

*The Temple of Solomon Could not Stand  
On its Water Tower*

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**THE WATER CONVEYANCE SYSTEM  
OF THE TEMPLE OF JERUSALEM  
WITH PURIFYING SPRING WATERS**

**THE AQUEDUCTS**

*The Temple of Solomon Could not Stand  
On its Water Tower*

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On its Water Tower*

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1/ In order to throw a useful light on the demonstration conducted in the present book it is necessary to examine, in a simplified form, the basic principles of applied Hydraulics in Antiquity, elements of which were employed, shared, or even sometimes invented in ancient Judah.

In fact, these principles of the Jewish Hydraulic Technology preserved in the bedrock of the Haram, the measurements of which were surveyed by the Archaeologists of the 19<sup>th</sup> century constitute the Archaeological Proof that the Temple of Solomon could be but situated downstream from the huge, complex and sophisticated underground Hydraulic System developed by the Jewish Hydraulics engineers and Priests, in order that the Rituals in the Sanctuary were in perfect communion with the Precepts of the *Torah*, exactly as the architecture of the Temple had to be in strict conformity with the Divine Will.

But these specifically Judaic Hydraulics elements were mostly part of the science of Hydraulics common to all ancient civilizations.

2/ The technology for catchments, retention, transportation and delivery of fresh running waters was born at the dawn of ancient civilizations.

The search for efficient Hydraulic Systems from a technological point of view was particularly developed for the need of agricultural irrigation, or for supply of waters for towns and cities not built on lakes or rivers, or which were built for reasons of defence on hills or high places.

In the same manner as for example in China or in Egypt, the vestiges of Near East civilizations bear witness to the fact that the first communities that appeared in this region employed very early Hydraulic techniques :

And, for example, what appears to be the oldest canal in the world known to this day, is found in Jericho, dating from around 7.000 BCE.

Other than naturally impermeable soils that constitute an indispensable base for the transport of all waters in Antiquity, practically every kind of raw materials were used to retain, circulate, store and distribute waters, these including for instance :

- rock, wood, clays, bitumen, animal skins, horns, etc..

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

Then progressively more elaborate materials juxtaposed these simple materials so as to improve the performances, and particularly from the point of view of being as much watertight as possible :

These included for instance, amongst others :

- Different coatings and joints of cement and mortar, the compositions of which were very diverse such as lime, broken and powdered rock, sand, different kinds of clay and marl, oils and animal fats, etc.
- Terracotta, tiles, pottery, and ceramics.
- Copper, bronze and then lead.

3/ Several techniques were employed for important water catchments in Antiquity, the principals of which were all used to ensure the supply of waters in the region of Jerusalem :

- A/ The catchment of Springs at their source.
- B/ The catchment of rain waters on conical surfaces, more or less truncated and extended : by this means, rain waters flowed down natural slopes or through channels towards holding dams or storage cisterns.
- C/ The natural catchment of ground waters drawn from vertical shafts or wells.
- D/ The natural catchment of the waters of an inclined phreatic table, drawn from hillsides by means of shafts of a lesser slope that allowed to waters to gush out like an artificial spring, and called "qanat".
- E/ The catchment by underground collector tunnels cut into porous or aquiferous rock through which waters could permeate and flow into underground sloping collectors.

4/ In Antiquity waters flowing by gravitation were carried by Aqueducts, Canals, Conduits and Pipes, following natural slopes.

Most of the antique techniques have been employed in the surrounding area of Jerusalem. The diverse processes used in Antiquity to make Aqueducts and conduits, following the natural slope, were mainly the followings :

- A- Aqueducts could be channels cut into the rock : these channels were generally covered with cemented stones in order to keep the waters clean and prevent them from being blocked by falling obstacles. In addition, for security reasons, they were often camouflaged which reduced the number of guards needed for the protection of the Aqueducts.

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

**-B-** When there were rocky hills on the planned passage of the Aqueduct, tunnels were cut into the rock having a predetermined slope.

To facilitate the work and wielding of hand tools, these tunnels were generally built with the height of a man. This has often resulted in archaeological observations that supposed these waters tunnels were secret passages, and, in fact ,many did also serve as such, though their primary use was to carry waters.

**-C-** To cross shallow valleys or permeable ground, earthen levees, or dykes, were built to ensure the continuity of the Aqueduct's slope.

In that case, the waters were conveyed across by canals which were constructed of different materials : as, for instance :

**a/** The waters flowed in **U** shaped rock sections, set end to end, and sealed with different kinds of cement joints : the **U** sections were covered with slabs in order to protect and camouflage the canal.

**b/** There were also whole stone blocks placed end to end in which holes had been cut to form a continuous conduit inside the stones, through which the waters flowed, and these blocks were sealed by different kinds of cement joints.

**c/** Then, there were underground pipes formed with semi-cones in terracotta or ceramic cemented together. These pipes being more fragile were often protected by stone rings.

**d/** Or the waters could flow in a succession of copper, bronze and then lead pipes, buried and/or set in stones rings and then camouflaged.

**-D-** In order to cross valleys or ravines, bridges were constructed on which watertight channels were built. Such aqueducts were relatively vulnerable.

This was the case for the region of Jerusalem, and, for the ancient Aqueduct that carried the Waters from the Etam springs, there was only one bridge which was constructed, and that was when the Aqueduct was already within the shelter of the City ramparts :

Thus, the Etam (or Solomon) Aqueduct crossed the Tyropean Valley (west of the Haram) inside of the City, passing over the so called Wilson Arch, to reach finally the underground rock, where the giant Cisterns had been dug beneath the Jewish Citadel ( nowadays Haram) which overlooked and protected the Temple.

**-E-** It can also be noted that, in the region of Jerusalem, before the destruction of the Temple, primitive siphons and reverse siphons had already been employed for the construction of the new Aqueducts, allowing them, by this means, to cross certain small valleys or crests, both upstream and downstream, from the large collecting ponds called Solomon's Pools.

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

These siphons and reverse siphons were necessarily watertight, with required necessary regular flow, both to avoid hydraulic shock, interruption or backflow.

5/ The storage of waters in Antiquity was essentially made in non-porous rock : In this respect, the natural rock of Judah offered a very broad range of possibilities. Amongst the different means employed in the Antiquity for storage of large quantities of waters were the followings :

**-A-** In the open air :

- dams, ponds, reservoirs built in the open air, or cisterns cut into the rock, and lined if necessary with a watertight sealing in their friable or porous zones.

These storage systems received waters from springs through appropriate conduits, or collected rainwater streams from the surface, disposed in the form of flat cones that allowed the waters to converge towards the reservoirs built inside the rock.

Whenever the slope was sufficiently great the waters could then be transferred by channels and conduits to relay tanks, or to other points of distribution.

**-B-** Underground :

Reservoirs and cisterns were cut into the rock and entirely enclosed by the rock itself or covered by stone slabs cemented into place.

The principle of construction of such rocky underground cisterns was to leave a single access from the ground surface to the cistern in the form of a relatively narrow neck. This access was protected by a cover and was in the form of a vertical, or oblique, well or shaft depending on the thickness of the cistern's or reservoir's rock roof.

Different conduits were connected to the cisterns or reservoirs supplying them with ground waters or rain waters.

The earliest underground cisterns in Antiquity had generally the form of an amphora with a spiral staircase cut into its walls to reach the bottom, in order to draw waters or to carry out cleaning and maintenance work. By increasing their size these underground cisterns could be expanded into giant reservoirs, progressively changing their form, and in the Roman times, their structure became systematically geometric.

**-C-** The Religious Jewish Specificity :

The Temple Cistern-Reservoirs were installed in a vast coherent Underground Hydraulic System which was specifically designed to supply the Temple of the Jews, according to exacting Religious Precepts of the *Torah* :

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

Therefore, **all these rocky underground Cisterns were systematically disposed in cascades**, within the inclined layers of the bedrock, with inlet channels and conduits interconnecting upstream and outlets interconnecting downstream, so that **all the Cisterns were interconnected together in a single Dynamic Hydraulic System**, to ultimately serve faithfully the specific needs of the Jewish religion :

These Religious Rules, as will be examined infra, required that the Waters flowed continuously, without the slightest interruption, and with a variable volume corresponding to instantaneous needs :

So that, the totality of the rain waters which had been stored could benefit from the Purifying Virtues engendered by the impregnating Flow of the Living Waters from the Etam Spring, which was, in a way, as the seminal spurting which conferred to all the rain waters stored in the underground giant Cisterns of the Jewish Citadel (Haram) the Purifying Virtues needed for the daily Worship in the Temple, that laid downstream from its fecundating "Water Tower".

In other terms, the rain waters, stored in the bedrock beneath the ancient Jewish Citadel (Haram) that overlooked and protected the Temple below, could only be validated for the Sanctuary's Rituals when fecundated by the uninterrupted Flow of the Living Waters coming from the distant fundamental Etam Spring.

