frequency of the walls, weakening their structure and causing their collapse. Resonance calculations indicate that human shouting (300 Hz) was closer to the wall's natural frequency (121.72 Hz) than the trumpets (1400 Hz), implying a higher potential for resonance with the shouting.Despite these plausible explanations, the study emphasizes the historical and religious ambiguity surrounding the event. The biblical account of the conquest of Jericho has been regarded as a miraculous event, and the exact cause of the walls' destruction remains unresolved. This event has left a profound impact on Western culture and religion, with interpretations continuing to be subject to debate and contemplation.The study highlights the significance of dialogue between science and religion. Archaeology and science offer an objective and data-based perspective, while religious beliefs provide spiritual and moral meaning to historical events. The coexistence of these approaches enriches our understanding of the past and cultural heritage.The present work offers a multidisciplinary view that encompasses archaeology, science, and religious beliefs. Although plausible scientific explanations have been proposed, the exact nature of the destruction of Jericho's walls remains a mystery, underscoring the richness of historical and cultural interpretations surrounding this event.

Keywords: Conquest of Jericho; Theory of Resonance; Jericho's Walls; Historical Events; Miraculous Events; Book of Joshua.

INTRODUCTION

Since time immemorial, humanity has been intrigued by supernatural phenomena—events that defy logic and natural laws, often associated with mysticism, the inexplicable, and the divine. Throughout history, these extraordinary occurrences have been subjects of study, controversy, and fascination. From ancient civilizations to the present day, numerous cultures have recorded encounters with the unexplained, from mysterious lights in the sky to alleged encounters with beings from other dimensions (McCauley & Lawson, 2002; Shermer, 1997; Snodgrass, 1981).

In antiquity, philosophers and mathematicians like Pythagoras, considered by many as the father of mathematics, sought rational explanations for events that challenged everyday perceptions (Chiotis, 2021). Pythagoras, who lived in the 6th century BC, postulated that the world was governed by numbers and proportions,

leading some to associate his work with the esoteric and the supernatural. His school, known as the "Pythagorean Brotherhood," was shrouded in an aura of mystery and secrecy (Burkert, 1972).

Simultaneously, in various ancient cultures, narratives about supernatural events were woven, such as the famous "Conquest of Jericho." According to the biblical account in the book of Joshua, the walls of Jericho fell after seven days of procession around the city. This event has generated debates between believers and skeptics, and over time, several studies have focused on finding scientific explanations for the event, from earthquakes to ingenious military strategies (Isaak, 2007).

The story of the destruction of Jericho's walls is one of the most emblematic and enigmatic episodes in the Old Testament (B.T. Arnold, 2012; Kitchen, 2006). This account is found in the book of Joshua, chapter 6, and recounts how the seemingly impregnable walls of the city of Jericho collapsed due to the power of sound waves generated by the shouting of the Hebrew people. Throughout the centuries, this event has been a subject of debate, both from a historical and archaeological perspective, inspiring numerous analyses and reflections on its veracity and significance.

Jericó, located in present-day Palestine, was a fortified city with imposing walls, making it a formidable obstacle for any invading army. According to biblical tradition, the people of Israel, led by Joshua, stood on the brink of the Promised Land, but to reach it, they had to overcome the city of Jericho. The city was surrounded by a stone wall, making it an apparently impregnable bulwark.

Ticho (2023) narrated the famous biblical episode where God instructed Joshua on the method to conquer Jericho. The people were to surround the city once a day for six days, carrying with them the Ark of the Covenant. Seven priests were to blow ram's horns while the people remained silent. However, on the seventh day, they were to surround it seven times, and the priests were to blow the horns while all the people shouted at once. It was then that the walls miraculously crumbled, allowing the Israelites to take the city. Jericho was an important city in ancient Israel and attracted pilgrims during the early centuries of Christianity in search of the scene of Joshua's siege (Figure 1).

Figure 1. Illustration of the People of Israel Shouting and Priests Blowing Trumpets, Carrying the Ark of the Covenant. Engraving, 1851-1860.

LITERATURE REVIEW

The biblical account of the destruction of Jericho has sparked diverse interpretations throughout history. Some believe the events should be taken literally as a divine miracle, while others propose more rational explanations linked to natural phenomena. The latter perspective is based on the hypothesis that the sound waves generated by the people's shouts could have caused the walls' collapse (Dever, 2001; Tyson, 2017).

Moreover, the musical realm has immortalized the fall of Jericho through various compositions and choruses, such as the renowned "Joshua Fit the Battle of Jericho," an African-American spiritual that highlights the victory of the people of Israel over the fortified city. These artistic representations not only perpetuate the story but also disseminate its symbolic and transcendent meaning. Beyond the artistic realm, intensive archaeological research has also focused on the destruction of Jericho. Advancements in science and technology have prompted experts to

unravel the mysteries behind this ancient city and its imposing walls. Archaeological and scientific studies have shed light on the possibility of a scientific explanation, rather than a solely divine one. Some researchers suggest that the sound waves emitted by the people's shouts could have resonated with the stones' natural frequency, resulting in a resonance effect that weakened the structure.

