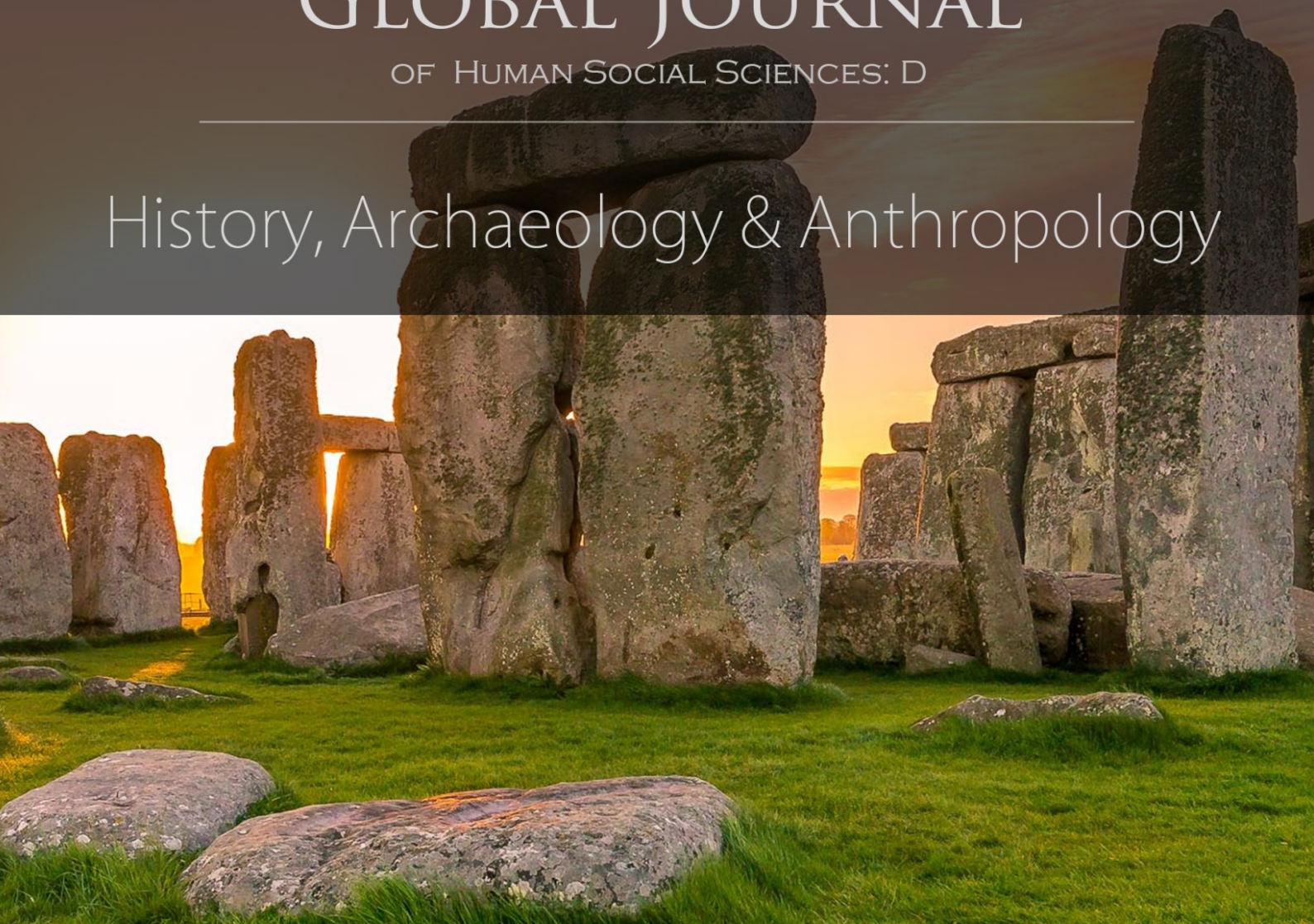
Online ISSN : 2249-460X
Print ISSN : 0975-587X
DOI : 10.17406/GJHSS

Global Journal

of Human Social Sciences: D

History, Archaeology & Anthropology



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VOLUME 17 ISSUE 2 VERSION 1.0

Global Journal of Human-Social Science: D
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Global Journal of Human-Social Science: D
History, Anthropology & Archaeology

Volume 17 Issue 2 (Ver. 1.0)

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Global Journal of Human-Social Science

Contents of the Issue

Global Journal of human-social science: D
History, Archaeology & Anthropology
Volume 17 Issue 2 Version 1.0 Year 2017
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-460X & Print ISSN: 0975-587X

Water Architectures in the Ottoman Empire, Examples from Antalya

By Hacer Mutlu Danacı & Ceren Özata
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Abstract- In the historical process, water structures have been developed in every period. In the Ottoman era, examples of water structures were constructed in accordance with the increasing political and economic power of the state. These developments are not simultaneous in Istanbul and in Anatolia. The classical style of Ottoman architecture that uses function and decoration in a balanced way is also seen in Anatolian water structures. Before Ottoman domination, Antalya, which is located on the southwest of Anatolia, was under the control of the Romans, Byzantines, Anatolian Seljuks, Cypriot states and the Principalities of Teke and Hamidids. This study will provide an analysis of exemplary evidence on water structures in the Ottoman period in the historical process in Rumelia and Anatolia and some examples of water structures in Antalya."

Keywords: *water structure, architecture, ottoman, antalya.*

GJHSS-D Classification: *FOR Code: 120199*

Strictly as per the compliance and regulations of:

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Hacer Mutlu Danacı[α] & Ceren Özata[σ]

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Keywords: water structure, architecture, ottoman, antalya.

I. Introduction

People have settled near water sources throughout history. Inhabitable areas expanded once people learned how to bring water to remote settlements. Civilisations constructed a variety of water structures in order to benefit from its functions and enjoy its aesthetic properties. Elements of water architecture found in Anatolia and Rumelia has been functional in almost all periods in history. Reservoirs used to store the transport water were also used for different functional purposes due to the difficulty of moving and collecting water. Due to the influences of Islam in this territory, the use of water gained popularity through public fountains and *sebils* that were mostly constructed with charitable intentions. For example, *shadirvans* gradually became an integral part of mosques where people did their ritual ablutions.

Water architecture in the Ottoman Empire Era also has an important role in daily life due to cultural and religious reasons. Although with some variation, there are many water structures in Anatolia and Rumelia. Located on the south of Anatolia, Antalya Province is home to several valuable water structures from the Ottoman Period, of which some are still non-existent in literature. This study will analyse water structures from the Ottoman period in Rumelia and Anatolia and some examples of water structures in Antalya Province from the same period.

II. Ottoman Era Water Architecture

Preceded by the Roman and Byzantine Empires, the Ottoman Empire is the third and last empire in the Mediterranean world. Back then, the Mediterranean region was regarded as a centre of development of civilisation (Ortaylı, 2003). The transport and provision of water was regarded as one of the most important issues in Ottoman urban technology. The quality of water structures was always at highest standards (Cerası, 2001). Parallel to the development of the Ottoman state's political and economic power as of the 16th century, it became possible to use larger amounts of expensive lead which granted new opportunities in hydraulic engineering. Lead is effective in water insulation, practical to mould and shape, while worn parts can be smelted and reused. Such properties of lead quickly made it more popular than clay pipes. Consequently, the stone water reservoirs seen in water fountains from the Seljuk Era were no longer needed. However, more traditional techniques, materials and forms remained in use in Anatolian settlements outside of Istanbul. 15th century fountains generally comprised of a vaulted or domed water reservoir with a rather deep niche housing the tap on one side. There were also fountains covered with a wooden cornice. Beginning in the 16th century, the classical style of Ottoman architecture integrated function and adornment in a balanced way and this gradually started to emerge in Anatolian drinking fountains in form, technique or detail (Önge, 1997).

During the region of Mehmed II [the Conqueror] a comprehensive repair and development project commenced on the 130 km-long "*Halkalı*" water supply system, which is first of the three systems that provided water to the *Rumelian* [European] side of Istanbul. The second largest water supply system designed by Sinan the Architect was "*Süleymaniye*". Similarly, the "*Kırk Çeşme* [Forty Fountains]" water supply system in Istanbul is worth noting as it still remains in use today. Having also been employed in the construction of water supply systems of cities like Pompeii in the Roman Empire, water gauges were most extensively used in Ottoman water supply systems. The upward growth of large cities in the 19th century required pressurised public water supply systems to provide water to taller buildings (Kıratlılar, 1995).

Drinking Fountains are a prevalent form of water structure in the Ottoman Period. In addition to the existing fountain types, a new fountain style starts to appear in 16th century which features twirling spout taps on the exterior or interior facades with some of them

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having cavities to place water urns on the mirror stone. Various forms included: plaza fountains consisting of twirling spout taps installed on the facades of detached cisterns; fountains installed on the exterior or interior of buildings of various functions for the sole aim of providing drinking water; kerb fountains consisting either of a console shaped small basin with sprinkler or a small mirror stone with a twirling spout tap that pours water in to a small carved basin; *shadirvan* kerb fountains consisting of only a small carved basin installed on the side of pools/ponds; and, namazgah fountains located on one façade of the namazgah buildings. The 18th century saw the appearance of small quay drinking fountains, generally along the shoreline of the Bosporus and Golden Horn in Istanbul for the benefit of fishermen and other seafarers in small vessels. By the end of the 19th century, original fountains were replaced by a sink installed with a tap and double volans. A good example is the sink inside Yıldız Palace made of white ceramic. Towards the end of the 19th century, following the legacy of the Balyan family, the famous Ottoman court architects, masters of Anatolian Greek and Armenian origin started to come into prominence in civilian architecture, particularly imperial architecture (Kıratlılar, 1997).

As with other structures of water architecture, major developments took place under Ottoman influence in *sebils* after the 15th century. In terms of architectural development, it is possible to say that starting in the 15th century Seljuk period *sebils,* in the form of a niched cistern installed on the walls of buildings, evolved into larger *sebilhanes* featuring sizable windows that opened out. Examples include Istanbul's first *sebil*, the Sebil of Efdalzade Seyyid Hamided din built in the Fatih district in 1496, and the TopkapıTekkeci İbrahim Agha *sebil* built in 1593. During the 16th century, *sebils* are usually seen integrated into civil architecture structures like palaces, mansions and pavilions. Towards the end of the 17th century changes start to take place in the polygonal plans of *sebilhanes* or consoles with the impact of the baroque rococo style. New structures featured curves and ornamentation alongside sharp corners and uniform facades. Such examples include the Sebil of Amcazade Hüseyin Pasha (c.1697) located in the Saraçhane *Külliye* (Social Complex) and the Sebil of Emin Agha in Dolmabahçe (c. 1740). Starting in the mid-17th century until the end of the 19th century, very diverse types of *sebilhanes* appeared in the Ottoman capital Istanbul with the abundance of water supplied to the city, largely owed to economic development and prosperity. The 19th century saw the appearance of sebil facades or plaza sebils, generally formed of sebil windows installed on the corners. Having said that, besides various architectural features, traditional sebil architecture survived in Istanbul and, in particular, Anatolia (Önge, 1997).

Mostly made using white marble, *Selsebils* (ornamental cascading fountains) consisted of small basins of varying shapes at different levels that were fixed symmetrically on a large mirror stone as a main console, nestled on a wall or inside a niche that was bordered by raised motifs and affluently decorated profiles. Water rills from the upper-most outlet or small basin to the basins below before finally reaching a small pool on the ground. One of the most beautiful examples of such garden sebils is located in the garden of Muhsinzade Yalısı, a waterside Istanbul mansion built in the 19th century. The *selsebil* found in the 19th century Konya Mawlana Islamic Monastery is much more modest compared to these examples. Inclined selseblis can be found inside the wall niche on the ground floor of the *iwan* of the Semanoğlu Mansion (c. 18th century) and in the *serdap* (basement) of the Gevraniler Estate's harem (c. 1819). Although in different compositions, the *selsebils* seen inside the windows of the Sünnet Mansion of the Topkapı Palace in Istanbul can be found in traditional Ottoman structures like Yalı Mansion, Tersane Palace and Has Oda Pavilion. Today, most of the *selsebils* in Istanbul date to the 18th and 19th centuries (Önge, 1997).

The term *shadirvan* is generally used to describe the raised sided pools with ritual ablution taps on either side, found frequently on the interior or exterior walls, or in the central courtyard of Anatolian mosques. The first example of a *shadirvan* of this nature is thought to be the one constructed in the inner courtyard of the Fatih Mosque in Istanbul (c. 1470). Similar to fountains, the *shadirvan* pools in mosque courtyards start to feature twirling spouts around the mid-16th century. A few of the original twirling spouts can be found in some Anatolian villages and towns; for example, the *shadirvan* at the 16th century *zawiyah* at Abdal Hasan Village in Taşköprü. An example of a non-twirling, classical type spouted *shadirvan* is found at LalaHüseyin Pasha Mosque in Kütahya (c. 1568). Classical Ottoman *shadirvans* more often have circular plans and prefer to use goblet shaped navel basins. Ornamentation can be seen on the exteriors of *shadirvans* that were built after the 15th century. Examples of barriers covering the sides and top of *shadirvan* pools intended to prevent contact with water and disposal of coins also appear in this century. This is also when wooden shelters resting on columns around the pool appear in mosque courtyards aiming to protect people performing ritual ablution from the sun or rain. One of the earliest examples of such *shadirvan* covers is again found in Istanbul's Fatih Mosque. 16th century is the period when mosque *shadirvans* reach their pinnacle in terms of architectural constitution and function. There are also water aeration facilities known as water mansions or enclosed *shadirvans* that resemble classical mosque *shadirvans*, but lack ablution taps on the sides of the pools. The *shadirvan* pool at the Manisa Hafıza Hatun Mosque

(c. 1522) has a circular plan with an approximate diameter of 5.50 m and an approximate height of 1.10 m. Beginning at the end of the 18th century, *shadirvans* gradually start lose their architectural character, get smaller and even start to disappear. The *shadirvans* at Laleli Mosque (c. 1763), Eyüp Sultan Mosque (c. 1800), Nusretiye Mosque (c. 1826) have a weakly founded architectural structure. The *shadirvans* at Dolmabahçe and Ortaköy Mosques (both c. 1853) and Yıldız Hamidiye Mosque (c. 1886) are no longer visible (Önge, 1997).

III. Ottoman Era Water Architecture, Antalya

Antalya Province is a touristic city situated on the Mediterranean coast in the Mediterranean Region, in South Turkey (Figure 1). It is encircled by the provinces of Burdur, Isparta and Konya to the north, Karaman and Mersin to the east and Muğla to the west. The Mediterranean Sea is to the south. Antalya, meaning "home of Attalus" is believed to have been founded by King Attalus II. After the demise of the Kingdom of Pergamum (133 BCE) the city briefly enjoyed independence before falling to pirates. It was annexed to the Roman empire by Commander ServiliusIsauricus in 77 BCE. In 67 BCE the city became the naval base of Pompeius' fleet. Hadrianus' visit to Attaleia in 130 CE contributed to the development of the city. During the reign of the Byzantines the city was listed an episcopate. Archaeological digs in and around Antalya prove that the place was first inhabited by people 40,000 years ago. Since 2000 BCE the region has successively been under the rule of city states like the Hittites, Pamphylia, Lycia, Cilicia and later Persians, Alexander the Great and the subsequent Kingdoms of Antigonos, Ptolemais, Selevkos and Pergamum. The city was later ruled by the Roman Empire. In the archaic ages Antalya was known as Pamphylia and the cities founded here went through a golden age in the 2nd and 3rd centuries but started declined towards the 5th century.