And it was only then, that these precious fecund and fecundated Waters could altogether, in total acquired Legitimacy, flow down to the Temple, to fulfill their Purifying Mission, for the Ceremonies required by The Eternal, in order to continually and relentlessly uphold and celebrate the House sheltering The Moral Pact that The Eternal had concluded with Humanity, and which was the Ultimate Condition of Survival of Civilization.

6/ What Rabbinic Literature called the Etam Spring was, in reality, a collection of several Springs, situated in a region to the south of Jerusalem, at the watershed around Hebron and Bethleem.

According to the information that reached us, this region was, at that time, a vast and abundant water reservoir (= natural Water Tower) situated at a higher elevation than Jerusalem.

In ancient times, this region (as many parts of Judea) was green and wooded, watered by numerous streams and torrents, before the progress of civilizations and their inexorable concomitant deforestations.

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

If, by chance, a number of important Archaeological vestiges remain of the Temple's Supply of Waters for Purification and cleansing - from Etam Springs downstream to the underground storage Cisterns of the Haram-, very little Historical evidence, prior to the destruction of the third Temple of Herod, exists concerning, as well the whole Hydraulic System of the rocky underground of the antique Jewish Citadel (Haram) as the catchments and retention of the Spring Waters at Etam, and their conveyance by Aqueducts to the Jewish Sanctuary.

Etam was mentioned in the work of Flavius Josephus, when he described the splendour of the royal Court during the reign of King Solomon ( 970 - 933 BCE) :  
The Jewish historian gives the following description of the royal cavalry that protected and accompanied the king near the place called Etam :

Flavius Josephus Antiquities of the Jews : Book VIII : Chapter VII : 185-186:

These horses also were so much exercised, in order to their making a fine appearance, and running swiftly, that no others could, upon the comparison, appear either finer or swifter. Their riders also were a further ornament to them, being, in the first place, young men in the most delightful flower of their age, and being eminent for their largeness, and far taller than other men. They also had very long heads of hair hanging down, and were clothed in garments of Tyrian purple. They also had dust of gold everyday sprinkled on their hair, so that their heads sparkled with the reflections of sunbeams from gold.

The King himself rode on a chariot in the midst of these men, who were still in armour, and had their bows fitted to them. He had on a white garment, and used to take his progress outside of the city in the morning.

There was in particular a certain place, about fifty furlongs distant from Jerusalem, which is called Etam, very pleasant : it was in fine gardens abounding with rivulets of water : thither did King Solomon liked to go out in the morning , proudly standing high in his chariot...

This region of Hebron, Etam and Bethlehem, where King Solomon liked to ride and where Living Spring Waters were collected in Solomon's Pools, for the Temple in Jerusalem, were to become of great strategic importance for the Jewish Kingdom.

It was probably for this reason that a series of Fortresses were reinforced in this region by Roboam (933-916 BCE), the son of Solomon, in order to protect the Temple's natural Source and water Reservoir.

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

The *Bible* provides evidence concerning the specific Defence System that had been reinforced by Roboam following the secession of the Jewish Tribes to the north, after the death of Solomon :

As a result the Legitimacy of Roboam, who then reigned over only the two Jewish Tribes to the south, -those of Judah and Benjamin-, was accentuated by a strengthening of Religious authority in the Sanctuary, which had a vital need of the Waters from Etam.

Indeed, as a consequence of the Sanctuary being in Jerusalem, almost all the Priests and Levites of the Kingdom of Judah, like those of Israel, rallied to Roboam :

2 Chronicles : Chapter 11 : verses 5 -13 :

Roboam dwelt in Jerusalem and fortified the cities in Judah : Bethlehem, Etam, Tekoa, (list of all the cities fortified) and Hebron.

All these fortified cities are in Judah and in Benjamin territories.

He fortified their strongholds, and put captains in them, and stores of food, and oil and wine. In every city he put shields and spears, and made them exceeding strong. Judah and Benjamin belonged to him.

The Priests and the Levites who were in all Israel came around to him out of their borders.

7/ Another Biblical indication concerning King Ezechias (716-687 BCE) provides more information, not on the Water Supply System for the Temple, but on the different technologies employed by the Jews in ancient times for their Hydraulic Works.

King Ezechias had decided to protect the Gihon Spring, in the Kedron Valley bordering the eastern walls of Jerusalem, from all attack, as this was the only Spring that provided waters to Jerusalem's Davidic lower City and was situated outside of the ramparts :

The Spring was walled up and deviated by a tunnel cut into the rock towards the Siloam Pool, a Reservoir that had been built inside of the ramparts to the south of the City.

Not only has Archaeology been able to fully explore this underground Aqueduct but, in addition, has discovered an inscription engraved in the rock, celebrating the junction between the two mining teams who had pierced this Aqueduct tunnel.

By this fortunate coincidence, evidence exists of the technical skills, in the different forms of Hydraulic Technology, which were employed by the Jews in the seventh century BCE, during the reign of King Ezechias, that is to say two centuries after the construction of the Temple by King Solomon.

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

The information provided by the tunnel and its inscription are sufficiently convincing to throw light on a significant number of particularities of the ancient technologies used by the Jews.

These techniques, in all probability, were approximately the same as those used two centuries before, for the construction of the Etam Aqueduct and the whole of the underground Hydraulic System installed upstream of the Temple.

The *Bible* describes the Hydraulic works of King Ezechias in *2Kings: Chapter 20: verse 20* and in *2Chronicles: Chapter 32: verse 30*.

During Ezechias reign, the Jews met the threat of the Assyrian armies of Sennacherib, whose ambition was to conquer Jerusalem.

In this threatening context, Ezechias decided to deviate the waters from the Gihon Spring by an underground tunnel to the Siloam Pool.

As it happened, the armies of Sennachrib were decimated by an epidemic, and Jerusalem was saved, that is until the not too distant reign of Nebuchadnezzar.

*2 Chronicles: Chapter 32 : verse 30 :*

This same Ezechias also diverted the Spring of the waters of Gihon, and brought them straight down inside the city of David.

8/ To bore the tunnel of this underground Aqueduct a team of miners commenced their work from the departure Gihon Spring whilst another worked in the opposite direction from the arrival Siloam Pool.

This underground work of the two teams of miners took place inside the bedrock itself on the flank of the hill.

A few metres from the Siloam Pool an inscription has been discovered engraved on the wall of the tunnel in Hebrew, doubtlessly by the miners themselves to commemorate their exploit. This is as follows :

*Inscription on the aqueduct tunnel from the Gihon spring to the Siloam Pool :*

...the drilling. And here is the story of this drilling :

While the hewers wielded the pickaxe, each man towards his fellow, and when only three cubits (1.5 metres) of rock remained to be pierced, there was heard a man's voice calling to his fellow that there was a deviation (?) in the rock to the right...

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

And on the day of the junction the last rock was pierced the hewers hacked each toward the other, pickaxe against pickaxe ...

And then the waters could flow from the Spring to the Pool, a distance of 1,200 cubits (500 metres). And there was 100 cubits (50 metres) of rock above the miners' heads (above the superior part of the Aqueduct).

As the tunnel still exists a great number of technological questions can be asked :

**-A-** The distance in a straight line from the Gihon Spring to the Siloam Pool is 335 metres.

However, the length of the tunnel is 555 metres and has several large bends :

The reasons for these bends are not known, nor the manner in which the path of the tunnel piercing could be rectified underground.

The different phases of the tunneling can be distinguished as follows :

- the two teams of miners commenced in a vast arc that significantly deviated from the right direction.

- For the team that left from Siloam a vertical shaft rising from the tunnel enabled them to rectify the erroneous path of this arc by an outside reference. These rising shafts were probably built with scaffolding to a height of thirty or forty meters.

- On the other hand it is not known how the team from the Gihon side was able to correct its own direction as significantly erroneous as the other team.

- Then on the side of the Siloam team a second vertical shaft was dug, once again to correct the path of the tunnel which was not aligned with that of the Gihon team.

- And again it is impossible to know how the Gihon team was able to know what precise direction they were in fact following and how they did correct it.

- Finally it can be remarked that a zigzag was made to arrive at the meeting point of the two tunnels : this was probably the result of searching the noises heard by the workers as mentioned in the Hebrew inscription.

In a broad sense it can be observed that the ancient Jewish engineers had a mining technology that was, altogether, rudimentary and elaborate, and which enabled them to accurately correct errors in their underground piercing on a horizontal level. But we do not know how they did operate exactly.

(In this respect it can be noted that the Jews in Antiquity had, and still have nowadays, a very peculiar link with piercing of rocks, quite an intimate link, the modern manifestation of which is, for instance, the diamonds cutting.)

**-B-** The difference in elevation between the Gihon spring and the Siloam Pool is approximately 30 centimetres.

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

Therefore the engineers, who bored the tunnel without any external reference point, built a slope of 30 centimetres to ensure the flow of water over a length of 555 metres :

This difference of 30 centimetres gave an average slope of 0.06%.

