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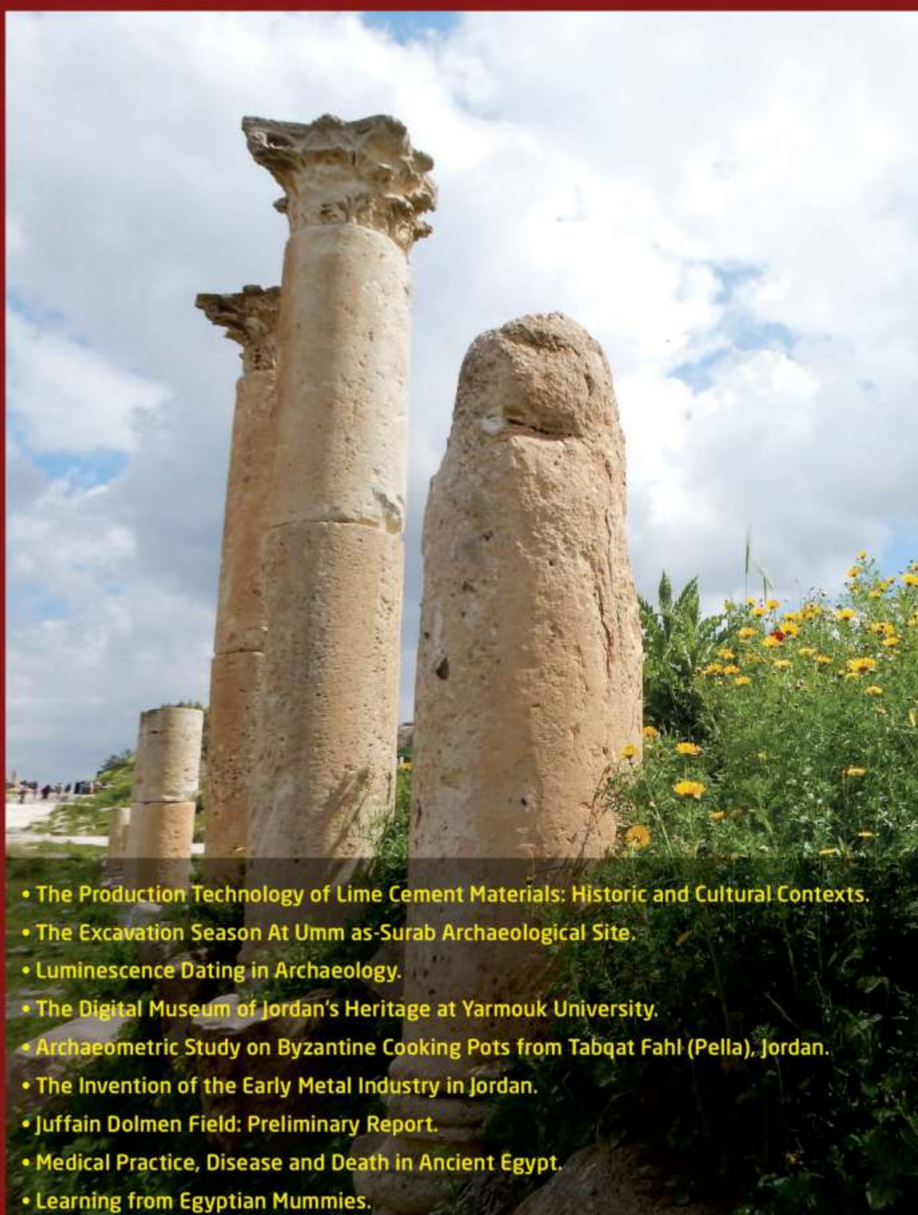

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COVER
Harra region - Northeastern Jordan (Photo: Hani Hayajneh)
Roman Columns - Umm Qais - Jordan (Photo: Hani Hayajneh)

CONTENTS

Editorial

Cultural Heritage: An Evolving Concept

Human heritage is an endless mine of knowledge, skills, ethics and achievements that illustrate the power of human creativity and innovation throughout history. Therefore, ‹Cultural Heritage›, as an academic discipline, aims to explore human creativity on the tangible and intangible levels, its expressions, and how to preserve and safeguard it. It seeks to understand man›s different cultural aspects, ways of thinking, material and immaterial production, customs and traditions, knowledge associated with his existence and identity, and contribution to human evolution.

The articles published in this journal, including the topics of the approved master's theses atthe Faculty of Archaeology and Anthropology, clarify the diversity of themes related to cultural heritage that our Faculty is concerned with, and reflect the complementary view between the natural and life sciences and the human sciences. They attemptto shed more light on our understanding of human cultural heritage through a multidisciplinary approach that encompasses a wide range of fields and subfields, including biology, geology, physics, fine arts, philosophy, anthropology, chemistry, customs and traditions, philology, education, economics, law, etc.

These contributions leave no room for doubt that our vision of the concept of ‹cultural heritage› is subject to development and change over time according to the economic, social, cultural, political, and technological developments. On the other hand, our understanding and questioning invite us to search for new research approaches that aim for understanding the complex and interwoven nature of human inheritance, which requires different partners and stakeholders seeking to develop new, innovative and comprehensive methods and paths to ensure the wise and sustainable safeguarding and transmission of cultural heritage.

Editor-in-Chief
Prof. Dr. Hani Hayajneh

Tell Deir Alla – Jordan Valley (Photo: Yousuf Al-Zoubi)
تل ديرعلا – وادي الأردن – الاردن (تصوير يوسف الزعبي)

THE PRODUCTION TECHNOLOGY OF LIME CEMENT MATERIALS: HISTORIC AND CULTURAL CONTEXTS

KHALED AL-BASHAIREH

Summary

This short essay defines the function of cement materials and places them in their historical and cultural contexts. It focuses on the lime cements which represent the most widely used material in archaeological architecture produced by a complex pyro- chemical industry. It discusses the archaeological evidences that this industry was originated in the Middle East during or before the Natufian times. The use of these materials in the neighboring regions (Anatolia, Mesopotamia and Egypt) dated to earlier periods. The large scale of lime production occurred during the Pre-Pottery Neolithic B (PPNB) period.

Cement materials

Ancient cultures used various bonding materials (cement) for covering and consolidating natural and synthetic bricks or friable grains. Clay, gypsum and limestone were the main sources for the production of ancient cement materials. All cements consist of a binder (clay, lime, gypsum) and aggregate (additives) however applied differently. Based on their application, cement materials were given different names including plaster, mortar, concrete, and stucco. Hydraulic or Pozzalanic cement was employed for underwater or water-contact installations. Mortar is a widely used term to indicate any cement material employed in joints, beds and coverings. However, mortar is mainly composed of coarse-aggregates and used between stones for bedding and jointing and leveling thick coat (Davey, 1961). Plaster is mainly composed of fine-aggregates and used for flat thin covering coats and surfaces for mural painting. The high-quality plaster of very fine-aggregates which is used for painting and decorations called stucco (Littmann, 1957). Concrete is another term applied to cements of very coarse-grained aggregates and employed for bases. Concrete was defined by some scholars as a mixture of lime, alumina, silica and aggregates (Lechtman and Hobbs, 1986). Roman concrete was made of lime, aggregates and pozzalana (a natural volcanic ash) which offers the alumina and silica (Wright, 2005). At present, Portland cement, invented by Joseph Aspin in 1924, is the binding material used for the production of cement materials (Callebaut et al., 2001).

Origin of lime technology

The development of cements technology relied on different factors; the availability of raw materials and fuels, complexity of production processes, climatic conditions and structural function. The production technology of lime-cements is very complicated process, since it involves a multi-step procedure, because it represents a pyrochemical industry (Al-Bashaireh, 2008). For many scholars, production of lime cement depicts the beginning of the pyrotechnology and the start of applying fire for production purposes (Kingery, Vandiver and Prikett 1988, Lambert, 2005). The origin of this industry is controversial as there is no clear evidence from early eras, however several scholars considered that lime technology transferred from the Middle East to the neighboring regions (Davey 1961, Moropoulou et al., 2005). Malinowski and Grafinkel (1991) claim that humans discovered the binding properties of lime very early when they used fire for warming dwellings in limestone caves. Al-Bashaireh (2008) argued that it might appear when early people heated water by dipping hot limestone in it. It is worth mentioning that the large use of lime plaster occurred after sedentism and domestication of animals and crops and before the production of moulded bricks and terra-cotta (Harris, 1998).

The first form of lime cement appeared on a small scale by the people of the Geometric Kebaran site of Lagama North VIII (12,000 BCE) in the Sinai Peninsula to attach handles to stone tools (Bar-Yosef and Gorin-Morris, 1977; Kingery, Vandiver and Prikett, 1988; Lambert, 1997). Belfer-Cohen (1991) and Kingery, Vandiver and Prikett (1988) state that the presence of the thick layer of white pure calcium carbonate at the Natufian site of Hayonim Cave (10,400 - 10,000 BCE) in Palestine features a lime kiln and shows a large-scale production of lime materials. Mercier et al. (2007) argue that the thick carbonate layer might accumulate by the effect of weathering or hearth on the cave's limestone. Excavations at Canjenü, Eastern Turkey, uncovered a terrazzo floor laid with a lime mortar dated between 12,000 and 5,000 BCE (Landsberg, 1992). During the Natufian period (12,800 - 10,300BP) and the Pre-Pottery Neolithic B PPNB of the Near East (ca 7,200 - 6,700 BCE), the Middle East and the Levant seen an extensive use of lime cement for floors and wall covering which characterized the architecture of these periods. Ain Ghazal (6,000 BCE) and Jericho (PPNB) sites show an early use of lime cement for sculpture. Ain Ghazal's well shaped statues were made by applying lime cement to reed skeletons (Rollefson 1992). Rollefson and Kohler-Rollefson (1990) argued that the Near East produced lime cement in an industrial scale by the seventh millennium BCE and reached its peak in the LPPNB of the Middle East (7,200 - 6,700 BCE). In the Mesopotamia, gypsum was the very common cement due to its plentiful outcrops; therefore, lime cement production was practiced late during the third millennium BCE according to the findings of the lime kiln at Khafage, dated back to middle of the third millennium BCE.

In Egypt, the main source of cement was gypsum; however, Gourdin and Kingery (1975) confirm that lime plaster was used in the production of the Pre-Ptolemaic plaster samples they analyzed. Hornbostel (1991) and Lambert (2005) claim that the Egyptians used both lime and gypsum cements to bind stone blocks during fifth millennium BCE.

Conclusion

The above discussion and literature review of the historical background of the use and production of lime-based cement materials, reveal that, their production technology was originated in the Middle East. Although it is possible that, the production of these cement materials started earlier than the abovementioned chronological dates, it is safe to conclude the emergence of this pyrotechnological industry most probably occurred sometime during or before the Natufian cultures in our region.

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THE EXCAVATION SEASON AT UMM AS-SURAB ARCHAEOLOGICAL SITE, EAST JORDAN (FIELDWORK SEASON 2018- PRELIMINARY REPORT).

KHALED AL-BASHAIREH & MA'EN OMOUSH

The Site of Umm as-Surab.

Umm as-Surab is a small village located in Mafraq Governorate, about 13 km to the north of the city of Mafraq and close to the border with Syria. It is about 12 km to the north of Umm el Jimal, the most important archaeological site in Mafraq governorate. The village is situated in southern Hawrān; within the Harrat Ash Shaam volcanic field which covers an area of about 11,400 km2 in NE Jordan and represents the largest volcanic field on the Arabian plate (Fig.1, showing the location of Umm as-Surab).

The first systematic study of the village was carried out by Butler between 1904 and 1905 and an architectural survey of the Church of Saints Sergius and Bacchus was performed. Umm as-Surab was visited again in the 1930s by the Italian scholar Renato Bartoccini. In the mid-1960s other scholars performed new research at the site, while a new interest in the village, and in particular in its ecclesiastical architecture, arose only after the early 1980s. At that time G.R.D. King carried out a complete survey of the site.