Supporting this theory, American geologist Dr. John Long argues that Jericho's wall stones had a natural frequency close to human vocal frequencies, potentially making the sound waves significantly affect the stones. Additionally, the significance of the number seven in the biblical narrative has intrigued researchers. The Israelites marching around the city seven times has led some to propose that this number may have held a symbolic function beyond its literal meaning. It is suggested that seven had a mystical and sacred meaning in antiquity, and its repetition in the story could have been used to emphasize the event's transcendence.

Conversely, there have been discrepancies and debates among archaeologists regarding the exact chronology and nature of Jericho's walls' destruction. Some scholars argue that the wall's collapse could have resulted from an earthquake, given Jericho's location in a seismically active zone. This theory is based on the presence of cracks and signs of seismic activity in the archaeological remains of the city. However, other archaeologists maintain that geological evidence is insufficient to dismiss the possibility that sound waves generated by the people's shouts may have also contributed to the wall's collapse. The biblical account mentions the use of trumpets and shouts, suggesting that the acoustic element could have played a crucial role in the event. Despite the diverse interpretations and theories, the tale of Jericho's wall destruction continues to hold significant importance in Judeo-Christian tradition and remains an intriguing subject for academic study and public interest. Regardless of the historical accuracy of the narrative, this event has left an indelible mark on Western culture and religion. Over the centuries, it has inspired theological, artistic, and philosophical reflections, prompting contemplation of the nature of divine power and natural phenomena.

Ultimately, regardless of the interpretations made regarding this historical account, the destruction of Jericho's walls has left a profound impact on Western culture and religion. Throughout time, it has been the subject of theological, artistic, and philosophical contemplation, and has inspired numerous reflections on the nature of divine power and natural phenomena. Additionally, the archaeological study of ancient Jericho has provided valuable insights into the city's past and the construction techniques used in that era. As science and rational inquiry continue to advance, many supernatural stories have been questioned and subjected to scrutiny. Nevertheless, inexplicable phenomena still ignite our curiosity, prompting us to explore beyond what science has thus far explained. This study delves into the past to explore the historical roots of supernatural phenomena, from antiquity to modern times, investigating how different cultures have interpreted them and attempting to uncover their scientific underpinnings. Through a comprehensive review of historical and scientific sources, it aims to shed light on the enigmatic world of the supernatural and its relationship with human thought throughout the centuries.

In conclusion, the biblical account of Jericho's walls' destruction is a historical event that has elicited both fascination and debate over the centuries. Whether interpreted as a divine miracle or a natural phenomenon based on sound waves and the people's shouting, this episode has left a lasting impression on human history and continues to be the subject of study and contemplation today.

As we continue to explore the historical and archaeological aspects of Jericho, it becomes evident that the city's origins date back to approximately 10,000 BC. It served as a frequent campsite for hunter-gatherers of the Natufian culture. However, it was only after the end of the Younger Dryas period, around 9,600 BC, that permanent settlements began to emerge in the region, inhabited year-round. The first permanent settlement, known as Tell es-Sultan or the Hill of the Sultan, was established about 2 kilometers north of present-day Jericho. This pre-pottery Neolithic settlement, belonging to the New Stone Age, was situated near the Ein as-Sultan spring (later referred to as Elisha's Spring) and was supplied with water from this source. By approximately 9,400 BC, the settlement experienced significant growth, boasting over 70 circular dwellings with diameters of around 5 meters (16 feet), constructed using materials like clay and straw.

During the 19th century, Charles Warren's excavations yielded few artifacts, which discouraged further exploration. However, in 1907-1911, Sellin and Watzinger (1913) identified walls dating to the 14th-13th centuries BC, linking them to the ones Joshua purportedly destroyed. Subsequently, Garstang (1941) discovered even earlier levels at Jericho, dating back to the Mesolithic period around 12,000 BC, which challenged the dating of the destroyed walls.

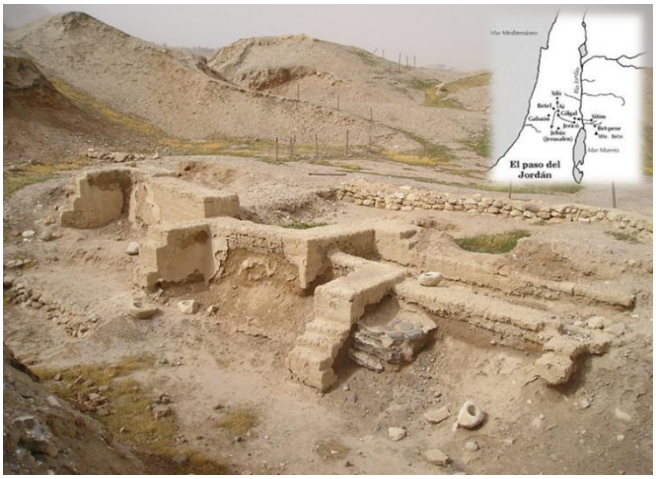

Figure 2. Image of the Ruins of Tell Es-Sultan in the Jordan Valley

The resolution of the Jericho enigma came through Kathleen Kenyon and her team in the 1950s. Kenyon applied modern archaeological methods, such as Mortimer Wheeler's grid method, and refined ceramic dating. She discovered that Jericho had roots in the Mesolithic period, with a circular defensive tower dated to around 7,000-8,000 BC. Kenyon also found human skulls modeled with plaster and two large stylized human statues from Neolithic levels around 7,000 BC. An image of the ruins of Tell Es-Sultan in the Jordan Valley is shown in Figure 2.