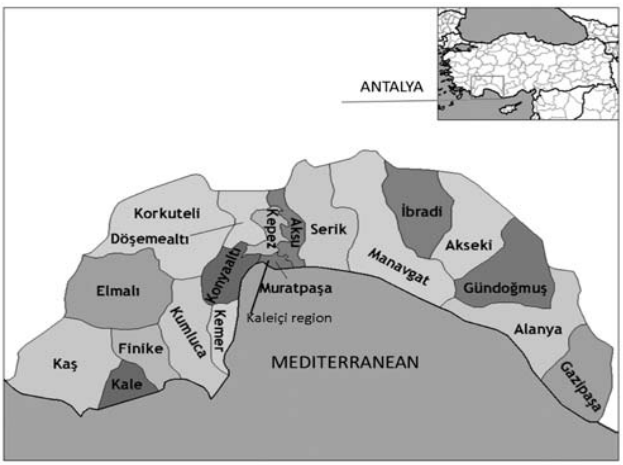


Figure 1: Location of Antalya, Emalı Districtand Kaleiçi historic urban quarter

The region fell to the Seljuks in 1207while it was still under the rule of the Byzantines (aka Eastern Roman Empire). During the Anatolian Principalities period it fell under the rule of the Hamids, an arm of the Teke Tribe. During the reign of the Ottomans, today's Antalya provincial centre was the centre of the Teke Region in the Anatolian State. The area was known as the Teke Region during this period. The famous Ottoman traveller EvliyaÇelebi who came to Antalya in the second half of the 17th century wrote about the presence of 3 quarters and 3000 homes in the citadel and an additional 24 quarters outside the walls. The commercial centre of the city was outside the castle walls. According to EvliyaÇelebi, the harbour was large enough to house 200 vessels. Antalya, the centre of the Teke Principality was under the administration of Konya however it became an independent principality towards the end of the Ottoman Empire (Anonymous, 2017).

Both situated within the borders of Antalya Province, Kaleiçi historic quarter and Elmalı District is home to structures from the Ottoman era. This study examines some of these which feature water elements.

Thought have been built between 1607-1616, Tekeli Mehmet Pasha Mosque is located in the Kaleiçi historic quarter of Antalya Province. The minaret is located on the north-western corner of the mosque while the *shadirvan* lies to the east (Kılıç, 2013). Today, the *shadirvan* is used for ritual ablution (Figure 2).

Murat Pasha Mosque was commissioned by Murat Pasha and was built between 1570-1571 and is near the Kaleiçi historic quarter. The *shadirvan* is located to the north of the courtyard, on the axis of the main entrance. Featuring an octagonal plan, the shadirvan has a reservoir in the middle. The octagonal shaped marble clad reservoir has taps on its facades. The *shadirvan* which features the characteristics of the period has a conical cover supported by eight marble columns with stalactite capitals (Kılıç, 2013) (Figure 2).

Ketenci Ömer Pasha Mosque stands out as the largest mosque and monumental structure of Antalya's Elmalı District. The structure which is a notable example of classical Ottoman architecture was renovated by the General Directorate of Foundations twice, in 1938 and 1968 (TVAEE, 1983). As with similar examples, the *shadirvan* seen adjacent to the mosque is for ritual ablutions (Figure 2).

Constructed using stone, the *shadirvan* has an octagonal plan and features a pool in the middle. The exterior of the pool has 16 cusps. Each façade has been separated into rectangular panels with embedded pillars. There is an ablution tap in the centre of each of these panels. The reservoir/ is set in motion with triple-tiered moulds. There are two rows of kaval moulds at the bottom and three rows of concave moulds above and at the ends of the reservoir. 16 pillars support the flat dome that covers the pool. The *shadirvan* has a conical cover

standing on eight reinforced concrete piers that are reinforced by Bursa style arches (Kılıç, 2013).

Constructed in the second half of the 14th century, the Nazır Hamam in Antalya Kaleiçi bears a lot of resemblance to the plan of the Bali BeyHamam. Adjacent to the wall on the northern façade, the building has a rectangular plan of approximately 9.50 x 2.50 m that extends on the southwest-northeast axis. An entrance unit has been added to the northwest façade at a later date. The entrance leads to the changing room and that leads to the warm room through a door opened in the middle of the north wall that is bordered with a rectangular cuspidate arch. The hot room is in the centre and consists of three *iwans* while the north and east corners functions as private rooms. The exterior façade is completely plastered and lime-washed and all of the domes have been cement coated with the exception of the circular glass windows (Yılmaz, 2002) (Figure 3).

Cumhuriyet Hamam (Bali Bey Hamam) lacks an inscription about its construction and renovation however, the Prime Ministerial Archives hold a record of the structure under "…Bali Beg hamam Ottoman Imperial Construction Contract" belonging to the Teke Region dated 1606-1607 (Hijri: 1015). The building has a 12.00 x 24.00 m sized rectangular plan that extends on the east-west axis. The eastern façade that looks to the Bali Bey Mosque is made of rubble stone. The building is accessed from the western façade which initially leads to the dressing room that features a hipped roof that has lost its original form. The door opened in the middle of the eastern wall of the dressing room leads to the warm room which consists of the central domes section and two smaller domes areas on either side. The hot room is accessed from the door opened on the eastern wall of the central domed area of the warm room. The hamam is covered with a roof containing windows known as "elephant's eyes". The building does not feature any decorations and has lost its original form internally and externally by means of various interventions (Yılmaz, 2002). Amongst the examined hamams, Bali BeyHamam is significant for being the oldest structure outside the citadel during Ottoman rule (Figure 3).

Ömer Pasha Hamam (Bey Hamam) is one of the oldest hamams in Antalya's Elmalı District. It is mentioned on records in 1455. Back then, the foundation is in the name of Mevlana Ali. There are records of the building in the foundation logs of 1530 and 1567. The hamam is located to the northeast of Ketenci Ömer Pasha Mosque and it is believed to be today's Bey Hamam. However, this is not precise information. The structure known as Bey Hamam has a renovation inscription dated to 1890 (Duymaz, 2008).

The hamam which consists of cold, warm and hot rooms has a plan of four *iwans* and cells in all corners. The hot room has a quadruple *iwan* plan with a central dome and four *iwans* covered by cavetto vaults on either side that open up to the centre with lancet arches (Köklü, 2003) (Figure 4).

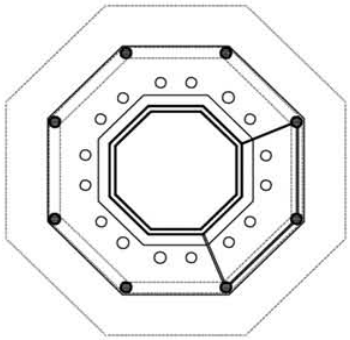
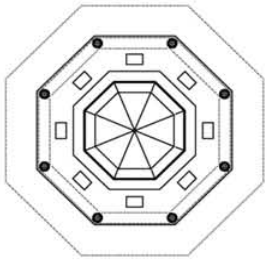
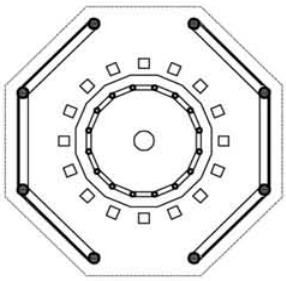
EXTERIOR VIEW	PLAN	POSITION
 Figure2a Tekeli Mehmet Paşa Mosque Şadırvan	 Figure 2b 0 0.5 1 2 5 m	36°53'11.8"N 30°42'20.6"E
 Figure2c MuratPaşa Mosque Şadırvan	 Figure 2d 0 0.5 1 2 5 m	36°53'28.4"N 30°42'09.2"E
 Figure 2e Ketenci Ömer Paşa Mosque Şadırvan	 Figure 2f 0 0.5 1 2 5 m	36°44'34.5"N 29°54'50.6"E

Figure 2a,Figure 2b. Tekeli Mehmet Paşa Mosque Şadırvanı, plan (Original,2017)
Figure 2c, Figure 2d. Murat Paşa Mosque Şadırvanı, plan (Original,2017)
Figure 2e, Figure 2f. Ketenci Ömer Paşa Mosque Şadırvanı, plan(Original,2017)

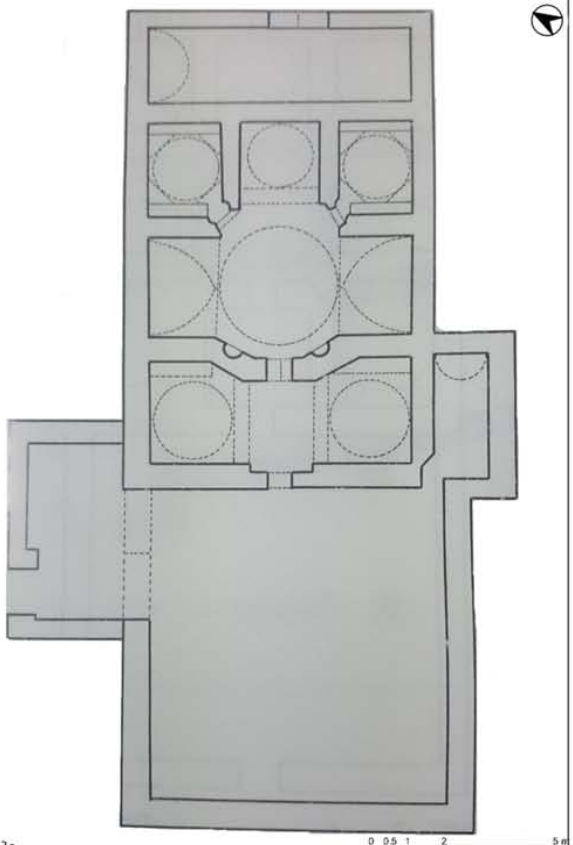
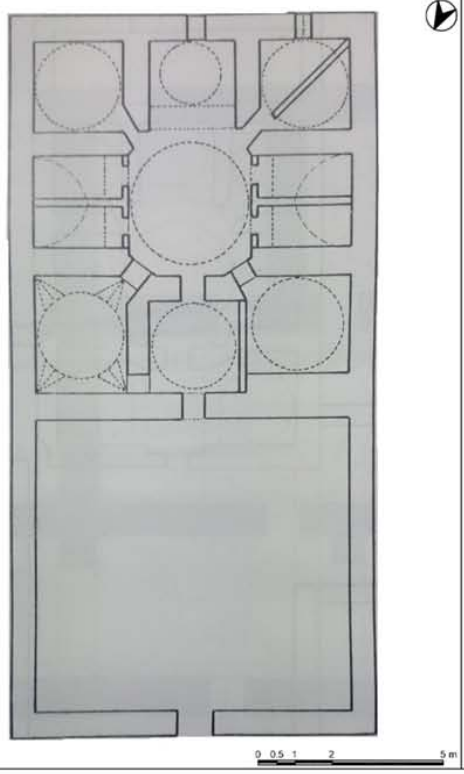
EXTERIOR-INTERIOR VIEW	PLAN	POSITION
 Figure3a:Nazır Hamamı dome view  Figure3b:Nazır Hamamı dome's exit stairs  Figure 3c :Nazır Hamamı warmth space  Figure 3d :Nazır Hamamı warmth space	 Figure 3e	36°53'10.4"N 30°42'23.1"E
 Figure 3f :Cumhuriyet Hamamı dome's view  Figure 3g :Cumhuriyet Hamamı entrance from main street  Figure 3h Cumhuriyet Hamamı warmth space	 Figure 3ı	36°53'18.4"N 30°42'20.9"E

Figure 3a,Figure 3b. Nazır Hamamı (Original,2017)
Figure 3c,Figure 3d. Nazır Hamamı (Yılmaz,2002)
Figure 3e. Nazır Hamamı plan (VGM,2017)
Figure 3f,Figure 3b. Cumhuriyet Hamamı (Yılmaz,2002)
Figure 3h. Cumhuriyet Hamamı (Original,2017)
Figure 3ı. Cumhuriyet Hamamı plan (VGM,2017)

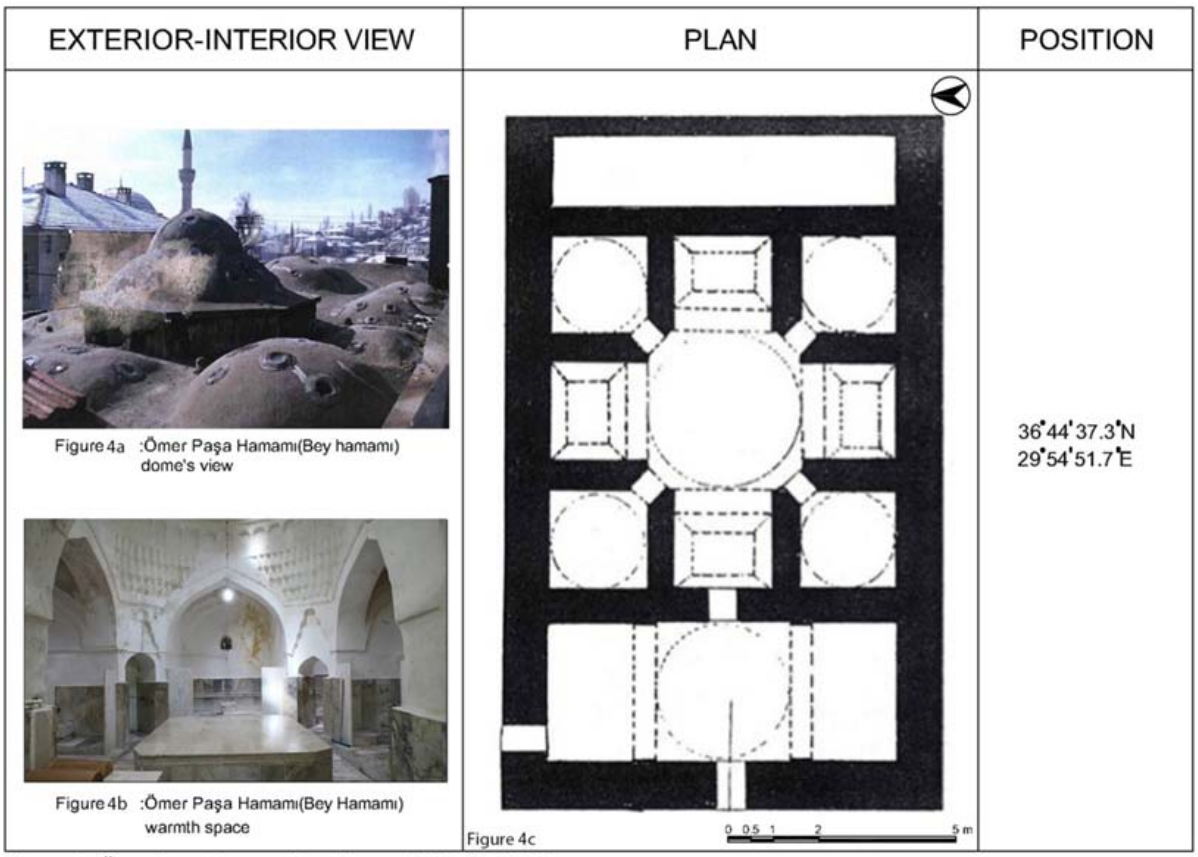


Figure 4a. Ömer Paşa Hamamı (Bey Hamamı) (Köşklü,2003)
Figure 4b. Ömer Paşa Hamamı (Bey Hamamı) (Karadağ,2017)
Figure 4c. Ömer Paşa Hamamı (Bey Hamamı) plan (VGM,2017)

IV. Conclusion

Owing to its climate and location, Antalya has always been a popular place to live in Anatolia in all stages of history. There are several historic structures from the Ottoman Era within Antalya. The water structures examined in scope of this study are located in Elmalı District, one of the fertile grain production centres of Anatolia during the Ottoman period, and in the historic Kaleiçi quarter on the coast, in downtown Antalya. Although previous renovations have caused a certain degree of damage to these structures, they still exist and even continue to be used within the historic fabric of the area. The existing relieves for the examined structures have been disseminated and relieves were prepared for those without in order for them to enter literature.