In 2002, an Italian mission from "La Sapienza" University of Rome performed a new archaeological and topographical survey of Umm as-Surab, focusing especially on the residential buildings of the site. The mission from the University of Siena made a preliminary visit to the site in 2008, when a limited photographic and photogrammetric survey was performed on the façade of the Church of Saints Sergius and Bacchus. During the 2009 season, with the launch of the Building Archaeology in Jordan Project from the University of Siena (Italy), Umm as-Surab was the subject of an organized scientific program including a surface survey, a topographic survey and a three-dimensional photogrammetric survey of its architectural remains. During the following research seasons (2011 - 2012), the surveys of the site were completed and the studies of the construction techniques were enlarged.

The new archaeological mission at Umm as-Surab (JHAS), led by Piero Gilento and

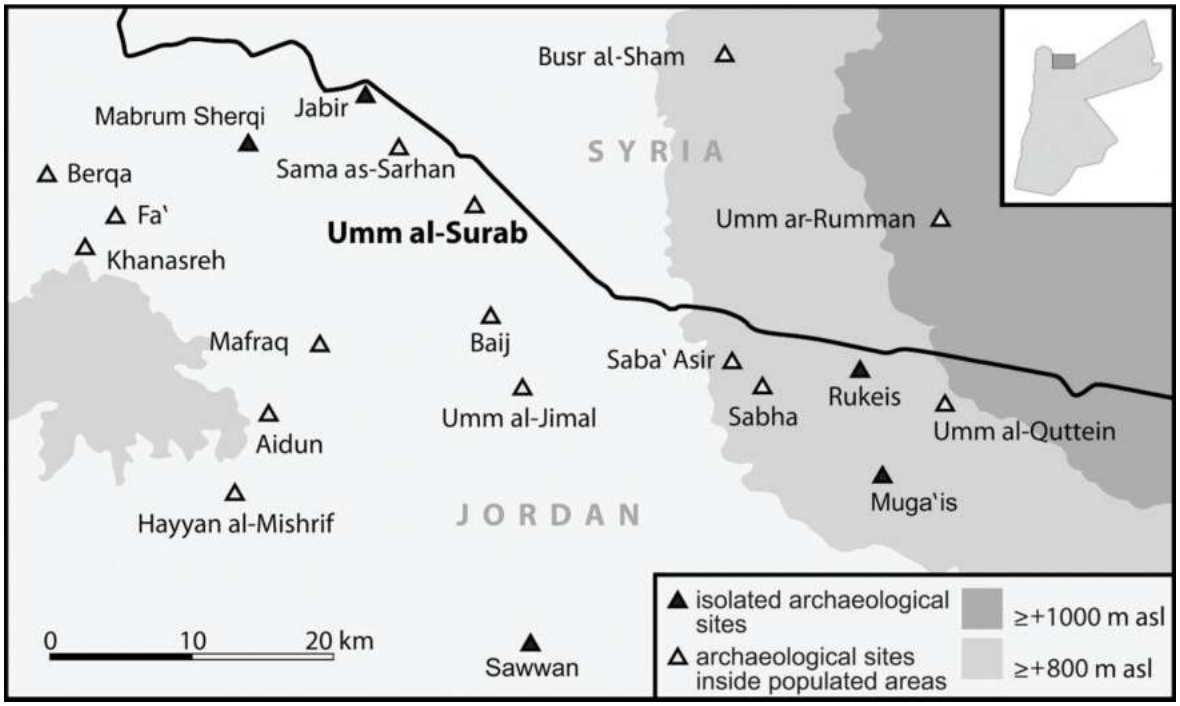

Fig. 1. Umm as-Surab site and its surroundings (after Anastasio.S, Gilento, P. Parnet, R. 2016: 300).

Pierre-Marie Blanc started in October 2017 . It intends to continue the work carried out by the Italian archaeological mission directed by Roberto Parenti extending the analysis both in the village and in the surrounding area. The data from the architectural analysis of the pottery collected during field survey and later archaeological excavations was cross-examined. A joint project began in 2018 between Paris1-Panthéon Sorbonne and Yarmouk University in order to reveal more detailed data concerning the settlement phases of the site from the excavation fieldwork.

The Team

The Umm as-Surab excavation season is a joint project between Paris1-Panthéon Sorbonne and Yarmouk University, and the collaboration of the Department of Antiquities of Jordan (DoA). It was carried out between the 13th to the 26th of October 2018 in the village of Umm as-Surab (MEGA Number 2806). The excavation team consisted of 11 members from both parties. The French team consisted of Dr. Pierre Marie Blanc, archaeologist (CNRS-APHOR/ArScAn-UMR7041), Dr. Piero Gilento, archaeologist (Paris1-Panthéon Sorbonne APHOR/ArScAn-UMR7041), Dr.Gurguen Davtian, research engineer (CNRS-CEPAM-UMR7264) and Mr. Hussein Madinah (PhD Student in Botanical Archaeometry- Paris1-Panthéon Sorbonne). The Yarmouk team consisted of Prof. of Archaeometry, Khaled Al-Bashaireh, and Assistant Prof. of Islamic

Archaeology Maen Omoush, Mr. Yousef al-Zou›bi (Photographer and illustrator), Mr. Mousa Serbel (Field technician) and three MA Archaeology students (Waseem Jaradat, Raghad Khalayleh, and Laith al-Shboul, from the Faculty of Archaeology and Anthropology - Yarmouk University).

The team also hired six young local workers. The representative of the DoA was Eng. Nael Tuhamer, of Mafraq local office. The logistic and technical support for the mission was provided by the IFPO-Amman and the Deanship of the Scientific Research and Graduate Studies - Yarmouk University (Fig. 2).

The Objectives of the Fieldwork of Yarmouk University team.

The main objectives of the 2018 excavation season of Yarmouk University team were:

A. Excavating Area A (A2 sector) (Fig. 3 and 4) aimed to highlight the stratigraphic sequence of the archaeological layers and uncover archaeological remains in order to understand in depth, the history of this area. This is important because this area seems to have had important occupational phases during ancient times especially during the Byzantine and Islamic periods. In addition, this data will contribute to an understanding of the connection between this area and

Fig. 2. Part of the team during the fieldwork.

the occupational trends of the whole site which can be then compared with those of the neighbouring archaeological sites.

B. Training the MA students of Yarmouk University on archaeological fieldwork (field and architecture surveys, collecting materials and excavation methods, building archaeology, GPS and total station techniques) and participating in other fieldwork activities.

C. The study and archaeometric analyses of the unrevealed archaeological remains.

Fig. 3. Area A2 before excavation.

Fig. 4. Area A sectors 1 and 2 from the top before excavation.

Preliminary Results of the Excavation.

The preliminary results achieved by the Umm as-Surab project in the 2018 season at area A2 can be summarized in the following main points:

1. After the removal of the top soil, a thick ashy layer was dug and appeared to be rich in ceramic fragments (some are glazed) mainly dated to the Mamluk and Ayyubid periods (Figs. 5 and 6). Other archaeological remains found were present in small amounts including glass pieces, animal bones and Tabun (clay oven) fragments. The layer showed traces of Tabun located in the central part of Area (A2).

2. The thick ashy layer appeared to cover fallen stones that sit on a hard brown-reddish layer comprising fragments ceramics mainly dated to the Umayyad period and some other fragments from the Abbasid period (Fig. 8, showing the stratigraphic section of area A2).

3. It is probable that the falling stones scattered in area (A) resulted from an earthquake that occurred during the Abbasid or at the end of the Umayyad period (Fig. 7).

4. The Umm as-Surab site witnessed a heavy occupation during the Ayyubid-Mamluk times.

5. The students were trained on pottery reading, total station use, stratigraphic section drawing and documentation (Fig. 8).
6. Several distinguished pieces of archaeological materials will be borrowed from the DoA for further scientific and archaeometric studies.

Future plans:

Based on these results, the team of Yarmouk University plans to continue the excavation at the same area in the next season in order to better understand the occupation periods at the site and to focus on dating the collapse of the wall (stones).

Fig. 5. Pottery Sherds from Islamic -Ayyubid- Mamluk- periods.

Fig. 6. Showing Decorated (Left) and Glazed (right) Islamic Pottery Sherds.

Fig. 7. Shows Area A2 (from top) after the end of excavations.

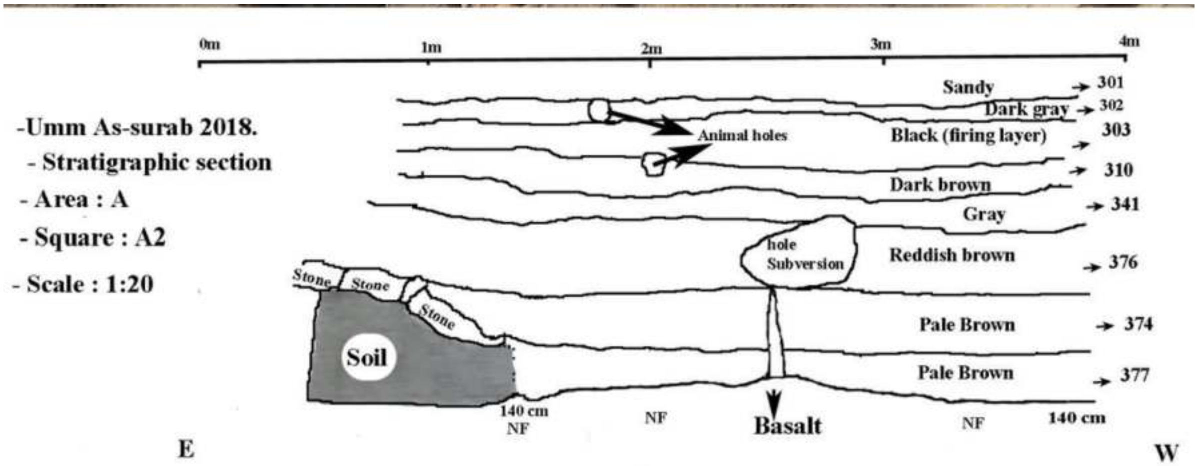

Fig. 8. The stratigraphic section of area A2.

LUMINESCENCE DATING IN ARCHAEOLOGY

SAHAR AL KHASAWNEH

Luminescence dating is a radiometric dating technique used to directly date geological and archaeological materials. The main principle of luminescence dating is based on the accumulation of energy in certain minerals due to its acquaintance to natural background radiation.

The stored energy is readily released by exposure to heat or light. By combining the measurement of the total amount of stored energy together with the knowledge of the rate of absorption of energy, time elapsed can be determined since last heating or light exposure (Aitken, 1985).

The mathematical expression for the age equation is :

Age = Paleodse (P)/ Dose rate (Dr)

The palaeodose (P) is the total amount of energy, in terms of dose, absorbed by the mineral throughout its burial time. It is estimated in the laboratory by the determination of the equivalent dose. Dose rate (Dr) is the annual dose that mineral grains receive from natural radiations.

The accuracy of luminescence dating is generally about 510%-. The valid time overlaps with radiocarbon dating, spanning from a few decades back to more than 300,000 years ago.

The technique was first developed in 1970s for dating pottery, bricks and other heated artefacts using heat to release the stored energy in minerals' crystalline structure. In the mid of 1980s, it was developed to use light as an alternative of heat for energy release and it is known as Optical Stimulation Luminescence (OSL) (Huntly et al., 1985) and it widely used for sediments and artefacts.

In archaeology, the use of luminesce dating helped to resolve several chronological questions in different sites. For example, the age of the world's oldest Homo sapiens found in Jebel Irhoud in Morocco determined by Thermoluminescence dating for fire-heated flint tools used by same old people. The results dated the age these artefacts and fossils of ~ 35,000 years ago (Richter et al., 2017).

In Australia, Luminescence dating offered new evidence for the minimum timeframe for the arrival of humans to Australia as early as

65,000 years ago, when it was believed to be only 35,000 years ago (Clarkson et al., 2017).

In our region, Luminescence has its significant contribution to archaeology. For instance, Jordan is well known for the wide spread of the enigmatic megalithic structures such as desert kites, wheels and line structures. Dating those structures by carbon dating has always been obstructed by the scarcity of organic substances. However, the recent development of luminescence dating of rock surfaces, which developed recently in Risø National laboratory in Roskilde (Freisleben et al., 2015), offered a new chance to determine absolute ages for these structures.