Further, the tunnelers from Gihon worked on a downhill slope designed to coincide exactly with the uphill slope from the Siloam side.

This precise information leads to the idea that the Hydraulic engineers of these ancient times used quite accurate water levels and instruments to measure the slopes, though no detailed knowledge remains of these tools.

Nevertheless, it could be imagined, for instance, that these instruments included a kind of long, narrow, recipient in wood or terracotta with a flat horizontal base filled with water, marked with graduations on a scale on the inside edge of the extremities. The surface of the water, remaining horizontal whatever the inclination of the recipient, should coincide with the predetermined point on the graduation scale.

In addition it could be also imagined, for instance, that a plumb line was employed with a rectangular frame with a horizontal scale of graduations marked on its base so that the plumb line could be positioned according to a predetermined scale.

On the same theme of measuring apparatus employed in ancient times for which no written or archaeological evidence remains, it is possible to make reference to evidence of the later Roman period, as for instance the works of Vitruvius, a contemporary of Augustus, Agrippa and Herod.

Vitruvius indicates in his work '*On Architecture*' three kinds of measuring apparatus to determine a given slope : the Dioptra, the Water Level and the Chorobates.

Vitruvius describes only the Chorobates, but not with sufficient precision.

However, a precise description given by Heron of Alexandria of the Dioptra still exists, but this apparatus can only function in the open and as a consequence could not be used in an underground tunnel.

On the other hand, the Water Level could be used in a tunnel, and we know that its indicating water was functioning on the principle of communicating vessels.

A vague indication on this subject of great perplexity, as to how the Jewish tunnelers succeeded in bringing the two slopes together with a precision of only a few centimetres is given in the following text of Vitruvius :

*Vitruvius : De Architecture: Book VIII: Chapter 5:*

I shall now describe how water is to be conveyed to houses and cities, for which purpose, **preliminary leveling** is absolutely necessary.

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

This is performed either with the dioptra, the level (libra aquaria), or the chorobates. The latter instrument is however the best, inasmuch as the dioptra and level are often found to be incorrect.

The chorobates is a rod about twenty feet in length (6 metres), having two legs at its extremities of equal length and dimensions, and fastened to the ends of the rod at right angles with it ;

Between the rod and the legs are cross pieces fastened with tenons, whereon vertical lines are correctly marked, through which correspondent plumb lines hang down from the rod. When the rod is set, these will coincide with the lines marked, and show that the instrument stands level.

But if the wind obstructs the operation, and the lines are put in motion, so that one cannot judge by them, let a channel be cut on top of the rod five feet long (1,5 metre), one inch wide, and half an inch high, and let water be poured into it: if the water touches each extremity of the channel equally, it is known to be level. When the chorobates is thus adjusted at level, the declivity may be ascertained.

In spite of a certain imprecision of Vitruvius, due perhaps to the difficulty to describe a technical instrument, and maybe also to the approximate transmission of copiers, it is possible from this description to try to reconstitute one of the ancient apparatus that served to measure Hydraulic slopes.

In any case the Jewish Hydraulic engineers possessed the necessary technology to build, with the precision of only a few centimetres, the slope of the underground aqueduct between Gihon and Siloam, which demonstrates that they sufficiently mastered the meticulous technology necessary to undertake the construction of the Hydraulic Complex upstream of the Temple, and, as will be seen further infra, to conceive and build, **with great precision**, the giant underground Cisterns positioned **in very precise cascades** inside the bedrock of the Haram.

9/ The last of the rare historical information concerning the Aqueducts, before the destruction of the third Temple of Herod, is given by Josephus Flavius, when he relates an episode during the period of the Roman occupation under the government of Pontius Pilate, the Procurator of Judah, probably after the death of Jesus.

On this occasion Flavius Josephus, whose almost encyclopedic work is generally very

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

precise, does not give any accurate details as to the location of the Etam Aqueduct, in the same way as he does not reveal in his works the existence of the underground Hydraulic System of the Temple, probably to preserve it for reuse in the Future, nor does the Jewish historian reveals the importance of the Etam Reservoirs (Solomon Pools) at the almost mythical Source that fulfilled the needs of the Temple and its Rites.

In fact, in the eyes of the Jewish historian, who flattered himself as being a member of a family of Priests descended from the family of Aaron, in the same way the second Temple had been rebuilt on the orders of Cyrus, the fourth Temple would inevitably be rebuilt at some future time to be decided by The Eternal.

Flavius Josephus reports the following rebellion of the Jews under the governorate of Pontius Pilates, both in his books *The War of the Jews* and *Jewish Antiquities*, by advancing an argument which would have caused the rebellion, that appears to be both biased and incomplete :

Flavius Josephus : Wars of the Jews : Book II : Chapter 14 :

After this sedition (of the Jews provoked by the images of the Roman Emperor-God Tiberius, which Pilates had introduced in secret in Jerusalem during the night) Pilates raised another disturbance, by expending that sacred treasure which is called 'Corban' upon aqueducts, whereby he brought waters to Jerusalem from sources situated at the distance of four hundred furlongs (72 kilometres). (In his later work, *Jewish Antiquities*, Flavius Josephus rectifies his mistake and indicates 36 kilometres.)

At this the Jewish multitude had great indignation and assembled in order to protest : and when Pilates was to come to Jerusalem, they came about his tribunal, and made a clamour at it.

Now, when he was apprised beforehand of this disturbance, Pilates ordered his own soldiers to mix in their armour with the multitude, and ordered them to conceal themselves under the habits of private men, and not indeed to use their swords, but with staves to beat those who made the clamour.

Pilates gave them the signal from his tribunal. Now the Jews were so sadly beaten, that many of them perished by the stripes they received, and many of them perished as trodden to death.

By these means the multitude was astounded at the calamity of those that were slain, and the rebellion was crushed immediately.

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

This episode constitutes one of the characteristic examples of the ideological misunderstandings that constantly arose between the Romans and the Jews, during the period of the Roman occupation of Judah after Herod's reign.

These fundamental and indomitable misunderstandings provoked recurrent confrontations that were more and more violent, finally ending in the Revolt of the Jews in 69 CE, a revolt that was mercilessly crushed by the Roman Army, and resulted in the destruction of the Temple of Jerusalem by Emperor Titus.

As a Roman Governor, both zealous and competent, with the aid of a praiseworthy project designed to rally the Jewish population to the cause of the Roman administration, Pontius Pilates, legitimately, wanted to improve the City's water supply. It is therefore natural that the Governor decided to employ Roman technology, in which Hydraulics and Aqueducts were a reputed speciality, in order to improve the catchment, retention and transport of the Spring Waters, situated at an elevation greater than that of Jerusalem.

It so happened that the Springs available were those on the watershed of the region between Hebron and Bethlehem the most emblematic of which was the Etam Spring.

By doing so, and very probably without knowing it or realizing its ideological implications, Pontius Pilate touched the network of the sacred Living Purifying Spring Waters that supplied the Jewish Sanctuary, where they empowered with Holiness all the waters stored in the huge underground Hydraulic System..

Now, only the Priests, Rabbis and Jewish engineers were together qualified to maintain and preserve this sacred characteristic of the vast Hydraulic Complex of religious significance, which had been designed for the Temple, and which was, therefore, indeed, financed by the Treasury of the Temple.

And if the Jewish crowd reacted immediately with such passion, it was to prevent the intervention of an irresponsible administration that, in search of efficiency, ignored or disdained the intricacies of the Jewish Religion dictated by the *Torah*, and, therefore, threatened to pollute and endanger the whole of the Sacred Hydraulic System whose specificity, both subtle and precise, conferred the indispensable Purifying Virtues necessary for the Perpetual Worship of the Sanctuary.

10/ From the archaeological view point there is a fundamental difference between the System of the so called Etam Aqueducts and the sophisticated underground Hydraulic System of the ancient Jewish Citadel (Haram) : Both of these Systems have received constant improvements, over the centuries, ever since the construction of the first Temple of Solomon up until the destruction of the third Temple of Herod.

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

But there are the following important differences :

**-A-** Cisterns and conduits had been continuously added to the underground Hydraulic System upstream of the Temple by successive generations, but without the initial System of interconnecting Cisterns being radically modified.

This means that the different archaeological strata and installations situated in the bedrock of the Haram had been, in general, preserved, and are, mostly, identifiable age by age.

**-B-** On the contrary, radical transformations have been carried out on the Etam Aqueduct System by successive generations, transformations always designed to improve the flow of waters to the City of Jerusalem.

However, these transformations had the inconvenience (seen from the archaeological point of view) of, more often than not, effacing the vestiges of the past.

Thus the only incontestable and permanent evidence is the remains of the rocky paths of these Aqueducts that were determined by the indispensable difference in elevation necessary for the flow of waters by simple gravitation towards Jerusalem.