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Global Journal of human-social science: D
History, Archaeology & Anthropology
Volume 17 Issue 2 Version 1.0 Year 2017
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-460X & Print ISSN: 0975-587X

Mortuary Rituals and *Perimortem* Interventions. Complex Burials at the Pozo De La Chola Site, Foothill Region in Jujuy, Northwestern Argentina (2000-1500 BP)

By Gabriela Ortiz, Brian Zenteno, Fernanda Paz & Soledad Zúñiga
Universidad Nacional de Jujuy

Abstract- Intervention on corpses as a mortuary practice has been reported in South America as early as 9000 BP (Strauss et al., 2015).In the region of the San Francisco River, in Argentine Northwest (NOA), complex forms of burial involving per mortem interventions on the body of the deceased have been reported in recent years. These complexes ritual cover all age classes and include defleshing, evisceration and selection of anatomical parts, associated with fire exposure practices on direct primary burials. The combination of different kinds of perimortem intervention and exposure to fire in direct primary burials seems to represent an idiosyncratic practice that has no parallel in other contemporary populations in Northwestern Argentina, and can therefore be considered a *funerary tradition.*

GJHSS-D Classification: *FOR Code: 210399*

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Mortuary Rituals and *Perimortem* Interventions. Complex Burials at the Pozo De La Chola Site, Foothill Region in Jujuy, Northwestern Argentina (2000-1500 BP)

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Abstract- Intervention on corpses as a mortuary practice has been reported in South America as early as 9000 BP (Strauss et al., 2015).In the region of the San Francisco River, in Argentine Northwest (NOA), complex forms of burial involving per mortem interventions on the body of the deceased have been reported in recent years. These complexes ritual cover all age classes and include defleshing, evisceration and selection of anatomical parts, associated with fire exposure practices on direct primary burials. The combination of different kinds of *perimortem* intervention and exposure to fire in direct primary burials seems to represent an idiosyncratic practice that has no parallel in other contemporary populations in Northwestern Argentina, and can therefore be considered a *funerary tradition*.

I. Introduction

Intervention on corpses as a mortuary practice has been reported in South America as early as 9000 BP (Strauss et al., 2015). This custom has persisted over time in different groups, both in those of high-Andean tradition, and in coastal (Swenson, 2014) and lowland peoples – especially Amazonian (Neves et al., 2002; Solari et al., 2015). The *peri/postmortem* selection of anatomical parts, performed as a ritual sign during burial or as a way of assembling a 'burial package' for the purpose of transportation, has been recorded in regions as diverse as the Andes, the Andean foothills, the Chaco, or the Pampa and Patagonia in Argentina (Martínez et al., 2006; Berón & Luna, 2007; Del Papa et al., 2011; Ortiz & Nieva, 2014a; Desántolo et al., n/d). In some studies, these practices have been interpreted as complex forms of worshiping ancestors (Bloch & Parry 1982; Buikstra 1999; Aschero 2007a y b; Cremonte & Gheggi 2012); in others, they have been connected with the return to the final burial site, considering that a person's decease could have occurred away from their place of origin (Berón & Luna 2007; López Campeny et al. 2014). Amongst the diverse forms of treating the bodies, we have been able to record the selection and extraction of specific anatomical elements, as well as more complex practices such as defleshing, evisceration, bone cutting and exposure to fire.

In the Cuyo region in Argentina, there is ethnographic documentation referring to the existence of 'specialists', who were summoned at the moment of death to perform the treatment of the body, including the skeletonization process (Rosales, 1978, cited in Scabuzzo & Politis 2010). These specialists may not have been natives, having to leave their places of residence to provide their services. This implies that a comprehensive knowledge of human anatomy, as well as skills, physical strength and the use of appropriate tools were necessary to perform certain procedures on the bodies.

In the northwestern region of Argentina (NOA), manipulation of the bodies as part of mortuary treatment procedures can be traced back to the period of hunter-gatherers, with dates as early as 9600 BP (Fernández Distel, 1975; Fernández Distel, 2001). In the puna regions of Jujuy and Catamarca, there have been reports of amputated, burnt, re-deposited, transported and manipulated bodies in domestic contexts, which seems to point towards ancient rituals that connect numerous groups which inhabited different Andean regions (Fernández Distel, 2001; Aschero, 2007a, b). However, and due to a limited understanding of the archaeology of pre-Hispanic populations which occupied the foothill regions and eastern valleys, funerary practices were barely recorded or even completely unknown. In this regard, the research carried out during the last few years in the San Francisco valley region has begun to reveal complex funerary practices which involve significant *perimortem* interventions on the corpses before their final burial.

The Region of the San Francisco River Valley. Background Studies on Burial Practices.

Although research in the foothill region of the province of Jujuy started at the beginning of the twentieth century, little was known about burial practices until less than a decade ago. According to the limited sources previously available, the burial types included primary grave burials for sub-adults and direct primary

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burials for adults (Nordenskiöld, 1903; Boman, 1908; Dougherty, 1975). The descriptions of finding contexts and grave goods were very inaccurate and vague, while bioarchaeological analyses were only concerned with age group identification and, occasionally, with sexing (Dougherty, 1975). It was not until the year 2009 that some of the burials recovered from the region were recorded and analyzed systematically for the first time (Seldes & Ortiz, 2009). From that moment, and due to the progress made in research, there has been an increase in the number of studies and the understanding of the funerary procedures performed by populations called 'San Francisco' (Ortiz & Nieva, 2014a y b;). Some of these practices included preparations for the final burial which involved *perimortem* intervention, whereas others did not show signs of such treatment of corpses. Numerous anthropic interventions were found on the bodies, typical of different mortuary practices, which involved skeletonization process, evisceration, selection of anatomical parts and cremation in burial graves.

II. Materials and Methods

The analyzed sample comes from an archaeological site which has been under study since 2009. Pozo de la Chola is located on the valley bottom of the foothill region in Jujuy, Argentina (24°06'56''S, 64°42'59''W; Figure 1). The site, placed on one of San Francisco river terraces, is only partially preserved due to a significant seasonal rise in the river level which largely destroyed it two decades ago. The Chaco serrano vegetation dominates the whole valley bottom, while higher on the hillsides, species typical of the Yungas or mountain rainforests become progressively more common. The average altitude is 650 MASL. A distributional prospection consisting of many boreholes has allowed us to estimate the extension of the preserved area at 2 hectares; the calculation is approximate because the environmental and cultural characteristics of the archaeological sites reduce visibility to zero (Ortiz et al., 2015). On the basis of its pottery materiality, the site has been assigned to what has been called the "San Francisco Tradition" (*sensu* Dougherty, 1975), considered to be one of the earliest agro-pottery traditions in Northwestern Argentina. Up to now, the excavated area represents 105m^2, and it has been distributed in three sectors (A; B; C). Direct primary burials, partial remains of a secondary burial and anatomical parts, selected and arranged over occupational floors or inside a large basin hearth, have been recorded in all three sectors (Ortiz & Nieva, 2014a). Radiocarbon dating performed on eight occasions on some burial skeletal remains and over floor carbon samples have revealed a long period of occupation spanning from the beginning of the era until 500 AD (Ortiz & Nieva, 2014; Ortiz et al., 2017).

Due to the differing exhumation conditions and to the cultural practices associated to the treatment of corpses, many skeletons were found fragmented or incomplete; consequently, it was necessary to perform reconstruction and conservation tasks. The sediments basic pH, along with the immediate burial of the remains, account for the outstanding state of conservation, even in sub-adult individuals.

The assessment of the sample composition started with the reassembly and continued with a distributional analysis of the skeletal remains and the associated context features and a close observation of alteration signs by means of hand lenses and binoculars. Age was calculated on the basis of the synostosis shown by the main ossification centers, the measurement of maximum length in long bones and the root dentine translucency in premolars, as well as through assessing the dental formation and calcification processes (Lamendin et al., 1992; Esponda Vila, 1994; Ubelaker, 1999; Scheuer & Black, 2000).

The minimum number of individuals (MNI) was 36. Eleven of the individuals were sub-adults and twenty-five, adults. Categorization of sub-adults through age intervals followed the criteria proposed by Bogin (1988) and Lewis (2007): 1. perinate: around birth to 3 months of age; 2. infant: 4 months of age to 2.9 years; 3. child: 3 to 6.9 years; and 4. juvenile: 7 to 12.9 years. In adults: adults (20-40 years), mature adults (40-60 years) and senile (older than 60 years of age).

Sexing was carried out following the criteria proposed by Bass (2005) and Buikstra & Ubelaker (1994), based on the morphological analysis of pelvic structures.

Signs of *peri* and *postmortem* manipulation, specifically of impact and cut marks, were taken as evidence for the assessment of anthropic intervention on the bodies, following the criteria proposed by Pijoan & Pastrana (1987), Botella López (2005), Spencer (2007) and Solari Giachino (2010). These take into consideration direct or indirect cut marks, type of cut (by attrition, percussion, tension, twisting and levering), anatomical location, shape of the transverse section, depth, size, orientation and color, as well as the practices connected to each of them (skinning, defleshing and disarticulation). Shades of color, localization and changes in the external surface were observed according to the criteria provided by Holck (2008), Pijoan et al. (2008) and Stodder (2008), with the aim of recording thermal alteration.

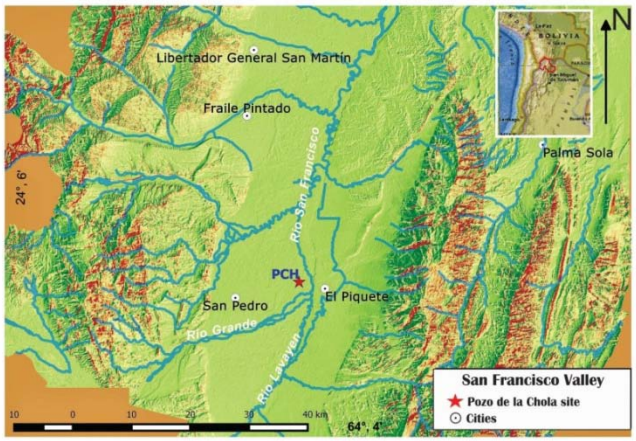

Figure 1

a) Contexts under Study

Sector A: at the moment, the total excavated area is 58m^2, where 25 individuals (MNI) have been recovered: 4 complete and 21 incomplete. Two of the complete individuals are sub-adults; the other two are adults recovered from two primary grave burials. One of the adults was found extended, in supine position and the other one, in sitting position. Both sub-adults were buried in extended, supine position. Other incomplete remains were found on the occupational floors and showed no clear signs of burial; only one secondary burial was recorded: some lower extremities bones from an adult individual were placed inside a pit delimited by large fragments of ceramic vessels and rounded stones (Table 1, Figure 2a). The incomplete sub-adults remains belong to the cranium, while the post-cranial skeleton has not been found. In some cases, there is evidence of exposure to fire: one of the bodies revealed that it had been burnt inside the grave (Table 1; Ortiz et al., 2017). Incomplete remains were recovered from inside a large basin hearth; some of them – foot bones – corresponded to an adult, and others – cranial remains – belonged to two sub-adults (Table 1). Only one male adult was found with a smoking pipe fragment placed between his legs, in the manner of grave goods. Cut marks were visible in both the parietal bones of the sub-adult individual burnt inside the grave and in the isolated cranial vault of another sub-adult, which also showed signs of thermal alteration (Ortiz et al., 2017).

Sector B: Two of the three different locations where excavations were carried out resulted in the discovery of inhumation burials. The first excavation covered an area of 9m^2 and the second, 8m^2. One of the excavated sections corresponds to an exclusive burial zone; the other seems to belong to a low-density waste area where an adult was buried. In the first section, 4 complete individuals (3 adults and 1 sub-adult), together with incomplete remains of 2 other sub-adults, were exhumed. The burials of adults were direct primary burials, where the bodies lay in extended supine position, whereas one of the sub adults was found in bent lateral decubitus position (Ortiz et al., 2017). Two of the adult burials presented ceramic objects as grave goods. A ring-shaped ceramic vessel was located approximately 0.5 meters away from all burials; consequently, it could not be assigned to any of them in particular (Ortiz, 2013). Three of the adult individuals showed cut marks and signs of thermal alteration (Table 1, Figure 2b y c). In the second section, a primary grave burial was excavated, where an adult individual lay in extended supine position, with overlapping lower limbs. It did not show any signs of *perimortem* intervention.

Sector C: This sector corresponds to another exclusive burial zone. The total area excavated is 14m^2, where three burials were recovered: two belonging to adults and one to a sub-adult (Table 1). All of them were characterized as primary burials: an adult and a sub-adult were found in extended, supine position, while the other adult was found in sitting position. The sub-adult individual shows many cut marks (Figure 2d).

