Report on Ceramics Conservation and Scientific Course for Training of Staff at the Eco-Global Museum June – August 2013

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Introduction

This report details collaboration between the Ceramics Conservation Lab, Royal University of Fine Arts (RUFA) and Mr. Pheng Sam Oeurn, Director of the Department of Monument and Archaeology in the Preah Vihear National Authority in conducting a "Ceramic Conservation and Scientific Course" for the training of three staff members at the Preah Vihear Eco-global Museum Lab, located in Eco-village, national road 62 and 25km from Preah Vihear temple. The project was supported by Ms. Lisa Sardegna (Private Donor from California USA), through Ms. Joyce Clark, Vice President of Friends of Khmer Culture.

The Department of Monument and Archaeology has been conducting archaeological research on monument conservation and prevention, focusing on Preah Vihear temple and surrounding archaeological sites. These sites are ten kilometers surrounding the Preah Vihear temple and are classified three zones:

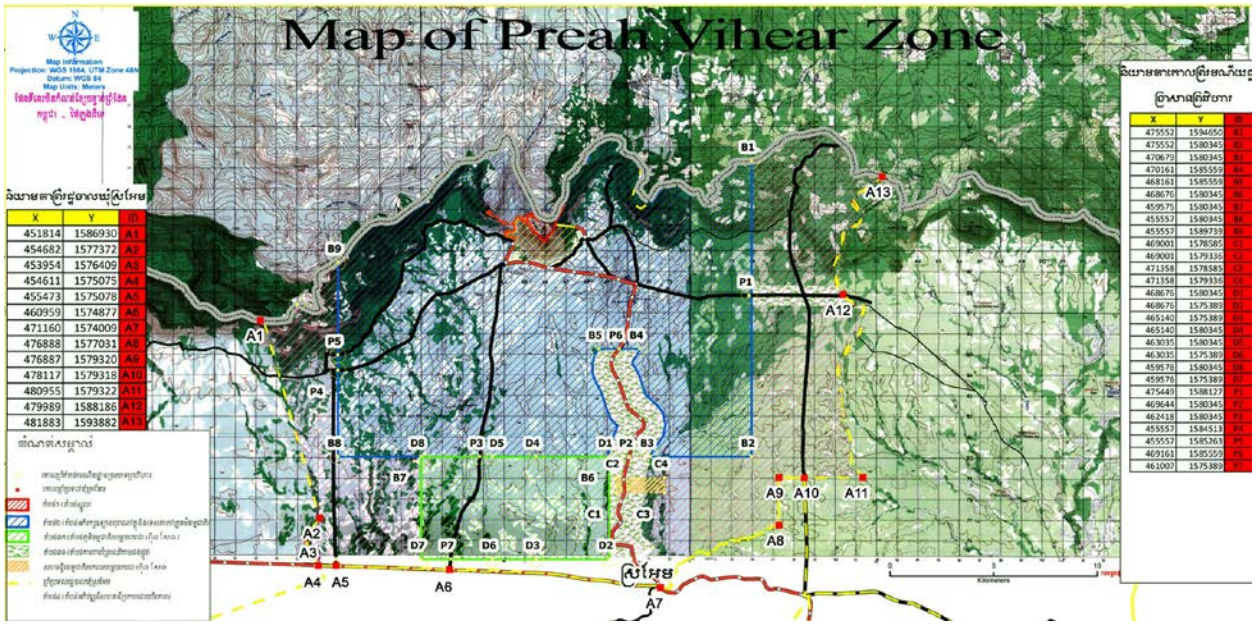
- **Zone 1**: An area on the Dang Reak mountain plateau of Preah Vihear Temple, including ceramics found from the archaeological excavation and survey collection at the north stairway of Preah Vihear temple, at the back side of Keo Sikhakirisvara monastery about 100m (GPS point: 48 P 0465640, UTM 1590818) and various locations.
- **Zone 2**: An area from Preah Vihear mountain, about 9km by foot (point B1 to point B9). Including the reservoir of Surya Tadak (GPS point:48 P 0463698, UTM 1589365), Prasat Touch temple (hospital in the reign of King Jayavarman VII (1181-1219)with GPS point: 48 P 0463945, UTM 1589123), the reservoir in front of Prasat Touch which is in an east-west orientation, Keo Kiri Seima pagoda, northeast of office of Preah Vihear National Authority "K1", and other locations.
- **Zone 3**: Divided into two zones:

  a) Zone 3k: A site in the Eco-village of Samdeach Deacho Hun Sen with dimension: 9km x 5km (green line with point D1-8). Northern part of Eco-village (GPS point: 48 P 0465158, UTM 1575154), Virak 82 site and Prasat Trapoeng Singh temple (GPS point: 48 P 0463001, UTM 1575104).

  b) Zone 3kh: An area along both sides of National Road 62 out around 1km to Sra Em market (area of tan lines with point C1-4).

- **Zone 4:** The yellow line from point A1-13., O'Teak Khiao, O'Angkrang, Ko Mouy (GPS point: 48 P 0469561, UTM 1589415),

  Most of the ceramics found date to the Angkorian period, including trade ceramics. Ceramics found include 1) Angkorian ceramics: roof tiles, finials, and the end of roof tiles (architectural ceramics); storage jars, brown glazed bottles, cooking pots, water jars, and basins; crocodile sandstone seal and metal objects; 2) trade wares: covered boxes with white glaze and floral motif designs, that were produced in the Yuan Dynasty (13th -AD 14th century). The ceramics found suggest they were used as a part of people's daily lives and used to serve the temples. Consequently, most of ceramics were broken in pieces and fragments that required conservation such as cleaning, assembling and restoring. Furthermore, after conserving the ceramics, we selected some of special objects to put on display in the Eco-Global Museum. In this main concept of the project was to provide an opportunity for the staff in the Museum and Department of Monument and Archaeology to improve their experience and training in ceramics conservation and scientific analysis of ceramics. In doing so, they will be able to continue to work on analysis and conservation of archaeological ceramics after their archaeological fieldwork.