However, for the most part, it is difficult to determine the exact period during which these different aqueducts, often modified and improved, had been really built for the first time.

Furthermore, the changes, that employed constantly new technologies, took place almost continuously, after the destruction of the Temple, with the successive occupation of the Romans, Byzantines, Arabs, Ottomans and finally British.

In addition those who undertook the improvement works sometimes left a record without however indicating the state of previous possible installations.

In this way, for example, aqueducts were found stamped by the 10th Fretensis Legio (L.X.F, Legio X Fretensis) that were stationed in Jerusalem after the destruction of the Temple by Titus, and these modifications probably constituted improvements on previous installations which have disappeared.

**11/** It is nevertheless possible to distinguish, in the chronology of the construction of the Aqueducts, as in the chronology of the construction of the underground Cisterns beneath the Haram, mainly **two principal phases** :

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

**-A- Chronology of the Aqueducts :**

**a/** A first most ancient phase, where the different courses of the Aqueduct followed extremely sinuous twists and turns, with sections in hair pin bends, using a very shallow slope, so as to take advantage of the smallest difference in elevations that separated the Springs and the storage Reservoirs for Spring Waters, -in particular Solomon's Pools-, from the storage Cisterns beneath the Jewish Citadel (Haram) in Jerusalem.

**b/** A second phase where the different courses of the Aqueduct were relatively direct and doubtlessly inspired by Roman Aqueduct technology, and which saw a considerable progress, particularly after the first century BCE.

In this respect, it is impossible to ignore the predominant influence of Roman civilization on the vast works undertaken by Herod, the protégé of Mark Anthony, and then of Augustus, and very close friend of Marcus Vipsanius Agrippa, the son-in-law of the Emperor, who had a great knowledge of Roman Hydraulics.

On this specific point it is worth recalling, as a possible chronological reference, that the first aqueduct supplying Rome had been built in 312 BCE :

- This aqueduct, the Aqua Appia, as all the most ancient aqueducts of the Etam Network, followed the natural slope of the land, with endless turns and bends, necessitating the construction of 17 kilometres of canals lying at ground level to transport the water over a distance that was only 11 kilometres, as the crow flies.

- It was only in the following centuries that Roman aqueducts could be built in straight lines by the intensive use of multi-arched bridges with water tight canals to cross valleys and ravines, and the concomitant digging of vertical shafts, called inspection holes, that helped to establish directions for piercing straight line tunnels in hills and escarpments, these vertical shafts also providing aeration for the tunnels, possibility of later drawing water, as well as providing access for inspection and maintenance visits.

**-B- Chronology of the underground system of Cisterns beneath the Haram :** (studied infra)  
Concerning the chronology of the construction of the underground Cisterns and Conduits beneath the Haram, it is also possible to distinguish two main distinct phases, that, generally speaking, correspond to the progress in aqueduct technology :

**a/** The first ancient phase was when the underground Cisterns were cut into the bedrock with very indistinct forms, and having inlet and outlet connections that were efficient, but empirical with frequent turns and bends.

*The Temple of Solomon Could not Stand  
On its Water Tower*

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b/ The second phase most probably occurred during the time of Herod, when the underground Cisterns were cut in more geometrical forms which progressively became regular. The greater part of these were then connected to a new network of Channels and Conduits that were far more rectilinear and efficient, so as to improve the control and regulation of the whole of the Waters Distribution System.

12/ The Etam Source gave its name to a group of Springs in the region of Hebron and Bethlehem, the Waters of which were gathered into three vast Reservoirs called Solomon's Pools :

And these Solomon's Pools supplied, in turn, via the Aqueducts, the giant Cisterns cut into the bedrock of the Jewish Citadel (Haram) that overlooked the Temple.

All these Installations designed for catchment, retention, storage and distribution of Waters for the Temple had imperatively to guaranty the continuous Supply without the least interruption in the flow of the Living Purifying Spring Waters towards the Sanctuary, either upstream or downstream of Etam, and even during the dry season, so as to preserve and perpetuate the original Flows from the Springs, as will be examined infra.

In order to respect this Fundamental Concept, identical to that applied in the Jerusalem Jewish Citadel (Haram) rocky underground, and to ensure a constant supply of Waters, the designers of the Temple's Water Supply System organized the systematic catchment of all the Spring Waters from most of the Sources, then abundant in the region of Hebron and Bethlehem.

And the Living Purifying Waters of all these combined Springs, which were not all directly flowing to Jerusalem by Aqueducts, were first collected in **three vast Reservoirs**, interconnected together in cascade : the **Solomon's Pools**.

Solomon's Pools are situated to the south of Bethlehem and not far from the Etam Spring, at an elevation of **810 metres** for the highest Reservoir to **780 metres** for the lowest Reservoir.

These Pools are composed of three large Reservoirs arranged in cascade, each separated from the other vertically by a height of a few metres, and a distance of about 50 metres : The smallest Reservoir is situated at the highest level and the largest Reservoir at the lowest level.

These large Reservoirs were cut into the rock in rectangular forms, their widths being more or less constant.

*The Temple of Solomon Could not Stand  
On its Water Tower*

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At certain points these Reservoirs were reinforced in places by stonework and masonry :

- The upper Pool measures approximately 120 metres long with an average width of 70 metres, with a sloping floor having a depth of 9 to 11 metres.
- The intermediary Pool measures approximately 150 metres long with an average width of 70 metres with a sloping floor having a depth of 10 to 12 metres deep.
- The lower Pool measures approximately 180 metres long with an average of 70 metres wide with a sloping floor having a depth of 10 to 16 metres.

These three Reservoirs, called Solomon's Pools, are situated in a region of nearby hills above (**upstream**) Jerusalem, and could store, approximately, **400 million litres of Living Spring Waters, as the circulation of the Waters, upstream and downstream, was constant and never interrupted.**

This System fed by Fecundating, Purifying and uninterrupted Spring Waters (constantly mixed with rain waters) was the Controlling Centre for collection and storage of Waters from the region of Hebron and Bethlehem :

These Reservoirs, thus, provided a continuous and abundant Supply of Living Spring Waters to the Temple's underground Hydraulic System, in perfect compliance with the strictest Ritual Prescriptions of the *Torah*.

**14/ In fact,** the origins of the Etam Spring Waters, collected in Solomon's Pools were extremely diversified :

- A-** The Solomon's Pools collected Waters from four nearby Springs of which the principal one was the Etam Spring.
- B-** The Solomon's Pools also collected rain waters that ran down the hillsides above the Reservoirs ; for this purpose, these hills had been arranged as vast collectors consisting of flattened sloppy cones.
- C-** The Solomon's Pools received waters from Springs situated at greater distances which were carried, in a first phase, by Aqueducts just as sinuous as the ancient lower Aqueduct that carried the Spring Waters from Solomon's Pools to Jerusalem. Because of the numerous meanderings of this Aqueduct, situated upstream the Etam Spring, it could be assumed that it had been built during the same period as the lower ancient Aqueduct that carried Etam Spring Waters to Jerusalem, of which it was a prolongation upstream.

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

-D- Finally, in a second phase, the Solomon's Pools received the Spring Waters from upstream by an Aqueduct of rectilinear construction and Roman (Herodian) design, which was to be prolonged from Solomon's Pools towards Jerusalem, by the so called Upper Aqueduct also of rectilinear design.

15/

**(-A-) Solomon's Pools collecting Waters from Etam Springs :**

As the **Etam Spring** gave its name to a Hydrological System that fully legitimized the Religious Rituals of the Temple, it would have been interesting to have a description from ancient times of this Symbolical and Ritual Spring that supplied the High Priests baths and that guaranteed the highest degree of Purification necessary particularly, in order that the High Priest may ask Pardon from the Eternal for the Sins of the Jews, so as to preserve and perpetuate the Divine Covenant with Israel.

But, unfortunately, the only descriptions that exist are recent and it is quite impossible to try to envisage how this Mythical Spring could have been organized in Antiquity.

In the same manner, the method by which the other three nearby Springs that supplied Solomon's Pools were organized can only be a subject of conjecture.

These four principal Springs are as follows (with their Arabic name, "Ain" meaning "spring") Ain Etam, Ain Salih, Ain al-Burak, and Ain Farruja.

Amongst the different descriptions of these Springs, in a pale reflection of the lost antiquity reality, is one given by the Frenchman, Francis Guerin, with a certain evocative description : Furthermore this description has the interest of being contemporary to the campaigns of exploration and surveys of the nineteenth century *Ordnance Survey of Jerusalem* (Palestine) headed by the British Archaeologists-Engineers Officers.

The French Geographer-Archaeologist describes his own explorations of the Ain Salih Spring (called Sealed Fountain by Christians) :

Guérin : Description of Palestine : Judea : Ain Saleh :

At one hundred and eighty steps from the west of Kalaat el-Bourak (Castle of the Pools : the remains of an ancient Fortress built near the Spring el Burak, in order to protect the Springs and the Solomon Pools), in the middle of an uncultivated field, the ground of which rises progressively, is the narrow opening of a kind of well.