Figure 3. Archaeological Excavations Conducted at the Sites of the City of Jericho

Figure 3 shows the archaeological excavations conducted at the sites of the City of Jericho. Despite the expectations, Kenyon found no evidence of walls destroyed by Joshua during the estimated period (14th-13th centuries BC). Her research revealed that Jericho had a defensive system from the Middle Bronze Age, which was likely destroyed by an earthquake around 1550 BC. No indications of walls being rebuilt and resisting the Israelite siege were found. The city remained sparsely inhabited until the Iron Age around 1200 BC, according to biblical accounts (Mazar, 1992).

Around 1400 BC, Jericho became the first city the Israelites attacked after crossing the Jordan River and entering Canaan (Noll, 2001; Redford, 1993). According to the biblical narrative in the book of Joshua, Jericho's walls collapsed when the Israelites encircled it for seven days, carrying the Ark of the Covenant. On the seventh day, under Joshua's orders, the people blew horns made of ram's horns and shouted, resulting in the wall's fall. Archaeological excavations at the site have revealed a network of collapsed walls dating to the late 17th or early 16th century BC. The most probable cause of the collapse appears to have been an earthquake. Descriptions of similar destructions by subsequent earthquakes, dated to 1267 and 1927, match the description of the fallen walls in the Bible. In these descriptions, the cliffs near the Jordan River collapsed into the river, temporarily damming it (Wood, 1990).

Nonetheless, some non-biblical scholars view the Jericho story as an allegory, arguing that it was written long after the supposed event, around 722 BC, as a claim for territory for the Kingdom of Israel (Van de Mieroop, 2007). However, biblical scholars point to the destruction of the walls 175 years earlier as evidence of the biblical story's authenticity. They suggest that the discrepancy in the Bible's dating could be due to different interpretations or historical recording errors, and maintain that the earthquake could have been perceived as a reward from God for the Israelites' obedience. After the destruction, Jericho remained unoccupied until, according to the Bible, Hiel the Bethelite established himself there in the 9th century BC. This ancient city has left a profound mark on Western culture and religion, inspiring literary, artistic, and musical expressions and other areas of the world (D. Arnold, 1991). As time has advanced, modern science and the scientific method have prevailed, leading to the questioning of many supernatural stories and subjecting them to rational scrutiny. Nevertheless, despite the progress in knowledge, inexplicable phenomena continue to pique our curiosity, encouraging us to explore beyond what science has explained thus far.

This study delves into the past to explore the historical roots of supernatural phenomena, from antiquity to modern times, investigating how different cultures have interpreted them and attempting to uncover their scientific underpinnings (Greene, 2004). Through a comprehensive review of historical and scientific sources, it aims to shed light on the enigmatic world of the supernatural and its relationship with human thought throughout the centuries.

In conclusion, the biblical account of Jericho's walls' destruction is a historical event that has elicited both fascination and debate over the centuries. Whether interpreted as a divine miracle or a natural phenomenon based on sound waves and the people's shouting, this episode has left a lasting impression on human history and continues to be the subject of study and contemplation today. The archaeological findings and scientific theories offer valuable insights into the ancient city of Jericho and its significance in shaping cultural and religious beliefs. The study serves as a testament to the interplay between science and faith and the importance of exploring the past to gain a deeper understanding of our collective human journey.

METHODOLOGY

Below is a general description of the methodology followed to address this approach.

Collection of archaeological and geological data:

The first step is to gather relevant archaeological and geological information about the city of Jericho and its walls, as partially presented in the previous section. This includes data about the type of materials used in the walls, their height, thickness, and overall design. Information about the natural frequency of the stones or materials used in the construction of the walls has also been obtained.

Determination of material's mechanical properties:

It is essential to understand the mechanical properties of the construction materials of the walls to perform accurate calculations. This includes factors such as density, elasticity, Young's modulus, and other characteristics that describe how the material responds to applied forces.

Study of the seismic environment of the region:

The region where Jericho was situated is seismically active, so it is necessary to research and analyze historical earthquake records and seismic characteristics of the area. This will provide insights into the magnitude and frequency of earthquakes that might have affected the city in the past.

Calculation of the natural frequency of the walls:

To determine the natural frequency of the walls, mathematical models and structural analyses would be used. This involves considering the geometry and mechanical properties of the materials to calculate the frequency at which the stones or structures would naturally vibrate in response to a disturbance.

Evaluation of human shouting frequency:

In this step, the typical frequency of human shouting will be analyzed based on previous research and measurements. Other factors, such as sound dispersion and propagation through the air and terrain, would also be considered.

Comparison of frequencies and resonance analysis:

The critical step would be to compare the natural frequency of the walls with the frequency of human shouting to determine if there is a possible resonance. If the frequencies are close or identical, calculations would be performed to assess the magnitude of the resonance and how it could affect the structure of the walls.

Simulation and validation:

Computer simulation techniques could be used to model the behavior of the walls under resonance conditions. These simulations should be based on the collected information and calculations done earlier. Validation of the simulation results would be crucial to support the claim that resonance might have caused the collapse of the walls.