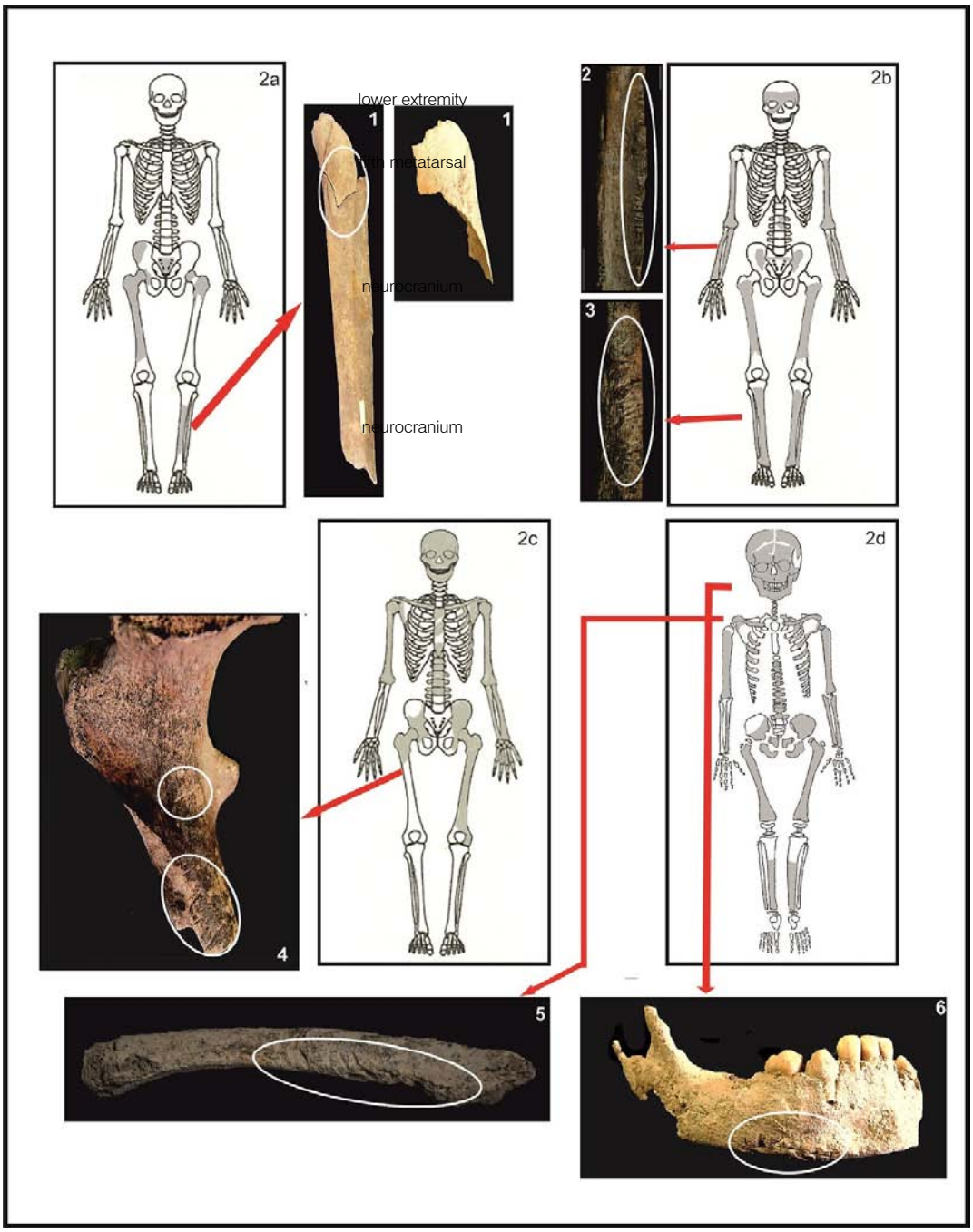

Figure 2

Sector	Indiv.	Condition	Cut-marks		Linkedaction	Cut-markslength/ type of fracture	Section	Location	Pattern	Morphology	Age	Sex	Thermosetting	Dating (year BP)	Contex
			Cutbone	Overthesurface											
A	1	complete		x	defleshing	range 9mm-15mm long	v	lower extremity	scattered	transversal - longitudinal	adult	Male	x		burialpit
A	2	incomplete	x	x	fracture/ defleshing	4 mm long Spiral	v	fifth metatarsal		helicoidal and transversal	adult				burialpit
A	3	incomplete		x	defleshing	4 mm	v	neurocranium		transversal	adult		x	2030 ±50 BP	traybonfire

Table 1

Sector	Indiv.	Condition	Cut-marks		Linked action	Cut-marks Length/type of fracture	Section	Location	Pattern	Morphology	Age	Sex	Thermosetting	Dating (year BP)	Contex
			Cut bone	Over the surface											
A	1	complete		x	defleshing	range 9mm-15mm long	v	neurocranium	scattered	transversal - longitudinal	adult	Male	x		burial pit
A	2	incomplete	x	x	fracture/ defleshing	4 mm long Spiral	v	lower extremity	grouped	helicoidal and transversal	adult				burial pit
A	3	incomplete		x	defleshing	4 mm	v	fifth metatarsal	grouped/ scattered	transversal	adult		x	2030±50 BP	tray bonfire
A	4	complete									adult	Male			burial pit
A	5	complete		x	defleshing	range 1,2 mm - 7,3 mm long	v	neurocranium	grouped	transversal - longitudinal	1 year ± 4 month		x	2030±80 BP	burial pit
A	6	incomplete									adult		x		floor
A	7	incomplete									6 year ± 1 year		x		floor
A	8	incomplete		x	defleshing	2-2,4 mm	v	neurocranium	grouped	transversal-longitudinal	sub-adult		x		floor
A	9	incomplete									adult		x		floor
A	10	incomplete									adult		x		burial pit
A	11	incomplete									adult		x		burial pit
A	12	incomplete									adult		x		burial pit
A	13	incomplete									adult		x		floor
A	14	incomplete									adult		x		floor
A	15	incomplete									adult		x		floor
A	16	incomplete									adult		x		floor
A	17	incomplete									adult		x		floor
A	18	incomplete									adult				floor
A	19	incomplete									adult		x		floor
A	20	incomplete									adult		x		floor
A	21	incomplete									4 year ± 1 year				tray bonfire
A	22	complete									6 year ± 1 year		x		tray bonfire
A	23	complete									9 year ± 1 year		x		burial pit

A	24	incomplete			x	defleshing	range 10mm-2mm long	v	Neurocranium left humerus; left ulna; left radium; right ulna; right radium; left femur; right femur; right tibia; right fibula	grouped	transversal/longitudinal	adult	1 year ± 4 month	female		1710±70 BP	tray bonfire
A	25	incomplete										adult	8 year ± 1 year				floor
B	26	Complete																burial pit
B	27	complete		x	x	defleshing	range 5mm-11mm long	v	right femur	scattered	transversal	adult	1930 ± 60 AP	male			burial pit
B	28	complete		x	x	evisceration	range 8mm-20mm long	v	right iliac	grouped	transversal/longitudinal	madu ro		male			burial pit
B	29	complete										3 year ± 1 year					burial pit
B	30	incomplete										5 month ± 3month			x		burial pit
B	31	complete										adult		male			burial pit
B	32	incomplete										adult			x		rescue
B	33	incomplete										adult					rescue
C	34	complete			x	Defleshing	range 1,2 mm - 1,7 mm long	v	lower jaw; clavicle	grouped	transversal	14 month ±2 month					burial pit
C	35	complete										adult		female			burial pit
C	36	complete										adult		female			burial pit

III. Results

Due to the fact that most skeletal remains are incomplete, the total estimates of *perimortem* interventions are only partially representative. Over a total of 36 individuals, a significant percentage of the sample shows signs of diverse types of interventions (Figure 3a). Likewise, if we analyze age groups separately, there is evidence of interventions performed on the bodies of both adults and sub-adults (Table 1 and Figure 3b). As regards age groups, these practices have been more regularly observed in adults; considering the size of the sample, however, the percentage is still high in sub-adults. The most frequent intervention practice is exposure to fire, followed by marks of actions involving skeleton cleaning or defleshing (Figure 3c).

The characteristics shown by the marks, as well as their anatomic location and the absence of disarticulation in primary burials are indicators of manipulations connected to defleshing before the body was deposited in the burial grave, and in some cases, of subsequent exposure to sources of heat.

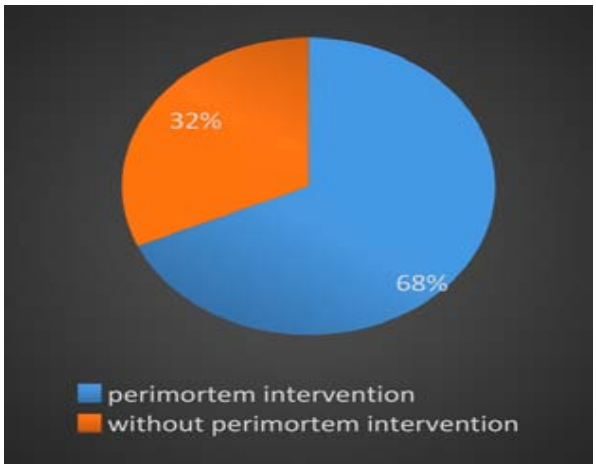

Figura 3 a.

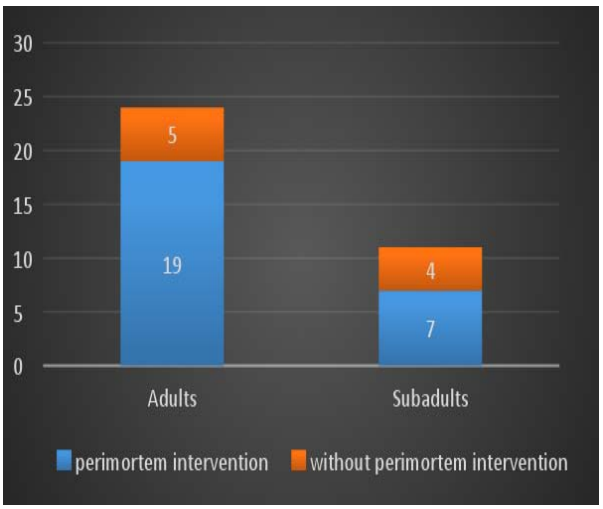

Figura 3b

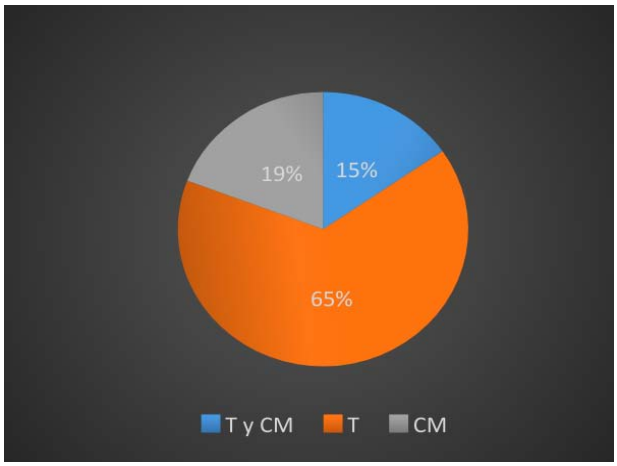

Figura 3c

a) *Final Words*

Manipulation of human remains has been very frequently interpreted as evidence of cannibalism (Turner, 1983; Pijoan, 2014; White, 1992). Although there is no absolute consensus among them, most researchers agree about considering the existence of thermal alteration, cut marks, brain exposure and isolated skeletal remains in cases of unique burials, as good indicators of such a practice. However, even when these signs are observed in the analyzed sample, they show neither co-occurrence nor intra-sample regularity. Neither are human bones mixed with animal bones, nor scattered on the floor without anatomical association. As for the remains which were found incomplete, they generally represent an intentional selection of specific anatomical parts.

In the light of all this evidence, we would like to propose that the societies under study performed formalized and specific rituals immediately after a person's death or even after the exequies. The data obtained from material imprints left by mortuary rituals revealed complex forms of treatment of the deceased, which involved significant corpse manipulation. Considering the fact that a high number of primary burials have undergone important *perimortem* interventions, the presence of isolated or incomplete skeletal remains in places which do not seem to be final burial sites can be interpreted either as similar inhumation practices, in which the remains were removed from their original burial sites for later re-deposition, or as other forms of ritual signs towards skeletal remains which had not been subject to primary burials.

On the basis of the recurrence of similar practices on different individuals and age groups, we set forth the existence of complex mortuary rituals that have no connection to instances of violence or cannibalism. The lack of clear indicators of anthropophagic practices proposed by other researchers – e.g. fractures, blunt force traumas, avulsions and medullary canal alterations (Solari et al., 2015) – point towards interpreting them as mortuary ritual practices – a hypothesis further supported by the fact that the forms of inhumation reveal, in most cases, primary burials.

Diversity in the forms of disposing the bodies cannot be explained as changes in the funerary customs throughout time: the radiocarbon dating obtained in different sites showed that some burials are contemporary with one another. Radiocarbon datings performed on two sub-adult individuals and on two adults revealed both diachronic and synchronic burial practices (Table 1). The episodes with the most similar datings showed that the ways of burying sub-adults did not differ from that of adults. In both cases, primary grave burial was the most common form of inhumation, and, in general, they did not present (non-perishable) grave goods. Some skeletal remains have been subjected to rituals involving fire; in some cases, in combination with a skeletonization *perimortem* process.

Other individuals' remains may have played the role of relics, as they have been preserved and

manipulated in domestic contexts (Ortiz 2013a). This practice appears to have been more frequent with sub-adult skeletal remains, as shown by the majority of the anatomical parts found on archaeological floors, incomplete and without evidence of final burial, which mostly belong to cranial remains of infants or children. Other bodies, found in primary burials and evidencing anatomical connection, were subjected to numerous interventions, including defleshing, evisceration and scraping. Finally, the presence of bones on the inside of hearths has proven to be the most elusive mortuary practice.

Therefore, we would like to propose that, like elsewhere in South America, the human body was used in specific mortuary rituals as a way of reifying and expressing cosmological principles related to death (Strauss et al., 2011). Even though, until now, there was no evidence of social asymmetry found (Ortiz, 2013b), the selective treatment that only some individuals received may bring to light social inequalities which are not visible in other material aspects (Ortiz 2013a).

Although in this study we have only analyzed data obtained in Pozo de la Chola, burials involving the same forms of intervention on the bodies were found in other contemporary archaeological sites of the region. This allows us to assert that we are in the presence of an extended cultural practice in these populations.

Finally, we would like to emphasize that the combination of different kinds of *perimortem* intervention and exposure to fire in direct primary burials seems to represent an idiosyncratic practice that has no parallel in other contemporary populations in Northwestern Argentina, and can therefore be considered a *funerary tradition.*

Acknowledgments

The authors would like to thanks their students Verónica Rojas, Alejandro Ugarte, Patricia Chocobar; Gabriela Quispe; Lorena Vaca, Hernán Vilte; Milton Mercado; Natalia Mamaní, Verónica Soruco; Constanza Chavez; Analía Godoy; Natalia Flores y Paula Ryena. We also thank to Alvaro Alavar for the map of figure 1 and Guillermo Chauque for the assistance of two photographs of figure 2. Also to the authorities of ''La Esperanza" for their logistical support. This work was supported by SECTER-UNJU [grant number C/0175].

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Global Journal of human-social science: D
History, Archaeology & Anthropology
Volume 17 Issue 2 Version 1.0 Year 2017
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-460X & Print ISSN: 0975-587X

Late Pleistocene Humans used Rice in Sri Lanka: Phytolith Investigation of the Deposits at Fahien Rock Shelter

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Keywords: fahien rock shelter; sediment; stratigraphy; phytoliths; rice;sri lanka.

GJHSS-A Classification: FOR Code: 219999

Strictly as per the compliance and regulations of:

Late Pleistocene Humans used Rice in Sri Lanka: Phytolith Investigation of the Deposits at Fahien Rock Shelter

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Abstract- **Phytolith (microscopic plant silicate bodies) evidence suggests that anatomically modern humans lived at Fahien rock shelterin the south-western Sri Lanka intensively used wild rice species (e.g. *Oryza* cf. *nivara*) in association with lowland rain forests from 47.80ka (47,800 calyrs BP). The intensive use of wild rice could be a local innovation.**

Keywords: fahien rock shelter; sediment; stratigraphy; phytoliths; rice; sri lanka.