Source: Department of Monument and Archaeology

A. Conservation, Training and Analysis

I. Ceramics Conservation


Fig.1a

Conservation of ceramics took place in the Eco-Global Museum Lab. Four trainees, Mok Doueng, Ol Sam An, Chum Phirum, Kuch Kadokaden and Ms. Em Dany (ceramic conservator assistant) were taught the "Ceramics Scientific Course" and practiced ceramics conservation. The students practiced on an Angkorian jar, I have conserved and restored from O'Teak khiao site (Fig.1-3). Additionally some roof tiles were cleaned and assembled, various ceramics were cleaned and we consolidated flaking glaze and biscuit clay. We used the standard and high-grade conservative adhesive for ceramics , which is adapted to the climate in Cambodia.

- **Cleaning and Consolidation**: In this step students observated and tested the dirt, we cleaned the dirt where it was stacked on the edge of shards and surface using a bamboo stick, scalpels, brushes and sponges. We used both dried and wet cleaning methods. Some of the ceramics has glaze flaking off that must be treated and consolidate using Acryloid B72 and B48 in pure Acetone, around 5-10 percent. We strengthened the ceramics by dropping liquid adhesive on the glaze and also using biscuit clay 3-4 times (the clay color becomes darker after consolidating).


Fig.1b

- **Assembling Ceramics**: We reconstructed a large jar, roof tiles, bottles, and cooking pots. Using high conservative grade adhesive Acryloid B72 and B48 in pure acetone for earthenware and stoneware is very important as both adhesives have a glass-transition temperature change higher than the heat in Cambodia. We join the ceramics piece by piece, and press the pieces together tightly so that the joining lines fit together well.


Fig.1c

- **Ceramics Restoration**: Figure 1c shows the process of stabilizing the structure of the jar. After I assembled the lower part (Fig.1b), I reproduced a section of the base by making a mold impression using flat wax and applying the mold to the missing section. In the next step, I mixed plaster with water and applied it to fill in the gap, this is done section by section. To stabilize the structure of the pots I use dental plaster, which has a hardness similar to earthenware and stoneware. If we are restoring a type of porcelain ware, we will use Milipat Plaster to fill in the missing gaps.

We sand the plaster to match the jar form. The last step involves painting the fill to match the plaster to the pot.

II. Metal Conservation

Bronze artifacts were discovered at Mound 95, located in an army camp. The artifacts included sculptures of Avalokesvara and Prahnapamita, three feet of a conch, and one medallion. Mr. Chheng Sovanna has conserved metal objects. He carried out the cleaning, joining and restoring process. I assembled a Pranhapamita figure, which was broken in three pieces.


Fig.2a

a)Cleaning of Metal Objects

The first step involved removing the corrosion on the surface using a bamboo stick and scalpel. The condition of the objects was still strong, although the feet of the conch were broken in several pieces and it was hard to match all the pieces together. We used a cotton swab with acetone to examine the real surface.

b)Assembling of Bronze Figures

We applied adhesive Acryloid B-48 in acetone and added glass-microballoons to join the bronze objects. After cleaning the cross sections I glued two parts of the figure and held them together for awhile. I used paper tape to stabilize the joining line so it would not move. (This is different from pottery assembling where we can use a quick-grip). A close examination revealed the adhesive moved while drying, so I had to rejoin the pieces and adjust them while the adhesive was still soft.


Fig.2b


Fig.3a

c) Restoration

For the Avalokesvara figure we needed to stabilize the missing section of the middle body. We applied Miliput to fill the gap, and we formed the shape using a scalpel, a small carpenter's chisel, and sandpaper. The hardness of Milliput is the same as porcelain and metal objects. We mixed two parts of Milliput by fifty and fifty percent, squeezed it together, and then coiled it to fill the interior. After forming the shape it was painted to match the color of the rest of the figure.

III. Ceramic Conservation Training

In this part of the project our goal was to train employees who have worked with ceramics in the field of archaeology, and focus on the theory of scientific ceramic analysis, the practice of conservation, and the study of archaeological ceramic kiln sites in the Angkor zone.

- The lectures focused on the clay, technical methods of production, firing, and how to excavate ceramics.

- For the analysis of ceramics we classified ceramics and took pictures to sort in different folders.

- We visited three archaeological ceramic kiln sites, Sar Sei kiln, Khna Por, and Tani kilns. We observed the ceramics at Preah Norodom Sihanuk Museum that derived from human burials, kiln sites, and ceramics used for cremated bones from the post-Angkorian period.

  a)The Sar Sei kilns (GPS 48 P 040372, UTM 1492087 the foot of the kiln is 110 meters above sea level and top of the kiln GPS 48 P 040371, UTM 1492100 is 86 meters above sea level) is located in Sar Sei and Thma Chul villages, near the foot of Phnom Kulen mountain. It is 2 km rom Srah Damrei pond and 10km from Thnal Mrek kilns at Anlong Thom village on the Phnom Kulen Mountain Plateau. I suggest that this site may be linked to the Thanl Mrek kiln. There are many ceramic kilns on south-north mounds (GPS 48 P 0404190, UTM 1491850 at 92m above sea level). The Trapeng Niang Snay kilns (GPS 48 P 0404488, UTM 1491223 at 79m above sea level) was excavated in 2005 by Nara Center under APSARA Authourity, Siem Reap.

  b) The Tani kilns (GPS 48 P 0393150, UTM 1489933 at 41m above sea level) was located in Tani village and excavated by the Nara Organization. It is located at the southern part of Phnom Bok mountain, where many kilns were built. We observed ceramics found on the surface in order to compare with ceramics found at other sites. We also observed the ceramics in the Ta Ni Museum and the structure of the kilns. One more kiln (GPS 48 P 0393153, UTM 1490188 at 45m above sea level) was located at the end of Tani Village.

c)The Khna Por kilns (GPS 48 P 0399468, UTM 1480109 at 40m above sea water level) is located along the road, and some have been destroyed. The Nara Center excavated one kiln (GPS 48 P 04158, UTM 1479683 at 36m above sea level) that produced roof tiles, basins, and some types of covered boxes with a green glaze were found on the surface.



Sar Sei Kilns visit (left), observing ceramics from Top Chey kiln(middle picture), Preah Norodom Sihanuk Museum (right).

Making pot s(left), assembling and restoring pots (middle), ceramics drawing course (right).