It is important to note that this approach would require precise data and numerous assumptions since many details of the historical event are likely unknown or subject to interpretation.

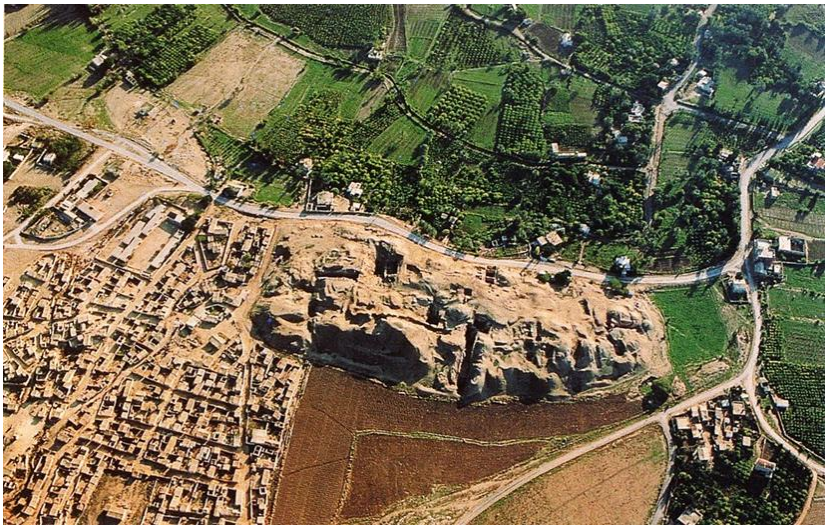

Figure 4. Aerial Image of the Remains of the City of Jericho

Figure 4 shows an aerial image of the remains of the City of Jericho. The function of the wall appears to have been the protection of the settlement from floods, while the tower had a ceremonial and social purpose (Aldrete, 2004). Scholars have theorized that the tower served to encourage participation in communal lifestyle and maintain social organization in the city. Population estimates vary significantly, placing the number of inhabitants between a minimum of 300 and a maximum of 3000. As mentioned earlier, several centuries ago, an initial settlement in Jericho was abandoned, and around 7000 BCE, an invading village established a second settlement that absorbed the original inhabitants into its culture. This new settlement belonged to the pre-pottery Neolithic period and brought significant advances in plant domestication, including the possible domestication of sheep. The structures during this time consisted of rectangular buildings constructed with mud bricks. Each building had several rooms arranged around a central courtyard. These rooms had terrazzo floors made of lime, while the courtyard was coated with clay.

The culture of this settlement also showed progress in technology, with the emergence of flint tools such as arrowheads, sickle blades, burins (used as chisels), scrapers, and stone axes. Grinding stones, hammer stones, and greenstone axes were also found. Additionally, the inhabitants carved plates and bowls from soft limestone, demonstrating their artistic and practical skills. One of the most distinctive aspects of this culture was their treatment of the deceased. They preserved the heads of deceased family members, plastered the skulls, and painted the features of the person on them. These skulls were kept in homes, while the rest of the body was buried.

This settlement thrived until approximately 6000 BCE, and then, for at least 1000 years, there is scarce evidence of occupation in Jericho. This fascinating archaeological history reveals the development and evolution of an ancient civilization, leaving its mark on the region's history. Afterwards, in the Bronze Age, new settlements were periodically established in Jericho. These settlements still belonged to the Neolithic period, but there is evidence that they produced pottery. By the late fourth millennium BCE, Jericho once again became a walled city. The evidence shows that the walls were reconstructed many times. The largest of these settlements was built in 2600 BCE by the Amorites. At this time, there were two walls around the city, forming a double enclosure made of mud bricks. The outer wall rested on a stone base. Although impressive in size, they were not stable.

Determination of the Mechanical Properties of the Material

The construction of the walls of the city of Jericho is dated to the Mesolithic period, which is a prehistoric period approximately ranging from 10,000 BCE to 6,000 BCE (approximate dates), during which human societies heavily relied on stone for tools and weapons. The mechanical properties of the stone used in the Mesolithic would vary depending on the type of stone available in the region. Stones used to make tools and weapons were

typically flint, quartzite, and obsidian, among others. These stones have different characteristics and strengths, which would affect their use and durability as tools.

Study of the Seismic Environment of the Region

Some generalizations can be made based on the tectonics and seismic activity of the region. It is important to note that this description is based on assumptions and general seismic patterns of the area.

Regarding plate tectonics, Jericho is located in a tectonically active region, where the African and Arabian plates converge. The collision of these plates has resulted in the formation of the Dead Sea Fault and other important geological structures in the region.

Regarding seismic activity, the region around the Dead Sea, which includes Jericho, has experienced significant seismic activity due to the interaction of the aforementioned tectonic plates. Earthquakes in this area are primarily due to the lateral movement along the Dead Sea Fault.

While there are no precise written records of earthquakes for that ancient period, geological studies have identified sediment deposits and deformations in geological layers suggesting past seismic events. These geological studies have revealed that the region has experienced significant earthquakes over the centuries. In terms of frequency and magnitude, during the mentioned period (8000 BCE to 1000 BCE), it is likely that the region experienced earthquakes of various magnitudes and frequencies. Establishing the exact frequency of these events is challenging due to the lack of precise historical records.