The new technique was applied to two different megalithic sites in Jordan. The first site is a desert kite in the south east of Jordan. The resulting ages revealed that the kite was constructed ~10,000 years ago and used for a brief period that did not exceed 50 years (al Khasawneh et al., 2019a). The second application was for Khatt Shebib stone structure, which extends for ~150 km in southern Jordan. Luminescence rock surfaces dating for part of the wall proved, for the first time, that the wall was constructed ~ 400 BCE (al Khasawneh et al., 2019b).

To summaries, it is clear now that the recent developments in luminescence dating had provided new capabilities and abilities for the progression of chronological work in the archaeological sites. Compared to carbon dating, luminescence technique is able to date various examined materials, such as rocks, heated artifacts and stratified or reworked sediments. The technique provides time range that exceeds that provided by carbon dating. The technique should therefore contribute to the development understanding of our archaeological sites.

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THE DIGITAL MUSEUM OF JORDAN'S HERITAGE AT YARMOUK UNIVERSITY

A PROJECT SPONSORED BY THE SCIENTIFIC RESEARCH FUND AT THE MINISTRY OF HIGHER EDUCATION

ABDULLA AL-SHORMAN

Museum of Jordanian Heritage:

The Museum of Jordanian Heritage at the Faculty of Archaeology and Anthropology represents a vital and important unit of Yarmouk University. It elucidates through archaeological artifacts the story of mankind, his material culture, and his relationship with the surrounding social and geographical environment. The Museum of Jordanian Heritage was opened in 1988 in cooperation with the German Government. The museum and its divisions are designed in a way that reflects the variety and interrelations between the academic disciplines at the Faculty of Archaeology and Anthropology. The museum recounts the story and history of mankind in Jordan throughout the main stages of development in a systematic way, that serves the academic disciplines at the faculty, and suits the needs and interests of both normal visitors and specialists at the same time.

The Museum of Jordanian Heritage consists of the following parts: the first floor, the rural house, the second floor, the temporary exhibit hall, the external courtyard, and the numismatics hall. The first floor contains the main gallery of the museum, which consists of four halls. The first one deals with Jordan's prehistory and includes exhibits on hunters and gatherers, agricultural evolution, and village farming communities. The second hall depicts Jordan's early history through exhibits on the emergence of city-states, territorial states, and early pastoralists and Bedouins. The third hall presents Jordan during the classical period and puts special emphasis on the local population during the Nabataean, Roman, and Byzantine Periods. The fourth hall highlights Jordan as part of the Islamic World and includes reconstructions of some traditional crafts.

The internal courtyard of the museum features a reconstructed rural house-complex from northern Jordan displaying basic local architectural elements, such as cross-vaulted rooms, transversal arches and an arched façade. The museum holds also in its first floor a special hall to host temporary exhibitions, travelling exhibitions from other museums and special exhibitions designed at the museum, to present new findings or special topics. The External courtyard of the museum contains some archaeological features and objects such as Roman sarcophagus, stone objects and columns, and mosaic panels.

The second floor in the museum contains exhibits on various topics related to the history of technology such as stone-implements and rock-art, metallurgy, basketry, textile techniques, pottery-making, and glass. In addition, a new hall devoted to Nabataean civilization was recently opened in this floor. The Museum of Jordanian Heritage contains also a separate hall established in 2002 that is entirely dedicated to numismatics. The numismatics hall aims to preserve and document the important numismatic collections at the museum, to display the emergence and development of coins and coinage systems throughout ages, and to support studies and research works devoted to numismatics. The hall presents the numismatic collections based on historical sequence starting from the emergence of coinage during the Lydian period, through Hellenistic, Nabataean, Roman, Byzantine, and Islamic periods and up to the modern Hashemite period. The display contains a reconstruction of a minting place, melting furnace and striking tools that were used during Islamic periods.

About the Project

This project is supported by the Scientific Research Fund of the Ministry of Higher Education, for the purpose of documenting and displaying the Jordanian cultural heritage. The project transforms the classical way of presenting the rural house and the associated heritage assemblages at the Museum of Jordan›s Heritage (Yarmouk University) to a more modern and sophisticated one that parallels western prestigious museums. The whole project relies on documenting the Jordanian heritage digitally using the modern techniques of ‹virtual reality›, laser scanning and 3d modeling. The availability of such a work over the World Wide Web (www) will promote and present Jordan›s heritage and create more potential visitors either to the museum or to rural Jordan. At the same time, the digital form of the museum can be used as an effective tool in teaching and presenting the rural way of life in Jordan through distance learning as the project will be available on the web. The project will be sustainable as it will be launched on the www, the procured equipment will have been available for future documentations of archaeological artifacts and heritage assemblages at the museum, and as a teaching tool at the Faculty of Archaeology and Anthropology/Yarmouk University.

Museums have started to realize the potential of modern technologies for the development of edutainment content and services for their visitors. One of these technologies is virtual reality that promises to offer a vivid, enjoyable experience to the museums guests. The rapid development in the field of museology has also demanded ease of access to museums through virtual promotions and presentations. This could only be achieved through virtual reality combined with the worldwide web (www). Virtual reality enables us to step into a computer generated artificial 3d world, where in many cases objects that do not exist in the real world can be easily simulated and visualized, especially objects that are difficult to understand through intuitive experience.

The presentation of the Museum of Jordanian Heritage demands revolutionization to achieve the mission behind the establishment of the museum (Heritage presentation and teaching). To surpass the other regional museums, our museum is making a leap in transforming its contents to a digital form where tourists, scholars, and students can access freely and learn about the rural life in Jordan during the last few decades; a matter that is considered as a precious legacy that needs to be maintained and kept alive for generations to come. This project contributes to the preservation of the national identity of Jordan which stems its roots from the rural way of life. The team of the project: Abdulla Al-Shorman, Yahia Shawabkih, Muafaq Bataineh, Mahmoud Alwan, Ahmad Al-Zeiot, Hussien deebajah and Mousa Sarbal.

The accomplished tasks and procured equipment of the project

A virtual reality tour was created, where a visitor can visualize the various rooms and hall exhibitions at the museum using his computer, tablet or smart phone. During the tour, there is a possibility to visualize several displayed objects in a 3d environment with the ability to rotate, zoom in and zoom out the object. Selected videos are automatically displayed during the tour showing the various aspects of the rural life in Jodan (Fig. 1).

Figure 1: A screen shot of the virtual tour.

The heritage objects in the museum were scanned using an advanced laser scanner and then embed into the website of the museum as 3d objects. A copy of some of these objects was created using a 3d printer; these objects can be displayed for example at schools and temporary exhibition halls.

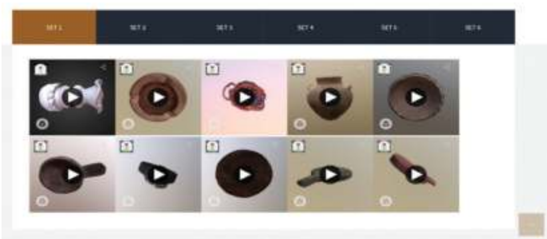

Figure 2: A screen shot of the 3d objects.

A photo gallery can also be accessed through the website. The photos stand for all of the displayed heritage objects at the museum. In addition, the team of the project created 3d videos, where a visitor can experience a virtual real life of the museum through the internet (Fig. 3).

Figure 3: A screen shot of the photos gallery.

the website of the museum offers information to the visitors prior to their visit: google map of the museum's location and directions, useful links, opening hours, etc. for researchers and students, the website offers also 3d, pdf and AutoCAD plans of the museum in a downloadable mode (Fig. 4).

Fig. 4: A 3d plan of the museum.

The home page of the museum is shown below, where upon designing visitor satisfaction was ensured. The elements of the website include HOME, EXHIBITIONS, EVENTS, VIRTUAL REASLITY AND GALLERY.

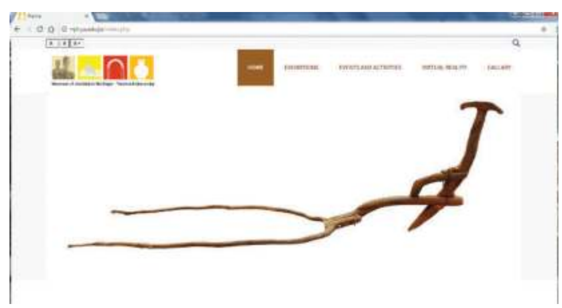

Figure 5: A screen shot of the home page of the museum.

ARCHAEOMETRIC STUDY ON BYZANTINE COOKING POTS FROM TABQAT FAHL (PELLA), JORDAN

AHMED AL-SHORMAN, ARABYA BATYNEH, LAITH SHBOUL, HANEEN ESA, RUWAYDA ATOOM, AND HUTAF ALATAYWI

Abstract:

Byzantine (4 sherds) and Roman (one sherd) pottery cooking potsherds from Tabqat Fahl (Pella), were studied using petrography and XRD techniques to investigate their mineralogical content, and EDX-SEM technique to measure their chemical composition. The collected data were used to infer some technological aspects and raw materials that were used in production of these cooking pots. The results show that the cooking pots were fired to high temperatures, between 850°C and 1050°C, in oxidizing conditions. The investigated pots were manufactured at Pella or the nearby region using calcareous and non-calcareous clays, with addition of crushed quartz.

Keywords:

Byzantine, cooking pots, archaeometry, Pella, technology, and raw materials

Introduction:

The study of archaeological pottery has become increasingly important over the past century; it shed light on many areas: chronology through identification of types, trade routes through identification of materials and their sources, and technological development through the physical, chemical and mineralogical characteristics of vessels (Orton et al., 1993).

Therefore, it is necessary to assess the mineralogical and chemical compositions to answer questions about these issues. For example, in their archaeometric study, Al-Shorman and El-Khouri (2013) found that the manufacturing techniques and traditions of pottery during the Byzantine period were continued during the later Islamic in the rural site of Barsinia, north Jordan. Byzantine potters in Qasr Ar Rabbah, south Jordan, were paid more attention on production of cooking pots than other pottery forms, i.e. fired at higher temperatures, produced using non-calcareous clay, and with a thinner walls (Al-Shorman and Shiyab, 2015).

A collection of Byzantine cooking pot fragments, from Pella, Jordan, were selected for the purpose of this study; to identify the raw materials, firing temperature and conditions that used in their manufacture. , by Knowing whether the samples are locally made or within the nearby region or imported, could help to interpret the culture, the skills of the Pella community and the trade activity. This will be combined with a geological study of the nearby areas to obtain more specific results.

Tabqat Fahl (Pella of the Decapolis):

Tabqat Fahl (Pella), a city of the Decapolis in Jordan is considered one of the most important ancient settlements in Jordan. It is located in the northern Jordan Valley, 5 km to the east of Jordan River (Fig.1). Human occupation in the region around Pella stretches back over a half million years (Bourke, 2004).

Figure 1: Location of Tabqat Fahl (Pella) among the other Decapolis cities.

The site itself has been occupied continuously since the Neolithic period (Churcher, 2008; McNicoll et al., 1982), thus, Pella is considered one of the longest pre-classical histories of any site in Jordan to this date. The Golan earthquake of 749 destroyed the city. The archaeological surveys and excavations at the site revealed that Pella reached its greatest extent and the peak point in the urban life during the Roman and Byzantine periods (Bourke, 2014).

The geology (mainly lithology) of the study area is represented by Ajloun Group (only WSL Formation, Turonian), Balqa group (Upper Cretaceous – Tertiary), Jordan valley group (Upper Tertiary) and the Quaternary deposits. WSL Formation is the only outcrop of Ajloun group, which is only exposed in the southern part of the study area and consists of mictite limestone, dolomitic limestone, and marly limestone. Balqa group formations (WG, ASL/AHP, MCM, URC, and WSC) outcrop to the northern, southern and eastern parts of Tabqat Fahel and its surroundings; they consist mainly of carbonate rocks (chalk, limestone, marl, chalky limestone, and marl limestone), chart, and phosphate.