IV. Ceramics Analysis

Ceramics were discovered from archaeological excavations undertaken by the Department of Monuments and Archaeolog: at the Surya Tadak reservoir (or west Baray) and at the northern stairs of Preah Vihear mountain. Ceramics were also found by people and soldiers as they dug trenches and buildings, which were given to the Department of Monument and Archaeology. In addition to ceramics conservation, we also focused on ceramics descriptions and funcational analysis, which primarily identified Angkorian stonewares, cooking pots, and Chinese wares , discussed below.

Angkorian Ceramics

Stoneware (high fired) ceramics were produced in the Angkorian period (802-1432 A.D.) and were identified by their form decoration, and brown or green glaze. Many kiln sites have been discovered inside and outside the Angkor Parks due to the work by various researchers working with the APSARA Authority and a variety of international projects undertaking archaeological research in Cambodia. Ceramics were made for people to use in their daily life. For example, they were used in households, for worship and ritual functions, and in architecture. Furthermore, ceramics were produced for the Imperial Court in China, which produced high quality masterpieces by skilled potters. A question we still must answer, were there special produced only for the Kings of Cambodia as we see in China? We have no evidence yet in Cambodia.

Ceramics were found at several archaeological sites that have been classified into three Zones that are managed bythe Preah Vihear Authority since March 2006. One hypothesis about how ceramics were transported from their location of production is found in Cambodia today. Traditional ceramics from Kompong Chhnang province are transported from place to place by ox-cart over long distance, with the ox-cart drivers spending several months selling ceramics. Therefore, we can speculate that ceramics may have been transported in a similar fashion in the past, and that Preah Vihear temple was part of this network.

A history of the Preah Vihear temple was written in a report by Department of Monument and Archaeology. The temple was started during the reign of King Yasovaraman I

(879- 910) and finished in the reign of King Surayavarman II (1113- 1150) which we can see in the architectural style. A location for this temple was chosen on the Dangrek Mountain, and it was devoted to the god Shri Sikhareshvarav. It is located a great distance from many temple complexes, being around 200km from the Hariharalaya capital, the Yasorapura capital, and the Koh Ker capital.. I believe that a group of people lived nearby during the construction of the Preah Vihear temple. We still do not understand why the King was interested in building the temple in this location, but we may be able to answer this question through the discovery of ceramics discovery at many locations on the mountain plateau and nearby areas where people lived.

Ceramics Description and Analysis

A description and analysis of ceramics found at various sites was undertaken and I suggested that the Preah Vihear temple was considered the main location. We analyzed the form or shape people used in order to determine its "Function". I have classified all of these ceramics and identified twenty functions, with each function having a different size and decoration. Some types of potsherds are difficult to identify and we could not classify them. In some cases we could identify the form or shape after having seen completed forms of Angkorian ceramics during ceramics conservation from National Museum in Phnom Penh; Wat Bo monastery, Preah Norodom Shihanouk –Angkor Museum, Japanese Angkor Safeguarding (JSA), Ecole Francaise d'Extreme Oriant Institute (EFEO) and ceramics from various kiln sites in Angkor region.

The twenty function of ceramics we classified were 1)storage jars, 2)jars with a pedestal foot and long neck, 3)basins, 4)water jars, 5)cooking pots, 6)bowls,7) pedestal bowls, 8)bottles, 9)green glazed bottles with narrow neck, 10)Chinese plates, 11)cylindrical covered boxes,12) lid handles, human shaped bottles, 13)lamps, 14)roof tiles,15) the end of roof tile, 16) finials, 17) human shaped bottles, and 18)elephant shapes and 19)clay balls.

1) Storage Jars ពាង និងក្រឡ

a) Largest Storage Jars ពាង: many storage jars were found at different sites, with one low fired jar with red clay derived from Surya Tadaka. All of collections are pot sherds, such as parts of of the base, bodies and rims.

- The general form of the large storage jars: a flat base, several series of rings, some of the jars were decorated with a series of wavy combed-lines in between the rings, and a series of curve-combed incised lines. The thickness and size of the base is smaller than the body and shoulder.
- The body of the pot sherds indicated an increased thickness and the decoration incldued a series of curve-comb incised lines under a brown glaze(OTK2011,B#1-3), a curving

shape at the shoulder, grey clay with iron spots, and a general large jar decorated with the curve-combed incised lines at the upper part of shoulder.

- The rim(Cat.#3/V82,B#2-4) has a round top shape, decorated with four looped handles on lotus leaves near the neck, ring and a series of four angles. Jars with thin brown glaze.

- A storage jar found at O'Angkrang site, was almost complete from the base to the to neck, but was missing the neck and had a hole drilled at on the side of the lower part of the body. This may be related to a funeral ritual. We discovered similar evidence from burial Jars of highland people from the Cardamom Mountains, Koh Kong provice. Decoration was mainly on the lower and upper part of body.

b) Medium and Small Storage Jars ក្រឡ (Kra La)

Three bases of storage jars were found at O'Teak Khiao (Cat.#7/OTK2010,B#1-4), Virah 82(Cat.#5/V82,B#2-2), and Surya Tadaka (Cat.#8/BPV2010-3,B#1-1) sites.

- The medium size jar from Virah 82 has a flat base, and decoration with wavy combed-incised lines on the lower part of the base, and a series of up curve comb-incised lines above the two ring lines under brown glaze.

- The jar derived from O'Teak Khiao site has a green glaze and flat base with knob rim that the potter scrapped on the lower part to form the base. A complete jar form is similar to this jar.

- The jar (Cat.#8/BPV2010-3,B#1-1) derived from Surya Tadak reservoir has a flat base and knob rim, pot was scraped to form the raised foot. For general types of this jar, potters formed an ovaloid shape with a pointed base.

2) Jar with pedestal foot and high neck ថូ (Tho)

This type of jar was found at almost every site, which indicates that people used them frequently. Jars were identified in various sizes and decorations with most of them having brown glaze, although several were unglazed. At various sites we found only found fragments of the base, the upper part of the body, and rims with a brown glaze and different decorations.

- O'Teak Khiao site: we found a special fragment (Cat.#9/OTK2010,B#1-1) that had a series of lotus fruit near the neck and above the curve a decoration of combed incised lines, and incised lines at shoulder.. This type of jar with lotus fruit molds is a similar to a jar from the National Museum Collection, but the decoration was not found at the rim and not in the same style. A fragment of the jar body(Cat.#10/OTK2011,B#1-13) was decorated with cross hatching in between rings. Other sherds found included a foot, rim

and upper part of body (OTK2011,B#1-14) with decorations saw face in between scraped lines.