I. Introduction

Domesticated rice (*Oryza sativa*) is one of the world's most important crops today. It is believed that early humans associated ancestors of domesticated rice (wild rice) before the appearance of domesticated rice in human cultures of South Asia from the early Pleistocene onwards (1). But, understanding the antiquity of the human usage of wild rice in the archaeological context remains in dispute due to lack of studies (1, 2-6). The available rice data indicate that several independent geographical origins of rice domestication from their wild ancestors appear to have occurred in East and/or Southern Asia (7-13). Currently, the Yangtze valley in China has yielded the earliest evidence for the intensive use of wild rice during the Late Glacial (20 ka), with a transition to domestication early in the Holocene, around 9 ka (11), and evidence from the Ganges plains in North India in dictates the use of wild rice from the post glacial time (15 ka), with a transition to domestication around 8 ka (12). In this paper, we report well-preserved rice phytolith evidence from the late Pleistocene archaeological context at the Fahien rock shelter in Sri Lanka which is indicative of the intensive use of wild rice species.

II. Fahien rock Shelter

Fahien rock shelter, one of the largest rock sheltersin Sri Lanka, is situated at E80° 12' 55" N6° 38' 55" at 130 m asl in Yatagampitiya village, near Bulathsinhala in the Kalutara District, southwest Sri Lanka (Fig. 1). The rock shelter has great potential for understanding the late Pleistocene humans and environment. It is a complex of interconnected rock shelters developed in coarse crystalline gneiss rock faces (14). The mouth has a width of 30 m and average height of 20 m above the floor. The interior is about 10 m in depth and slopes down from west to east. The present day climate is warm-humid monsoonal, with an average rainfall around 3000-4000 mm/yr and a mean annual temperature at sea level about 26-27°C(15). The landscape around the rock shelter is characterized by disturbed lowland rainforest with paddy fields present in the slightly incised valley below the rock shelter(16.20).

III. Material and Methods

a) Site Stratigraphy

In 1968, W. J. Wijeyapala, the former Director General in the Department of Archaeological Survey of Sri Lanka (DAS) first examined Fahien and excavated over several seasons between 1986 and 2012 under the direction of the DAS. The depiction of litho logical succession with archaeological contexts at Fahien was made according to the standard tool, Harris Matrix. Excavation (4 x 5 m) located in the east of the main chamber of the Fahien rock shelter has indicated the potential for understanding of the archaeological stratigraphies (16-20). The excavation penetrated ca. 2.40 m of heterogeneous clast-rich loam sediments showing 5 major layers, 10 archaeological phases and approximately 250 archaeological contexts (Table 1). The bio-stratigraphy comprises of human bones, animal remains, burnt and unburnt shells, shell beads, charcoal, plant remains and coprolites. Human remains include several internments; some coated with red ochre and are associated with the first microlith and osseous technologies anywhere in South Asia. The stratigraphy also contains palaeo-floors, postholes, excavated pits and preserved hearths.

Renewed excavation at the rock shelter yielded a secure chrono-stratigraphy for the earliest modern human habitation deposits (18-21). This work led to the site being recognized as having, to date, the oldest archaeological sequence in Sri Lanka. Well preserved, in situ charcoal, charred wood, shells and sediment samples were taken from the sections for ^{14}C and OSL dating. Twenty six (26) radiocarbon dates were

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produced using Accelerator Mass Spectrometry at the CHRONO centre, Queens University, Belfast and the Beta Analytic Laboratory in USA. They were calibrated using Calib 6.11 (22). Two sediment samples from the context 92 were processed using OSL and indicate that the base of the sequence is between 39.9 ± 2.5 ka (SUTL2327) and 22.0 ± 1.3 ka (SUTL2326) in age. Twenty six AMS dates obtained from charred seeds, charred wood, charcoal, *Canarium* cf. *zylanicum* nut and freshwater shells indicate that the period of sequence formation was between 47.80 ka and 3.85 ka. The most significant late Pleistocene archaeological evidence, which includes the oldest microlith toolkits known to South Asia associated with the contexts from 87 to 92 are dated to between 47.80 ka and 28.5 ka (**Fig. 2**).

b) Sediment processing for phytolith extraction

Twelve 30x10x8 cm monoliths were taken from the southern profile of the excavated area (**Fig. 2**). These covered five major layers (L1-L5) including the described archaeological phases (I-X) (**Table 1**, 18-19). From these monoliths, seventeen subsamples were selected. Eleven subsamples (C-44 to C-86) of early to late Holocene age were taken from L2 and L3. Six of the subsamples (C-81 to C-92) were taken from L3/L4, L5 covering the late Pleistocene age (Fig. 2).The current work considers the late Pleistocene sample only. Phytolith extraction was made according the standard procedure (23).

c) Phytolith taxonomy and taphonomy

Classifications and taxonomic identification of phytoliths from archaeological samples were made using a modern and archaeological phytolith collections housed at the Laboratory for Palaeoecology, Postgraduate Institute of Archaeology, University of Kelaniya, Sri Lanka and at the French Institute of Pondicherry(IFP), India. In order to precisely identify rice taxa from the archaeological samples, comparative knowledge from multiple reference samples of phytoliths from a wide range of the parts (e.g. seeds/husks and leaves) of rice plants growing in different ecological and environmental contexts, both in Sri Lanka and Southern India was used. In this procedure, the most common morphological characteristics, general occurrence and appearance of key archaeological phytoliths were comparatively studied (1, 8-9, 13, 24-27).

IV. Results

a) Phytoliths from the Late Pleistocene samples (47.80-12.15 ka)

In this paper, we mainly highlight the rice phytolith records from late Pleistocene samples, while the detailed phytolith records from the sequence studied will be published elsewhere. The summary of the phytolith assemblages are shown in **Fig.3**.All samples contained high counts of well-preserved phytoliths.A few samples yielded pitted, displayed a few relatively large micro-channels, mineralized micro-structures and broken phytoliths. More than 54 phytolith morphotypes (monocot and dicots) were identified. In this composition, wild rice (Oryza spp)and banana phytoliths are extremely abundant in the samples. Phytoliths from rice leaves (e.g. bulliforms and elongates) and seeds/husks/glumes (e.g. double and single peaked morphotypes) are closely comparable with modern material from the leaves and seeds/husks/glumes of modern wild rice, Oryza rufipogon and Oryza nivara from Sri Lanka and South India. In addition, phytoliths from several other economic plants, e.g. Palmae, *Artocarpus* cf. *nobilis* (wild breadfruit), *Durio*sp and Poaceae (wild grasses) are foundin all samples. Burseraceae (*Canarium* sp. nut) and Cyperaceae phytolithsare found in several samples. Freshwater diatomsare common in many samples. Few brackish/marine diatomsare limited to few samples.

V. Discussion

a) Reliability of the late Pleistocene samples and phytoliths evidence

Fahienrockshelter sediments are heterogeneous and the archaeological analysis of the ca. 250 contexts indicates complex sedimentary processes (18-20, 28). All dates of the late Pleistocene samples are in good strait graphic order. The chronology indicates that a significant depositional hiatuses occur within the excavated sequence between the late Pleistocene and early Holocene. Multiple hiatuses extended only from 29.9ka (C-87) to 12.5 ka, marked by the reduction of phytolith sum(**Fig. 2**).These hiatuses can be explained by alternating periods of desiccation and erosion of the rock shelter sediments. The condition of the desiccation corresponds to the number of severe millennial to multi century-scale dry climatic cycles (e.g. arid/semi-arid) due to monsoon failures identified from the peat and sedimentary archives in Southern Asia between 24 ka and 8.1 ka (29-35). The records suggest that the impact of climate, environmental conditions including humans was the dominant factor for forming the litho-stratigraphy through the late Pleistocene.

Understanding phytolith taphonomy (a-e, described below) is essential for interpreting therock shelter phytoliths. The presence of phytoliths in the rock shelter sediments provides information about the depositional processes in several ways (a) *in situ* plant decay leading to phytoliths deposition on surfaces (b) alluvial or colluvial re-deposition of phytoliths along with their associated sediments (c) wind deposition (d) cultural deposition of phytoliths through plant materials used by the occupants of the rockshelter for food and other cultural purposes and (e) fossilization. The lack of living plants taxa such as rice, banana and Palmaein the

rock shelter suggests a minimal input of *in situ* deposition of phytoliths. Abundant phytoliths from these taxa in the samples suggest that alluvial and/or colluvial processes (effect of horizontal and vertical movements) may have played a limited role in the phytolith re-deposition. Due to the presence of drip line, the impact of rain water penetration into the rock shelter is minimal. Wind deposition is rare due to the particular geomorphology of the rock shelter in the humid tropical environment. This is clearly confirmed by the highly variable phytolith counts/sum in all the samples (Fig. 3). Except for very uppermost parts of the sequence (e.g. Holocene samples), a lack of the post-depositional disruptions through roof falling, vertical cracks and animal burrows indicate limited vertical movement of phytoliths in the late Pleistocene samples (18-19). Indeed, the lack of evidence of root penetration from plants and the lack of organic litter deposits within the clay- and silt-rich, highly-compacted and multi-layered sediments do not interfere with phytoliths buried at much deeper stratigraphic levels through multiple re-working events and bioturbation. More homogeneous distribution of the smallest phytoliths (3-10 μm) from wild banana seeds and from Bombacaceae and fine-grained sediments in all the samples suggest the minimal impact of illuviation of clay minerals as common process in the rock shelter stratigraphy (28, 36-37). All these minimized sources of biases indicate that spatial and temporal fidelity ishigh in the late Pleistocene samples (38).

The main process, therefore, of phytolith deposition in the rock shelter is most likely to have been through human or animal vectors. However, animals such as bats, birds, and insects in the vicinity of the rock shelter environment are very unlikely to play a role in the phytolith deposition reported. This agrees with highly variable phytolith counts through the sequence studied (39). It is inferred that humans are the most likely agents for phytolith deposition in the rock shelter, - the materials from economic/anthropic plants such as rice and banana and breadfruit brought into the rock shelter are from the plants commonly grown in disturbed lowland rainforest near to the rock shelter (most possibly within a few kilometers at most). Abundant phytoliths from monocotyledonous taxa (e.g. Poaceae/grasses and Cyperaceae/sedges) identified as anthropic taxa in this context, probably associated the rice plants brought by humans. The significant occurrence of freshwater and brackish-marine diatom species throughout is not surprising in habitation deposits and is consistent with a number of human activities. In the majority of samples, abundantwith rice seeds/husks and leaf phytoliths together with the lack of taphonomic markers (e.g. breakage, corrosion, microchannels, regulation, dissolution pits, mineralized microstructures, cut marks and pitted patterns) indicate excellent preservation conditions and selective distribution of phytoliths from rice used by rockshelter occupants. This suggests high phytolith compositional fidelity in the samples.

The well-preserved phytoliths suggest that they were directly subjected to the processes of diagenesis, i.e., physical and chemical impact on phytoliths due to the long-time environmental burial (or buried for a long time) and permanent incorporation into the rock shelter sediments (37, 40, 41-54). Alkaline conditions are also thought to contribute to phytolith dissolution processes (47, 53, 55-56) due to the increase in solubility of silica at pH > 7.8. This impact on the iron (Fe) rich fine-grained Fahienrock shelter sediments is limited as indicated by pH measurements (6.5-7.3) in all the sediment samples studied (57). Facetate and sclereidsphytoliths from woody dicotyledonous (e.g. forest taxa) are rare in the Late Pleistocene, possibly due to dissolution (44), and/or less incorporation of phytoliths from woody materials. We report that facetate and sclereidsare were unlikely to be preserved in much older samples (1).

b) Late Pleistocene wild rice exploitation

Late Pleistocene deposits yielded archaeological records *(Table 1)* and high amounts of phytoliths from economic plants. Phytolith records from the wild rice species, together with number of other economic plants (e.g. wild banana and breadfruit) suggests that rock shelter occupants have usedwild rice plants, most probably for food and also for various other purposes, e.g. fuel, rituals medicines and artifacts.The methodological constrains used for rice identification confirm that phytoliths were from *Oryza nivara* and/or *O. rufipogon,* but the criteria used herewith, cannot fully separate the *rufipogon*, perennial from *nivara* annual ecotype.

c) Ecology of wild rice

Understanding the evidence related to ecology of wild rice provides an opportunity to explore the relationship between human activity and the presence of wild rice in the late Pleistocene. The ecology of the wild rice species clearly indicates differing modes of human exploitation of wild rice for food from the prehistoric period in South Asia (58-61). The latter works suggest that *O. nivara,* which commonly grows in drylands and has a large-scale seed production could have been easily used by prehistoric hunter-gatherers without any serious cultivation whereas *O. rufipogon*, which is prominently grown in aquatic habitats has a much lower seed production during the very early stage of plant domestication, i.e. late Pleistocene (59-60, 62-64). *O. nivara* rice tends to grow in relatively small isolated patches and not in stands of genetically uniform populations.

Prior to the Toba volcanic event ca. 74 ka years ago, humans at Jwalapuram, Locality 22, Southern Asia lived in a mixed woodland and grassland mosaic. This was followed by cooler and possibly drier conditions

after the eruption (65). The elevated $\delta^{13}C$ and $\delta^{18}O$ from Batadomba-lenarock shelter (**Fig. 1**) faunal remains (66) and Himalayan ice cores(67) indicate that lowland rainforest of Southern Asia were more open with decreased canopy cover during the period 36-29 ka. This has been linked to decreased rainfall and temperature (68). Prior to the Last Glacial maximum (LGM), humid environments appear to have prevailed in the Indian subcontinent (69-71). Paleoclimatic records suggest that atmospheric cooling by 3-4 °C occurred in the Tropics (72), with a remarkable drop in precipitation during the LGM much greater than during any of the earlier (middle Pleistocene) glaciations (66). Palaeoclimate data from Sri Lanka suggest a drier LGM punctuated by climatic ameliorations in short bursts (73-74).It is obvious that climatic fluctuations that includes prevailing prominent dry conditions in the Late Quaternary may have resulted in a number of climatically adapted wild rice populations (61,75-76). Rock shelter occupants could have easily modified *O. nivara* populations leading to more reliable wild grains for human use, especially when they were already widely growing in ideal habitats associated with prolonged dry conditions long before the domesticated forms arose (1, 60, 77-79). During early rice exploitation, it is worth noting that high micro charcoal, phytolith and poll encore records indicate regular anthropogenic burning from the Terminal (14.5-13 ka) and end of the Pleistocene through early-middle Holocene in the archaeological sites from Ganges plains in north India (80-81). Several sites in the Yangzte valley in China, dating from 17 ka through the Terminal Pleistocene yielded *O. nivara* phytolithsin association with humans (11, 82-85). Similarly, multi-proxy investigations (e.g. pollen, phytolith, charcoal, mineral magnetics, stable carbon and diatom) in the Horton Plains, Sri Lanka, suggest anthropogenic burning and disturbance in association with south west monsoon fluctuations from 17.5 ka through the late glacial time (31,35,75). In this ecological regime, phytoliths from *Oryza*sppwere reported in association with dry climate between 15.9-13.8 ka. All those records indicate that wild rice was present in human economies through the late Pleistocene to the Holocene in South and East Asia. This indicates that the rice species exploited by Fahien rock shelter occupants (i.e. late Pleistocene hunter-gatherers) was more likely *O. nivara* than *O. rufipogon*, adopting to the ecological/habitant, e.g. dry and mixed woodland and grassland conditions prevailed in the late Pleistocene (Fig. 4). The antiquity of human use of wild rice species, *O. nivara* at Fahien is remarkably as early as 48 ka, compared to the tradition of rice foraging in known Asian sites (77,86).