As it was blocked by large stones, I managed with the help of some of my bachibouzouks, to clear it, then I slid into the hole and fell on a pile of rubble.

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

With a candle, I saw that I was in a chamber that measured seven steps long and three and a half wide. Its height at the point where it was not cluttered with stones was approximately five metres high. It had an arched vault, and this vault, as well as the walls of the chamber, were built with well aligned stones.

From there, turning right I entered into a second chamber, a little smaller than the precedent and built in the same manner. At the end of this second chamber, to the west, an abundant spring pours out from the rock by several fissures and forms a brook, the waters of which are first collected in a small pool. This brook after having crossed the first chamber flows into a channel, or a kind of passageway cut into the rock, of which only the vestibule is vaulted as the chambers themselves : but along the rest of its path, at least the part I could see, it is covered with a triangular roof formed by large slabs inclined one against the other from right to left, and coming together at the upper edge.

This underground passage, that is one metre wide, goes in a south-westerly direction towards the Castle (Fortress), and part of its waters flow near the first of Solomon's Pools into a vaulted construction that forms a fountain for the use of passers-by. Going down a few degrees one can see an abundant flow of waters that cascade down before flowing into the Pool I mentioned (Solomon's Pools).

It is difficult to discern the different phases of construction of the Ain Salih Spring or reconstitute its ancient configuration. The only certitude that remains from ancient times is the connection established between this Spring, as for the three other Springs, to Solomon's Pools.

**(-B-) Solomon's Pools collecting rain waters :**

Numerous vestiges of open channels, descending the mountains and neighbouring hills, attest to the fact that the hill slopes surrounding Solomon's Pools were modified on a large scale to collect the greatest possible quantity of rain waters streams during the wet season.

**(-C-) Solomon's Pools collecting Waters from various upstream Springs by an antique Aqueduct:**

Ten kilometres in the direction of Hebron, upstream of Solomon's Pools, a number of the region Springs, principally Ain Kuweiziba, Ain al-Dible and Ain Arrub, were connected together, so that their Waters could supply the Solomon's Pools, and from there the underground Cisterns of the Haram. Ain Arub gave its name to this collection of Springs, as well as the ancient Aqueduct that connected them to Solomon's Pools.

*The Temple of Solomon Could not Stand  
On its Water Tower*

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In exactly the same way as in the Waters collection and storage Centre of Solomon's Pools, the Waters of Ain Arub were firstly collected and delivered in a continuous flow to a Reservoir that could contain approximately **20 millions litres** of Waters.

The distance between Ain Arub and Solomon's Pools is only 10 kilometres, but the ancient Aqueduct was forced to twist and turn to such a point, crossing the twenty odd valleys and ravines (wadis), that its course was multiplied by four and lengthened to 40 kilometres.

The Springs of Ain Arub are at an average elevation of **810 metres** above sea level, and the Solomon's Pools at an average elevation of **790 metres**, so the slope of this ancient meandering Aqueduct was 0.05%.

**(-D-) Solomon's Pools collecting Waters from various upstream Springs, by a rectilinear Herodian Aqueduct :**

At a time that is difficult to determine, but, in all probability, Herodian, as will be seen further infra, in this same region of hills between Hebron and Bethlehem, a first rectilinear Aqueduct was built from an elevation of approximately **800 metres**, that is 60 metres higher than the Springs of Ain Arub.

Amongst the Springs that supplied this rectilinear Aqueduct was Ain Fureidis, and, then, the Spring of Wadi Biyar.

This region of Wadi Biyar constituted a real Water Reservoir (Water Tower) and the rectilinear Aqueduct that crossed it was running to the Solomon's Pools, and, then, continued to Jerusalem where it was given the name 'Upper Aqueduct'.

This rectilinear Aqueduct from Ain Fureidis and Ain Wadi Biyar had a steeper inclination in its descent towards Solomon's Pools than the antique sinuous Aqueduct from Ain Arrub.

In addition, the Aqueduct from Wadi Biyar traversed several tunnels and had the particularity of collecting Waters altogether from other Springs in its underground passage, and waters that drained by capillarity through the porous rocks forming this Watery Tunnel. The continuous and abundant volume of Waters supplied from these upstream regions to Solomon's Pools by this Aqueduct was most important for Jerusalem and its Sanctuary.

**16/** The Waters that arrived directly from all the different Springs situated in the region of Hebron and Bethlehem, as well as the **400 million litres** collected in the three tier Cascade of Solomon's Pools, were then carried downstream by Aqueducts to the underground giant Cisterns of the antique Jewish Citadel (Haram) that dominated and protected the Temple in Jerusalem.

It seems to appear (in simplifying) that there had been three successive Aqueducts between the region of Solomon's Pools and Jerusalem.

*The Temple of Solomon Could not Stand  
On its Water Tower*

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But because of the **incessant renovation works on this Network**, carried out over the centuries, some of which, on occasions, very radical, it is possible that the Supply of Living Spring Waters collected in the Solomon's Pools and flowing to the underground giant Cisterns of the antique Jewish Citadel (Haram) was, in fact, limited to just two Aqueducts, before the third Temple of Herod was destroyed.

These two ancient Aqueducts connecting the Solomon's Pools to the underground giant Cisterns of the Jewish Citadel (Haram) were thus :

- The most ancient Aqueduct, constructed by Solomon, and called 'Lower Aqueduct', or 'Solomon's Aqueduct' or '**Etam Aqueduct**'.
- The more recent Aqueduct, constructed by Herod with the aid of Roman engineers, and called 'Upper Aqueduct' or, also, '**Etam Aqueduct**'.

In effect, these two main Aqueducts, alone, could carry the Living Purifying Waters from the Springs to the heart of the Sanctuary, allowing to validate Religious Rituals in the Temple, according to the Prescriptions of the *Torah*, and which two Jewish Kings, Solomon, then Herod, successively glorified themselves in building the Temple and organizing its Worship, under the theological direction of the Jewish Priests and Doctors of the Law.

Without these Aqueducts the Temple of Solomon, (like the second Temple) and like the Temple of Herod, would have been hollow shells, and, at best, disembodied sites, simply intended to celebrate the pride of ephemeral Sovereigns.

In other terms, in spite of the ambitious royal works undertaken by each of these Sovereigns, a legitimate and valid Temple could have never existed before The Exacting Eternal, without the Aqueduct contribution of Living Spring Waters, generators of Life and guarantors of Purification.

**17/** The Solomon's Pools, that lie to the south of Bethlehem near to the Etam Springs, are situated in cascade at an elevation of **810 metres** above sea level for the highest and **780 metres** for the lowest, the latter being considered in this present study as the starting point of the last path of the different Aqueducts, the oldest of which is the Lower Aqueduct.

The difference in elevation between the collection and storage point of Spring Living Waters constituted by Solomon's Pools (approx. **780 metres** ) and the point of penetration of the Aqueduct into the Haram underground (approx. **730 metres**) was :  $780 - 730 = 50$  **metres** : This difference being of **50 metres of altitude**, over a distance of **12 kilometres** as the crow flies.

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

But for the Lower Aqueduct (most ancient) this distance was multiplied by two to **24 kilometres** due to the incessant meandering and convolutions needed to follow the rocky contours of the natural topography and maintain the gravitational flow necessary to reach Jerusalem : That is to say an inclination of **0.21%** from departure to arrival.

Once in Jerusalem the Living Purifying Spring Waters had to cross the Tyropean Valley, that ran alongside the western rampart of the Jewish Citadel (Haram), so as to be able to penetrate into the Haram's rocky underground.

It is doubtlessly why the bridge, called the Wilson Arch, after the British officer of the Ordnance Survey, was built.

According to the figures noted by Warren, who had been able to proceed to excavations and measurements of this Arch, in 1869, the ancient Aqueduct penetrated into the Haram at an elevation of 2,385-2,390 feet (approximately **727-729 metres**) above sea level, whilst he noted that the surface of the Haram at this precise point on the Esplanade was situated at an elevation of 2,240 feet (approx. **738 metres**) above sea level.

In other terms this meant that, at the level and axis of the Wilson Arch, situated to the north of the Wailing Wall and approximately midway between the Dome of the Rock and the Al-Aqsa Mosque, the Aqueduct arrived **10 metres below the surface of the Haram** when it penetrated its western rampart and entered into the ground beneath it.

**The course of this Aqueduct could then only continue in a downward direction, even if it was very slight, in order to discharge into the underground giant Cisterns that were, of course, disposed downstream.**

**18/** The construction of an Aqueduct on the arches of a bridge was probably a technological feat of engineering, or, at least, a relatively new exploit in the times of Solomon.