- Virah 82 Site: A beautiful and high foot of jar shape (Cat.#17/V82,B#2-3) with a series of three combed-incised lines with different patterns, rings and under a thin brown glaze. Thick clay walls and gray color. For some of the jars, the potters only designed incised lines at the shoulder. Jar(Cat.#21/V82,B#1-2) had curved comb-incised lines in between rings at the shoulder and neck. The glaze was in good condition, but it flew off during firing. The jar rim (Cat.#19/V82,B#1-3) has the same design as jar (Cat.#12/V82,B#1-2). This jar has a tall neck profile rim and pointed top. Red slip was applied underthe glaze, and most of glaze is flaking off. Jar body(Cat.#13/V82,B#1-4) has a wide shoulder and similar style of design as the above two jars. This jar was decorated with curved comb incised lines, close to the rings at the neck and rings at the shoulder, with wavy comb-incised lines below, and thin brown glaze. Jar sherd (Cat.#14/NDST,B#1-2) had cross hatching in between rings and brown glaze.

- Kiri Seima Pagoda: We found a jar foot (Cat.#18/KSP,B#1) with decorated comb incised lines in between rings and thick brown glaze.

- Other sites also found sherds of pedestal feet and high neck jars as feet, and rims.

3)Basin ផើង (Pheung)

Basins in Angkorian period had an ellipsoid shape, unrestricted opening, short and incurved neck, exterior rim and wide mouth, square or round top and flat base. As for decoration, they often had incised lines and rings on the shoulder and rim, some of bases were unglazed. The base shape has persisted until the present time and can be found in Andoung Rusey village, Kompong Chnang province and Damnak Chambak village, Kompot province. At archaeological sites located in Preah Vihear Zones we found some types of basin rim sherds. For example, rim sherd (Cat.#20/OTK2011,B#1-6) has applied incised lines and rings at the shoulder and rim. There is one basin (Cat.#21/V82,B#2-1) derived from Virah 82 site which has black glaze. Some basins are high and low fired, and have gray and tan clay. One basin (Cat.#22/KSKP2011,B#3) is low fired, in a small size with a smooth scraping design on the surface and at the shoulder.

4) Water Jar ក្អម (Kaam)

There are two types of water jars.

- **Traditional low fired water jar:** This jar is found in a shape similar to a cooking pot but with a long neck and narrow mouth. This form of water jar have evolved from the prehistoric to the present period, but it is difficult to identify the evolution of the shape

from period to period. We did not find many rim sherds at the archaeological sites at Preah Vihear, but one sherd (Cat.#24/OTK2010,B#1-9) is red with rough clay, a high neck, exterior and round top. It is possible that it dates to the Angkorian Period, although difficult to tell.

- **High fired ware jar:** There is a regular form of water jar shape during the Angkorian period. When we find body, neck and rim sherds of this type we can identify its production know that it was produced in the Angkorian Period. This jar has a sample carinate shape, restricted opening, narrow and high neck, flaring mouth, exterior rim, pointed top and flat base. Our finds included rim shard (Cat.#25/OTK2011,B#1-11), neck of water jar (Cat.#26/OAK,B#1b-4), and body(Cat.#29/KSKP2011,B#1).

5) Cooking Pot ឆ្នាំង (Chnang)

Cooking pots are important ceramics that potters normally produced from rough clay, fired at a low temperature, classified as Earthenware. Pots were used to cook food or rice, and were heated by the cooking. When the clay is heated its particles were expanded into 15 to 30 percent of porosity. People do not use stoneware or porcelain for cooking pots, as the pots will crack when they are heated for a long time. Consequently, various sherds found from archaeological sites at Preah Vihear zone consisted of earthenware with rough clay and red and gray clay etc (Cat.# 30-33) .

Stylistically cooking pot are found in round or ellipsoid shapes, with restricted openings, short necks and wide mouths, an exterior rim, round top and round base. The interior rim has a notch for lid support. The relative date of cooking pots is difficult to determine. Moreover, it is also difficult to identify the source of production. During the present period, traditional methods of making cooking pots and similar ceramics use a low fire, such as open firing. The evidence for pot firing is important for identifying the source of pot production. Stoneware normally requires a kiln in order to control the heat which it causes Silica (SiO_2) to melt and depends on the red Iron Oxide(Fe_2O_3) .Therefore, cooking pots were fired at low temperatures and were used for cooking.

6) Bowl ចានក្រឡុម (Can Kra Lum)

There is a bowl (Cat.#34/OTK2011,B#1-1) with a deep bottom, ellipsoid shape, unrestricted opening, flaring mouth, exterior rim, and profile top. Decoration consisted of incised lines above the curve, and combed incised lines under brown glaze. Green glaze bowl with ellipsoid shape, unrestricted opening, water jar rim, round top, and ring base (Cat.#35).

7) Pedestal Bowl ជើងពាន (Chheung Pian)

There is only one example of aof pedestal bowl (Cat.#36/OTK2011,B#1-2) found from O'Teak Khiao. It is small and has applied brown glaze, which is flaking off. Normally bowl shapes are ellipsoid, with an unrestricted opening, short neck, exterior rim and round top.

8)Bottle with narrow neck ថូ (Tho)

There is a base of a bottle (C#35/V82,B#1-6) with a brown glaze found from Virah 82 site. This type of bottle may have been produced in the 12^{th} -13^{th} century, and is a brown stoneware with iron glaze, from Buriram province. There is a similar type of bottle (Louise Cort 2000) it is a gift of Osborne and Grata Hauge, S 1996.133

9) Covered Boxes ដន្លាប់ (Danlap)

Many sherds of covered boxes which there are bodies and lids found at O'Angkrang site and it is indicated us trade wares were imported in Cambodia. These types of covered boxes were produced in 13^{th} to 14^{th} century in Yuan Dynasty. Moreover, other sites also found Chines covered box shards such as O'Teak Khiao, Surya Tadaka reservoir, Southwest of Prasat Touch, and Trapeng Singh temple sites.

10) Chinese Celadon Plats ចានសេឡាដូន (Can Sela Dun)

Some Chinese sherds were found at O'Angkrang and Southwest of Prasat Touch temple (built in the reign of King Jayavraman VII). A Plate sherd (Cat.#50/OAK,B#1a-13) had a green thick glaze and fluted wall. Celadon plate sherds (Cat.#51-52/PVH K1-01,B#8c-2) have a ring base.