VI. Conclusion

Little is known of the use of wild rice in prehistoric Sri Lanka. Investigations from the archaeological sequence at Fahien rock shelter in south western Sri Lanka, dated to 47.80-3.87 ka provide phytolith evidence suggesting the use of wild rice, most possibly *Oryza* cf.*nivara*, with several other wild plant resources, e.g. banana, breadfruitand a number of species from Palmae. The rock shelter provides the oldest evidence for the wild rice associated late Pleistocene human rainforest occupation among the archaeological sites in Southeast Asia, Melanesia and South Asia.

Acknowledgments

British Academy provided a Visiting Fellowship for RPat the School of Geography, Palaeoecology and Archaeology, Queens University Belfast (QUB). Financial support received from National Research Council (NRC, grant-14-43) is appreciated. We thank Professors Keith Bennett, Paula Reimer, Jonathan Pilcher and Dr. Maarten Blaauw for supporting the project; Mrs. Elizabeth Woodgyer and Mr. Martin Xanthos of the Herbarium, Royal Botanic Garden, Kew, for providing herbarium specimens. Directions and field facilities received from Dr Dr. Senerat Dissanayake, Director General, Department of Archaeological Survey and Dr. S. U. Deraniyagala, Former Director General, Department of Archaeological Survey, Sri Lanka are greatly appreciated. Constructive comments received from Mrs. Sewwandhi Gunasekara, University of Colombo School of Computing and Mrs. Nuvanprabha Kapugeekiyana Whittall appreciated. RP thanks Mr. L. V. De Mal, excavation officer, the Department of Archaeological Survey, Mr. Asoka Perera and Mr. Sampath Perera at the Postgraduate Institute of Archaeology, University of Kelaniya for field support; the Director, Professor Jagath Weerasinghe, and the Board of Management at the PGIAR, University of Kelaniya for leave to complete this project and Mr. Jim Bradley for personal support.

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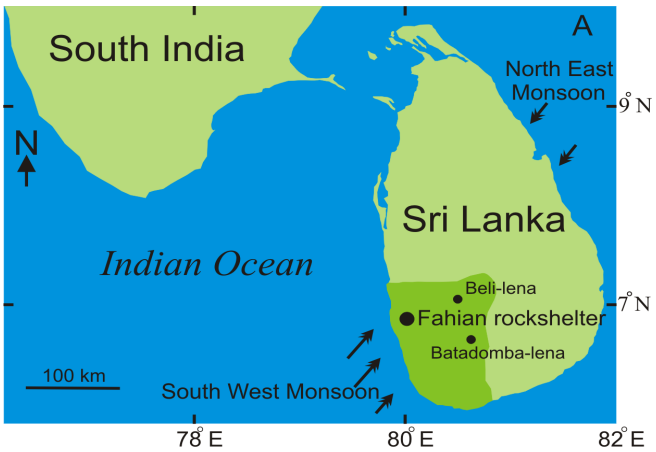


Fig. 1: Location of the Fahien rock shelter in the southwestern Sri Lanka. Beli-lena and Batadomba-lena are excavated prehistoric rock shelters.

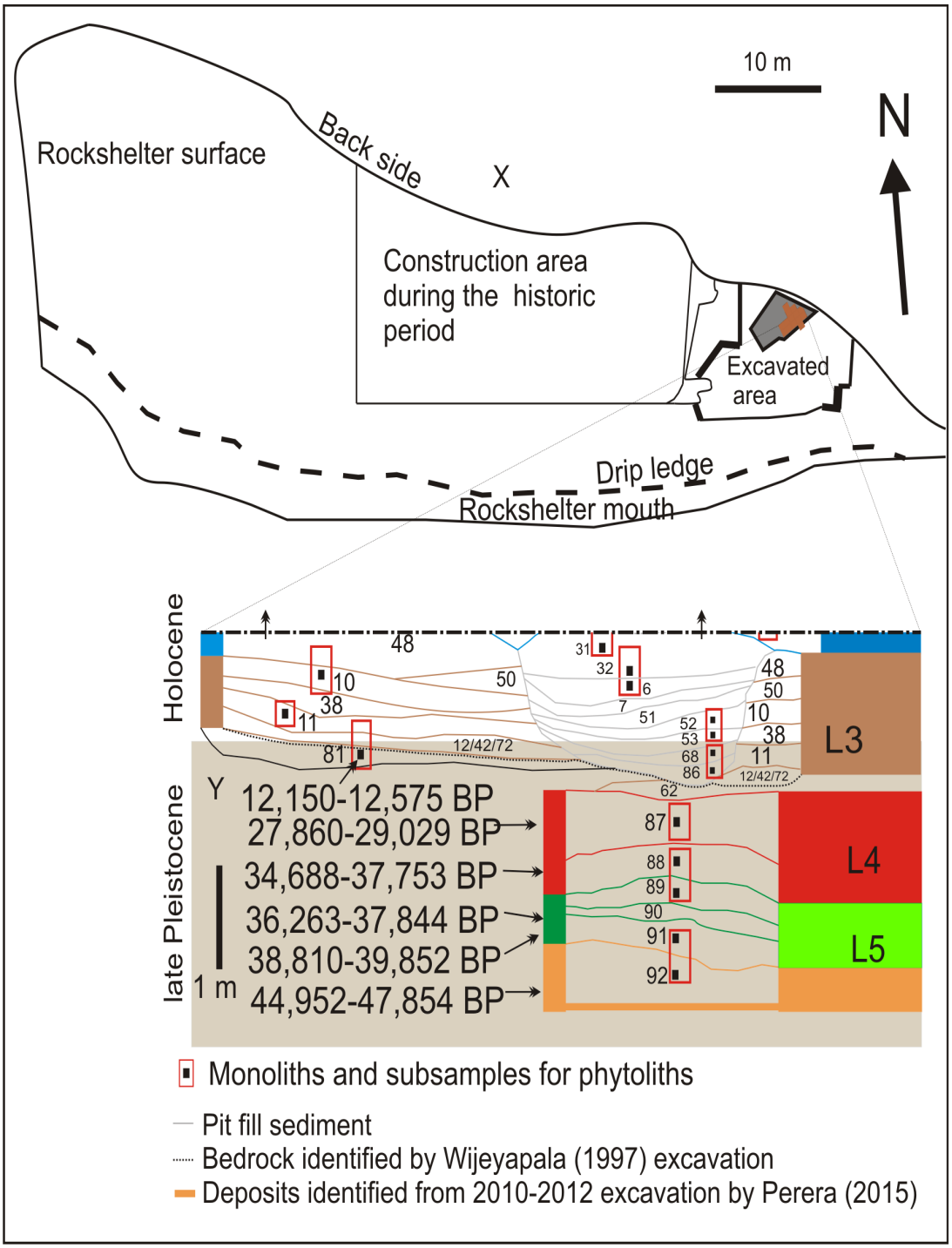
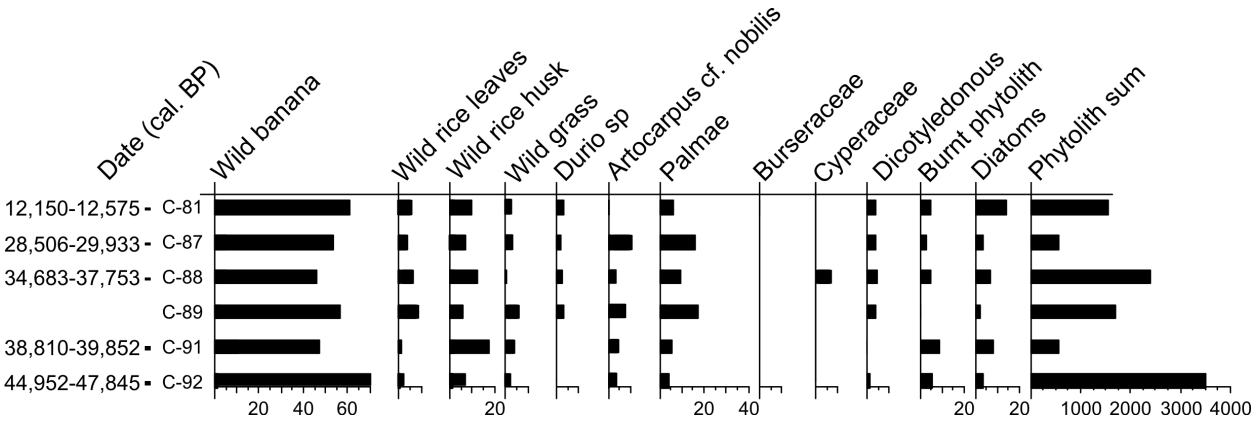


Fig. 2: Late Pleistocene stratigraphy of the rock shelter (Y). Excavated area is marked (X)



Note that C-81 sample contained a few phytolith finds of Bursercaeae.

Fig. 3: Phytolith records (%) of the selected taxa from the late Pleistocene samples at the Fahienrockshelter

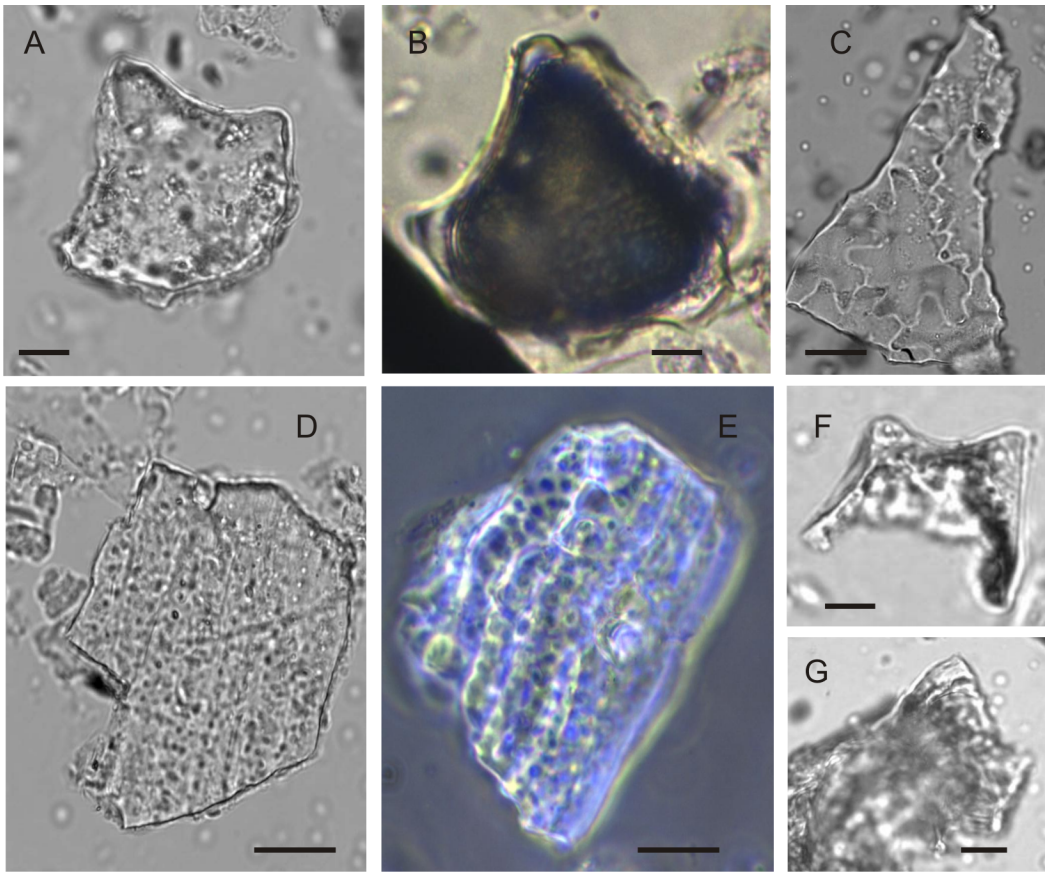


Fig. 4. Wild rice phytolith morphotypes. A: Bulliforms from rice leaf. B: Black color coat on bulliform indicates that it was released from burnt rice leaf. C-E: Glume cells with small projections arising deeply serrated cells from rice husk. F-G: Double and single peak phytoliths from rice husk (reference: 1, 27), scale bar = 10 micron.

Table 1: Summary of archaeology and stratigraphy described from the Fahienrockshelter. Bold font indicates the contexts sampled for phytolith analysis

Layers (Wijeyapala (1997)	Thickness (m)	Contexts	Archaeogical phases	Litho-stratigraphy	Colour	Bio-stratigraphy	Cultural density
Bedrock	NA	95	I	NA	NA	NA	NA
NA	0.40	**92**	II	Consolidated clast-rich loam	Yellowish brown	Ashy habitation deposits, human bone, tool fragment	Relatively low
L5	0.15	90, **91**, 89	III	Moderately unconsolidated clast-rich loam	Pinkish grey to greyish brown	Ashy habitation deposits, charcoal, fragment of small mammals and human bones, burnt shells, hearths, microliths	Relatively high
L4 NA	1.00	**89**, **88**, **87** 70	IV V	Moderately unconsolidated clast-rich loam	Dark grey to brown	Ashy habitation deposits, charcoal, burnt shells, unburnt shell, human bones, *Canarium* nuts, microliths, red ochre, grindstones, postholes	High
L3 L3 NA/Pit fill Re-worked	0.25	12/42/72 **10**, **11**, 38, 48, 50, 62, **81** **6**, 7, 51, **52**,**53**, **68**, **86** **5**, 26, **31**–**32**	VI VI VII VIII	Moderately unconsolidated loam	Brown	Charcoal rich habitation deposits, ashy, *Canarium* nuts, carnivore coprolites, bones, shells, unburnt shells, carnivores coprolites, wood, microliths. Fragmentary human skeleton found from the context 81, which has been directly dated to around 12,000 BP.	Relatively high
L2	1.10	3, 4, 33, **44**, 49	IX	Moderately unconsolidated loam	Yellowish light brown to grey	Ashy habitation deposits, Charcoal, ash and shell rich habitation deposits, shell ash, red ochre coated human skull, red ochre, bones, unburnt shells, burnt shells, *Canarium* nuts, *Artocarpus* epicarps, graphite, microliths	High
L1	1.25	1, 2/8/9, 17, 18, 19, 20, 40	X	Moderately unconsolidated loam	Brown to reddish brown	Disturbed deposits, prehistoric occupation debris mixed with historical artefacts, animal burrows, shells, bones, *Canarium* nut	Low

NA = not available. Reference: (16-20)

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Global Journal of human-social science: D
History, Archaeology & Anthropology
Volume 17 Issue 2 Version 1.0 Year 2017
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-460X & Print ISSN: 0975-587X

New Research on Archaeological Wood and Wooden Artifacts in Kiev

By Marina Sergeyeva
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Abstract- Wood is usually poorly preserved in the cultural layers of medieval Kiev. Exception is the wet cultural layers dated from the 10th century to the first half of the 11th century, where natural conditions are favorable for conservation of organic matter. In these layers the most of wooden artifacts were found [**Гупало**, **Толочко**, 1975; **Гупало** 1981, **с**. 319— 325; **Сагайдак**, 1991, **табл**. XVI—XXII; **Сергєєва**, 2015, **с**. 42—45]. In other cases when studying Ancient Rus layers in Kiev remnants of wood, wooden artifacts and especially small wooden objects are absent or at best are represented by single samples. So any new finding of archaeological wood in Kiev is noteworthy and important for replenishing the archaeological Ancient Rus wood database.