The carbonates and phosphate rocks are rich in fossil fragments such as fish bone and teeth (Abu Qudaira, 2005; Abed, 2000). Jordan valley group is represented by WC and LM formations, which are outcrop at the western parts of the study area and its surroundings. WC formation consists of vary lithology and color gravel such as: conglomerates, limestone, marl and basalt. LM formation consists of intercalations of evaporates (Fig.2) (gypsum and clay minerals) (Abu Qudaira, 2005; Abed, 2000). Finally, the recent soils cover almost a large area of the western part the study area.

Description of the samples:

The five samples of the study are all fragments of body sherds with diagnostic features. No loci or stratigraphic context a available, because they are surface collection from the same area. Four of them dated to the Byzantine period, while the fifth was of late Roman, which is chosen for the purpose of comparison. The samples were dated based on comparison with parallel examples from the literature (Table 1). Typological description based on observation of the pottery fragments, colors are based on Munsell (2000), is as follow (Fig.3):

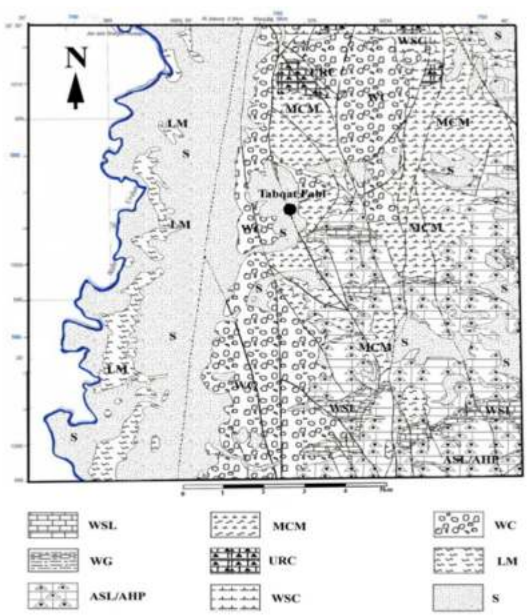

Figure 2: Geological map of Tabqat Fahl and its surrounding (modified after Abu-Qudaira, 2005)

FT1: Body sherd of cooking pot, with loop handle started from shoulder to body, with calcareous crusts. The ware is reddish gray (5YR 5/ 2), not well fired, gray core (5Y 4/ 1). The ware is non-porous with coarse inclusions and rough touch. The regular lines and the constant thickness of the body wall gives clear evidence of wheel made. Rounded, deep and sharp band of ribbings decorated the body. **FT2:** Fragment of a cooking pot body sherd with a vertical loop handle. The ware is reddish yellow (5YR 6/ 6), while the added outer slip is dark gray (5Y 4/ 1). **FT3:** Fragment of horizontal loop handle of a casserole (on rim handle). The ware is yellowish red (5YR 5/ 6) with brown color (maybe slip) on outer surface (7.5YR 4/ 2). Medium- coarse levigation, coarse temper and rough touch, well fired fabric with obvious porosity. **FT4:** Red ware casserole Body sherd with horizontal under rim loop handle. Carbon blackening is clear from use. The fabric is Yellowish red (5YR 5/ 6) from inside and reddish yellow fabric outside (5YR 6/ 6). Well fired coarse ware and rough touch, with black inclusions. **FT5:** Body sherd of cooking pot, small grain size, sharp ribbings on the outer surface. The ware is brown (7YR 4/ 2) and the outer surface is very dark grey (2.5Y 3/ 1).

All the studied samples are made of grey, reddish- grey, reddish- yellow poorly levigated clay. The clay includes visible small black and white grits. Samples TF1 and TF5 decorated with ribbings, sample TF2 has gray slip with white lines of calcareous crust, sample TF3 is decorated with brown slip, while the sample TF4 is not decorated.

Sample .no	Form	Parallels and date
TF1	Cooking pot	Abu Dayyah et al., 1991: fig.7:2; Linder and Gunsam, 1995: P.27, fig.13; Zayadine, 1986: P.190, fig.10:6. Byzantine
TF2	Cooking pot	Johnson 2006: no.27; McNicoll et al., 1982: pl.138:6. Byzantine
TF3	Casserole	Fuller, 1987: fig.53C; Gabrieli, 1994: fig.4:18. Byzantine
TF4	Casserole	Zayadine, 1977-78: P.294, fig.21; Harrison, 1994: fig.6:11. Byzantine
TF5	Cooking pot	Arthur, 1982:61. Late Roman

Table 1: Form, date and parallel examples of the studied sherds

Figure 3: Cooking pots investigated sherds, TF1 – 4: Byzantine, TF5: (Late Roman)

The color of the cross section of the pottery sherds can be used to infer the firing atmosphere; red and brown colors caused by Fe^{3+} and/or hematite formation indicate oxidizing atmosphere, while black and grey colors caused by Fe^{2+} and/or magnetite formation indicate reducing atmosphere (Viti et al., 2003; Molera et al., 1998; Molera et al., 1997; Maniatis et al., 1982). However, the combination of black/grey and brown/red indicates the change from a reducing to an oxidizing conditions or a mixed atmosphere (Ntah et al., 2017), thus, samples TF3, and TF4 were fired in an oxidizing atmosphere. For Sample TF1 may be the third situation is the most suitable, as the grey core indicates either incomplete oxidizing, or rapid firing conditions (Tite, 1972). Samples TF2 and TF5, contrary to the oxidizing colors of the body, they have dark grey surfaces, it seems that this was intentionally applied as a slip to give the vessels dark appearance.

Analytical Methods

The sherds were conventionally cleaned, after the samples were photographed and described. Two slices were cut for the mineralogical and chemical analyses, the first was used in order to prepare thin section for petrographic study (using Leica refracted polarized light microscope), and the other was ground in order to be analyzed using X-Ray Diffraction (using Shimadzu XRD-600) and SEM-EDX (using FEI quanta 200) techniques. The samples were prepared and analyzed in the laboratories of Yarmouk University.

Results and discussion

Petrography and XRD analysis

Petrographic study revealed that quartz grains are the main dominant non-plastic inclusions (Fig. 4). Micrite limestone fragments present in samples TF1 and TF2. The crushed quartz can easily be observed, these grains have a well-defined sharp angles and planes, which is rare in a natural state (Albero, 2014). Its content ranges in studied sherds between 20- 40%.

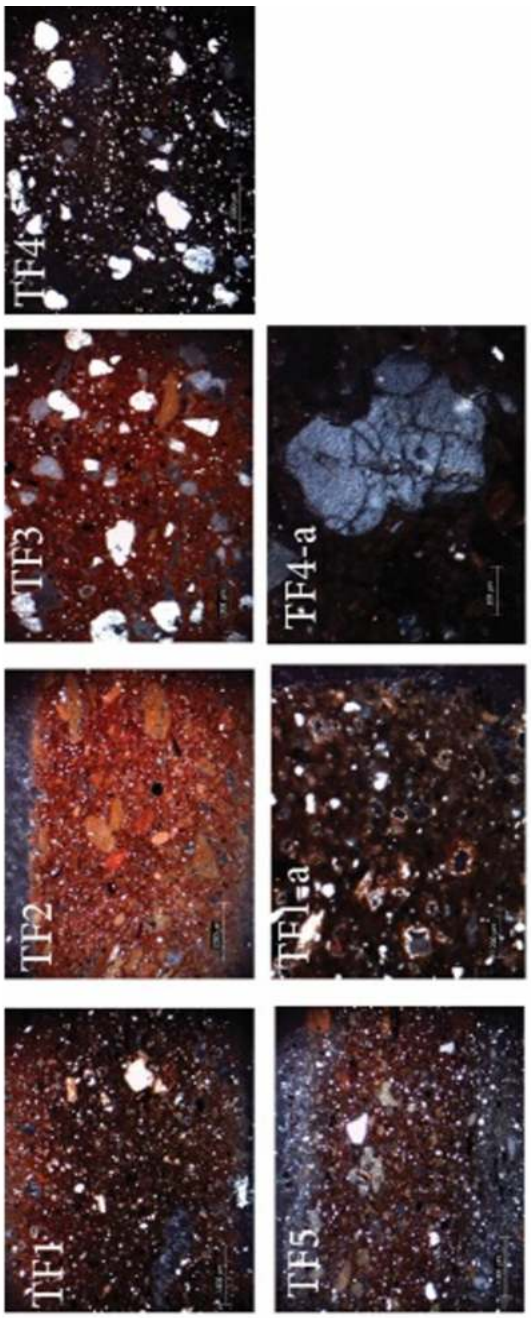

Figure 4: Micrographs showing the fabric of the studied samples, all taken in CPL (cross polarized light).

TF1: fine to medium fabric, homogeneous uni-model. TF2: fine fabric, homogeneous uni-model. TF3: fine to coarse fabric, non-homogeneous bi-model. TF4: fine to coarse fabric, non-homogeneous bi-model. TF5: fine to medium fabric, homogeneous bi-model. TF1-a: secondary calcite as after burial deposition in the longitudinal cracks and voids. TF4-a: fractured quartz, which was levigated before adding it to the clay.

The fabric of samples TF3, TF4 is medium to coarse, while samples TF1, TF2, TF5 it is fine to medium. The reddish color observed in all the samples is due to the presence of iron oxide (hematite). Thus, Quartz has been added to the clay in samples TF3 and TF4, while it is natural in the others. In addition, it is clear that two types of clay have been mixed (Fig. 4, TF2) in order to produce a suitable paste for pottery production i.e. to improve the plasticity and thermal properties of the product.

The results of XRD (Table 2, Fig. 5) confirmed petrography; quartz is the main mineral phase in all samples, plagioclase (anorthite) exists as a minor phase, gehlenite appears as minor phase in samples FT1 and FT2 indicating firing temperature more than 850 °C (Al-Shorman and El-Khouri, 2013; Shoval, 2003; Riccardi et al., 1999; Maggetti et al., 1991), however, high amount of gehlenite and the formation of diopside in these samples suggest even higher temperature of firing ca. 950 °C (Al-Shorman and El-Khouri, 2013; Heimann, 1989), while mullite exists in samples FT3 and FT4 pointing that the firing temperature of these samples exceeded 1050 °C (Ntah et al., 2017; Lee et al., 1999; Bellotto et al., 1995). Hematite appears as minor or trace phase in the samples indicating oxidizing or partially oxidizing firing atmosphere (Table 4) (Palanivel and Rajesh Kumar, 2011). Calcite presents as trace phase in TF1 as secondary type, which deposited in the fissures and cracks from the surrounding soil after burial, finally, the formation of diopside as a trace phase in sample TF5 indicates firing temperature between 900 and 950 °C.

Mineral phases that exist in samples FT1, FT2, and FT5 were formed in calcareous clay at temperature above 850 °C (Al-Shorman and El-Khouri, 2013), while mullite normally develops from non-calcareous clay at temperature above 1050 °C. The chemical composition of the samples as shown in table (3) confirmed that samples TF1, TF2, and FT5 contains high amounts of CaO (8.34 – 11.74 wt.%) and high amounts of Fe2O3 (8.50 – 9.41 wt.%), which indicate that they were manufactured using ferruginous calcareous clays as indicated by the developed minerals phases. While samples FT3 and FT4 contain low amounts of CaO (1.49 – 2.95 wt.%) and high amounts of Fe2O3 (5.97 – 8.62 wt.%), which indicate that the potters were used ferruginous non-calcareous clays.

Edwards (1992) carried out an intensive study to assess the suitability of the clays near the Tell of Pella for pottery making. The results of his study revealed that the soil is extremely high lime content, this clay needs high skills and advance knowledge to produce pottery, through thoroughly preparation by levigation, and optimum firing temperature between 850-950 °C. This is concordant with the results of our study; for calcareous clay samples the potters mixed them with another (red) clay and fired them at temperatures around 950 °C, thus all the calcite have been decomposed and the relatively refractory gehlenite phase formed.

For non-calcareous clay samples, they fired the samples at higher temperature enough to form the refractory phase mullite. These information indicate the high degree of skill the potters in Tabqat Fahl (Pella) have gained during Byzantine and even earlier periods.

Conclusion

This study revealed that cooking pots are often made of well-prepared clay mixed with an appreciable quantities of quartz, the quartz was added deliberately as crushed particles of sand, to enhancing desirable properties of fired clay (Rice, 1987), and burned at a high temperature to reinforce and strengthen them.