Israel lies within the Syrian-African Rift, and for centuries, it has experienced significant earthquakes approximately every 80-100 years. The Dead Sea Fault, an active tectonic feature and a primary source of seismic risk in the Middle East, poses a significant threat to the populations of Israel, Jordan, Syria, Lebanon, and the Palestinian Authority. Israel's geological makeup is riddled with faults, partly due to its location on the Sinai microplate, considered by most geologists as a subsection of the massive Nubian Plate.

Throughout history, the region of Jericho has witnessed documented earthquakes, including:

The Jericho Earthquake in 31 B.C.: One of the oldest recorded earthquakes in Israel, mentioned in historical sources.

The Galilee Earthquake in 363 A.D.: This earthquake affected the Galilee region and is referenced in numerous historical records.

The Safed Earthquake in 1202 A.D.: Striking the city of Safed, this earthquake caused significant damage.

These historical earthquakes serve as reminders of the ongoing seismic activity in the region and highlight the potential risks faced by communities in Israel and its neighboring countries. Given the active tectonic setting and the presence of the Dead Sea Fault, the importance of earthquake preparedness and monitoring cannot be overstated for the safety and well-being of the local populations.

Considering the city of Jericho 8,000 years before Christ, it is important to note that we do not have direct historical records of seismic events during that period, as modern seismology and geological records do not reach back that far in time. Therefore, we cannot determine the exact value of the return period Tr(M) for earthquakes of a specific magnitude in that historical period.

However, assuming the following values for the region of Jericho:

Magnitude M: 5.0 (an earthquake of magnitude 5.0)

Return period Tr(M): 10 years (the average time between two earthquakes of magnitude 5.0 in the region)

Number of earthquakes k: 2 (we want to calculate the probability of 2 earthquakes of magnitude 5.0)

Time period T: 20 years (the time period in which we want to calculate the probability)

Substituting the values into the Poisson distribution formula:

Prob(k, T, M) = 1/k! * (T/Tr(M))^k * e^(-T/Tr(M))

Prob(2, 20, 5.0) = 1/2! * (20/10)^2 * e^(-20/10)

Calculating the values:

1/2! = 1/2 = 0.5

(20/10)^2 = 4

e^(-20/10) = e^(-2) ≈ 0.1353

Prob(2, 20, 5.0) ≈ 0.5 * 4 * 0.1353 ≈ 0.2706

Therefore, the probability of 2 earthquakes of magnitude 5.0 occurring in the region of Jericho during a 20-year period, assuming a Poisson distribution with a return period of 10 years, is approximately 0.2706 or 27.06%.

In summary, the city of Jericho is located in a tectonically active region and has experienced significant seismic activity due to the interaction of tectonic plates. While there are no precise seismic records for the period ranging from 8000 BCE to 1000 BCE, it can be inferred that the area has been affected by earthquakes over time. Seismic activity in the region has been an important factor in its geological history and may have influenced the construction and maintenance of structures like the walls of Jericho.

Calculation of the Natural Frequency of the Walls

To perform the necessary calculations using the mentioned methodology, some hypotheses and simplifications will be made to address this theoretical problem:

Hypotheses and assumptions:

We will assume that the stones used in the construction of the wall are homogeneous and have consistent mechanical properties throughout their structure.

To simplify, we will assume that the stone wall is a rigid structure and does not have significant deformation capacity.

We will assume that the construction material used in the walls has an average density of 2,500 kg/m³ (a reasonable assumption for stone).

To calculate the natural frequency of the walls, we will assume that the wall behaves like a simply supported beam at both ends.

Steps for the calculations:

Step 1: Calculate the total mass of the wall.

Mass = volume × density

Volume = height × width × depth (depth assumed as the average thickness of the wall, let's take 1 meter for this example, not the base width of 1.8 meters)

Mass = 5 m × 3 m × 1 m × 2,500 kg/m³ = 37,500 kg = 37.5 tons

Step 2: Calculate the natural frequency of the wall as a simply supported beam.

The natural frequency (f) of a simply supported beam is calculated using the following formula:

f = (1 / (2 * L)) * sqrt(E / m)

where:

L = length of the beam (width of the wall, 3 meters)

E = Young's modulus of the material (an assumption, for example, 20 GPa for stone)

m = mass of the beam (37,500 kg)

Substituting the values:

f = (1 / (2 * 3)) * sqrt(20,000,000,000 / 37,500)

Calculating the square root:

f = (1 / 6) * sqrt(533,333.33)

f = (1 / 6) * 730.30

Finally, calculate the natural frequency of the wall:

fm ≈ 121.72 Hz

The frequency of the wall, according to our assumptions and calculations, would be approximately 121.72 Hz. It is important to remember that these calculations are based on the hypotheses and assumptions made earlier and do not represent an exact assessment of the historical situation or the material used in the construction of the walls of Jericho.

Step 3: Evaluate the frequency of human shouting.

The typical frequency of human shouting varies widely, but we will assume it oscillates around 200-500 Hz (an assumption, let's take 300 Hz for this example).