Keywords: *ancient rus, kiev, wood processing, fuel, wood identification, anthracology.*

GJHSS-D Classification: *FOR Code: 219999p*

New Research on Archaeological Wood and Wooden Artifacts in Kiev

Marina Sergeyeva

Abstract- Wood is usually poorly preserved in the cultural layers of medieval Kiev. Exception is the wet cultural layers dated from the 10th century to the first half of the 11th century, where natural conditions are favorable for conservation of organic matter. In these layers the most of wooden artifacts were found [**Гупало, Толочко**, 1975; **Гупало** 1981, **с.** 319—325; **Сагайдак**, 1991, **табл.** XVI—XXII; **Сергєєва**, 2015, **с.** 42—45]. In other cases when studying Ancient Rus layers in Kiev remnants of wood, wooden artifacts and especially small wooden objects are absent or at best are represented by single samples. So any new finding of archaeological wood in Kiev is noteworthy and important for replenishing the archaeological Ancient Rus wood database.

For a long time archaeological wood from Kiev remained out of attention of scholars. Systematic studies of Ancient Rus wood and especially charcoal began to appear only recently. Now the state of research of the fossil wood and charcoal in Ukraine can be characterized as an initial stage, that is, a stage of accumulation of material [**Сергеева**, 2016]. Now the importance of such researches in the context of studying relationship between paleoecology and bioeconomic human activity is indisputable. The main directions of such researches are the study of wood as the main material for building and manufacturing, and its role as fuel. One of the most important directions of the modern study of the fossil wood in this connection is the definition of wood species. Considering the fact that most of the archaeological wood is stored in a charred form we have to take into account that along with the usual dendrological studies an important place in its studying is occupied by the anthracology (science that deals with the study of fossil coal in general). In archeology the methods of this science are used to identify species of fossil charred wood. Charcoal associated with dated cultural layers of settlements, gives additional data on the nature of the woody vegetation of the microregion in each defined period. The samples obtained directly from archaeological sites allow to identify basic tree species, used in production and economy and show preference to one or another species in various sectors. The obtained data can be the basis for studying the raw material base of the wood processing in Ancient Rus, the fuel base and the other branches related to the use of the wood.

In this regard, it is necessary to pay attention to the wooden artifacts found in Kiev Podil, Kyrylivska str., 37 in 2016. The importance of materials in question is that they are represented not only by separate small fragments of wood and charcoal, as it takes place usually but also by the remnants of structures, by particular products and by the remnants of the woodworking industry (wood chips and fragments of wood with the traces of processing). This is very important because in Kiev (and in Ancient Rus sites in general) woodworking centers are fixed extremely uncommonly. Another important result of research in 2016 is finding of pre-Rus objects which contained charcoal in their fillings. They are remains of building and oven previously dated to 7th century. Anthracological studies on this period in Kiev and its outskirts have not yet been taken place and the investigated objects gave such opportunity for the first time. Below we present the main results of the study of archaeological wood from the excavations in Kiev in 2016.

Keywords: ancient rus, kiev, wood processing, fuel, wood identification, anthracology.

Резюме- **Сергеева М.С. Новые исследования археологического дерева и деревянных артефактов в Киеве (Киевский Подол, ул. Кирилловская, 37, 2016 г.).**

Статья вводит в научный оборот результаты исследования археологической древесины, выявленной в 2016 г. в результате раскопок на Киевском Подоле: материала деревянных конструкций и изделий и угля.

Все дерево из раскопа, исходя из датировки, разделяется на три группы: материалы 18 — начала 19 вв., 11—12 вв. и 7 в. Материалы получены методом ручного отбора (образцы дерева конструкций, изделия, частично уголь) и флотации и промывки грунта (большая часть угля).

С точки зрения определения пород дерева среди материалов 18—19 вв. изучались остатки конструкций и мелкие деревянные изделия: орудия ткачества и дно бочки. Дерево древнерусского периода представлено единичными конструкциями (забор) и остатками деревообрабатывающего комплекса (щепа, колья, фрагмент изделия). Изучался также уголь всех трех периодов.

Дерево конструкций 18 — начала 19 вв. и 11 вв. представлено сосной (*Pinus* sp.), в отдельных случаях дубом (*Quercus* sp.). Остатки топлива (уголь) представлены тремя видами: дубом и сосной для всех трех периодов и березой (*Betula sp.)* для 18—19 вв. Отсутствие березы в ранних слоях пока не находит объяснения. Единичными угольками представлены также ясень (*Fraxinus* sp.), тополь / осина (*Populus* sp.), липа (*Tilia* sp.), дерево сімейства розовых (Rosaceae), ива (*Salix* sp.). Ввиду малочисленности интерпретации не поддаются.

Вся древесина принадлежит местным породам. В целом отбор сырья является традиционным для региона.

Ключевые слова: Древняя Русь, Киев, обработка дерева, топливо, определение древесины, антракология.

I. Materials and Methods

All the wood from this dig can be divided into three groups by date. This is the wood dated by the time periods from the 18th to the early 19th century, from the 11th to the 12th century and to

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the 7th century. The Ancient Rus period and the latest one are represented by the remnants of structures, by fragmented wooden products, by wood chips and wooden pieces of uncertain destination and by charcoal. Materials of the 7th century are represented only by small pieces of charcoal.

The materials for studying were obtained by manual selection from the soil or from filling of the objects (samples of the wood of details of structures, small wooden objects and partly charcoal) as well as the method of flotation and ground washing (the most of charcoal). The identification of tree species required the use of natural sciences methods. The basis of wood identification is studying features of microstructure, which are characteristic for wood of each kind of tree. The method assumes their diagnosis in three sections. Obtained results were compared with the data of wood determinants. The determinants on wood of different Eastern European tree species were published repeatedly [Сукачев, 1940; Гаммерман и др., 1946; Вихров, 1959]. When the structure of the wood is preserved satisfactorily tree species can be identified to the genus.

The results of wood and charcoal identification are represented in the tables (Tab. 1—4).

II. The Main Results of the Study

Among the materials of the 18th century small wooden objects were found in one of the buildings. They are fragmented bottom of barrel with the diameter of 48 cm (fig. 1: *1*) and knife-like object 28 cm long (fig. 1: *3*). This object may be interpreted as a tool for weft tampering in weaving. Analogies of such tools are known from Slavic ethnography [Лебедева, 1956, рис. 24]. Another wooden object was discovered in the cultural layer dated from 18th century (fig. 1: *2*). This is bifurcated tool 12.8 cm long. The most possible interpretation is its definition as a tool for weaving (ropes, belts, etc). Analogies are different bifurcated tools used for weaving ropes or belts are widely known in the ethnography of many peoples of Eurasia. All mentioned artifacts were made of pine.

Among the structures with the preserved wooden details, the object 1 dated to 18th century is of special interest. It could be interpreted as a lower part (probably cellar) of above-ground building. This preserved lower part had a wooden covering of the ground walls, which was made from vertically stacked timber fortified on the bottom by a frame structure on two crowns built of square timbers. The building had a plank floor. All the wooden details were of pine with the exception of the lower timbers built of oak. Wood chips taken from filling of the top of the building (preserved only in stratigraphic level on the wall of the dig) are also of pine. They may indicate material for the construction of the upper, terrestrial part of the building. Such a choice of raw materials for construction is consistent with the tradition well-known in Slavic ethnography, when the main material for the walls of the building was pine wood, but the lower part was constructed of oak wood. In Eastern Europe, this practice has been extended at least at the 1st half of the 20th century [Плотников, 1924, с. 6; Юрченко, 1941, с. 37]. It should be noted that this tradition developed gradually. In residential buildings in ancient Kyiv such combination of too kinds of wood was demonstrated only by isolated examples [Сагайдак, 2010, с. 539]. In Ancient Kiev and its outskirts residential buildings were constructed mainly of pine wood only.

The rest of the wooden structures of 18th century found within the dig were also constructed of pine. Oak constructions were not numerous. One of the planks of the 18th century fence was of an oak tree (the rest were of pine). The use of single oak plank may indicate a possible repair of this fence. Several poles of some structure found in the northern part of the dig were also made of pine wood, and only one was of oak wood. Judging by the fact that the oak pole unlike the rest ones was preserved only as wood chips in the pole hole, it was the earliest of all. The rest poles were preserved to a height of about 0.50 m from the daylight surface of that time.

Among the Ancient Rus materials, the woodworking complex related to the cultural layer of 11th century is of the greatest interest. It consisted of waste from wood processing. These are wood chips (the overwhelming majority is of pine), and a pine bark. Among the pieces of wood there were wood chips from the primary processing of logs and those that were waste from making some wooden products (small pieces of wood in the form of small planks and bars). This may indicate a presence of woodworking workshop situated somewhere nearby. The experience of handicraftsmen-woodworkers at the end of the 19th and early 20th centuries shows manufacturing of many kinds of products (details of wagons and sledges, wooden shovels, some kinds of barrels, etc) in the area of logging [Плотников, 1924, с. 73—81]. In this regard, it is worth mentioning the layer with the wood chips discovered on the north-western outskirts of the Kiev Podil. This layer refers to the period preceded the colonization of this territory (i.e. before the end of 11th century or the beginning of 12th century) [Сагайдак, 1991, с. 39—40, 69—70]. At this time, timber could be stored here for drying and initial processing. It can be noted a large number of pine bark in this layer (my observation during the excavations in 1993). The complex discovered in 2016 was located near this area.
In the complex in question, besides wood chips and bark, the part of tool was found (fig. 1: *4*). It had oblong form with a recess cut on one side. In the same complex a part of stave of some cooperage product (fig. 1: *7*)

and two pegs from some structures (fig. 1: *5, 6*) were also found. These materials, except the part of unidentified tool, were studied for wood identification. The stave and one of the pegs were of pine wood and another peg was of oak wood (fig. 1: *5*).

A wood of three poles from the fence dated to 11th century was also studied. It was identified as pine.

Among the analyzed charcoal samples a charcoal from the heating devices deserves special attention.

Studying charcoal as the main kind of fuel, in my opinion, is promising. This applies both to domestic and technical fuel. The source for studying this aspect of human economic and productive activities is coal from ovens (including those of technical purpose), furnaces and fireplaces. Such charcoal is a source of information about composition of local woody vegetation and the principles of its possible selection taking into account calorific values of different wood species creating the desired temperature heating mode. This direction of research in spite of the Western European researchers' attention to it [Marston, 2009; Veal,. Thompson, 2008; Veal, 2012а; 2012б; 2013], in Ancient Rus archeology until recently remained uncharted area. Its development began only in recent years after the first results from the Hlinske archaeological complex in Poltava oblast (charcoal from furnace and fireplace) [Пуголовок та ін., 2016, с. 115]. Subsequently, materials from some other Slavic-Rus sites (Vypovziv and Svedlovka, both in Chernihiv oblast) were obtained and identified by the author. Studying the fuel from the dig in Kyrylivska str., 37 is one more step in this direction.

Residues of fuel from the oven of the 18th century was represented by pine, oar and birch. This correspond to the general tendency of its selection that is seen in the ethnographic present. Birch, old resinous pine and oak belonged to the group of the most valuable fuel [Плотников, 1924, с. 14]. The birch charcoal mixed with the remains of bones, eggshells, fish scales, etc. was also found in the filling of another object. As judged by nature of filling this object could serve as a pit for garbage. The birch charcoal in this context also may be interpreted as remains of fuel. In this object the charcoal of pine and of other species of trees were also found (Tab. 3, object 8).

Charcoal from Ancient Rus and Slavic objects, which can be associated with fuel (oven 2, fireplace, Slavic oven 7) is represented only by oak and pine. It is worth noting that Old Rus and Early Slavic materials do not yet allow us to speak of any significant advantage of birch as fuel in these periods. The author's investigations reveal only isolated samples of charcoal from fuel on separate Slavic and Rus sites They are Vypovziv hillfort of 10th century and Sverdlovka settlement (Romny culture, 8—10 centuries). It should be noted that birch in general is very rare among of fossil coals of Ancient Rus period. This may be explained either by its relatively low specific gravity in the forests of the studied micro-regions in medieval period or by relatively small amount of materials studied for today. The presence of birch bark in the Ancient Rus cultural layers of Kiev is in favor of the second assumption. It is also possible that birch was used more for technical purposes (for obtaining tar) therefore its wood is not preserved. In general the reasons for such situation can be detected only with further research.

As a result of anthracological research single samples of charcoal of such wood as ash-tree (*Fraxinus* sp., apparently *Fraxinus excelsior*), poplar or aspen (*Populus* sp.), willow (*Salix* sp.), linden (*Tilia* sp.) and a tree of rose family, apparently pear-tree or apple-tree (Rosaceae) were also identified. These are very small solitary pieces of charcoal that cannot be interpreted.

Thus the studied wood is mainly represented by such species as pine (*Pinus* sp,), probably common pine (*Pinus sylvestris*), oak (*Quercus* sp.) and birch (*Betula* sp.). Pine and oak were represented both by unburned wood and by charcoal, and birch was found only as charcoal. The distribution of wood of these tree species is not the same for different periods.

In all chronological sections pine prevails. The most of wooden artifacts (structures and small objects) were made of pine. In particular details of cooperage products from the complexes of 11th century and 18th century, as well as both weaving tools found in the 18th century layer were made of pine wood. Pine charcoal is represented as the remains of both working wood and fuel. This fact can be considered as a marker for the presence of pine forests in the immediate proximity to the site, may be higher on the hill.

Kiev is located on the border of the Eastern Polissia (forest zone) with forest-steppe zone. The Eastern Polissia covers the right bank area of the Dnieper river, the area between the Dnieper and the Desna rivers and partly the area of the left bank of the Desna river to the watershed with the Supoy and Sula rivers that are the tributaries of the Dnieper Pine and oak are the main forest-forming species here [Пятницкий, Изюмский, 1966, с. 148].

Some researchers explain the proliferation of pine forests in the Ancient Rus period by anthropogenous factor that was a specificity of development of territories by the Ancient Rus population. Sandy and loamy podzolic soils preferred by pine were less suitable for farming therefore such soils were mastered last. Oak forests gradually reduced for plowing which narrowed the area of oak distribution [Лосицкий, 1981, с. 21; Сагайдак, 1991, с. 68]. It also should be taken into account that the productivity of pine is much higher than that of oak [Чеведаев, 1963, с. 201], therefore the pine forests cut down could be restored rather quickly. Thus, coniferous forests could be a significant reserve of raw materials in the area of their distribution.

Oak also has a significant role in the economy of the local population in the studied area. Among the analyzed charcoal samples from Kyrylivska str., 37 oak occupies a second place. Its wood was used as a fuel and a working wood throughout the entire time of the economic activity of the Kievan population here. Therefore, the advantage of the mentioned kinds of wood in the investigated complexes is expected. Birch, the third wood by the number of charcoal pieces, was discovered only in the complexes dated from 18th to 19th centuries. In its period it was used as a fuel. Among the charcoal samples from the cultural layers with the date of the 7th century and of the 11th and 12th centuries birch is absent. Except separate cases a material of products and structures of the 11th century is represented by pine wood. Only one of the pegs was of oak wood.

III. Conclusions and Prospects for Further Research

The results of studying of archaeological wood allowed to trace the particular use of its different species in a particular area for a long period.