The high temperature calcium aluminum silicate (gehlenite) and aluminum silicate (mullite) phases exist almost in all samples. Therefore, samples TF3 and TF4 were fired at temperature around 1050°C, while samples TF1, TF2, TF5 were fired at temperature ranges between 850 °C and 950 °C. All samples were fired in oxidizing kiln atmosphere.

The results of petrographic and mineralogical analysis indicate that Byzantine potters were made their products using both ferruginus calcareous and non-calcareous clays to come over the problem of body crumbling due to the use of calcareous clays only. Moreover, the clay was mixed with the available non-plastic inclusions; such as quartz (mainly) and micrite limestone. Quartz resists high firing temperatures that usually used several times for cooking, thus improve the product thermal properties (Ntah et al., 2017) Byzantine potters in Tabqat Fahl were used the local raw materials; as they are available in the local lithology (see Fig. 2) (Abu Qudaira, 2005), using their skills in preparing clay, mixing with another other type, adding temper, and firing at the proper temperatures to produce pots suite the purpose of use.

Finally, the results of the study show that the local community of Tabqat Fahl was very skillful and knowledgeable in making pottery since the Byzantine period, and they used and developed the tradition of pottery production from their Roman ancestors.

Acknowledgements

This paper is a part of an MA course (Arch 660, Applied sciences in archaeology). The authors acknowledge the Faculty of Archeology and Anthropology at Yarmouk University for the permission of using the laboratories.

Sample No	Non-plastic inclusion	Grain size	Grain shape	Abundant	Notes	Mineral phases measured by XRD
TF1	Quartz Micrite lime stone	Fine –medium Medium	Subrounded-Subangular Subrounded-Rounded	xx x	Fine to medium fabric, contains moderate amount (ca.30%) of non-plastic inclusions. The color is dark brown in PPL, and reddish brown to brown in CPL. Iron oxide staining. Secondary calcite on boundaries.	Major: Quartz. Minor: Anorthite, Gehlenite. Trace: Calcite ,hematite.
TF2	Quartz Micrite lime stone	Fine Medium-coarse	Subrounded Subrounded-Subangular	xx X	Fine to coarse fabric, contains moderate amount (ca.20%) of non-plastic inclusions. The color is brown in PPL, and reddish brown in CPL. Iron oxide staining.	Major: Quarz. Minor: Anorthite Gehlenite,hematite Trace:diopside,apatite.
TF3	Quartz	Fine – Coarse	Subrounded-Subangular	xxxx	Fine to coarse fabric, contains moderate amount (ca.40%) of non-plastic inclusions. The color is dark brown in PPL, and brownin CPL. Iron oxide staining. Quartz is ofpolycrystalline wavy extinction type, and is highly fractured.	Major: Quartz. Minor: Mullite.
TF4	Quartz	Fine – Coarse	Subrounded-Angular	xxxx	Fine to coarse fabric, contains moderate amount (ca.40%) of non-plastic inclusions. The color is light reddish brown in PPL, and reddish brown in CPL. Quartz is of polycrystalline, highly fracture type. Iron oxide staining.	Major: Quartz Minor: Anorthite Trace: hematite,mullite
TF5	Quartz	Fine – medium	Subrounded-Subangular	xxx	Fine to medium fabric, contains moderate amount (ca.25%) of non-plastic inclusions. The color is light gray to brown in PPL, and gray to brown in CPL. Iron oxide staining.	Major:Quarz Minor:Anorthite Trace:Gehlenite,hematite ,diopside

Table 2: Petrographic characterization and XRD results of the studied pottery sherds

Sample No.	TF1	TF2	TF3	TF4	TF5
SiO_2	49.65	52.45	56.28	63.59	51.33
Al_2O_3	21.82	24.08	24.60	21.93	23.63
CaO	11.74	9.03	2.95	1.49	8.34
MgO	2.49	1.56	2.13	1.93	1.88
K_2O	1.84	2.32	1.86	1.91	2.31
Na_2O	1.28	n.d.	1.45	0.96	1.30
Fe_2O_3	9.41	8.50	8.62	5.97	8.56
TiO_2	1.77	2.07	2.11	2.23	2.66
Total	100	100	100	100	100

Table 3: Bulk chemical composition of the investigated samples as measured by SEM-EDX.

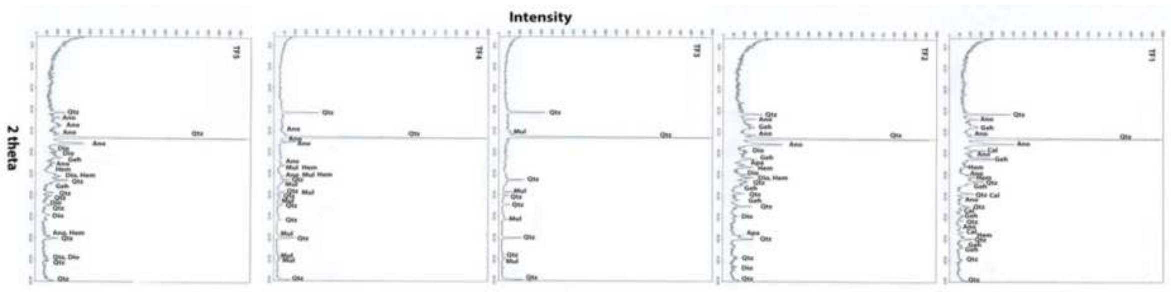

Figure 5: Diffractographs show the minerals phases in the different samples, (Qtz: quartz, Cal: calcite, Ano: anorthite, Geh:gehlenite, Hem: hematite, Mul: mullite, Dio: diopside, Apa: apatite).

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THE INVENTION OF THE EARLY METAL INDUSTRY IN JORDAN

ZEIDAN A. KAFAFI

I decided to grasp the opportunity of organizing the international conference (World Science Forum) in Jordan (7 - 11 November 2017) by the Royal Scientific Society, under the patronage of His Majesty King Abdullah II, and publish a very brief note discussing the role of the land Jordan in the invention of the early metal industry (copper and Iron) during the Chalcolithic (ca. 4500 - 3900 BC) and the Iron Ages (ca. 1200 - 539 BC).

It is well understood that to produce metal objects ore must be mined then smelted with a strong fire to release the metal. To let a fire needs a large quantity of timber, this makes cutting wood for metal smelting vital for its inhabitants through ages because it takes a long time to regenerate. For this reason, it has been argued that, in addition to the existence of the ancient village smithing, the metal objects industry must be kept in the hands of temples, palaces and rulers who controlled the distribution of the products (Philip 1991). Or one may suggest in the absence of the smelting and smithing installations that metal tools might be imported from other places or areas.

Unfortunately, metal technology was not a form of administrative or scribal concern in Mesopotamia and Egypt during the ancient times as were the other crafts. In fact, when it comes to metal technology, written documents present only limited information and are often silent concerning the geographical provenience, from where they got the metal ore, its quantity, price, or techniques of fabrication.

However, it might be announced that jewelry objects were excavated from the prehistoric times onward, and in our point-of-view those found in the cemetery of Ur (south Iraq) (Zettler and Horne 1998) or at several sites in Egypt are representing an advanced handicrafts (Andrews 1990; Wilkenson 1971).

To study the early metal production and use it has been left to the archaeologists, archaeo-metallurgists to address these questions. Nevertheless, the Akkadian cuneiform texts uncovered in Mesopotamia refer to the importance of copper from the mountainous area located to the east of the Tigris and of metal stones from Magan (Oman).

V. G. Childe (1942) was the first to place metallurgy on the top of his list of important crafts. He assumed that the development and progress of early civilizations was a consequence of the invention of metallurgy, and added that the manufacturing of the metal in turn led to more productive agriculture and the growth of early cities in the world. In this brief discussion of the innovation of the early metal in Jordan, emphasis is placed on the sincere efforts and contributions made by various teams carrying out archaeo-metallurgical research at two regions in Jordan, the Wadi Faynan «Wadi Araba» and Tell el-Himmah «Jordan Valley», both are located in the Afro-Asian rift.

Invention of Copper Industry in Jordan:

Jordan is considered a major source of copper which only became commonly used during the Chalcolithic period. Copper cores in Jordan are to be found at Wadi Feinan, on the east side of the Wadi Arabah, south of the Dead Sea.

A General View of the Mining Area at Feinan which is covered by 150 000 - 200 000 tons of Slag (Hauptmann, Levy and Weisgerber 2005: Fig. 4.12)

The earliest copper objects registered from the excavated archaeological sites comprise of tools and decorative items. Actually, the excavated copper objects excavated at Wadi Mehres/ Palestine reflect the capabilities of the Chalcolithic metal smiths that are illustrated by the shapes of the cult-objects. It also indicates that these objects were molded. Moulds for casting ingots during the Chalcolithic period (ca. 4500 - 3900 BC) were excavated by the Jordanian- German expedition directed by Lutfi Khalil of the Jordan University and Ricardo Eichmann of the German Archaeological Institute in Berlin, at the site Hujayrat al-Ghuzlan near 'Aqaba.

After Hauptmann, Levy & Weisgerber 2005: Fig. 4.12

However, weapons such as daggers, and crescent-shaped axes made of copper became more popular only later in the Early Bronze Age.

Moulds for casting dated to ca. 23002200- BC from Khirbet Hamra Ifdan/Wadi ‹Araba area (Hauptmann, Levy and Weisgerber 2005: Fig. 4.12)

The Middle Bronze Age witnessed the real use of true bronze, and more sophisticated bronze objects were manufactured. Some of these products were molded. Moreover, the Late Bronze Age metal production was a continuation and a development of the Middle Bronze Age industry. This is clearly seen in the metal objects excavated at the Amman Airport Late Bronze Age temple.

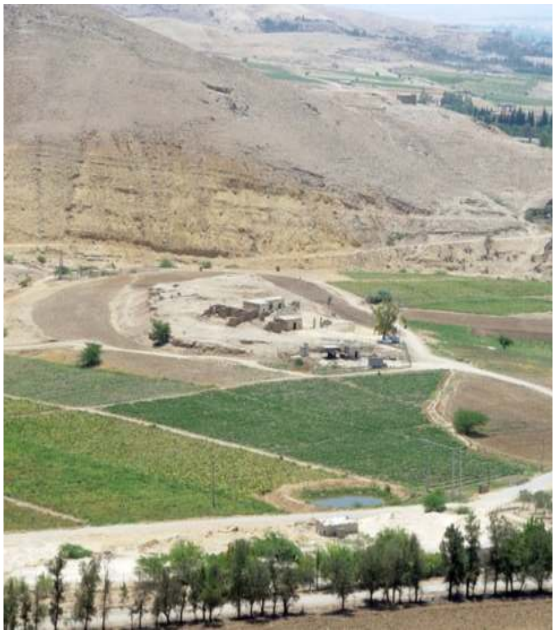
In addition, metal objects found in archaeological contexts dated to the end of the Late Bronze and the beginning of the Iron Age included items of ‹international› types (Philip 1991). Actually, it has been mentioned that the luxury objects such as jewelry, was an important part of the metal industry’s repertoir.

A jewelry mould found in 1996 at the site of Tell Deir Alla, measures 12.5 cm in length and ca. 6.5 cm in width. The mould is in a good condition and is considered to be one of the most unique objects found at the site. It is especially important because it provides more information about the jewelry industry during the Late Bronze Age (Kafafi 2009).

Late Bronze Age (1550 -1200 BC) Deir 'Alla Jewelry Mould

Iron Industry during the Iron Age:

This small-scale dig at the site Tell el-Hammeh, located in the mouth of Wadi az-Zarqa, approximately 2 km to the east of Tell Deir ‹Alla, in the Jordan Valley, identified a number of iron furnaces, first thought to be dated to the eighth/seventh centuries BC, and uncovered a large amount of slag (Al- Amri 1999). The excavators claim that the study of the excavated archaeological materials from Tell el-Hammeh prove the presence of an iron production center. The new information obtained about the dating of the iron production at the site was based on the results of the recent excavations conducted in 2000 and 2009, (Veldhuijzen 2005a; 2005b; Veldhuijzen and Steen 1999; 2000; Veldhuijzen and Rehren 2006). Veldhuijzen argued that the excavations yielded a large smithing workshop, which he dated to ca. 930 Cal BC, by using scientific dating method, and claimed that it represents the earliest in the region. This date invited the excavators to argue that the Iron Age workshop industry remarked at Tell al-Hammeh might represent if not the oldest of its type, then must be one of the earliest in the Ancient Near East region.