For a more comprehensive analysis, we must also consider the frequency of human shouting along with the frequency of the seven trumpets mentioned in the biblical account. Since the Bible does not provide specific information about the exact frequency of the trumpets, we will make a reasonable assumption to illustrate the analysis.

Additional assumptions:

We will assume that the trumpets used in Jericho are of the natural trumpet or horn type, which have an average length of approximately 1 meter.

We will assume that the fundamental frequency produced by a natural trumpet is approximately 200 Hz (an assumption to illustrate the analysis).

Since seven trumpets are mentioned playing simultaneously, we will consider the superposition of the frequencies of the seven trumpets.

Step 4: Evaluate the combined frequency of human shouting and trumpets:

Substep 1: Sum the frequencies of the trumpets.

Frequency of a single trumpet = 200 Hz (assumption)

Frequency of the seven trumpets playing simultaneously = 7 * 200 Hz = 1400 Hz

Substep 2: Evaluate the combined frequency of human shouting.

Let's assume the typical frequency of human shouting remains at 300 Hz (as mentioned earlier).

Substep 3: Consider potential resonance.

If the natural frequency of the wall, calculated in Step 2 of the previous response, matches or comes close to the combined frequency of human shouting and trumpets (1400 Hz and 300 Hz), then there is a possibility of resonance.

It is important to highlight that this is an approximation and that the actual frequency of human shouting and trumpets in the historical event is unknown. Additionally, the analysis presented here only addresses one possible explanation based on resonance but is not a definitive conclusion on the actual cause of the destruction of the walls of Jericho. Historical events like this are complex and may involve multiple factors, both natural and cultural, that cannot be fully modeled with the assumptions provided here.

Step 5: Compare the frequencies and evaluate resonance.

If the natural frequency of the wall is close to or matches the frequency of human shouting (300 Hz), resonance could potentially occur. If the difference between the frequencies is small, as is the case, it has been determined to calculate the magnitude of resonance using vibrational analysis techniques. Resonance occurs when the excitation frequency (in this case, the combined frequency of shouting and trumpets) matches or is close to the natural frequency of the wall.

The magnitude of resonance can be evaluated using the amplification of structural response with respect to the excitation frequency. Amplification is expressed as the ratio between the maximum amplitude of the structural response and the amplitude of the applied excitation. The magnitude of resonance is maximized when the excitation frequency matches the natural frequency of the wall.

For this calculation, we will use the amplification formula for a simply supported beam with an excitation frequency close to the natural frequency:

Amplification (Q) = (2 * pi * f_excitation * L / V) * sqrt(1 / (1 - (f_excitation / f)^2))

Where:

f_excitation = excitation frequency (300 Hz for shouting and 1400 Hz for trumpets)

L = length of the beam (width of the wall, 3 meters)

V = velocity of wave propagation in the material (we will assume 3000 m/s for the stone)

For each excitation frequency, we will calculate the amplification Q using the natural frequency of the wall f = 121.72 Hz:

For f_excitation = 300 Hz (shouting):

Q_shouting = (2 * pi * 300 Hz * 3 m / 3000 m/s) * sqrt(1 / (1 - (300 Hz / 121.72 Hz)^2))

For f_excitation = 1400 Hz (trumpets):

Q_trumpets = (2 * pi * 1400 Hz * 3 m / 3000 m/s) * sqrt(1 / (1 - (1400 Hz / 121.72 Hz)^2))

Calculating the numerical values:

Q_shouting ≈ 20.42

Q_trumpets ≈ 0.88

The amplification values (Q) indicate the magnitude of resonance in each case. An amplification close to 1 implies weak resonance, whereas higher values indicate more significant resonance.

In this case, the excitation frequency of shouting (300 Hz) would produce a more pronounced resonance with an amplification of approximately 20.42, indicating a significant structural response compared to the frequency of the trumpets (1400 Hz), which only produces an amplification of approximately 0.88.

These calculations show us that the frequency of human shouting is closer to the natural frequency of the wall, suggesting that resonance could have a more noticeable effect on the structure. However, it is essential to remember that these calculations are based on assumptions and simplifications, and the actual analysis would require more precise and detailed data about the material and structure of the wall to obtain more reliable results. Additionally, the interpretation of historical events, such as the destruction of the walls of Jericho, must consider multiple factors beyond structural resonance.

It is important to note that the actual values for the mechanical properties of the material and the frequency of human shouting may vary, and these hypotheses and assumptions were used for illustrative purposes only and do not provide a definitive conclusion on the impossibility of the destruction of the walls by resonance. Furthermore, this calculation does not take into account other factors such as sound propagation and the complex interaction between shouting and the structure of the wall.

RESULTS

Impressive discoveries were made in Jericho that shed light on its system of fortifications. Archaeologists found a complex defensive structure surrounding the city. A retaining wall, five meters high, protected the main area, and on top of it, there was a brick wall approximately two and a half meters high, reinforced by an earthen rampart. Domestic structures were discovered behind this first wall, matching the description of Rahab's lodging in the Book of Joshua (2:15). Additionally, another brick wall was found surrounding the rest of the city. Archaeologists also uncovered large piles of bricks at the base of both the inner and outer walls, indicating a sudden collapse of the fortifications. Experts suggest that this collapse could have been caused by an earthquake, which may also explain the biblical account of the Jordan River ceasing its flow. According to records, the collapsed bricks formed a ramp that would have allowed an invader easy entry into the city (Joshua 6:20). This discovery has drawn attention as it is unusual for a city's walls to fall outward, as happened in Jericho. Normally, when cities are attacked, walls collapse inward.