11) Bottles with narrow neck ខូច (Khuc)

There are three locations in which sherds and almost complete bottles were found, one sherd (Cat.#53/BPT,B#1-5) has a potter's mark on the base. Other sherds and almost two complete bottles (Cat.#55/KSKP2013,B#9) and (Cat.#56) were found at a location about 100 meters behind Keo Sikharisvara monastery in a defensive trench dug for the war between Cambodia and Thailand. One bottle (Cat.#56/KSKP2013, B#0) was not given by soldier, but has a nice decoration with carved straight lines on the body and a green glaze. We are not sure where green glazed bottles like these were made, but one source may be the Thnal Mrek kilns in Anlong Thom village on the Phnom Kulen Plateau, 60km from Siem Reap. There were two more bottles with a narrow neck found at O'Angkrang site where they were found by villager. It was not donated to Department of Monument and Archaeology.

12) Cylindrical Covered Boxes ថោ (Thou)

This ware is sometimes referred to as an "urn" in the Khmer dictionary, describing some types of containers made of clay, stone, wood, or metal in which human bones are contained. However, we prefer to refer to tis ceramic type as a "Cylindrical Covered Box ថោ".

Cylindrical covered boxes were discovered by Mrs. Nouv Savy, a villager who lives north of the Eco-village, and dug a trench on her land to look for buried treasure. Most of these objects were broken into pieces, with body and lid sherds. We were able to reconstruct some of the bodies and lids, but most of them are not complete. There is a lid with lotus bud handle (Cat.#67/SECV2013,B#1-1), and has has avery thin glaze that is flaking. Generally the body shapes are cylindrical shape, with an interior raised wall at the rim, a notch to support the lid, and a ring base. The lids have a dome shape with an even edge on top. Decorations include a ring and incised lines. There is one shard (Cat.#75/SECV2013,B#1-6) which is a covered box with domed shape and small incised circle at the center. Another sherd (SECV2013,B#1-14) is a jarlet. This jarlet may be round with a round top. At this location, we observed some surface remains that included tubular clay sherds which are unidentified. More fieldwork is needed to understand these pieces.

Lid sherds were found at other sites. (PVNST,B#13-B#13b-1) and (TS2013-B#2) have a top handle with straight incised lines and curved design and an applied green glaze. A body sherd (Cat.#60/NDST,B#1-3) has a beautiful shape, decorated incised lines, with ring and cross hatching on top.

13) Lid Handles កំពូលគម្រប (Kampul Kamrap)

- A lid handle was found at O'Teak Khiao (Cat.#77/OTK2011,B#1-4) with a conical shape, brown glaze, and circle incised lines as several levels. This type of lid handle may be a part of a dome shaped ewer lid.
- A low-fired lid handle was found O'Angkrang(Cat.#78/AOK,B#1b) and may be the handle of a cooking pot lid or ewer lid.

14)Human Shaped Bottle ថូរូបមនុស្ស (Tho Rup Manussa)

A special face sherd (Cat.#79a-b/OAK,B#1c) was found at O'Angkrang site, we can identify it as part of a human shaped bottle with brown and green glaze. It may be dated from 11^{th} -12^{th} century. This type of ware was not made by many potters, although there are similar forms that have been identified elsewhere (Dawn Rooney,2010) and (Louise Allison Cort,2000). The bottles were made in a gourd shape and then they applied clay and incised lines to create the

human figure. The potter also applied brown and green glaze. The sherds found at the above site, had two colors mixed together, and seems to illustrate us dark and bright light.

The human facial sherd has big bold eyes, eyebrows are connected to the nose, the small was formed below the nose, large ears were also added and, wavy incised lines and cross-hatching depicted hair. The face appears to be in the form of an old man.

15) Lamp ចង្កៀង (Cangkiang)

A sherd I identified as a "Lamp" (Cat.#80a-b/V82,B#1-5) was found at the Virah 82 site. This classification was made based on the vertical incised line decoration and carinate shape. similar lamps are found in the collection in the National Museum. The completed lamp form has a hyperboloid shape, restricted opening, narrow mouth interior rim, round top and flat base. It is made with a grey clay and brown glaze, melted iron spots were also seen on the surface. There are other types of lamps in different styles. For example a was lamp found at the pond of Prasat Sour Prat temple in the Angkor Thom Zone. We have about the method that they used and what type of oil were used in the lamps.

16) Final នាងច្រាល (Niang Cral)

Finals are objects made from wood, clay, or stone and characterized by a round shape. They normally were used to decorate the top of the roofs of temples, monasteries, and traditional houses. Nowadays, some monastery buildings still have finials, which creates a beautiful decoration. In our surveys we found a low-fired finial with red clay and high-fired finial with grey clay that was from the area surrounding the Preah Vihear temple(Cat.#83-84). Finials can still be found on top of the roof of Preah Vihear temple, but made from stone. Some stone finials were found 100 m behind Kesekhakiri Svara monastery when soldiers dug a trench. The date of these finials must coincide with the temple.

17) End of Roof Tiles កញ្ចាំង (Kanhcang)

Various ornaments were installed on the roofs of temples. Ornaments typical of Khmer architecture during the Angkorian period include Naga backs at the end of a roof (Prum Cung Dambul ព្រំចុងដំបូល ឬកញ្ចាំង), a back of a Naga on a roof (Bai Raka បៃរកា), and a finial (Niang Cral នាងច្រាល). These were made of sandstone(Cat.#85-86). On the other hand, similar ornaments were made of clay for use on Khmer wooden houses. Potters produced many pieces in the shape of Naga heads. We identified two ends of roof tiles as follows:

- One end of roof tile (Cat.#85/AS-PVE 2009,B#4-1was found at the ancient east stairway, it has a rectangular shape with a face and an Angkorian lotus petal at the edge of the tile. It is grey clay with some spots of iron.

- Another end of roof tile (Cat.#86/KSKP2011,B#2-B#2a-3) was found approximately 100m behind Keosikhakiri Svara pagoda. This tile has a rectangular shape and the face of the tile has lotus petal and a thin green glaze made of wooden ash (ash composed of low silica). This applied ash glaze with low silica easily flakes off the tiles.