Tell al-Hammeh (Photo by: Yousef al-Zoubi)

An Iron Furnace and Fragments of Tuyères at Tell al -Hammeh (Photo by Yousef al-Zoubi)

Moreover, metallurgists believed that the main source of the Iron Ore comes from Ajloun Mountain ranges, and more precisely from a place namely, Mugaret el-Wardeh, which is in close distance of Tell al-Hammeh. A team of the Jordan Museum consisted of Yousha al-Amri and the late Raeda Abdalla, excavated the Iron Age mining site Mugharet el-Wardeh in 2005. They proved that this is the site from which the inhabitants of the Jordan Valley used to mine iron ore during the Iron Age II, and more intensively during the Auyyubid/Mamluk period (Alamri and Hauptmann 2013).

The Magharet el-Wardeh Entrances and a general view from the interior of the mining cave (after a permission of Dr. Yousha al-Amri)

The land of Jordan is therefore considered to be the region where earliest steps of the copper mining, smelting, molding and hammering happened. The copper industry started during the second half of the fifth millennium BC (ca. 4500 BC), meanwhile the Iron industry took place during the beginning of the first millennium BC (ca. 900 BC).

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JUFFAIN DOLMEN FIELD: PRELIMINARY REPORT - 2017

ATEF SHIYAB

Background

From October 4 to October 23a scientific Archaeological Survey was conducted for the Dolmen Heritage Park Juffain, by a team directed by Dr. Atef Shiyab from Yarmouk university, Jordan. This was the first year of an ambitious project to build a heritage park in the Juffain Dolmen Field. The focus this year was on producing a topographical map of the site, showing the location of all structures in the dolmen field using a total station and GPS devices. This culminated in the identification and prioritization of several areas, clusters and, structures for future study, conservation and development. In addition an assessment of destruction was made since the completion of the survey in May 2016. The created maps will help the combined multi-disciplinary team make informed decisions about cultural and the social importance of the site, under the control of the Ministry of Tourism and Antiquities and Departments of Antiquities. Year two recommendations are outlined.

Juffain Dolmen Field Location

The Juffain Dolmen Field is located on the southwest border of the modern town Juffain, overlooking the Jordan Valley and the Sheikh Hussein Bridge to the West. The east corner of the field corresponds to the coordinates N 3255.0 ‘28°”, E 03559.5 ‘38°” (Figure 1) Known as Juffain in MEGA-Jordan.Org, in AL koura District, Irbid Governorate. A unique forest of oak and pine trees covers most of the central Dolmen Field.

The site measures 1 km east to west and 1.3 km north to south, and is broken by six major mountains and five minor valleys. Two other sites in Jordan show corresponding topographical and walled borders within the dolmen field, Mutawwaq and Matabi (Polcaro et al, 2014: 2 - 4, Schath et al 2012 and Clayton, 2007).

The only way to understand the group dynamics of the occupying people is to adopt a holistic approach of studying all megalithic relationships and distribution (Schath, 2017). The Dolmen Heritage Park Project developed a map and documented 384 structures.

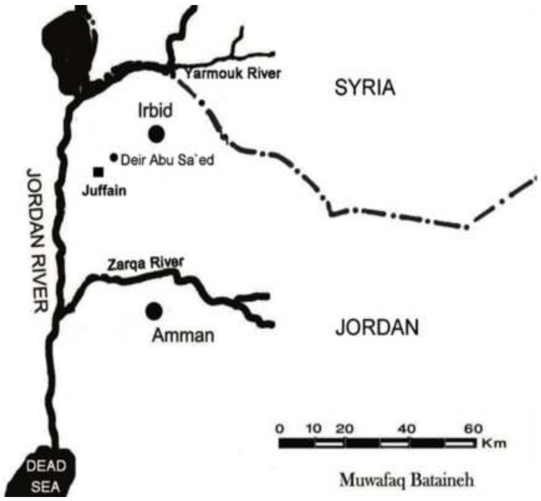

Figure 1. Location map of Juffain Dolmen Field

Methodology

The Juffain Dolmen Field is essentially a 1000-meter circle, cut by six major Wadis emanating outward from one general point. The team was made up of a co-directors, a senior archaeologist, two assistant archaeologists, a photographer, a surveyor and two workers. To document all of the structures, the team selected a particular hill top and slope, and traversed on foot along more than fifteen slopes of rugged terrain and often through dense forest.

384 structures were documented using a Garmin, Global Positioning System (GPS) to locate North, East and Elevation coordinates as a bare line. Then the structure was identified and each was documented on a worksheet providing a sequence number, letter designation, photo numbers and the coordinates. All information was inputted to a data base for future work and publication.

Later, a Wild Total Station T1000, was used to survey the site and develop the topographical map with a scale of 1: 10,000, using the Universal Transverse Mercator Projection (UTM). All features, roads and borders were identified and represented in the key of the map.

Results of Survey

The top three goals of this project were fully accomplished.

1. Data for a topographical map has been collected. It shows the borders of the Juffain Dolmen Field, along with internal roads and the main road through the site going East to West.

2. All structures were identified and entered on a work sheet, categorized, given coordinates, photographed and inputted to a designated data base. They were given symbols to be placed on the key of the topographical map and will be added to the map.

3. Areas are being analyzed for individual and group dynamics and informed decisions about future research, conservation, and development of the Juffain Dolmen Heritage Park are being made based on these..

The group dynamics of the Juffain Dolmen Field is complex and diverse showing distinctly separate groups of structures. The relationship to each other will clarify cultural interaction within the field. Sixteen structure types were documented, among the 384 structures (table 1).

Designation	Type of Structure	Quantity
D	Dolmen	145
TU	Tumulus	51
T	Tomb	14
PA	Patio	6
W	Wall	56
CA	Cave	10
CIS	Cistern	4
S	Silo	3
P	Press	6
WP	Press Grinding Wheel	1
QS	Quarry Stone	14
C	Circle	29
SS	Standing Stones	27
CH	Cup Hole Center	10
Q	Quarry	5
Sq	Square	3

Table 1: Listing of 384 structures

The holistic nature of research at Juffain requires detailed definitions and description of the structures (figures 2, 3, 4, 5). Though much general knowledge of dolmens and their megalithic neighbors is accurate, much is not.

The Dolmen Heritage Park survey was highly successful. The overall success lies in the completion of a topographical map with all 384 collected features shown on it. Some very important discoveries were made and attracted the media to push the project agenda forward.

The chronology proposed by the author is dated from the Chalcolithic and Early Bronze Ages. This is based on consideration of the vast documentation of the dolmen culture and its dating. The pottery sherds collected along with the data from earlier surveys show the extended re-use of the area in the Late Roman or Early Byzantine periods.

The comparison of features collected and the design aspects point to Early Bronze and Roman Tomb use. Caves suggest Early Bronze or earlier use, Cup Hole Centers with the Byzantine and Early Bronze Presses, again indicate a long period of use. Excavation and further studies are required to ensure the dating for the Juffain Dolmen Field.

Figure 2. Cup Hole Center

Figure 3. Type A dolmen

Figure 4. Byzantine Press

Figure 5. Type C dolmen

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MEDICAL PRACTICE, DISEASE AND DEATH IN ANCIENT EGYPT

MICHAEL ZIMMERMAN

Most of our knowledge of ancient Egyptian medicine is based on a number of medical papyri, in various degrees of completeness, which have been studied by physicians and Egyptologists. They have done remarkably well, particularly in that the writing is mostly in the difficult hieratic rather than hieroglyphic text.

The Ebers papyrus tells us of three types of medical professionals: the doctor (swnw), a secular physician; the priest (wab), a healer; and the magician (sau). Egyptian medicine was made up of specialists, in "diseases of the eyes, others of the head, others of the teeth, others of the stomach, and so on….

Physicians were paid, by a barter system regulated by the state. Training of physicians was by instruction within the family and by schools and apprenticeship. There was little knowledge of anatomy or physiology, thought and emotions were believed to be centred in the heart, which was not removed in the embalming process.

The funerary ritual included a belief that the heart was weighed by the god Thoth against the feather of truth, maat. If the heart was heavy with sin, the deceased was condemned to the lowest level of the underworld, populated by three headed crocodiles and other monsters, an exceedingly unpleasant place to spend eternity.

Medical practice did have similarities to the present, with examination, diagnosis and prognosis. Thorough questioning (on the history of the present illness) was followed by examination of the body (physical examination), utilizing palpation, the sense of smell and, perhaps, checking the pulse.

As there was no knowledge of the circulation of the blood, it is unclear if the significance of the pulse was known. Study followed of the urine, excrement, and expectoration (laboratory results).

Set phrases were used: "If you examine a man having…" "You will say what is the matter with him; a patient who suffers from…" Treatment was based on prognosis, with three general statements: "A disease that I will treat"; "A disease that I will contend with"; or "A disease that nothing can be done about. There were no pharmacists, as medications were prepared by the doctor (swnw).

As ancient Egyptians believed that disease or pain was the effect of hostile divinities or demons and that cure could be achieved by magical or religious incantations, they did not diagnose disease in the modern sense. There is evidence of identifiable diseases. These include achondroplastic dwarfism, the treatment of wounds, tuberculosis, atherosclerosis, heart disease, and parasitic disease. On the other hand, there is little evidence of cancer, with only two cases diagnosed by microscopic examination of Egyptian mummies.

Medications used in ancient Egypt were aimed at symptom relief rather than cure, as the cause of most diseases was unknown. Little is known about how raw materials for drugs were collected. Animal products were taken from farm or domestic animals but those from wild animals, such as crocodile excrement, must have presented certain issues. Mineral products were readily found in Egypt and drugs were prepared from a wide variety of plants.

The most common route of administration was oral and drugs were also given by enema or suppository into the rectum.

Although hundreds of medicinal items are in the medical papyri, many have not been translated and the diseases for which they were intended are often obscure.

Some remedies contained as many as 37 items. It is unclear whether an item was an active principle, a vehicle or simply added for taste. Honey, for example, might work for all three categories.

Many drugs were used so extensively that it is not possible to determine what they were or for what they were intended.

Many substances were also used for supposed magical properties. Drugs of mineral origin are more easily identified. Natron (hesmen), used in mummification, was widely available and its effect in drawing out fluid and reducing swelling was used as a paste, often under a bandage. Common salt is a mild emetic (inducing vomiting), and had a wide use, being taken orally, by enema, or applied locally to the eyes, ears and skin.

Malachite, a green pigment, was used cosmetically and for eye diseases. The green color is due to copper and would inhibit the growth of Staphylococcus aureus. The Ebers papyrus prescribes it for a burn that had become foul. Many other listed minerals are virtually insoluble in body fluids and would have had no effect.

There was a wide variety of drugs of animal origin. Honey was used in hundreds of remedies, especially in open wounds. Milk and urine were mostly used as a vehicle. Excrement and blood was used from many species, cat, ass, birds, lizard, crocodile, fly and human, mostly applied externally, but it is hard to see any benefit. Placenta of cat was recommended to prevent hair from turning gray. Cow or goat bile was used for human bites and for eye issues. Animal fat was used in making greasy ointments and also to transfer some desired property of the animal. Meat was applied to wounds the first day, probably to aid clotting. Liver and other organs were prescribed but for untranslated disorders.

There are about 160 herbal remedies that have been identified but again there is little agreement on what diseases were being treated. There is some evidence of narcotic agents but none as to their medical uses. Cannabis (hemp) was used in making rope and its medical application is occasionally seen in the papyri but without mention of an effect on the nervous system.

The most effective pain medication was probably beer or wine and intoxication was well known.

There were many remedies for the gastro-intestinal and urinary systems, although the distinction between the two is often unclear, the treatments generally do not define the illnesses and the large number of remedies suggests that none were efficacious.

The word for cough, (seryt), is well understood. There is no evidence of the use of opiate suppressants but the use of honey and dates would have provided some relief. Honey is a component of modern cough drops.