In general, the composition of studied wood species does not contradict the data on the woody vegetation of the region. All wood belongs to local species. The selection of raw materials is traditional for the region. Investigations in Kyrylivska str., 37 in 2016 confirmed the composition of the wood species that were preferred in different branches of the economy. First of all, they are pine and oak (used both as material for woodworking and as fuel) with predominance of pine. The third place is occupied by birch. It is represented only by charcoal of the fuel. The role of birch as a fuel in the everyday life of people in the 18th and 19th centuries received one more confirmation.

The importance of the results obtained for the further development of the source base for the fossil tree is beyond doubt. Obtaining sufficient information due to further research of materials from different settlements will allow it to be used in the context of the study of paleoecology and economic activity during this period.

Wooden artifacts dating back to the 18th and early 19th centuries are important for replenishing the ethnographic material database. This applies to both individual products and structures. Materials of the 11th century allow expanding the informative base for the history of wood processing and using in Kiev.

Further dendrological and anthracological studies of the materials from the Slavic and Rus sites will make it possible to specify the obtained results and will allow reasonable interpretations on the use the wood of different tree species for different needs (using wood as the fuel or as the building and working raw material).

Table 1: Identification of wood species of the artifacts dated from 18th to 19th centuries

Complex	Wooden Artifacts	Number of Samples	Wood
Object 1 (building).	Vertical poles inside the building	2	Oak (*Quercus* sp.) — 2
	Upper bars of the SE and SW walls	2	Pine (*Pinus* sp.) — 2
	Lower bars of the framework	2	Oak (*Quercus* sp.) — 2
	Bar of the NW wall	1	Pine (*Pinus* sp.) — 1
	Pole in the W corner	1	Pine (*Pinus* sp.) — 1
	Vertical logs along the SW wall	5	Pine (*Pinus* sp.) — 5
	Vertical logs along the NW wall	7	Pine (*Pinus* sp.) — 7
	Planks of the upper tier of the floor	5	Pine (*Pinus* sp.) — 5
	Planks of the lower tier of the floor	8	Pine (*Pinus* sp.) — 8
	Chips from the filling of the ground level	35	Pine (*Pinus* sp.) — 35
Fence	Planks	22	Pine (*Pinus* sp.) — 21 Oak (*Quercus* sp.) — 1
Object 2, filling	Branch with th bark	1	Pine (*Pinus* sp.) — 1
	Stump of the log	1	Oak (*Quercus* sp.) — 1
	Wood chips	36	Pine (*Pinus* sp.) — 34 Oak (*Quercus* sp.) — 1 Birch (*Betula* sp.) — 1
	Small fragments of the planks	3	Pine (*Pinus* sp.) — 3
	Bottom of the barrel	1	Pine (*Pinus* sp.) — 1
	Weaver's tool	1	Pine (*Pinus* sp.) — 1
Object 5, remains of the structure	Piece of processed wood of quadrangular section	1	Pine (*Pinus* sp.) — 1
	Piece of wood	1	Oak (*Quercus* sp.) — 1
	Planks of the floor	3	Pine (*Pinus* sp.) — 3
	Lower planks of the wall covering	4	Pine (*Pinus* sp.) — 4
Object 7, remains of the structure	Pole in the S corner	1	Pine (*Pinus* sp.) — 1
	Pole in the N corner	1	Pine (*Pinus* sp.) — 1
	SW wall, upper plank	1	Pine (*Pinus* sp.) — 1
	SE wall, lower plank	1	Pine (*Pinus* sp.) — 1
	NW wall, a plank edgeways	1	Pine (*Pinus* sp.) — 1
	Planks edgeways in the building	2	Pine (*Pinus* sp.) — 2
	Upper plank edgeways	1	Pine (*Pinus* sp.) — 1
	Horizontal plank	1	Pine (*Pinus* sp.) — 1
Poles	Lower parts of the poles	2	Pine (*Pinus* sp.) — 2
Filling of the posthole	Wood (small chips)	37	Oak (*Quercus* sp.) — 34 Oak bark — 3
Cultural layer	Bifurcated tool	1	Pine (*Pinus* sp.) — 1
Object 3, filling	Horizontal block from the filling	1	Pine (*Pinus* sp.) — 1
Cultural layer	Fence planks (?)	2	Pine (*Pinus* sp.) — 2
Well in the NE wall of the dig	Horizontal logs	2	Pine (*Pinus* sp.) — 2
	Wood from the lower part of the framework structure	1	Oak (*Quercus* sp.) — 1

Table 2: Identification of wood species of Ancient Rus wooden artifacts

Complex	Wooden Artifacts	Number of Samples	Wood
Ditch 3, 11th century	Poles of the fence	3	Pine (*Pinus* sp.) — 3
Cultural layer 5, accumulation of wood, 11th century	Wood chips	186	Pine (*Pinus* sp.) — 183 Oak (*Quercus* sp.) — 1 Poplar or aspen (*Populus* sp.) — 2
	Branches	4	Pine (*Pinus* sp.) — 4
	Fragment of stave	1	Pine (*Pinus* sp.) — 1
	Peg	1	Oak (*Quercus* sp.) — 1
	Peg	1	Pine (*Pinus* sp.) — 1
	Rectangular bar	1	Pine (*Pinus* sp.) — 1
Cultural layer 5b, 11th century	Wood chips	6	Oak (*Quercus* sp.) — 6

Table 3: Results of anthracological research. Materials dated from 17th to 19th centuries

Complex	Number of Samples	Wood
Object 3, oven.	232	Pine (*Pinus* sp.) — 135 Oak (*Quercus* sp.) — 60 Birch (*Betula* sp.) — 37
Cultural layer, under the heap of bricks	12	Pine (*Pinus* sp.) — 12
Cultural layer, charred spot	1	Birch (*Betula* sp.) — 1
Object 8, filling	438	Pine (*Pinus* sp.) — 420 Birch (*Betula* sp.) — 12 Poplar or aspen (*Populus* sp.) — 2 Oak (*Quercus* sp.) — 2 Willow (*Salix* sp.)(?) — 1 Rose family (Rosaceae) — 1

Table 4: Results of anthracological research. Slavic and Rus materials

Complex	Number of Samples	Wood
Cultural layer 3, 12th century	18	Oak (*Quercus* sp.) — 10 Pine (*Pinus* sp.) — 7 Rose family (Rosaceae) — 1
Object 9, filling, 11th century	9	Pine (*Pinus* sp.) — 5
Object 11, filling, 11th century	13	Ash-tree (*Fraxinus* sp.) — 11 Pine (*Pinus* sp.) — 2
Spot of charred wood (cultural layer 4), 11th century	16	Pine (*Pinus* sp.) — 8 Oak (*Quercus* sp.) — 7 Linden (*Tilia* sp.) — 1
Ditch 10 (cultural layer 4), 11th century	81	Pine (*Pinus* sp.) — 81
Ditch 18(cultural layer 4), 11th century	1	Oak (*Quercus* sp.) — 1
Cultural layer 4, 11th century	71	Pine (*Pinus* sp.) — 4 Oak (*Quercus* sp.) — 67
Oven 2, 11th century	59	Oak (*Quercus* sp.) — 59
Fireplace, 11th century	24	Pine (*Pinus* sp.) — 21 Oak (*Quercus* sp.) — 2

		Deciduous tree — 1
Cultural layer 5, 11th century	103	Pine (*Pinus* sp.) — 103
Oven 6, 11th century	21	Oak (*Quercus* sp.) — 21
Oven 7 (7th century.)	89	Pine (*Pinus* sp.) — 15 Oak (*Quercus* sp.) — 74
Dwelling of 7th century, the floor	21	Oak (*Quercus* sp.) — 21

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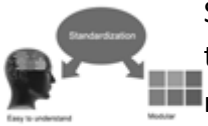

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Institutional Fellow of Open Association of Research Society (USA) - OARS (USA)

Global Journals Incorporation (USA) is accredited by Open Association of Research Society, U.S.A (OARS) and in turn, affiliates research institutions as "Institutional Fellow of Open Association of Research Society" (IFOARS).

The "FARSC" is a dignified title which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., FARSC or William Walldroff, M.S., FARSC.

The IFOARS institution is entitled to form a Board comprised of one Chairperson and three to five board members preferably from different streams. The Board will be recognized as "Institutional Board of Open Association of Research Society"-(IBOARS).

The Institute will be entitled to following benefits:

The IBOARS can initially review research papers of their institute and recommend them to publish with respective journal of Global Journals. It can also review the papers of other institutions after obtaining our consent. The second review will be done by peer reviewer of Global Journals Incorporation (USA) The Board is at liberty to appoint a peer reviewer with the approval of chairperson after consulting us.

The author fees of such paper may be waived off up to 40%.

The Global Journals Incorporation (USA) at its discretion can also refer double blind peer reviewed paper at their end to the board for the verification and to get recommendation for final stage of acceptance of publication.

The IBOARS can organize symposium/seminar/conference in their country on behalf of Global Journals Incorporation (USA)-OARS (USA). The terms and conditions can be discussed separately.

The Board can also play vital role by exploring and giving valuable suggestions regarding the Standards of "Open Association of Research Society, U.S.A (OARS)" so that proper amendment can take place for the benefit of entire research community. We shall provide details of particular standard only on receipt of request from the Board.

The board members can also join us as Individual Fellow with 40% discount on total fees applicable to Individual Fellow. They will be entitled to avail all the benefits as declared. Please visit Individual Fellow-sub menu of GlobalJournals.org to have more relevant details.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

After nomination of your institution as "Institutional Fellow" and constantly functioning successfully for one year, we can consider giving recognition to your institute to function as Regional/Zonal office on our behalf.
The board can also take up the additional allied activities for betterment after our consultation.

The following entitlements are applicable to individual Fellows:

Open Association of Research Society, U.S.A (OARS) By-laws states that an individual Fellow may use the designations as applicable, or the corresponding initials. The Credentials of individual Fellow and Associate designations signify that the individual has gained knowledge of the fundamental concepts. One is magnanimous and proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice.

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We shall provide print version of 12 issues of any three journals [as per your requirement] out of our 38 journals worth $ 2376 USD.

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- The professional accredited with Fellow honor, is entitled to various benefits viz. name, fame, honor, regular flow of income, secured bright future, social status etc.

- In addition to above, if one is single author, then entitled to 40% discount on publishing research paper and can get 10%discount if one is co-author or main author among group of authors.
- The Fellow can organize symposium/seminar/conference on behalf of Global Journals Incorporation (USA) and he/she can also attend the same organized by other institutes on behalf of Global Journals.
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- Fellow can also join as paid peer reviewer and earn 15% remuneration of author charges and can also get an opportunity to join as member of the Editorial Board of Global Journals Incorporation (USA)
- • This individual has learned the basic methods of applying those concepts and techniques to common challenging situations. This individual has further demonstrated an in–depth understanding of the application of suitable techniques to a particular area of research practice.

Note :

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- In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.
- In case, the chairperson needs to be replaced then consent of 2/3rd board members are required and they are also required to jointly pass the resolution copy of which should be sent to us. In such case, it will be compulsory to obtain our approval before replacement.
- In case of "Difference of Opinion [if any]" among the Board members, our decision will be final and binding to everyone.

"

Process of submission of Research Paper

The Area or field of specialization may or may not be of any category as mentioned in 'Scope of Journal' menu of the GlobalJournals.org website. There are 37 Research Journal categorized with Six parental Journals GJCST, GJMR, GJRE, GJMBR, GJSFR, GJHSS. For Authors should prefer the mentioned categories. There are three widely used systems UDC, DDC and LCC. The details are available as 'Knowledge Abstract' at Home page. The major advantage of this coding is that, the research work will be exposed to and shared with all over the world as we are being abstracted and indexed worldwide.

The paper should be in proper format. The format can be downloaded from first page of 'Author Guideline' Menu. The Author is expected to follow the general rules as mentioned in this menu. The paper should be written in MS-Word Format (*.DOC,*.DOCX).

The Author can submit the paper either online or offline. The authors should prefer online submission.Online Submission: There are three ways to submit your paper:

(A) (I) First, register yourself using top right corner of Home page then Login. If you are already registered, then login using your username and password.

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- Font type of all text should be Swis 721 Lt BT.
- Paper Title should be of Font Size 24 with one Column section.
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- Two Column with Equal Column with of 3.38 and Gaping of .2
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- Paragraph before Spacing of 1 pt and After of 0 pt.
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You can use your own standard format also.
Author Guidelines:

1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript's Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

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All authors should have been credited according to their appropriate contribution in research activity and preparing paper. Contributors who do not match the criteria as authors may be mentioned under Acknowledgement.

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Complete support for both authors and co-author is provided.

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Original research paper: Such papers are reports of high-level significant original research work.

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Research articles: These are handled with small investigation and applications

Research letters: The letters are small and concise comments on previously published matters.

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The recommended size of original research paper is less than seven thousand words, review papers fewer than seven thousands words also.Preparation of research paper or how to write research paper, are major hurdle, while writing manuscript. The research articles and research letters should be fewer than three thousand words, the structure original research paper; sometime review paper should be as follows:

Papers: These are reports of significant research (typically less than 7000 words equivalent, including tables, figures, references), and comprise:

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(c) Up to ten keywords, that precisely identifies the paper's subject, purpose, and focus.

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(e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition; sources of information must be given and numerical methods must be specified by reference, unless non-standard.

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(g) Discussion should cover the implications and consequences, not just recapitulating the results; conclusions should be summarizing.

(h) Brief Acknowledgements.

(i) References in the proper form.

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It is vital, that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

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Language: The language of publication is UK English. Authors, for whom English is a second language, must have their manuscript efficiently edited by an English-speaking person before submission to make sure that, the English is of high excellence. It is preferable, that manuscripts should be professionally edited.

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Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than 1.4 × 10-3 m3, or 4 mm somewhat than 4 × 10-3 m. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

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A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

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Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

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- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

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TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

1. Choosing the topic: In most cases, the topic is searched by the interest of author but it can be also suggested by the guides. You can have several topics and then you can judge that in which topic or subject you are finding yourself most comfortable. This can be done by asking several questions to yourself, like Will I be able to carry our search in this area? Will I find all necessary recourses to accomplish the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

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7. Use right software: Always use good quality software packages. If you are not capable to judge good software then you can lose quality of your paper unknowingly. There are various software programs available to help you, which you can get through Internet.

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10. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right! It is a good habit, which helps to not to lose your continuity. You should always use bookmarks while searching on Internet also, which will make your search easier.

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20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

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33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

Please carefully note down following rules and regulation before submitting your Research Paper to Global Journals Inc. (US):

Segment Draft and Final Research Paper: You have to strictly follow the template of research paper. If it is not done your paper may get rejected.

- The **major constraint** is that you must independently make all content, tables, graphs, and facts that are offered in the paper. You must write each part of the paper wholly on your own. The Peer-reviewers need to identify your own perceptive of the concepts in your own terms. NEVER extract straight from any foundation, and never rephrase someone else's analysis.

- Do not give permission to anyone else to "PROOFREAD" your manuscript.

- Methods to avoid Plagiarism is applied by us on every paper, if found guilty, you will be blacklisted by all of our collaborated research groups, your institution will be informed for this and strict legal actions will be taken immediately.)
- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

Criterion for Grading a Research Paper (Compilation) by Global Journals Inc. (US)

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

INDEX

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ISSN 975587