Nazareth G-69/2012 Nazareth Report

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Nazareth Projects near Mary’s Well, Nazareth: bathhouse and the Church of the Annunciation (St. Gabriel’s Church) 2012 Report

Mary’s Well itself was carefully excavated by Israeli archaeologist Yardena Alexandre on behalf of the IAA and reported on (1997-1998).¹ Our project began with two major parts which start with the understanding of Mary’s Well and continue to the adjacent bathhouse.

The first part of our follow up was the continuation of a hydrological mapping project supervised by Dr. Philip Reeder from the back of St. Gabriel’s Church to the bathhouse extension in the store named “Byzantion” and in and under the Church. Professor Philip Reeder of Duquesne University conducted a follow up to his earlier research study to determine if it was possible for the water to have been directed from MW to the bathhouse, and how. Based upon this detailed survey, Reeder answered several research questions including, (1) What is the local hydrology of the area? (2) How is the bathhouse related to the local hydrology? (3) How are the bathhouse and Mary’s Well hydrologically related? As part of the research design for this project some of the objectives were, (1) to complete a detailed map of the bathhouse, (2) to map the local hydrologic features and their spatial relationship, (3) to relate local construction patterns to area hydrology, and (4) to establish relationships between the lower room portion of the Cactus gift shop, the hypocaust of the bathhouse, and other construction in the area. As part of this research design, two maps were generated based upon the Total Station Survey. One is the map with the relationship of the Church of the Annunciation (the Greek Orthodox Church of the Annunciation has two names: St. Gabriel’s and the Church of the Annunciation. The other Roman Catholic Church of the Annunciation is located down the street from the Greek Orthodox Church is not the subject of the study) which contains a part of the water source that continues to Mary’s Well, and the second is of the Mary’s Well site in relation to the bathhouse nearby. These maps are intended to indicate the relationships between the local water sources, inside of St. Gabriel’s Church, Mary’s Well, and the bathhouse. An assessment of the Mary’s Well Area map is as follows (starting at the north part of the map and moving to the south): The water that is accessed at the well in St. Gabriel’s Church Courtyard likely flows from the north, and is first accessible in what appears to be a hand-dug, stone lined well (station 1 on the map). The land surface elevation of this courtyard was designated as the zero datum for this survey. The depth to the water from ground level in the courtyard is 5.27m. At Base Station 12, the ground surface of the plaza is 8.37m below the ground surface (mbgs) of the northeast

¹Yardenna Alexandre, Mary’s Well, Nazareth: The Late Hellenistic to the Ottoman Periods, IAA Reports, 49 (Jerusalem: Israel Antiquities Authority, 2012).
courtyard in the church, and it is 3.1m below the elevation of the water at the bottom of the well in the church courtyard. This indicates that a hydrologic gradient exists and that water could flow via gravity from the well at the church toward the south and eventually to the bathhouse and Mary’s Well. Station 13 is the floor elevation of a building adjacent to the plaza what was then an internet café (today a restaurant). The floor of the internet café (they allowed us to do non-invasive survey work inside) is 9.13m below the zero datum in the church courtyard. The elevation of the lower room floor of Cactus is 11.28m below the zero datum. The most prominent and revealing feature in the lower room is the north wall with an arch indicated on the map above. The center of an arch in the east wall of the beverage serving room (referred to as the “juice”, “coffee” or “tea room” in this report) is 2.2m above the level of the floor of the tea room; consequently, the top of the arch is approximately 9.2m below the zero datum.
The second part was a geophysical survey of all of the locations from St. Gabriel’s to Mary’s Well and of the bathhouse and its spatial and hydrological relationship to Mary’s Well co-supervised by Paul.
Bauman of WorleyParsons of Calgary, Canada and by Harry Jol of the University of Wisconsin, Eau Claire (ERT and GPR respectively).

Figure II - The mapping of the movement of the water sources (Courtesy, P. Reeder, 2006 Nazareth Project)

GPR and ERT: Non-invasive investigation of the continuation of the Bathhouse

We began our work at the continuation of the Bathhouse located in an adjoining shop to the original study of 2003 at the Cactus store near Mary's Well. It was our desire, therefore, to try to continue our research in an area where the floor and the remains have not been excavated. This is the reason for our work at Byzantion. An ERT section of Byzantion was done on July 9, 2011 for the purpose of determining likely areas of the presumed extension of the hypocaust from Cactus, and to identify where to excavate.