In this respect it is probable that the Phoenicians and more particularly the Tyrians had played an important role in the construction of this Solomon's achievement, in the same way they had played an important role for the supply of wood necessary for the construction of the Temple, and the works in gold and bronze, such as, for example, the Brazen Laver of Hiram, supported by twelve bronze bulls, and designed for the Purification of the Priests.

In fact it appears quite probable that arched Aqueducts were invented by the Phoenicians at least in that region of the World :

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

The ancient Port of Tyre had prospered as a result of the commercial talent of the Phoenicians, but also because this port, partly cemented, was solidly situated on an island at 1,500 metres from the coast, thus making their City almost impregnable.

The water supply and security storing in this prosperous island port was vital and it is the reasons why Tyre built three aqueducts that brought the waters from the Kasimieh and from a number of springs on the mainland.

One of these ancient aqueducts, of which a few vestiges remain, measured 5 metres in height.

The traditional reputation of Phoenicians and Tyrians as builders of aqueducts and other hydraulic works was extremely widespread in antiquity :

Herodotus reported that during the building of the Canal of Athos, that had enabled Xerxes to invade Greece, the Phoenicians alone avoided the loss of workers' lives, because they built the canal with sloping banks thus averting the risk of collapse, whilst the workers of other nations, by lack of experience, were satisfied with vertical banks that often revealed to be disastrously unstable and collapsed on the workers.

In the same way the Tyrians had built for Sennacherib, the King of Assyria (the enemy of the Jewish King Ezechias), a canal-bridge designed to carry waters to Nineveh, with the Phoenician engineers using watertight bitumen in its construction.

19/ Several facts point to the idea that the works confided to the Tyrians by Solomon were extended to the construction of the Lower Aqueduct and in particular of the Wilson's Arch.

In fact the accounts of relations between the King of Tyre (named Hiram in the Bible) and Solomon concerning the edification of the Temple of Jerusalem, demonstrated the close degree of cooperation between the two Sovereigns that doubtlessly went beyond the sole construction of the Temple itself.

In addition the Head of works, also called Hiram, who had been appointed by the King of Tyre, was a Phoenician with a Jewish mother, which qualified him to undertake certain works for the Jewish Temple.

The objectives that had been assigned to Hiram seemed to have been more extensive than the bronze and golden objects that were necessary for the rituals in the Temple and that the *Bible* describes in detail. In addition the extremely high number of Phoenician workers, approximately one hundred thousand, employed in the construction of the Sanctuary, let suppose that they were also engaged in the preparatory and ancillary works including, most probably, the different Hydraulic Installations :

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

2 Chronicles : Chapter 2 : verse 10-13:

Hiram, the King of Tyre, wrote to King Solomon (concerning his request for help for building the Temple):

Now I have sent a very skilful man, endowed with understanding, Hiram, (Called Hiram in the parallel text of *1Kings 7 : 13-14*).

Hiram is Tyrian by his father but originated from the Jewish tribe of Dan by his mother

He is skilful to work in gold, in silver, in brass, in iron, in stone, and in timbers ; he is skilful to dye materials in red, purple or in crimson as well as fine linen.

He can also engrave any manner of engraving, and devise any device :

In fact, he is able to carry out as well any project which would be entrusted to him.

Eusebius of Caesarea in the *Evangelical Preparations of the Gospel* presented the correspondence exchanged between King Solomon and the King of Tyre, Souron ('Hiram' in the *Bible*).

In particular is a letter from the King of Tyre, replying to the request presented by Solomon for workers, and introducing also Hiram as a very exceptional construction leader, capable of carrying out almost every different kinds of works :

Eusebius of Ceasarea : Preparation for the Gospel : Chapter XXXIV :

Letter of Suron (King of Tyre) to Solomon

And as to what you wrote concerning the men in our various peoples, I have sent thee of Tyrians and Phoenicians eighty thousands, and as Chief Engineer I have sent thee a man of Tyre, of a Jewish mother of the tribe of David :

On whatsoever you shall ask him of all things under heaven, relating to building or manufacturing, he will give you advice, and he will always be most competent to carry out the work.

Therefore it is most probable that the Phoenician specialists had, at Solomon's request, carefully examined, as reputed Hydraulic Experts, the specific Problems of the Hydraulics permanent Supply of Living Spring Waters to the Temple, in compliance with the exacting Requirements formulated by the Jewish Priests.

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

20/ After having go down the Hinom Valley by following the natural slope and then passing around the hill that was to become the Christian Mount Zion, the course of the Lower Aqueduct met with an obstacle that had to be crossed over :  
- the deep Tyropean Valley that bordered the western rampart of the antique Jewish Citadel (Haram).

The problems of crossing this valley had been studied and had been solved by the Tyrian Hydraulic Engineers, since Wilson's Arch had been built, and, in that way, the lower Aqueduct could cross the valley to enter into the western rampart of the Jewish Citadel overlooking the Temple, and then penetrate into the underground of the future Haram.

It can also be conjectured that the sealing necessary to render water tight the Channel system up to the point where it could discharge its waters into the rocky underground giant Cisterns had been provided by the Phoenicians, both with the use of bitumen and bronze conduits, since bronze was also a speciality of the Tyrians as the *Bible* indicates :

For example, *1Kings 1 : 7* and *2Chronicles 3 and 4* give the list of all the objects made by the Tyrian Hiram, including the elaborate Porch bronze Columns, the "Brazen Sea" Laver supported by twelve bronze bulls, as well as the ten engraved and decorated Baths supported by chariots, and finally the brazen Altar.

On the subject of bronze castings the Bible provides precise technical information relating to the conditions under which these works were carried out by the Tyrians :

*1 Kings : Chapter 7 : verses 45 - 46 :*

All these utensils which Hiram made for King Solomon for the House of the Lord were of polished bronze.

They were cast, in the plain of the Jordan, in the clay ground between Succoth and Zarethan. (at a spot on the east bank of the river where the earth was, in all likelihood, suitable for this casting, near to the waters of the Jordan)

21/ It is most probable that it was in this same place, in the Jordan Valley, that the bronze conduits and other connections in bronze for the Lower Aqueduct were cast : These different pieces of bronze were necessary to ensure that the Lower Aqueduct was watertight and robust, not only when it crossed the Tyropean Valley over Wilson's Arch, but also from the moment it entered inside the Haram's underground, for the reasons outlined below :

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

The Measurements made by Warren at Wilson's Arch (*Plate XXXIII of the Western Palestine Survey—Jerusalem Section through Wilson's Arch*), as well as the Measurements in his Diagram : *Section across the Tyropeon Valley at Robinson's Arch*, (confirmed by Diagrams drawn by Vincent) are presented in appendix of the present Study (cf. *Temple Maps*).

All these Measurements of Warren, which were then collated by Conder, gave the following Elevations, starting **from the surface of the Haram**, and descending vertically to its rock base beneath the ground, **to the very bottom of the Tyropeon Valley**, on which the western Rampart of the antique Jewish Citadel (Haram) had been built :

(This is from top to bottom : )

- The **Surface of the Haram** at the western rampart, inline with Wilson's Arch, approximated elevation 2,420 feet (**738 metres**) above sea level.

- **Ancient Aqueduct Inlet** at the Western slope of the Tyropeon Valley: approximated elevation 2,420 feet (**738 metres**) above sea level.  
(Warren's : *Section across the Tyropeon Valley at Robinson's Arch*, and Vincent's Diagram)

- **The point of penetration of the Aqueduct into the Western Rampart of the Haram**, approximated elevation 2,385-2,390 feet (**727-729 metres**) above sea level.  
indicated by Warren : *Vault running East & West with Aqueduct*, in *Plate XXXIII*

- The **Rock base at the Western Rampart** in line with Wilson's Arch, descending in an abrupt slope from 2,375 to 2,339 feet (**724-713 metres**) above sea level.

This means that in Wilson's Arch axis :

A/ on the Western slope of the Tyropeon Valley, the Hydraulics Engineers (probably Tyrians) in the Reign of Solomon (and after them, those in the Reign of Herod) had to arrange a canalization, most probably in bronze, which would allow the Living Spring Waters conveyed by the Aqueduct of Etam to flow on a steep slope, from an approximate 738 meters elevation down to an approximate 728 meters elevation, in order to be able to cross the Tyropeon Valley, on the Solomonian Arch, and after on the Herodian Arch (called later *Wilson's Arch*).

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

**B/** the builders of the Esplanade of the ancient Jewish Citadel (Haram), which dominated upstream the Temple, in view of leveling the surface of the future Haram, had made an earth infill from the rock base at the bottom of the Tyropean Valley to a height of **25 metres**, filling in the space left between the vertical wall of the rampart and the steep sloping surface (**738-713 metres** elevation) of the rocky crest that rose up to the summit of the Haram.