The little information in the papyri on surgery in ancient Egypt indicates that it was largely related to trauma. No surgical instruments have been found. A wall relief on the temple of Kom Ombo shows a number of instruments but it is not clear if these are for surgical or simply household uses. One clear diagnosis of a case that would presently be treated surgically, an umbilical hernia, is in the Ebers Papyrus. "A swelling of … his abdomen above his umbilicus….which comes forth when he coughs…. You treat it like the sahemem treatment." Unfortunately, the translation of that treatment is not known.

Umbilical hernias are clearly depicted in some tomb reliefs. Circumcision of an adult male is clearly shown in an Old Kingdom tomb and the hieroglyphs indicate the use of some pain medication, the nature of which is unknown. Evidence of orthopedic surgery is seen on a mummy with a prosthetic toe

The Edwin Smith papyrus consists of 48 cases of trauma, starting at the top of the head and proceeding down to finish with a spinal injury.

The usual treatment for a wound was initial bandaging with meat, followed by oil and honey, which would lessen swelling and inhibit infection, as bacteria do not grow in honey.

Stitching was recommended in appropriate cases and we have needles made of copper and silver. Infected wounds (with "ruddy lips") were treated with herbs and green pigment, a copper salt that would have had some anti-bacterial effect.

The treatment of fractures and dislocations are well described and many mummies and skeletons show good healing. One remarkable case is that of the Pharaoh Seqenenra, who was wounded in battle. X-rays have shown signs of early healing on the upper lesion, indicating survival of at least a few months.

Snake bites were much feared and the Brooklyn papyrus has an extensive listing of types of snakes, clinical effects and prognosis. Treatment was primarily local, with the addition of magical incantations. The papyrus also notes bites by scorpions (but the treatment section is lost), crocodiles and humans.

We have some titles for a number of specialty practices in ancient Egypt, such as dentists and ophthalmologists but there are none for gynecology or obstetrics. It is probable that medical care of women was by women. Although midwives must have existed, there is no Egyptian word for midwife and no medical papyri for childbirth, wet-nursing or child care. The papyri do list many tests for fertility, pregnancy and the sex determination of the unborn child. An example is moistening the seed of barley and emmer with a woman's urine. Growth of all would indicate pregnancy, barley for a male, emmer for a female and no growth would indicate that there was no pregnancy. Modern tests showed that this test was not valid.

The papyri say little about labor and delivery other than a few incantations to hasten birth. A variety of drugs are listed for contraction of the uterus. There appears to be early descriptions of complications of delivery such as fistulas between the vagina and rectum and urinary bladder. Information about treatment of the neonate includes prognostic indicators for survival.

Various materials are recommended for contraception, all to be placed in the vagina. Some, such as crocodile excrement, might have been to discourage the male! Crocodile dung is actually slightly alkaline, like modern-day spermicides, so it could have worked.

The eye plays a major part in Egyptian mythology. The eye of Horus was torn out by Seth and magically restored, and the wedjat eye is a symbol for protection and cure. While there is no evidence of eye disease in mummies, there are many representations of blindness, particularly of harpists. Ophthalmologists were swny irty, doctor of the eyes and there are many remedies for various conditions, including blindness, cloudiness and darkness (presumably cataracts), trachoma, foreign body removal, and many words which have not been translated.

Although ancient Egyptians suffered all of the dental ills seen in modern populations, including attrition, caries, abscesses and periodontal disease, and the word for dentist is ibhy, there is little in the papyri about dental operative techniques. A few remedies for strengthening the teeth are seen but the pathology is not clear and the application of herbs or honey was not likely to have been helpful. Dentists used gold wire as a means to bind a loose tooth to a neighboring tooth that was sound. Patients could have their jaw bone drilled in order to drain an abscessed tooth or teeth. Caries were filled using a type of mineral cement and gum disease was treated by using myrrh and other antiseptic herbs.

Egyptian medicine appears to have been static for over 2,000 years, from the Old Kingdom until the influence of Greek medicine.

Greek medicine essentially supplanted that of ancient Egypt in the third century BCE.. Medicine remained predominantly Greek until the Arab conquest of 641 CE

The language of ancient Egyptian and its medicine was lost until the nineteenth century decipherment of hieroglyphics by Champollion. Our understanding of ancient Egyptian medicine remains an ongoing process.

LEARNING FROM EGYPTIAN MUMMIES

MICHAEL ZIMMERMAN

The earliest mummies were accidental, as Egypt's the dry sand and air preserved some bodies buried in shallow pits. When it became customary to provide the deceased with food and funerary furniture, larger graves and above ground tombs allowed decomposition, necessitating the development of artificial techniques of mummification. All moisture was removed, leaving only a dried form that would not easily decay.

Our knowledge of mummification is based on archaeological studies of the mummy's bodies, painted and carved representations in tomb scenes of the mummification procedure, and some textual references. The Ritual of Embalming gives a set of instructions for the mummification process, with prayers and incantations to be intoned after each rite.

Herodotus described a seventy day process, with a cutter making the first incision and priests worked as embalmers. The brain was removed by inserting special hooked instruments through the nostrils to pull out the brain tissue. Internal organs were removed through an incision on the left side of the abdomen. The heart, believed to be the center of a person's being and intelligence, was left in place and was needed for the weighing against the feather of truth, maat. The stomach, liver, lungs, and intestines were placed in canopic jars in the tomb with the mummy. In later mummies, the organs were treated, wrapped, and replaced within the body. By the Roman period, the jars were solid dummies.

Moisture was removed from the body by covering it temporarily with natron, sodium carbonate, and placing additional natron packets inside the body. Sunken areas of the body were filled out with linen and other materials, false eyes were added and the body was wrapped in linen. Men were employed to wash and cleanse the mummy and the viscera, prepare the natron and resin, wrap the body with layers of linen bandages and as coffin-makers. The process associated with death and burial was a major industry.

An important part of the ceremony was called the «Opening of the Mouth». A priest touched various parts of the mummy with a special instrument to «open» those parts of the body to the senses enjoyed in life and needed in the Afterlife. The person was now ready for his journey to the Afterlife.

Egyptians began early to make plans for their death because of their great love of life. Thinking of no life better than the present, they wanted to be sure it would continue after death.

The Egyptians believed that the mummified body was the home for its soul or spirit, which involved three parts: the ka, ba, and akh. The akh traveled through the Underworld to the Final Judgment and entrance to the Afterlife.

All deceased Egyptians were mummified until the Christian era, c. 200 - 400 AD, although in all periods the poor were less carefully mummified. Mummies may be intact or broken up by tomb robbers. English physicians, Marc Armand Ruffer and Grafton Elliot-Smith started the scientific studies of mummies in pre-World War I Egypt. Ruffer introduced the use of modern techniques such as rehydration and microscopy into the field.

In the mid-20th century studies were begun by the Paleopathology Association, a group of scientists representing various disciplines on Egyptian mummies, workers on Peruvian mummies, and study of mummies in the Manchester Museum. The actual dissection of a mummy would take one or two days, beginning with radiographic techniques, followed by months of laboratory work. The effort was to focus the study on the interface of the physical, social, biological and medical sciences, with publication of the findings as an eventual result.

As in all other branches of scientific and medical investigation, the study of mummies has been facilitated by the development of new technology. The advent of computerized tomography (CT) scanning and other non-invasive techniques has allowed for more thorough examination of mummies either before or instead of traditional autopsy procedures. CT scanning is followed by endoscopically guided biopsies of sites of interest, thereby avoiding the often somewhat destructive nature of a full autopsy examination.

An example of this progress is the examination of Tutankhamun. In 1968 a portable x-ray machine was used to determine age and cause of death of Tutankhamun. The sternum and most of the ribs were missing and it was believed that they might have been damaged before his death. It was determined more recently that the mummy had not been re-wrapped after the initial examination on1926, the limbs had been amputated in order to remove some of the jewelry, the hands had been cut off, both legs were removed from the pelvis, and the head was severed from the body in order to get the mask off. Loose bone fragments in the skull led many to assume the king was murdered by a blow to the head.

In 2005 Tutankhamun was removed from his tomb and a CT scan was performed at the Cairo University School of Medicine. There was no traumatic injury to the head. The CT scan showed no radiologic evidence of any long-term disease but more recent studies have indicated that he died of malaria.

Histologic examination is based on rehydration of the mummified tissues. A variety of special stains can be used to show specific features of the tissues. My collection of over 3,000 slides and a number of tissue specimens is now at the KNH Centre for Biomedical Anthropology at the University of Manchester, where it can be viewed on their website.

The analysis of mummified material for ancient DNA (aDNA) has received much recent interest. Although, there are technical problems related to the survival of aDNA and contamination by modern DNA, applications can include the determination of genetic relationships, such as clarification of the relationships among the members of King Tutankhamun's family.

Date and age determination are important aspects of the examination of mummies. Dating places the individual in historical context and at the individual level, many diseases occur in specific age ranges and age determination can be a critical factor in differential diagnosis. Techniques include radiocarbon, or C14, dating, electron spin resonance, amino acid racemization, dendrochronology, and evaluation of tattoos or mummification styles. No one aging technique is best. Techniques used include gross evaluation of the skeleton and viscera, hand-wrist radiographs, bone histology, dental changes and amino acid racemization.

Chemical analysis of bone is used primarily for dietary reconstruction. Studies of bone reveal evidence of age, sex, disease, nutrition and trauma. A dentist can help assess age, nutrition, disease and racial characteristics.

Experimental approaches have been applied to the study of the effects of mummification. Tissue samples removed from recently deceased individuals during hospital based autopsies were desiccated, rehydrated and examined by light microscopy. Although preservation of histologic detail was variable, cytoplasmic structures were discernable. An important point was that the large dark staining nuclei of malignant cells were much better preserved that the smaller, lighter staining nuclei of benign cells.

A second major study involved the replication of an ancient Egyptian mummy, using a modern donor body. Examination of the mummified organs showed the general state of preservation of the organs in this experimental mummy to be comparable to that of actual 1,800–3,200-year-old Egyptian mummies. Diagnoses included hepatic fibrosis, pulmonary anthracosis, edema and thromboembolism, consistent with the clinical history. Egyptian mummification practices were quite effective and that there was probably little further degradation over the centuries (with the exception of mechanical disruption, i.e., tomb robbers or attack by insects).

We study mummies to decide what diseases they suffered from, and how they died. These paleopathologic studies add the dimension of time to our understanding of the evolution of diseases and their role in human biologic and social history. The examination of skeletal material and mummies yields the most reliable paleopathologic information. Skeletonization may be erratic and most diseases leave little or no direct mark on the bones. Mummies hold a great potential for paleopathologic examination.

We have learned much about the history of disease such as anthracosis, tuberculosis, atherosclerosis, parasitism and cancer. In ancient Egypt, tombs were often reused and become the site for intrusive burials and mummies found in any tomb may represent accumulations over centuries. The experimental studies noted above tell us that such diagnoses can be viewed with confidence in both the efficacy of ancient Egyptian mummification practices and our diagnostic ability in examining ancient human remains

Master Theses Defended at the

Faculty of Archaeology and Anthropology

2017 / 2018 - 2018 / 2019

Conservation of Byzantine Icons from Georgios Church in Ajloun

Rita Suliman Al-dawood
Supervisor: Prof. Abdelrahman Elserogy

Icons vary in materials and methods of preparation, especially the wooden or linen supports, the ground layers, and the various painting techniques. The change of relative humidity around the icon is among the physical deterioration factors that affect the wooden support, the gesso layer, and the color layer. The use of modern scientific methods is important for investigating and analyzing the ground layer or color layer of these icons. In this study, the physical condition and chemical composition of Byzantine Icons from Georgios Church in Ajloun were examined before conducting a conservation and restoration process on them. X-ray Fluorescence (XRF) was used to identify the colored materials, gilding layer and preparation layer, Furrier Transformation Infrared (FTIR) spectroscopy was used to identify the bonding materials for colored materials, and scanning electron microscopy (SEM) was used to identify the linen that supports the ground layer. The study also included an analytical investigation of the microbes in the icons, where several infections of bacteria and fungi were identified as the causes of microbiological degradation of the icon.