The resulting images from these geophysical surveys show that various anomalies exist in the subsurface and may indicate archaeological features that still exist below the present floors. For example, the upper bath house may have been built upon an earlier bath house that more closely aligns with the water system located and excavated at the adjacent Mary's Well site. Several test probes and samples for radiocarbon dating are planned to be undertaken as based upon the results from these geophysical surveys.
In July, 2010, a new shop adjacent to the Cactus site was being prepared; we asked the new shop keeper to not dig out his basement before we were able to do a geophysical survey, assess the situation and apply for a license to scientifically dig a portion to complete our research.

On July 9, 2011, an initial Electrical Resistivity Tomography (non-invasive) geophysical survey was conducted which showed that the same type of void present in the Cactus site would be available for research. In December, 2012, we were able to assess the continuation of the bathhouse structure and add more detail to the work which we have been doing since 2003. The floor has a number of viewing glass areas (see Figure XIII), one of the viewing areas above a particular void had a broken piece of floor area for a fiber-optic camera to be sent down to assess the area below Byzantion’s floor. The fiber-optic allowed us to assess the area, finish drawing the complete the design of the bathhouse, and assess exactly where a sample for C14 testing from below the undisturbed area could be taken in a future excavation period.
Figure IV - The already existing hole in the floor through which the fiber-optic camera was positioned in December, 2012 (Courtesy P. Bauman, Nazareth Project)

Figure V - the ERT scan of the Byzantium shop (2011, Courtesy P. Bauman, Nazareth Project)

The Byzantium work included a full mapping of the entire site with undisturbed sites for systematic excavation, coring and sampling the future.
The 2012 December work included a full documentation of the connections between the parts of the unmapped area with a fiber-optic camera and mapping. This includes an area where the floor has been reinforced with concrete. These areas will be investigated to assess the area which can be cored for carbon 14 dating in an undisturbed area.
Figure VII-The fill below *Byzantium*, December, 2012.
Conclusions:

1. We now know that the area of the bathhouse conclusively contains another section of the bathhouse and further research should be done here. Mapping will include the finishing of the mapping of the exact GPS locations for the pylons for the bathhouse, taking samples of the individual areas which were preliminarily mapped in Figure XV.

![Figure VIII: The mapping of the floor beneath Byzantion, December, 2012](image)

2. The main elements of our work are:

A. Careful GPR investigation of the "fill" in the basement area of Byzantion to see if remains (artifacts) of un-compacted fill from the earlier facility is contained in the upper fill. This might include: glass,
pottery, coins, decorative design work, ash, wood, charcoal, plaster and ceramic pipe which would provide ample material for C14 and other comparative testing.

B. Investigation of whether in Byzantium there is the same or similar architectural feature, an arch, from the earlier structure is on the northern wall. This will involve a GPR study of the walls below the floor.

C. Investigations will continue in the eastern chimney hearth remnant below the floor Byzantion, which would have been centered in Byzantion, for the purpose of providing additional cored samples for C14 testing from below the top layer of fill through the bottom plaster floor.

Appendix: Nazareth Bath Radiocarbon Samples from 2003 Excavation

Dr. Elisabetta Boaretto, Weizmann Institute of Science

Three charcoal samples from Hammam Bath in Nazareth, were submitted for Radiocarbon dating. The samples were separated from the plaster and cleaned following the Acid-Base-Acid procedure, in order to reduce the possibility of contamination. The final efficiency was of 50-60%, which is in the range for charcoal material. The radiocarbon measurement was made using Accelerator Mass Spectrometry technique at NSF-AMS radiocarbon laboratory Tucson, Arizona.

1. Two samples (RTT 4691-4692) were collected from the pavement of the Hammam and RTT 4693 is from a oven (Tabun) that was probably used to warm the room.

2. The three samples are quite different in radiocarbon age, indicating that the site was used during the second millennium, in different periods.

3. RTT 4693 Tabun, inside the building is very young, possibly post-bomb. In the Table all the results with the different % for ±1σ are given to show all the possibilities. Such multiple solutions are the effect of the calibration curve. The last few hundred years are not an easy period for the calibration.