18) Roof Tiles ក្បឿង (Kbeung)

Roof tiles were made of fired clay and were set on the roof of a house with a knob to link the slats together. There are two types of tile used on the roofs of houses and various buildings made of wood. Finials and the ends of roof tiles were ornamented the roof in a beautiful style is part of Khmer traditional architecture. Roof tiles are not commonly used in the present day ,but finials are still used for pagodas and traditional buildings, but they are made of cement instead of clay. There are around ten roof tiles found at a location 100m behind Keosikhakiri Svara pagoda and in the south part of natural pond where soldiers dug trenches.

19) Elephant Shaped Wares ភាជន៍រូបដំរី (Phachh Rup Damrei)

One of animal shaped wares produced in the Angkorian period is in the shape of an elephant, as well as other animal forms including lions, turtles, serpents, parrots, a kind of vulture, etc. Elephant shaped wares were found at two sites as O' Teak Khiao (Cat.#95) and O'Angkrang (Cat#96). These were broken body sherds with four feet and the head of an elephant. This ware was high-fire and coated with a brown glaze (iron ash glaze). Elephant shaped sherd (Cat#95) has an applied brown glaze on the body, but no glaze on the four feet. Some complete elephant ceramics have globular shape and a narrow rounded mouth on the elephant's back with lip cut incised body. Some of elephant wares have a raised rim with a narrow round mouth. A head of an elephant shaped form (Cat#96) with brown glaze has both eyes open, tusks are curved up, and and attached elephant's trunk. The trunk was curved with the end of trunk attached to the mid part of the body on the right side. Both were large as seen on a real elephant. Elephant sherds have a grey and medium fine clay. Some types of elephants were decorated with ornaments, like a string with four bells hanging down the body or with a cloth on their head. This style of elephant is like those used in the army or royal processisons, as seen on the bas-reliefs at Angkor Wat and Bayon temples.

20) Clay Ball គ្រាប់លុញ (Krab Lunh)

A clay ball found at front of north stairway when they excavated, this clay ball is grey in color. In general, we did know its function. Many balls of clay have been found at prehistoric sites and may be used for bird hunting.

b) Ceramics of the Yuan Dynasty (1271-1368 A.D)

Analysis of the shapes of special porcelain shards found at the O'Angkrang site enables us to identify their function in the past. These porcelain shards with white glaze and molded floral design, lotus motif, and various other designs are covered boxes. All of them were produced in the Yuan dynasty (1271-1368), which was a transitional age in the developmental history of China's porcelain. During this period, Jingdezhen) in Jiangxi province became the center of porcelain production. Compared to Song dynasty shapes, Yuan Dynasty porcelains became thick, heavy, and larger in size. (www. Google, Ceramics in the Yuan Dynasty, accessed 20 Sept 2013).

I have been able to studywhite-glazed covered boxes produced in the Yuan Dynasty and imported in the Angkorian period. Researchers who worked on archaeological sites inside and outside of Angkor Park Zone, in projects sponsored by the APSARA Authority, EFEO, Sophia University, University of Sydney, Japanese Safegarding of Angkor (JSA) and Nara Center, discovered some types of white-glazed covered boxes with floral designs (Fig.1), lotus motif (Fig.2), molded eight-sided shapes (Fig.3), and vertical molded lobes like those of a pumpkin (Fig.4). The walls of this type of porcelain wares are typically thin. I would refer to examples found at the Prasat Sor Prat pond and the Phimean Akhas temple within the Royal Palace compound of Angkor Thom; shard finds at the south moat of Angkor Thom; some collections from Phum Snay site housed at Bantey Meanchey Provincial Museum; the collection in Wat Bo monastery; and many examples in thecollection in the National Museum of Cambodia, Phnom Penh. Moreover, a new discovery of white-glazed covered boxes contained in a basin was made by Mr. Tho Thun, APSARA Authority (fig. X). I expect that some shards of these types of wares were found at the group of Sambor Prei Kuk temples. Consequently, my work on the conservation and research on this type of covered box gives important evidence for the ceramics that people used for a long or short period after they were produced and imported to Cambodia and elsewhere in Southeast Asia.

My new project in July to Sept 2013 focused on the conservation and identification of ceramics derived from the area of Preah Vihear temple (on the Dangrek Mountain in northern Cambodia), and various archaeological sites near the foot of the mountain and 10 km away. At a site near O'Angkrang temple, thistype of white-glazed covered box was found when a road was built. The finds on which I worked included white-glazed covered boxes and a piece of a celadon-glazed lid of a covered box. (We found this type of lid at Prasat Sor Prat, Angkor Thom.) These finds give evidence that the use of this type of ceramics expanded to the area near the Preah Vihear temple, in locales settled by people possibly associated with the temple.

Fig.1) White glazed covered box with molded decoration. Yuan Dynasty (1279 - 1368), Fujian ware, probably Anxi or Dehua kilns. A similar piece is in the collection of the National Museum of Cambodia, Phnom Penh. The rounded shape uses fine, white porcelain clay and and was formed in a mold with a floral design. All covered boxes of this type have thin walls.

Fig.2a-b) White-glazed covered boxes with molded decoration. Southern Song or Yuan, 13-14th centuries. Fujian, Dehua kilns. They are both made from clear white, powdery porcelain, covered in a white/ off-white glaze, except for the bottom and the wiped-off rim. Both have a raised lotus pattern on the side. The glaze is finely crazed. The smaller one, diameter 10 cm, height 2.5 cm, is the whiter of the two. The larger one is 12 cm by 4 cm.

Fig.3) Pale-green (*qingbai*) glazed covered box with molded eight-sided shape. This piece is from the body, with a raised edge to support the cover. Glaze does not cover the clay entirely.

Fig.4) Pale-green (*qingbai*) glazed covered box with molded pumpkin shape, slightly raised ring foot, glazed wiped from the edge, Very white fine clay. Fragment of a small size of covered box.

Fig.5) Celadon-glazed shard of a box lid. Yuan dynasty, Zhejiang or Fujian province, Longquan-related kilns. A complete covered box was found at the pond of Prasat Sor Prat temple, Angkor Thom. There is another similar type of lid without a handle. With regard to the shard found at the O'Angkrang site, I am not sure whether it could have a handle or not. The lid is has an angular edge, and the interior is unglazed. Shard has got thick green and crack glaze to cover on the pale grey clay.