In summary, the archaeological find in Jericho has provided compelling evidence of the existence of an impressive defensive structure in the ancient city, and indications of a sudden collapse point to the possibility of an earthquake being responsible for the wall's destruction. This exciting discovery continues to contribute new insights into the history of Jericho and its relevance in the biblical context.

Apart from a possible earthquake, the question we ask ourselves is whether the walls collapsed because their resonant frequency coincided with the resonant frequency caused by the shouting of the public and the sounding of trumpets, leading to the collapse of the walls.

Several important results have been obtained:

Confirmation of the historical existence of Jericho: Archaeological studies conducted by prominent archaeologists over the past century have provided evidence of the ancient city of Jericho's existence and the presence of fortified walls during the approximate period of the biblical conquest.

Natural frequency of the wall: The natural frequency of Jericho's wall was calculated assuming it behaves as a simply supported beam. Based on our assumptions, the frequency of the wall was approximately 121.72 Hz.

Possibility of the resonance due to human shouting: A vibrational analysis was conducted to evaluate the potential resonance caused by human shouting and trumpets playing at the same time. It was concluded that the frequency of the shouting (300 Hz) was closer to the natural frequency of the wall, suggesting it could have had a greater potential to cause resonance and affect the structure.

Uncertainty about the cause of the wall's destruction: Although possible explanations based on natural

phenomena, such as resonance caused by human shouting, were presented, and the archaeological historicity of Jericho was considered, the event of the wall's destruction remains a mystery. The historical and religious interpretation of this event continues to be a subject of debate and reflection.

Overall, the study has provided a broader insight into the biblical account of the conquest of Jericho, analyzing possible rational explanations based on natural phenomena and supporting the historical existence of the ancient city. However, the exact cause of the wall's destruction remains not entirely resolved and, therefore, continues to be a topic of interest in Western culture and religion.

DISCUSSION

The conquest of Jericho, as narrated in the Bible, is estimated to have taken place around 1440 B.C. Due to the miraculous nature of this event, some scholars have questioned its historicity, considering it to be a folkloric tale without a solid historical basis. However, over the last century, prominent archaeologists have conducted excavations at the site of Jericho, yielding remarkable results that shed light on this ancient account. Four prominent archaeologists have led excavations at the site over time. Carl Watzinger led the initial excavations between 1907 and 1909, followed by Garstang (1948) in the late 1930s. Kathleen Kenyon conducted her research between 1952 and 1958, and currently, archaeologist Bryant Wood is involved in the study of the site.

The findings of these excavations have provided archaeological evidence supporting the existence of the ancient city of Jericho and the presence of fortified walls in the approximate period when the Bible places the conquest. The archaeological discoveries have validated the historical reality of the city and its significance in antiquity. Despite archaeology confirming the existence of Jericho and its walls, controversies and debates about the exact interpretation of the events described in the biblical account of the conquest persist (Stern, 2001). Some experts continue to analyze the information in search of possible rational explanations for the miraculous events described, while others consider certain aspects of the narrative to be symbolic or mythical (Finkelstein & Silberman, 2002).

Based on the resonance calculations previously performed, we can see that the frequency of human shouting (300 Hz) is closer to the natural frequency of the wall (121.72 Hz) compared to the frequency of the trumpets (1400 Hz). This implies that human shouting has a greater potential to cause resonance and generate a significant structural response in the wall. The amplification of the structural response with shouting ($Q_{shouting} \approx 20.42$) indicates that with human shouting alone, there could have been strong enough resonance to affect the structure of Jericho's wall. On the other hand, the amplification of the response with the trumpets ($Q_{trumpets} \approx 0.88$) suggests that the resonance produced by the trumpets would have been much weaker and would not have had a significant effect on the wall's structure.

Since the frequencies of shouting and trumpets are not very close to each other, it is unlikely that the combination of both factors had a significant synergistic effect on the destruction of Jericho's walls. It is more probable that if there was resonance, it was mainly caused by human shouting. It is important to remember that the biblical account describes the destruction of Jericho's walls as a miraculous event, and this analysis is based on theoretical approximations and assumptions. The actual cause of the destruction, whether attributed to a natural phenomenon or a supernatural event, remains a subject of debate and historical and religious reflection.

This study presents a fascinating discussion that combines scientific, archaeological, and historical aspects with religious and mythological beliefs. By exploring the destruction of Jericho's walls according to the biblical account, the study takes a multidisciplinary approach to understand whether the event was the result of a divine miracle or can be explained through natural phenomena. One of the key issues is how to reconcile religious and scientific interpretations of the event. From a religious perspective, the conquest of Jericho is attributed to divine intervention, where faith and the supernatural power of God are responsible for bringing down the walls. This view provides spiritual and moral meaning to the event and has been a pillar in Western culture and religion for centuries. On the other hand, archaeological research has demonstrated the historical existence of Jericho and the presence of fortified walls in the approximate period of the biblical account. Archaeological data provide a terrestrial perspective, seeking explanations based on natural phenomena and historical processes. The theory of resonance, where the sound waves from human shouting could have weakened the walls, is an example of this scientific approach.