4. RTT 4691 and 4692 are older. They are between 14th-15th centuries indicating a middle age use of the Hammam. The date of the charcoal included in the plaster should provide a close date to the formation of the plaster, but because charcoal could have been derived from the burning of large wood beams and it might be subjected to the “old wood effect”. Therefore its age could be older than the time of the plaster formation by tens or hundred years.
Following the invitation by St. Gabriel Church’s Arab Orthodox Council to complete the hydrological survey of the Church in December, 2012, we completed an extensive survey from the original location or source of the water through the Church and out through to connect up with our work.

Goal: Ground Penetrating Radar (GPR) and Electrical Resistivity Tomography (ERT) survey to determine a series of excavatable points within or around the Church for future work

Using: Non-invasive archaeology and mapping of sensitive
Ground penetrating radar (GPR) is a high frequency electromagnetic technique that uses the reflection of radar waves to map a subsurface area. In general, any change in soil texture or moisture content will create a radar reflection. GPR has been gaining the growing recognition in its ability to detect and map buried archaeological sites in a safe, quick and non-destructive manner. Discrete objects, whether made of stone, cement, leather, wood, bones, plastic, metal, etc. will also create distinct radar reflections or anomalies down to eight feet (2-3 meters) and are collected on a computer and interpreted by geophysicists and mapped onto a map by our cartographer. Electrical Resistivity Tomography uses electrical impulses and collects the reflections down to 30 feet (10 meters) on a computer and then interpretations by geophysicists allow interpretation of the archaeological strata and allow pin-pointing of where to excavate and not disturb already existing streets, buildings, floors, etc. The interpretation of the data by the geophysicists and then the collaboration with local archaeologists has led to excavations which pin-point elements which then are excavated without damaging or destroying unnecessarily any of the site that does not need to be fully excavated to assess the data of a site.

Two surveys were conducted on December 17 and 18, 2012 at St. Gabriel’s Church with authorization and cooperation from the Municipality of Nazareth and facilitated by Dr. Sharif Sharif Safadi and granted by Dr. Azmi Hakim, Chairman of the Arab Orthodox Council-Nazareth. This is a report of the work done and recommendations for a follow up study, excavation and restoration in 2013-2015. The study follows the study already conducted of the complex of the Orthodox Church of the Annunciation and extends in spatial terms to a well determined portion of the district, aims at the enhancement of its constituent elements: squares, paths, sacred and symbolic places, values that are not perceived, as the water cycle and the source that feeds the well of Mary, and the archaeological excavations.2

2 Study for the improvement of the religious complex of the Orthodox Church of the Annunciation in Nazareth

Arch. Michele Culatti in collaboration with arch. Laura Astegno, Maurizio Merlo, arch. Viviana Martini, arch. Alessandro Stocco - supervision Arch. Renzo Ravagnan, Dr. Sharif Sharif-Safadi
The University of Hartford has been conducting a multi-year project which included an in-depth study of the hydrological resources in the Mary’s Well area including the bathhouse and Mary’s Well as well as the plaza behind the Well which included a study all of the way up to an including St. Gabriel’s starting in 2003. This work has yielded an understanding of the water sources which were historically used both for the Church, a religious collection source in the Churches from the Byzantine period through the modern period, to the Mary’s Well and to the bathhouse which may have been used multiple times thanks to the abundant water sources in the area and to the flow which was before the modern period conducted through a specific water channel which is mapped below (Figure II)
Figure II: The evidence gives us exact information of the level of the water from the Church all of the way down to Well.
The Church of the Annunciation, St. Gabriel’s Church in perspective

The ERT and GPR surveys which we conducted inside of the Church and outside of the Church in December, 2012 gave us a data set for understanding how the Church was built and rebuilt often without following the same exact line and dimensions, but always with the water sources flowing in the same way from the springs which emerged from a cave now located under the street above and which continued under the Church until the 1960s when modern sewage cut off the main water source from travelling below the Church and an artificial source was created with piping to the back of the modern incarnation of the Church. We will start with the information gleaned from an ERT and GPR survey behind the Church (arrow pointing to back where the survey was conducted in Figure III).

Figure III: The back of the Church location where an ERT and GPR survey were conducted
Figure IV: The back of the Church has an open area where there was an excavation performed and then covered.