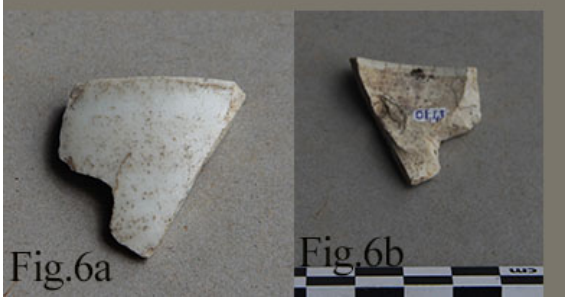


Fig.6) Rim of white-glazed covered box, with unglazed interior and even top.

Fig.7) Rim of covered box with copper-green lead glaze on outside, brown slip on inside. Yuan dynasty, Fujian province, possibly Cizao kilns.

Fig.8) Rim of celadon-glazed dish.

Yuan dynasty, Zhejiang province, Longquan kilns.

Fig.9) Rim of pale green (*qingbai*)glazed covered box

Fig.10) Rim of celadon-glazed dish Yuan dynasty, Zhejiang province, LongquanKilns.

Fig.11) Probably part of a covered box.

Yuan dynasty, Fujian province, possibly Cizao kilns. The molded design seems to be a pattern of fish scales. These shards use thin, lead-silicate glaze tinted green with coper. These wares are typical of cizao and related kilns in Fujian province. Cobalt (very expensive) was not use at kilns in Fujian until the 16th century . The inside of the shard is unglazed.

Fig.12) Shard of a white glazed lid of -covered box with

lobed top and angled sides. Yuan dynasty. The inside is unglazed except for some glaze at the center. It could be white-glaze ware from the Chaozhou kilns in Guangdong province.

Fig.13

13) White-glazed covered boxes with molded floral designs and bottles with underglaze cobalt-pigment decoration.Yuan Dynasty (1279-1368). Found at a mound near Bai Kaek temple foundation and western Angkor Wat temple the Tanle Um location or at the dam of the southeast part of the Angkor Thom moat.

A white-glazed covered box with floral design similar to the one near the basin rim on the right was found at the O'Angkrang site, located near the Prasat O'Angkrang temple in the Preah Vihear Zone. This find also gives evidence for how Chinese covered boxes and bottles were kept in an unglazed basin produced in the Angkorian period.(Photo Source: Chay Rachna)

Potter's Marks

Writing or symbols were used by potters who marked the ceramics by number or calligraphy in Chinese wares. These potter's marks were painted using blue, black and red paint color, either under-glaze or over glaze. Moreover, other marks on ceramics include stamps on the pots that were the brand marks that belonged to the kilns.

Ceramic production during the Angkorian period (late 9^{th} – Ca.14^{th} century), has benefitted from recent research at ceramics kiln sites such as Thnal Mreck, Khna Por, Sar Sei, Bangkong, Tani and various kilns inside and outside the Angkor Zone Park. Marks and incised lines at the base of small ceramics were probably numbers, and have been found on cylindrical covered boxes, dome shaped covered boxes, bowls, bottles with narrow necks, and other types. Moreover, we have found marks on other various pots, such as water jars with marks on the upper shoulder, body and base. More rarely marks were found on basins and Kendi vessels. We have not yet found potter's mark on storage jars, although additional research may identify these features in the future.

In the Preah Vihear archaeological zone, potter's mark were found on dome shaped covered boxes, cylindrical covered boxes, bowls, and bottles with a narrow neck, with the mark on the base. There are five different marks found in a collection from the north Eco-village in 2010. Only one bottle with narrow neck (Cat.#98) from the reservoir in front of Prasat Touch temple contained a mark with a circlular incised line and three incised lines forming a triangle. Other wares found at the north Eco-village are as follows:

- Two bottles with narrow necks (Cat.#100 and 103) had the same mark, a single incised line at the bottom and another bottle had two incised lines at the base.
- Bowl (Cat.#102) was incised with an "X" mark at the center of bottom of the bowl.

- One cylindrical covered box (Cat.#99) had a circular incised line made by wheel and two single incised lines in a parallel and horizontal direction from right to left, with the end of both lines crossing the circular line and another single line crossing the two lines.
- A dome covered box (Cat.#104) had an "X" mark incised on the base. It is the same mark as the bowl (Cat.#101). The starting points for the marks are also the same, moving from left to right, but the bottom and top incised lines were inversed. This suggests some carelessness by the potter.

Sources of Ceramics Production

The ceramics in this study may come from several kiln sites and this could be determined by carrying out a comparison based on analysis of physical properties, material composition, techniques of production, and the style. Determining the kiln site can also help us determine the uses of the ceramics. This further research requires experts who have experience in these types of techniques, so they can provide additional information on the above points.

There are several kiln sites where we suggest further comparison with the ceramics collection from the Preah Vihear archaeological zones. These are the kilns at Tani, Khnar Por, Bangkoang,Thnal Mrek, Buriram and Torp Chey kilns. Additional kilns include Sar Sey, and Cheung Ek kilns (whose 2013 excavation provides exciting radiocarbon dates). Using the style of the wares and the potter's marks, I have classified the ceramics by kiln.

- Buriram Kilns: there are some wares from this site with Catalogue Number or Cat.#9,10, 11, 12, 13,14, 15,16,17,18,23,32,34,35,58,59,78,80,81, 96 and 97
- Tani Kilns: Cat.# 7,25,26,33,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76, and 77.
- Thnal Mrek kilns: Cat.# 54, 55, 56, 57, 60, 61
- Khnar Por kilns: Cat.#88, 89-95
- Bangkoang kiln: Cat.#8, 19,20,21 and 22
- Unknown source of kiln: Cat.# 22,24, 28, 29, 30, 79, 82, 83, 84, 85, and 98

This classification of the ceramics assists with understanding the function of the ceramics and where they were transported from. However, it is not exact evidence on the production source for these ceramics. Further research is needed to analyze the ceramics collection in the Eco-global museum using scientific analyses, such as XRF, to determine the clay composition.