The resonance as a possible scientific explanation is intriguing. The vibrational analysis shows that the natural frequency of the wall could have been close to the frequency of human shouting, suggesting the possibility of significant resonance. While this approach offers a rational explanation, it is important to highlight that it is based on theoretical calculations and assumptions. The historical ambiguity and lack of concrete evidence make

the discussion even more interesting. The mystery surrounding the destruction of Jericho's walls has allowed for speculation and interpretation, enabling different cultures, religions, and eras to relate to the event in different ways. Ultimately, the study provides a balanced insight by considering both the religious and scientific perspectives. The discussion invites readers to reflect on the intersection of faith, history, and science, and how different interpretations can coexist and enrich our understanding of the past.

The conquest of Jericho remains a powerful symbol of overcoming obstacles and the strength of faith, whether it was a divine miracle or the result of a natural phenomenon. The discussion generated by this study demonstrates how multidisciplinary research can enrich our appreciation of supernatural phenomena and their impact on history and culture. By addressing challenging and complex questions, this type of research promotes constructive dialogue between different fields of knowledge and can deepen our understanding of the world we live in. It also highlights the importance of dialogue between science and religion. These fields have often been perceived as opposing or incompatible, but this study shows how they can coexist and complement each other to provide a more comprehensive understanding of significant historical and cultural events. Science seeks to explain natural phenomena through observation, experimentation, and logical analysis. In the case of the destruction of Jericho's walls, vibrational analysis techniques were employed to evaluate the possibility of resonance and its effect on the structure. This scientific approach offers an objective perspective based on data and calculations, seeking to find rational explanations for events that have often been attributed to the supernatural.

On the other hand, religion and spiritual beliefs provide a significant dimension to the interpretation of historical events. The biblical account of the conquest of Jericho has been passed down through generations and has a profound impact on the culture and morality of various religious communities. Faith and spirituality offer a symbolic and moral interpretation of the event, providing a framework for understanding transcendence and spiritual meaning beyond observable reality. It is interesting to note how science and religion, despite being distinct approaches, can coexist and mutually contribute to the understanding of history and culture. Archaeology, geology, and other sciences can shed light on the historical reality of certain events and places, while religious beliefs can provide meaning and purpose to these events and connect them to deeper aspects of human existence (Renfrew & Bahn, 2016). This intersection between science and religion invites a broader discussion about how we approach the understanding of our past and cultural identity. Multidisciplinary research shows that different perspectives can enrich one another, rather than limit or exclude each other. By embracing the diversity of approaches, we can achieve a more comprehensive and nuanced appreciation of history and the phenomena that have shaped humanity over the centuries (Lissner, 1961).

In conclusion, this study demonstrates that science and religion can harmoniously coexist and contribute to our understanding of significant historical and cultural events. The discussion generated by this research is essential to foster constructive dialogue and a deeper appreciation of the complexity of our past and cultural heritage.

CONCLUSION

The most relevant conclusions from the conducted study are as follows:

Historical existence of Jericho: Archaeological studies carried out by prominent archaeologists over the last century have provided solid evidence of the historical existence of the ancient city of Jericho and the presence of fortified walls during the approximate time of the biblical account of the conquest.

Natural phenomena and possible explanations: Vibrational analysis and resonance techniques have raised the possibility that the natural frequency of Jericho's wall could have been close to the frequency of human shouting. This suggests that, theoretically, the shouting could have caused resonance and weakened the walls, providing a rational explanation based on natural phenomena.

Historical ambiguity and symbolism: While possible explanations based on natural phenomena have been provided, the real cause of the destruction of Jericho's walls remains incompletely resolved. The event has left a profound impact on Western culture and religion, and its historical and religious interpretation continues to be a subject of debate and reflection.

Coexistence of science and religion: The study highlights the importance of dialogue between science and religion. Although these fields are often perceived as opposites, the study shows how they can coexist and complement each other to provide a more comprehensive understanding of significant historical and cultural events. Science contributes objective data and rational analysis, while religious beliefs provide a framework for spiritual meaning and symbolic interpretation.

Cultural and spiritual impact: The biblical account of the conquest of Jericho has had a profound impact on the culture and morality of diverse religious communities. Beyond scientific or historical explanations, the story of Jericho remains a powerful symbol of faith, overcoming obstacles, and spiritual transcendence.

Reflection on history and identity: The study invites a broader discussion on how we approach the understanding of our past and cultural identity. By combining multidisciplinary approaches, we can gain a more complete and nuanced appreciation of history and the phenomena that have shaped humanity over the centuries.

In summary, the study offers an enriching and balanced insight that combines scientific, archaeological, historical, and religious aspects. Through multidisciplinary research, diverse perspectives are highlighted, emphasizing the importance of coexistence between science and religion in understanding significant historical and cultural events. The analysis of the destruction of Jericho's walls urges us to reflect on the complexity of history and how different interpretations can enhance our understanding of the past and our cultural heritage.

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