The area behind the Church has an open area which was apparently opened and excavated and we did not have access to whatever information may have been available from the excavation behind the Church which is covered with corrugated metal to protect the area from inundation (Figure IV). The undocumented excavation revealed Byzantine-style mosaic which were removed but there appears to be a large area unexcavated area inside of the open area which is still excavatable. Many of the unexcavated areas reveal mosaic style flooring still imbedded in the sub-surface (Figure V)
Figure V: There are still pieces that should be systematically excavated imbedded in the wall of the open area.

We conducted the ERT and the GPR survey behind the Church in the area closest to the Church wall one meter above the continuation of the feature.
Figure VI: The ERT Survey

Here is the update on the processing of the ERT section behind the Greek Orthodox Church of the Annunciation.

Figure VII-The evidence of a large crypt 1 meter below the ground that continues down two meters.
Paul Bauman report, WorleyParsons, Inc. Chief Geophysicist for our project of the area:

Background

On December 19, 2012, a single 28 m electrical resistivity tomography (ERT) spread was surveyed in the courtyard behind the Greek Orthodox Church of the Annunciation. The objective of the survey was to identify voids or massive stone features that may indicate the remains of an earlier church. It was assumed that either void space (e.g. a crypt) or large stone architectural features would be imaged as strong resistors.

Methodology

A single resistivity section of 28 m length, imaging to a depth of approximately 4 m below ground surface (mbgs), was surveyed. 81 electrodes were evenly spaced at a minimum separation of 0.35 m. Common nails were used for electrodes where they could be placed between paving stones. Aluminum foil and electrolytic gel were used where there were no gaps between paving stones.

Results and Interpretation

The resulting geoelectric section, plotting modeled true resistivities at true depths. Resistivities in the section range from low values of less than 100 ohm-m, to very high values of greater than 7,000 ohm-m. The blocky resistive feature centered at the 16 m line position is interpreted to be indicative of a buried structure. The dimensions of this feature are from line position 12 m to 20 m, and from depths of 1 mbgs to 3 mbgs. The very high resistivity arched feature centered at line position 16 m is likely the continuation of the barrel shaped crypt visible in the excavation.
Recommendations

Despite collecting data over a paved surface, the data quality of the survey is excellent. The main concern of the results and interpretation is that the large, blocky resistor may, perhaps partially, be influenced by the air filled void of the excavation. While it is true that the anomaly roughly coincides with the open face of the excavation, it is also true that the remnants of a mosaic floor and the barrel crypt are present in the excavation, indicating the certainty of a preexisting structure. As such, some limited ground truthing (excavation, test pitting, expanding the existing excavation, etc.) would be recommended before fully excavating the geophysical target. Also, spatially correlating the GPR anomalies with the resistivity anomalies may add to increased confidence of the significance of the resistive anomaly. While resistivity surveying appears to be very effective in the courtyard, the small area of the courtyard limit the possibilities of any further surveys.

Figure VIII: The mapping of the barrel shaped structure is a well-known feature which has been seen and documented by other teams.
The difference is that we know how far it extends and that it is worthwhile to excavate behind the area that is presently open.

Again, the data are preliminary, there is a clear understanding of the site which emerges from the ERT data. Viewing Figure VII looking at the 0 to 7,000 ohm-m section, we see a hot pink, extremely high arch-shaped anomaly. This, of course, is very likely the barrel vault/crypt itself coming from the existing church – an air filled passage constructed of stone. Also, the peak (highest elevation point) begins at about 17 m on the line (depth of about 1 meter), which more or less lines up with the location of the Barrel Vault Ceiling peak as I GPS’d it on the base map. This, in itself, suggests the data are real (that is, the data are not being corrupted by the open excavation or rebar in the concrete or anything else).
Figure IX: The Barrel Shaped Crypt
The section plotted on a scale of 0 to 1000 ohm-m is exactly the same data, but contoured differently. We still see the ceiling/peak of the barrel vault/crypt, but we also see a much larger anomaly extending from about 11 m West to 20 m West (9 or 10 m in length), and from say 1.2 mbgs to 3.2 mbgs, or about 2 m in height (ignoring the peak of the barrel vault). I would guess/assume that this anomaly is the foundation or some portion of an earlier building. It is very resistive (suggesting massive blocks), 1000 ohm-m versus background resistivities of less than 100 ohm-m, but far less resistive than the air filled barrel vault (>7,000 ohm-m). This all makes sense. Extending from 20 m West to 23 m West is a moderate resistive “slab” of about 250 ohm-m (yellow/orange anomaly at a depth of 1 to 1.5 meters). If I try to explain this in terms of the original Byzantine church, I would like to suggest that this moderate resistor ties into the remains of the mosaic floor – which it does – however, it also falls outside the imaged interpreted foundation, so not sure what this is or could be.