As a result, particularly watertight and robust conduits had been necessary to enable the Aqueduct to penetrate into the Western Rampart **about 10 metres below the surface of the Haram**, because at this point it had to cross the earth fill, i.e. an accumulation of porous material composed of 'mezzeh' and rubble.

Then and only after having traversed this earth fill through the watertight bronze conduits the Aqueduct could finally enter into the bedrock base of the ancient Citadel where it could discharge the Living Spring Waters into the different underground giant Cisterns, where the ever-running Purifying Flow of Waters could be stored for the Worship in the Temple.

It was only by this arrangement that the Lower Aqueduct, called the **Etam Aqueduct** or Solomon Aqueduct, could complete its course intact delivering uninterrupted Living Waters from the Etam Springs and from Solomon's Pools to the heart of the Sanctuary, for an uninterrupted Ritual Insemination of the vast Network of underground rocky Cisterns, situated beneath the ancient Jewish Citadel that was to become the Haram.

Thus, the ancient Citadel of Jerusalem was designed, above and upstream Solomon's Temple, to guaranty both the strategic defence of the Sanctuary, and constitute its underground Water Reservoir (Water Tower) indispensable for the exacting Rites of the Jewish Worship in the Temple :

And all this innovating Dynamic Hydraulic System, specifically invented with an upstream-downstream layout from the Etam Springs to the Temple, had been created by the Jewish Engineers (with the skillful help of the Tyrians) in order to scrupulously fulfill the exacting Demands laid down by The Eternal in the Precepts of the *Torah*.

And in the same meticulous manner as the Jewish Priestly Hierarchy oversaw the Architecture of the Temple conformed to the strict Commandments of The Eternal, the Priests ensured that the organization of the Hydraulic System was in total compliance with the Fundamental Laws that governed the Rules for the Purification of Israel, decreed also by The Eternal.

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

22/ It is rather probable that, over the centuries, the transport of Waters to the underground Cisterns was continuously perfected up, until the destruction of the Temple of Solomon by Nebuchadnezzar, but this is however subject of conjecture.

Nevertheless, it is obviously under Herod and his decision to build a new Temple, even more magnificent than that of Solomon and worthy of the accomplishments of the Roman Empire, that the Hydraulic System of the Sanctuary underwent significant modifications.

In this particular respect and from the examination of the ancient aqueducts in the region of Bethlehem an important evolution in Hydraulic Technology can be discerned in two different phases during the reign of Herod :

Archaeology permits the comparison of two principal types of Herodian Aqueducts corresponding to two chronological phases of construction during Herod's reign, most probably influenced by the fast concomitant expansion of the Roman Hydraulic Technology.

These two distinct Herodian phases succeeded each other in the following way :

**-A-** The first phase during the earlier period of Herod's reign when Hydraulic Technology was mostly inherited from past Jewish and Tyrian experience.

**-B-** The second phase corresponded to the latter part of Herod's reign during which the Technology was greatly influenced by Roman Hydraulics, with geometrical forms and rectilinear courses, corresponding with the more advanced Technology used during the same period for the Hydraulic Works in the rocky underground of the antique Jewish Citadel (Haram).

**-A-** As for example of the first Herodian phase, an Aqueduct from the region of Solomon's Pools, to be exact that of Artas, was constructed by Herod in order to supply waters to the Herodion Fortress which he built 10 kilometres to the east of Bethlehem :

For this secular aqueduct, that is to say with no religious connotations, Herod appears to have avoided drawing on the waters held in Solomon's Pools, which was reserved for Jerusalem and its Sanctuary, in order to supply the Herodion Fortress (unless he had done this in the most discrete way possible). This Herodion Aqueduct had a rectilinear tendency that nevertheless followed the natural topographical contours of the land with a sinuosity comparable to those of the Jewish Aqueducts constructed in earlier times, including those built at the time of Solomon.

A text of Flavius Josephus confirms the archaeological vestiges of this aqueduct that supplied the Herodion Fortress :

*The Temple of Solomon Could not Stand  
On its Water Tower*

---

Flavius Josephus : *Antiquities of the Jews* : Book XV Chapter XII :

When Herod's wedding was over (with the grand-daughter of a Jewish Priest of Alexandria), he built another Citadel at a distance of 60 furlongs (12 kilometres) from Jerusalem, in that place where he had defeated the Jews led by Antigonus (legitimate Hasmonean pretender to the throne of Judea).

This Citadel was strong by nature, and fit for such a building. It was a sort of moderate hill, raised to a further height by the hand of man, till it was the shape of a woman's breast. It was encompassed by circular towers, and had a straight ascent up to it, which ascent was composed of steps of polished stone, in number of two hundreds. Within it were royal and very rich apartments, of a structure that provided for security and for beauty.

At the bottom there were habitations of such a structure as are well worth seeing, both on other accounts, and also on account of the quantities of beautiful waters that were brought there from a great way off (from the region of Solomon's Pools), and at vast expenses.

For the place itself was destitute of waters.

**-B-** The second phase of development in Herodian Hydraulic Technology, which is possible to observe in the same key region of Solomon's Pools, is represented by the Waters Supply System Works that Herod undertook to significantly improve and increase the Supply to the new Temple with Living Spring Waters for Purifications, and of great quantities of waters at the necessary pressure for cleansing and washing.

This improvement in the Waters Supply System undertaken by Herod included mainly the construction of the Upper Aqueduct :

This Upper Aqueduct, which doubled and reinforced the volume of the ancient meandering Lower Aqueduct of Solomon, was a rectilinear Aqueduct at an elevation approximately 30 metres higher than that of the Lower Aqueduct.

The Upper Aqueduct of Herod was constructed with the new technologies inspired by Roman works and probably included one or more inverse siphons.

This Upper Aqueduct constituted a prolongation of the Aqueduct from the region of Ain Furedis and Ain Wadi Biyar, also rectilinear and probably dating from the same period, which supplied Solomon's Pools and had been designed to consolidate and increase the volume of this new Upper Aqueduct.

*The Temple of Solomon Could not Stand  
On its Water Tower*

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It seems probable that part of the waters from the Upper Aqueduct were directed towards the Upper City of Jerusalem, whilst the remainder joined the Lower Aqueduct downstream before crossing the Tyropean Valley.

In fact until the destruction of the third Temple of Herod all the waters intended for religious purposes in the Temple **had absolutely** to pass over Wilson's Arch, in order to cross the deep depression of the Tyropean Valley, so as to be able to flow down by gravity into the rocky underground giant Cisterns of the Jewish Citadel (Haram).

23/ The extent of Roman influence, in the different Water Supply Works undertaken by Herod for the ambitious construction of the new Temple of the Jews, cannot be totally evaluated without examining the very privileged relations developed between Herod (73-4 BEC) and the second most important personality in the Roman Empire, Agrippa, during the first part of the reign of Augustus (the creator, after Julius Caesar, of the Roman Empire).

Agrippa (63-12 BEC) married Julia, the daughter of Augustus (63-14 BEC) and was therefore the son-in-law of the Roman Emperor : and the children of Agrippa and Julia were therefore the grandchildren of the Emperor and were entitled to succeed him.

Agrippa owed his close relations to Octavius (Augustus) to the fact that he had always faithfully and loyally served Augustus during his ascension to the imperial throne, and, in particular, that he had played a decisive role in the Battle of Actium, in which Augustus had finally defeated his rival, Marc Anthony.

It was in this context that Agrippa became very close to the Roman Empire's seat of power and in a certain manner exercised the role of Vice-Emperor.

Now, if Agrippa was an excellent military strategist he was also one of the most eminent representatives of progress and advocates of Roman civilization, in particular through his enthusiasm for monumental Hydraulic Works.

As the Decider for Hydraulic works in the whole Roman Empire, Agrippa not only made considerable technological progress in the projects he undertook, but he also transformed them lavishly into veritable Works of Art.

For example, concerning Rome itself, Agrippa improved the flow of all the Aqueducts built before the reign of Augustus, and, on occasions, transformed their course and structures employing arcades and superimposed bridges.

*The Temple of Solomon Could not Stand  
On its Water Tower*

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To supply Rome in particular, Agrippa built several new aqueducts including the Aqua Julia, after the name of his wife and daughter, Aqua Alsienila, Aqua Virgo and Aqua Augusta.

- Aqua Julia measured 23 kilometres long
- Aqua Alsienila measured 33 kilometres long
- Aqua Augusta was entirely underground and measured 1,2 kilometres long.

According to the Encyclopaedist, Pliny the Ancient (23-79 BEC), in just one year, Agrippa constructed 130 water towers in Rome, that is to say half of all those that will exist in the centuries old Capital of the Empire.

Agrippa also built 500 fountains and 700 public water basins in the City.

The Romans owed also to Agrippa the construction of the first Thermae as being spectacular monuments besides their technological achievements, which were in constant development, and characterized this particular aspect of Roman life :

Pliny the Elder : *Natural History* : Book XXXVI : 121 :

Agrippa, during his aedileship, united the Marcian and the Virgin Aqueducts and repaired and strengthened the channels of others.