Preah Vihear Temple

The Preah Vihear temple is located on the long range of the Dangrek Mountain and faces to the east in the direction in Kantut commune, Cham Ksan disctrict, Preah Vihear province (about 100km from town) and about 150km from the southwest part of Angkor Wat temple. This temple was extended in a South to North direction and was built to worship the god Shiva. This is clear in the art style, inscriptions, and the architectural plan of the temple on the hill.

The highest principle towers in the southern part of the temple was built to worship the god Sri Sekharesvara who is also called "Shiva.". The temple is surrounded by a gallery and small doorways. There are 5 Gopuras with access to the main towers. Moreover, there are three bridges called "Hal bridges" that connect Gopura 3 to 5. There are also two libaries in between Gopura 1 and 2, and four ancient ponds. There are two stairways, 1)the Naga stairway from the northern direction and 2) the eastern ancient stairway, which is 1460 in length where it links Gopura 5 to the foot of the mountain. The stairs were carved in the natural mountain rock, which indicates the technical method used to build stairways.

The dating of the Preah Vihear temple is based on inscriptios, which are important sources to identify the when it was built and by which kings. Khmer inscriptions were found inside and outside the Preah Vihear Zones. An inventery list numbered by the Ecole Francaise d'Extreme Oriant Institute includes inscriptions K.380, K.381, K.382, K.383, and K.384 which mention the King who built Preah Vihear temple, and contributed land, temple servants, animals, ritual objects for the god. These inscriptions also mention that the temple was named for Sri Sikharesvara. Preah Vihear archetecture is identified by a specific style, such as the decoration of collonels, lintels, frontens; statues and bas reliefs. There are eight kings who built the Preah Vihear temple:King Yasovarman I (889-900 AD.), Jayavarman IV (921-944 AD.), Rachjendravarman (944-968AD.), Jayavarman V (968-1001 AD.), Sorysavarman I (1002-1050 AD.), Udayaditvarman II (1050-1066 AD.), Jayavarman VI (1080-1107 AD.), and Surayavarman II (1113-1150 AD.).

Architectural evidence suggests King Yasovarman I, Surayavarman I and SurayavarmanII were the major kings who built the temple. Additional evidence indicates the eastern stairway which is linked to Gopura 5 was probably built after Gopura 5 was constructed and dried pond at flank of a mountain. Futhermore, research by the Department of Monument and Archaeology has found a trace of an ancient road near the Touch temple which some researchers suggest may have been a hospital in the reign of King Jayavarman VII (mid- 13th century).

Exhibition Plan

The next step after ceramics conservation is to create an exhibition in the museum. There are some ceramics that we can select to put on display. Many types of ceramics were found in the Preah Vihear Zone and this evidence can tell us about the trade of wares from Angkorian kilns, the Buriram kiln sites, and from the Chinese kilns. Ceramics discovered in this region are important for understanding how ceramics were used in both ritual and household functions and will attract tourists and researchers in the future. The Preah Vihear temple and museum are connected, and tourists must visit the museum to see the artifact collection and research on display when they see the temple.

ACKNOWLEGMENT

First, I would like to firmly thank HE. Chhuch Phoeurn President of Preah Vihear Authority, Mr.Pheng Sam Oeurn, Director of the Department of Monument and Archaeology and Mr.Phoeurng Revan, Vice General Director for the Authority undertaking the Eco-global Museum, who approved and strongly supported the ceramics conservation and Eco-global Museum staff training project in Samdech Decho Hun Sen Preah Vihear from July to September 2013. I would like to thank Mr. Seng Kompheak, Vice Director of the Eco-global Museum, who assisted with this project in the Museum and support from Mr. Ben Sovat, Som Prapei, Mok Doueng, Meun Seyha, Naing Ol, and Tep Kearatha.

I would like to thank my trainees who work for the Department of Monument and Archaeology and the Preah Vihear National Authourity, Mr. Ol Sam An, Chum Phirum, Kuch Kadokaden and Ms. Em Dany, for their attention in the class. Thanks also to the driver for taking us to the archaeological sites in the Preah Vihear zone. Thanks to Mr. Hun Chantha ,head of police for the Preah Vihear Authourity. Thank also to the various people in the area who kindly worked with us on this project.

I would like to deeply thank Lisa Sardegna who has supported many projects in ceramics conservation. A very special thanks to Joyce Clark, who has strongly supported my work and has had wonderful kindness and patience for my work process. I would like to firmly thank Helen Jessup, Director of the Friends of Khmer Culture, who has always approved my projects on ceramics conservation. Also thanks to Jenny Spancake who helped approved my project for FOKCI.

I would also like to thank Drs. Nancy Beavan and Alison Carter, who assisted me in preparing this report. I am also thankful to Louise Alison Cort who provided support and advice for the material and ceramic conservation and the analysis of ceramics from Southeast Asia.

I would like to dedicate my report to Prof. Bonnie Baskin, who trained me in ceramics conservation since 2002, and Roxanna Brown who was an expert in Southeast Asia Ceramics.

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Catalogue
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b)Medium Storage Jars ក្រឹឡ

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c) Small Storage Jars ក្រឡុតូច

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2)Jars with Pedestal Foot and High Neck ថូ

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3) Basin ដើង

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4) Water Jars ក្អម

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Appendix Photos

Location found O'Angkrang ceramics in November 2009. Source: Chhum Phirum

Ceramics found by villager at O'Angkrang village. Source: Chhum Phirum

Bronze bracelets, foot of jar, stone pestle was found by villagers at O'Angkrang Area Source: Chhum Phirum

Ceramics and metal artifacts found when built road from Srah Kdul to Eco-village December 2009. Source: Chhum Phirum

Roof tiles and pots found when soldiers dug the war trench is about 100 m behind Wat Keo Sekhakirsvara monastery in April 2011. Source: Chhum Phirum

Ceramics foundat Sambuk Khmum August 2009. Source: Chhum Phirum

Prasat Touch temple near Suriya Tadak reservoir, was built in reign of King Jayavarman VII, this is perhaps hospital.

Prasat Touch reservoir is located front of temple, December 2013.

Western reservoir or Surya Tadak reservoir was built in reign of King Suryavaraman I, near Preah Vihear temple

Location Ko Mouy (K-1) was found ceramics during built the road to Preah Vihear temple. December 2013

Nortern Eco-village found many covered boxes with green glaze, September 2013

Virah 82 Soldier camps was dug the trench found many ceramics and donated Department of Monument and Archaeology.