Figure X: Pottery from the area of the Barrel Shaped tunnel with a stone area which conducted water.
Figure XI: GPR conducted by Professor Harry Jol, University of Wisconsin and Yossi Salomon, University of Haifa
Ground penetrating radar (GPR) experiments were undertaken at two localities within the Greek Orthodox Church of the Annunciation site during December 2012 Summary of Findings

A Geophysical Survey Systems, Incorporated (GSSI) GPR system with 3 different frequency antennae was utilized for the project. At first locality in the passage to the ‘Grotto’, all three frequencies (270, 400 and 900 MHz) were tested and compared on the passage floor and walls. The initial results from passage show GPR can penetrate the surface material and into the “sediment” below the floor and behind the walls showing potential structures. At second locality on the main floor of the modern church, a 400 MHz transect was collected west to east. The data imagery shows that GPR can penetrate the floor material and in the materials below the floor showing potential features such as a wall.

A ground penetrating radar (GPR) experiment was undertaken at one outdoor locality to the rear of the Greek Orthodox Church of the Annunciation during December 2012. A Geophysical Survey Systems, Incorporated (GSSI) GPR system with 400 MHz frequency antennae was utilized for the project. At locality to the rear of the church which is hypothesized to be above the ‘Grotto’ passage, multiple, parallel 400 MHz transects were collected in a west to east pattern resulting a grid dataset. The data imagery shows that GPR can penetrate the outside tile material and into the “sediment” below the tiles. The grid pattern allows for time slices (horizontal layers) and a 3D perspective of potential features in the subsurface.
The continuation of the GPR survey took place in the Church of the Annunciation

The survey of floor of the passage to the grotto

Figure 1 - survey area inside the Church

Grid 1 - inside the church, the passage floor to the grotto.

Orientation: North-South

Antenna 900MHz

Files:
Start: file___034 End: file___042

Survey spacing 0.25 m

Gains: -15,13,25,28,33

Range: 30 ns

Offset 1.47 ns

Figure 2 - scama of the survey line Grid 1
Grid 2 - inside the church, the passage floor to the grotto

Orientation: North-South

Antenna 400MHz

Files:
Start: file___046  End: file___054

Survey spacing 0.25 m

Gains: -17, 3, 24, 31, 34

Range: 50 ns

Offset 1.47 ns

Figure 2 - scama of the survey line Grid 2

Grid 3 - inside the church, the passage floor to the grotto

Orientation: North-South

Antenna 270MHz

Files:
Start: file___046  End: file___054

Survey spacing 0.5 m

Gains: -20, 5, 29, 44, 54

Range: 75 ns

Offset 2.25 ns

Figure 3 - scama of the survey line Grid 3
The survey of the eastern wall of the passage to the grotto
Profile of the eastern wall of the passage to the grotto inside the church

Figure 4: the eastern wall of passage

Profile made by 900MHz antenna
File___043 continuous time survey (without the survey wheel)
Orientation: North to South; Range: 30ns
User marks every 0.25 m; Gains -15,13,25,28,33

Figure 5: GPR image profile (900MHz antenna) of the eastern wall of the passage to the grotto. Processed applied in the following order: Horizontal scaling→ 0 offset correction → Background removal filter.
Between the first and the second 0.5 to 1.2m there is a series of horizontal anomalies that maybe can be interpreted of fill that seem to me like sealing of an entrance.

File references: File___043.DZT row data, File___043 P_1144.DZT horizontal scaling, File___043 P_11441.DZT 0 offset correction, File___043 P_114411.DZT Background removal filter.

Profile made by 400MHz antenna

* Files: file___056.dzt and file___057 are the same.