He also dug 700 wells, in addition to 500 fountains of running waters, and 130 reservoirs, many of them magnificently adorned.

Upon these works Agrippa erected 300 statues of marble or bronze, and 400 marble columns, and all this in the space of a single year.

In the work which he has written in commemoration of his aedileship, he also informs us that public games were celebrated for the space of 59 days, and 170 gratuitous bathing places (thermae) were opened to the public. The number of these at Rome (in time of Vespasian) has vastly increased since his time.

**24/** The deliberate political and aesthetic approach of Agrippa, concerning the distribution of waters, both as a public service and as a monumental instrument of the expansion of Roman civilization and its values, was extended to the whole Empire :

Amongst others, Roman Gaul, conquered by Caesar of whom Augustus was the adopted son, was endowed by Agrippa with an extraordinary system of aqueducts designed both for the needs of the population, and to be seen by the Gauls as part of the Civilization benefits offered by the marvels of Roman technology :

*The Temple of Solomon Could not Stand  
On its Water Tower*

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In the region of Lyon Agrippa built a network of aqueducts with the most advanced technology of the time, including a succession of bridges and siphons.

Amongst the different achievements of Agrippa in Gaul was the aqueduct that carried the waters from springs in the region of Uzès to supply the city of Nîmes :

This aqueduct had an inclination of 0,034% over a distance of 50 kilometres obliging the Roman engineers to dig tunnels and build a certain number of bridges :

These included the Pont du Gard an aqueduct constructed with three levels of superimposed arcades bridging the River Gardon over a distance of 275 metres and a height of 50 metres. The technological renown and the aesthetic appearance of this aqueduct became one of the references for the Roman Hydraulic Engineers as well as for the Empire's client Kings who wished to demonstrate to Augustus their ability to govern their own province or kingdom.

It is also probable that these same Roman engineers led by Agrippa invented the concave form of Dam, buttressed against the walls of the valley in order to provide the greatest resistance to the waters retained in the lake behind it :

The first Dam of this type invented and constructed under Agrippa is that of Glanum, which appears to have applied for the first time the principle of vertical concave structure to an horizontal pressure.

25/ Flavius Josephus often underlines, in a sometimes hyperbolic manner, very privileged relations that Herod had succeeded in building with Augustus and Agrippa.

In this way and style Josephus had at his disposition first hand evidence in the form of the now lost work of Nicolas of Damascus, the official biographer of Herod.

It is true that Augustus knew that the father of Herod, Antipater, had provided decisive help to Julius Caesar during his perilous campaign in Egypt.

It is also true that Herod represented, from the Roman Imperial point of view, the perfect model of a client King of Rome, by his indefectible fidelity, by his total adhesion to the Values of Roman civilization, and by his eminent qualities as a military Leader, Administrator, and a modern and ambitious Builder :

*The Temple of Solomon Could not Stand  
On its Water Tower*

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It is in this perspective that Herod built the City of Sebaste (City of Augustus) in Samaria with a temple consecrated to the Divine Emperor ;  
Herod also built the Port of Caesarea where a majestic temple was also consecrated to the Divine Emperor Augustus (Caesar being altogether the name of the founder of the Roman Empire who had adopted Augustus, and the name, altogether with that of Augustus, of all the succeeding Roman Emperors).  
In addition, Herod built a temple dedicated to Divine Augustus at Pania in a symbolic location : the Source of the River Jordan.

Herod even organized Roman Games in Jerusalem held every five years which were both festive and religious, provoking tensions with Religious Jews outraged by this profanation of the Holy City consecrated to their Sole and Unique God.

In return for his devotion and total adhesion to the Ideology of Imperial Rome, Herod always obtained the support and favour of Imperial Rome :  
Flavius Josephus reports the character of these privileged relations between Augustus and Agrippa with Herod in the following terms :

Flavius Josephus :

*Wars of the Jews : Book I: Chapter XV:*

Yet, what was still of more consequence to Herod, he was beloved by Caesar next after Agrippa, and by Agrippa next after Caesar : Whence he arrived at a very great degree of felicity ; yet did the greatness of his soul exceed it, and the main part of his magnanimity was extended to the highest promotion of piety.

*Antiquities of the Jews : Book XVI : Chapter IX:*

And it is related that Augustus and Agrippa often said that, the dominions of Herod were too little for the greatness of his soul ; for he deserved to have both all the Kingdom of Syria, and that of Egypt also.

*Antiquities of the Jews : Book XVI : Chapter III :*

(Herod comes to join Agrippa, who is doing a tour in the Roman Orient)

Agrippa was surprised and happy to see Herod appear unexpectedly with a fleet (loaded with gifts from Herod for the Imperial Treasury). Many friendly salutations were between them, insomuch that Agrippa thought he had received the greatest marks of humanity towards him possible, since the King Herod had come so long a voyage, and at a very proper season, to offer assistance to Agrippa : and, especially, as Herod had left the government of his own dominions, and thought it more worth to come with Agrippa.

*The Temple of Solomon Could not Stand  
On its Water Tower*

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Accordingly, Herod was all in all to Agrippa, in the management of war, and a great assistant in civil affairs, and in giving him council to particular matters. Herod was also a great companion when Agrippa relaxed himself, and a joint partaker with him in all things : in troubles because of his kindness, and in prosperity, because of the confidence that Agrippa had in Herod.

26/ Indeed, another account presents Agrippa, at the same time, as a very close friend of Herod and like a very open character, and specially interested, among others, in the Judaic Rites :

Following a pogrom in Alexandria in 39 EC, two Embassies went to Rome in order to present to the Roman Emperor Caligula the versions of the two opposing parties : i.e. the victims, Jews on one hand, and the aggressors, Pagan Alexandrines, on the other hand, who accused each other of bearing responsibility for these violent events.

The account of the Jewish Embassy is contained in *Legatio ad Caium*, (Embassy to Caligula) a work written by Philo of Alexandria, who directed the Jewish Delegation of Alexandria.

But, meanwhile, Caligula had decided to place in the Temple of Jerusalem, his own monumental Statue, which would have to be revered there, under the name of "Zeus-Caligula", thus transforming the Jewish Temple into his own Sanctuary. And only, the assassination of Caligula will prevent this programmed transformation of the Temple of the Jews into a Pagan Temple, dedicated specifically to the Roman God-Emperor.

In the following extract, in order to dissuade Caligula from committing such terrible profanation, a letter is written by the grand-son of Herod, King Agrippa (thus named in testimony of the friendship of Herod and of Agrippa) which recalls to the Emperor Caligula (grandson of the same Marcus Agrippa) the respect and affection that Agrippa had displayed for the Temple of Jerusalem :

Philo of Alexandria : *Legatio ad Caium (Embassy to Caligula) : 301-302 :*

*Letter from Agrippa to Caius Caligula :*

However, when Agrippa (son-in-law of August) saw the Temple of Jerusalem, the behaviour of the Priests and the devotion of the Inhabitants, he was in rapture, because he estimated to have seen there something sublime and superior to all that one could be seen :

*The Temple of Solomon Could not Stand  
On its Water Tower*

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Agrippa did not have other subjects for conversation with his close friends only to praise the Temple and all its organization. And during all the stay which he made in Jerusalem, by friendship for Herod, everyday he would return to the Temple for the pleasure of contemplating its Structure, the spectacle of the Sacrifices, the Ritual and the Ceremonial of the Worship, the solemnity which surrounded the High Priest when, wearing the sacred Clothing, he governed the Ceremonies.

Agrippa decorated the Sanctuary with all the allowed ex-votos, and lavished the Population of Jerusalem with all the possible favours.

And when he had complimented Herod well, and that he had been, in return, thousand times thanked, Agrippa was escorted to the Port (of Caesarea), not by the only town of Jerusalem, but by the entire Country population who threw branches on his steps, and praised his Piety.

27/ It seems quite natural that such close relations between Agrippa and Herod, made up of numerous conversations, could not leave out the favourite subjects common to the two men :

Amongst these shared subjects and passions were monumental Architecture and effective, aesthetic, Hydraulic Architecture, which in view of their immense achievements, occupied an important place in the imagination and ambition of these two men, who were so similar in this sense.

Thus, in all probability, an important part of the Hydraulic Works inspired by the Romans, whose vestiges have been preserved around Jerusalem and in the rocky underground of the Haram, go back in their initial phase to the ambitious enterprise that Herod had conceived for Jerusalem and its Temple, so as to put his own Reign down in History and to bequeath it to his Dynasty, in exactly the same way as, during the Reign of Augustus, Agrippa had undertaken the edification of a monumental, technological, Hydraulic Work for the Glory of the Roman Empire and for the Glory of the living God Augustus, the grandfather of Agrippa's children and possible inheritors of the Roman Empire.

*The Temple of Solomon Could not Stand  
On its Water Tower*

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