Conservation and restoration work started with sterilization, cleaning, filling and coloring the missing parts and gaps according to well recognized international scientific methods. After that the wood was treated and consolidated. The icons were retouched or repainted with colors in order to retain its old glamour. The last step of the conservation process was to exhibit the icons under suitable conditions in the church.

Conservation of Selected Glazed Pottery Objects from the Museum of Jordanian Heritage

Ala' Mohammad-Khair Garden
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Dr. Mustafa Al-Naddaf

The purpose of this thesis is to identify the methods of cleaning and treating of some pottery objects from the Museum of Jordanian Heritage at Yarmouk University. Three glazed pottery objects were selected and documented by description, photography and drawing. Samples were then taken for analysis by scientific methods, such as X-ray diffraction (XRD) to identify their mineralogical composition and scanning electron microscopy (SEM) to study the interaction between the pottery body and the glaze layer.

The study examined the efficiency of different cleaning methods to conserve the selected glazed pottery, such as laser cleaning using a *Q-switched ruby (QSR) laser device*, and chemical cleaning using diluted acids, but none of these methods gave satisfactory results due to the corrosion of enamel layer, which forming the glaze layer. The researcher worked to complete the missing parts using appropriate materials and colors to give them a good shape.

This study was divided into five chapters in addition to the results and references in both Arabic and English languages:

The first chapter: includes the importance, methodology and justifications of this study, in addition to previous studies.

The second chapter: includes the emerging of porcelain and glazing and the Islamic techniques of ceramics.

The third chapter: includes the ingredients, the colored oxides and the influencing factors of glazed layer.

The fourth chapter: includes the internal and external damage that occurred on the glaze layer of the glazed pottery pieces.

The fifth chapter: includes the practical side of the documentation, analysis, and treatment method.

The study ends with the most important results and recommendations of the researcher, and these are some of the results:

1. The glazed pottery jar contained the layer of salts formed on the glaze layer, and it did not show efficient results in the cleaning process due to the complete corrosion of the enamel layer.
2. The Ewer & Basin sample is a wash basin and jug to pour water, or to put hot water in the jug and keep it hot for as long as possible / for example hot tea.
3. The results of the XRD analysis showed that gypsum was present at high concentrations,

due to the burial environment in which the piece was located or to the location where the piece was stored.

4. Findings using the SEM technique showed that there is no connection between the glaze layer and the pottery fragment in the Ayyubid-Mamluk period.

The thesis includes photo lists, tables, and references in Arabic and English in order to clarify the presented information and it sources.

Conservation and Rehabilitation plan for the Roman Market Place of the archaeological city of in Gadara

Abeer Mahasneh
Supervisor: Prof. Ziad Al-saad

The aim of this thesis is to prepare a conservation and rehabilitation plan for the Roman market in Gadara. The study focused on the examination and written and pictorial documentation of the market to identify its architectural elements, its materials and construction techniques, and available deterioration forms.

The examination process includes a survey of historical information about the market and its nature and use. In addition to the visual examination which enabled the determination of the current situation of the structure, precise examination using laboratory tests was carried out to determine the properties of building materials and their deterioration.

The applied laboratory tests and analyses included: X-ray diffraction technique (XRD), microscopic examination, chemical analysis ($CaCO3$ content), and physical properties (porosity, density, water absorption under atmospheric pressure and under vacuum, capillary water uptake).

The study focused on one shop of the market to be considered as a model for future restoration and conservation. Based on the condition of the studied shop, a conservation plan was prepared to deal with the deterioration problems found on the architectural elements of this shop. The proposed conservation treatments and measures were based on the ethics and standards for conservation highlighted in international charters for historic building conservation.

The approach used in this plan focused on the rehabilitation and reuse of the Roman market, after carrying out the required restoration, as a place for promoting the traditional crafts and craftsmanship of the people of Umm Qais village.

Restoration and Rehabilitation Plan of the Roman Theatre in Beit Ras Archaeological Site

Moayad Mahmoud Jerwan
Supervisor: Dr. Mustafa Al-Naddaf

The Roman theatre in the archaeological site of Beit Ras is one of the most important Roman architectural monuments in Jordan in general, and in the archaeological site of Beit Ras in particular. The Roman antiquities reflect the effects of Roman architecture and its various elements during a period of time in the history of the region. It is an important cultural aspect that must be taken care of and preserved. However, the Roman theatre in the archaeological site of Beit Ras faces several threats that may cause damage and loss of a large part of its features. The archaeological theatre is subject to demolition and removal as it suffers from abandonment and misuse, which worsens its situation day by day in the absence of any serious solutions on the horizon to solve these problems and stop the threats that the theatre is exposed to. Therefore, this study will examine the most important factors that threaten the Roman theatre in the archaeological site of Beit Ras, whether physical, chemical, mechanical or biological, or all or some of them, and the most important damage caused by these factors.

This study will deal with historical and archaeological studies in addition to the archaeological and architectural description of the archaeological theatre in Beit Ras site. The study will also discuss the proposal of an integrated scientific plan for the maintenance and restoration of the archaeological theatre, which will be implemented by the concerned and specialized authorities. In this context, the study will propose some recommendations and proposals to overcome the present obstacles and contribute to the preservation of the theatre and alleviate the abuse and neglect.

The laboratory tests were carried out using German standards (DIN) for determining the mineral and chemical composition of the stone and mortar samples (samples of the study) using X-ray diffraction (XRD), determining the physical properties of building materials, including porosity, density, water absorption capacity, capillary properties and saturation, and determining the specifications to be met in the treatment materials and other methods used by the researcher.

The results showed that the main component of limestone is calcium carbonate with a high parentage of 95%. In addition, it was found that one of the limestone samples has a secondary component of apatite and the percentage of calcium carbonate inside it is 53%. The results also showed that the main component of the basalt stone is pyroxene and Feldspar, while olivine was not detected within the basalt stone because it is covered with a layer and is the result of a chemical reaction.

The results of the mortar samples showed that calcium carbonate is the main component in all the mortar samples and ranges between M1 33%, M2 76%, M3 51%, while quartz is the secondary component in all mortar samples, while gypsum is rare in some samples used as additives.

The results of the outer and internal render layers showed that the two layers have a similar mineral composition: calcium carbonate, which is the main component of the sample with a proportion of 64%, and quartz is a secondary component, while dolomite is found only in the outer layer.

The Aramaic Tombstones from «Zoar» Ghour As-Safi in Comparison with the Dead Sea Scrolls

Nida'a Ayed AlKhazali
Supervisor: Dr. Omar Al-Ghul

The thesis tackles the 3rd to 6th century AD Aramaic tombstones from Zoar "Ghor As-Safi" and compares them to the Dead Sea Scrolls. The study has four chapters: The First Chapter discussed the location of Zoar based on the religious and historical sources. It also reviewed the previous literature on the subject matter, presenting the major archaeological surveys and excavations carried out in the region. It paid special attention to four main locations in Zoar: Tawahin as-Sukkar, Khirbat ash-Sheikh Isa, al-Naq', and Qasr at-Tuba.

The Second Chapter studied the published epitaphs from Zoar. It mentioned their main features, described their language and script, and discussed the literary elements occurring in them: The opening formulas, the personal names, the verbs that signified death, the dating system(s) and the concluding formulas. In addition, it tackled the drawings depicted on the tombstones. In the Third Chapter, two hitherto unpublished epitaphs are studied. Photographs, drawings, transliterations, translations, linguistic analysis and a general commentary to the two texts were delivered. The Fourth Chapter was dedicated to the comparison of the Aramaic epitaphs from Zoar to the Dead Sea Scrolls. This was motivated by the fact that Qumran delivered the largest textual collection in the realm of the Dead Sea. The comparison was further encouraged by the religious contents of the scrolls, which are seemingly conservative in nature, and probably manifest a similar religious background as the Aramaic tombstones from Zoar notwithstanding the time difference between them. The Chapter paid special attention to the questions of resurrection and the afterlife death in both corpora.

Kinship Nomenclature in Ancient North Arabian Inscriptions: Cultural Historical Approach in the Context of the Semitic Tradition.

Ahmad Mousa Al-Ghizawat
Supervisor: Prof. Hani Hayajneh

Identifying corporate groups, from their simplest to more complex forms, is rather problematic in ancient societies. Often scholars rely on certain linguistic items to define whether a group is a lineage, tribe, or a national identity. However, scholars often make false identifications based on unexamined assumptions, and sometimes stereotypes. This paper surveys Kinship terms' attestations in Ancient North Arabian inscription in an attempt to further understanding of social structure in pre-Islamic Arabia and its relation to ethnicity, and ethnic identity. This paper begins with offering a general definition of Ancient North Arabia, and presents what epigraphy has revealed so far about the nature of the societies that flourished there. In the second chapter, the idea of ethnicity is discussed with special attention to its applicability to the evidence provided by Ancient North Arabian epigraphy. The third chapter provides the theoretical framework employed in this study. This study has revealed that same kinship terms may across several cultures and languages, but that does by no means is indicative of the presence of similar social institutions.

The Role of Micro-Projects in the Socio-Economic Empowerment of Women: An Anthropological Field Study of the Ajloun Governorate

Arwa Mahmoud Al Gharaibeh
Supervisor: Prof. Mohmmad Shunnaq

This study aimed to identify the role of micro-projects in the socio-economic empowerment of women as an Anthropological field study in the Ajloun Governorate. Forty-five women were interviewed in a concentrated group and individual interviews as a representative sample of women who set up small businesses in Ajloun as a study society. The field data was collected through concentrated group interviews and individual interviews, in addition to secondary sources of books and periodicals. The study was based on the sub-variables related to empowerment of women, which were focused on interviews (improvement of economic competencies, improvement of social competencies and thinking skills).

The study concluded that the role of small projects was in empowering women in Ajloun governorate to transform them from dependent women to breadwinning women and relieve their suffering. The study also emphasized the role of small projects in empowering women to achieve social well-being. The women who participate in these projects also have the ability to prove her identity by participating in the decision-making of the small enterprises she manages, which will subsequently lead to her economic efficiency through good governance. This reflects on her social efficiency by enhancing good interpersonal skills and knowledge creation.

The study recommended conducting the same study on other governorates for the possibility of generalizing the results. It also recommended that women should be empowered by improving and supporting services for women to become entrepreneurs. This relies on the donors and micro-credit institutions to provide sources of finance in an accessible manner

The Transformation of Gender Roles in Crises: An Anthropological Study of the Informal Tented Settlement (ITS) for Syrian Refugee in Jordan

Wedad Muhammad Al-Tamimi
Supervisor: Prof. Abdel Hakim Al Husban

This research studied the transformations and shifts in the gender roles, within the informal tented settlement camps for the

Syrian refugees in Jordan. The objective of the research is to capture the direct and indirect effects of the refugee crises on the modes of production, and to define the shifts on the traditional gender roles. These are transformed due to the changes occurring in the modes of production affected by the crises, which occur in the private space inside the household unit. The research also determined the impact of the hard living conditions on the refugees living in the informal tented settlement camps. It assessed changes in these inherited roles, and how this impacts on the public space and how the overall cultural aspects are transformed by the harsh economic, social, environmental and cultural conditions.

The analytical descriptive approach and the functional structural theoretical perspective were used to present the results of the field work. The data were collected by means of participatory observation, focus groups, and semi-structured interviews. The methods of data collection and analysis have been diversified to provide scientific knowledge based on the attitudes, behaviors, and experiences of individuals within the informal tented settlement camp community. It was also able to capture the meanings and values inherent within the cultural context that brings them together.

The research concluded that transformation in gender roles occur within a presence of a cognitive ideological component, that is recognized and transmitted among individuals through the channels of communication, which must be accessible to all, easy to be used, and to be understood. There is also an economic component to the transformation, in which new and multiple opportunities are available, and suitable for personal differences. They are able to engage women as a collaborative productive component. There is also a well-maintained infrastructure of transportation to facilitate movement to-and-from the centers of new economic opportunities. These kinds of transformations appeat to reinforce relations of power and authority and do not disrupt them. These pillars re-enforce the transformation and shifts of the gender roles among Syrian refugees and is understood to be the copping mechanism inside a community affected by a crisis such as that of the Syrian refugees in Jordan.