File___056 time continuous survey (without the survey wheel)

Orientation: North to South Range:50ns

User marks every 0.25 m

Gains -17, 3,24,31,34

Figure 6: GPR image profile (400MHz antenna) of the eastern wall of the passage to the grotto. Processed applied in the following order: Horizontal scaling→ 0 offset correction → Background removal filter.

File references: File___056.DZT row data, File___056 P_11.DZT horizontal scaling, File___056 P_111.DZT 0 offset correction, File___056 P_1111.DZT, Background removal filter.
Profile made by 270MHz antenna

File___064 continuous time survey (without the survey wheel)

Orientation: North to South; Range: 75ns

User marks every 0.25 m

Gains -20, 0,23,44,51

Figure 6: GPR image profile (270MHz antenna) of the eastern wall of the passage to the grotto. Processed applied in the following order: Horizontal scaling→ 0 offset correction → Background removal filter

File references: File___064.DZT row data, File___064 P_11.DZT horizontal scaling, File___064 P_111.DZT 0 offset correction, File___064 P_1111.DZT Background removal filter.

* Four supporting walls!!!!

*All profiles of the eastern wall of the passage to the grotto indicate to an additional vault shape parallel structure with at list 4 distinctive arches.

The survey of the western wall of the passage to the grotto
Profile made by 900MHz antenna

Figure 5: the eastern wall of passage

File___44 continuous time survey (without the survey wheel)

Orientation: North to South; Range: 30ns

User marks every 0.25 m Gains -15,13,25,28,33
Figure 6: Image of GPR profile (900MHz antenna) of the western wall of the passage to the grotto. Processed applied in the following order: Horizontal scaling → 0 offset correction → Background removal filter.

File references: File____044.DZT row data, File____044 P_11.DZT horizontal scaling, File____044 P_111.DZT 0 offset correction, File____044 P_112.DZT Background removal filter.

* There is symmetry between GPR profiles beyond the eastern and the western walls. Beyond both walls, we find two supporting pillars and between them we find the same flat architectural element. These architectural elements are probable part of same architectural plan that represent an earlier phase of the church.

**Profile made by 400MHz antenna**

File____057 continuous time survey (without the survey wheel)

Orientation: North to South; Rang: 50ns

User marks every 0.25 m

Gains: -17, 3, 24, 31, 34
Figure 7: Image of GPR profile (400MHz antenna) of the western wall of the passage to the grotto. Processed applied in the following order: Horizontal scaling → 0 offset correction → Background removal filter.

File references: File____057.DZT row data, File____057 P_11.DZT horizontal scaling, File____057 P_111.DZT 0 offset correction, File____057 P_1111.DZT Background removal filter

* from both profiles the 400MHz and the 900MHz, it seems that there is parallel passage with arches

*files 65-66 are the same

Profile made by 270MHz antenna

File___066 continuous time survey (without the survey wheel)

Orientation: North to South; Rang: 50ns

User marks every 0.25 m

Gains: --20, 0, 23, 44, 51
Figure 8: Image of GPR profile (270MHz antenna) of the western wall of the passage to the grotto. Processed applied in the following order: Horizontal scaling → 0 offset correction → Background removal filter.

* Possible two vault shape structures that are positioned parallel to the grotto passage beyond the western wall!!

File references: File____066.DZT row data, File____066 P_11.DZT horizontal scaling, File____066 P_111.DZT 0 offset correction, File____066 P_1111.DZT Background removal filter

Section in the middle of the modern church main service hall
Orientation: west to east

File: file____067.DZT, Antenna: 400MHz, range 50ns gains: -17, 1, 25, 42, 48.

Figure 9: Image of GPR profile (antenna 400MHz) in the middle of the modern church main service hall. Processed applied in the following order: 0 offset correction → Background removal filter.

File references: file____67 p_1.DZT, file____67 p_11.DZT
Grid 4-ouside the church situates above the passage to the grotto.

Orientation: West-East

Antenna 400MHz

Start: file___068 End: file___078

Survey spacing 0.25 m

Gains: -18,-15,37,58,75

Range: 80 ns

Offset 2.65ns

Figure 10- scama of the survey line Grid 4(the file marked in red are were collected in reverse to the survey orientation)
Figure 11- Amplitude maps of the Grid 4

Figure 12- 3D model of the amplitude maps Grid 4

**The model show additional vault-shape building towards the east**