Zeugma Archaeological Project 2000 - The Conservation Programme

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Introduction

Zeugma is the name given to the site of two towns located on opposing banks of the Euphrates, in the Southeast of nowadays Turkey. One of the successors of Alexander the great, Seleucus I Nicator (312-281 BC), founded the twin towns naming them Seleucia and Apamea after himself and his wife. In the first century AD, the towns passed under Roman rule. A legionary garrison, the Legio IIII Scythica was established here to protect what was the only permanent bridge across the Euphrates for several hundred kilometres. For 200 years the towns constituted an important trade link between the Roman and Parthian empires. At its peak, the city may have had a population of 50,000 - 75,000. On the west bank, the city extended over approximately 2000 hectares. With the dwindling power of the Roman Empire in the 3rd century AD, the city was sacked and burnt in AD 252 by the Sassanids. Zeugma is mentioned for the last time in AD 1048 just before the arrival of the crusaders after which historical sources fall silent.

In the 1970s the German archaeologist Jörg Wagner identified the site of the ancient city. Research excavation principally by David Kennedy from the University of Western Australia; Catherine Abadie-Reynal, Professor at the University of La Rochelle; and Gaziantep Museum, has taken place over the last 15 years furthering our knowledge of the international significance of the site.

The valley, which hosts the site, was included in the south Anatolian development Project as the place of the Birecik Hydroelectric dam. This meant that approximately 1/3 of the city area would be inundated.

During the excavations 1999/2000 extraordinary archaeological remains were discovered, which finally draw the attention of a broader public to the problems of the site. In this context, the Packard Humanities Institute (PHI) organised in co-ordination with the Turkish Authorities an international programme for emergency archaeological rescue operations, based on excavation and on site conservation: the Zeugma Archaeological Project (ZAP 2000).

The CCA Centro di Conservazione Archeologica of Rome was called to manage and to implement a conservation management program based on "*in situ*" conservation of the archaeological remains.

During the year 2000 a full team of professional conservators implemented the conservation plan: field assistance to the archaeologists, first aid during excavation, preventive conservation, protection, reburial and risks mitigation of the area before the flooding are some of the operations carried out.

Premise

Before the Packard Humanities Institute (PHI) sponsored rescue excavation, the zone to be inundated has been excavated with an extremely low amount of manpower and budget. This forced the excavation to adopt murdering working rhythms and plenty of sacrifices from all points of view. The first to fall victims of these conditions were wall paintings and mosaics. At least part of them has been lifted by not specialised workers, and without drawing up a sufficient documentation. The result of 1 month of excavation has been heredity of 700 square meters of mosaics and about 100 square meters of mural paintings recovered with a multitude of different methods and piled in the garden of a museum in open air condition.

The first rule we imposed ourselves was not to continue in this line of action. At the contrary trying to leave the site as integer as possible in all its structures. It remains understood that our first suggestion on behalf of the further conservation of the site has been to limit the archaeological inquiry to a minimum number of trenches. As the archaeological layers would be conserved best under the natural earth covering which had build up over the centuries. This suggestion has been only partially accepted by the other groups of the

project and the great majority of the area destined to inundation has been submitted to archaeological inquiry.
To give you some numbers and in order to fully understand the dimension of the problem: we were confronted with the problems caused by an excavation carried out by 100 archaeologists, 300 workmen and heavy, mechanical gear in ambient conditions with temperatures above 50° C and a couple of weeks of preannoucement.
Our response was to organise a team of 20 professionals for 3 month on site and on the other hand to set up a list of priorities, which used as determining factors the level of the water, the velocity of the water rising, the times of the archaeological excavation and the fragility of the archaeological structures.

The result was a plan of action structured as follows:

- To design preventive conservation measures during the excavation agreed on with the archaeologists, in order to mitigate the physical impact on structures and finds and in order to diminish the amount of work necessary to carry out future conservation;
- To provide the archaeologists with a time limit calendar for the excavation according to the needs of the in situ conservation (calculated at minimum time required);
- To set a common table of discussion (archaeologists – conservators) to plan integrated actions in those cases where the raising water level did not allow further intervention phases;
- To document all artefacts with conservation requires;
- To gather the information necessary to set up the priority plan;
- To carry out the conservation treatments;
- Setting up, carrying out and control of a reburial program;

The reburial of archaeological remains. Was this a choice?

Protection by reburial with carefully placed fill and full conservation processes on the materials is one of the number of options available for reducing the impact of the deterioration processes starting at the moment of the archaeological excavation caused by natural and human factors.
Its principal advantage is that it leaves the remains untouched beneath a protective layer of fill so that they will be available to future generations to study. The principal disadvantage is that all the remains will not be accessible (SHILSTON 1996).
It is useful to consider this point more thoroughly. The conservation in situ is today a oblation for the scientific community, which has to assume the responsibility not only of the discovery the study and the complete documentation of the materials remains of the past, but as well their conservation as a unitary context for the future. Monuments or remains, which pertain to a unique archaeological texture, cannot be seen as single artefacts, if not at the price of the dispersal of homogenous contexts, or yet worse the destruction of the existing information potential. Only the lecture of the completeness of all the stratygraphical components of an archaeological site, together with all the elements, which make up the external context (landscape), now and in the future, can provide complete and understandable historic information. A basic condition obviously is that these contexts are preserved for the future. Only in this case nowadays interpretations can be ratified or at the contrary contested and changed.

At this point it is necessary to reflect on the dam as an event in the lifetime of the site. The dam is considered economically reasonable for the next 50-80 years. After this time the progressive obliteration of the lake by the erosive material transported downstream by the Euphrates will render inoperative the hydroelectric power plant of the dam. This most probably will not coincide with the end of the lake itself as it will be used for other purposes for some time, but for sure the life spawn of the lake has to be measured in centuries at the most and not in the thousands of years. This means that the event with which we are confronted today is not the complete destruction, but one of the many events in the 23 centuries of life tie of the site. It is not a final curtain that we are facing but an event that might harm the site.

At the same time, the act of removing from their original context single elements (as occurred in Zeugma for the mosaics and frescos of the area A) without protecting what is left *in situ* risks to be a operation culturally limited and scientifically dangerous, which can be the origin of erroneous historic interpretations and irreparable damage. An operation of this kind ratifies the concept that something has to be saved and

something else might be left to destruction according to a subjective judgement, which is completely contestable. This choice leaves to chance the survival of anything, which remains in situ and destroys in a single operation-with-no-return information and original materials.

Therefore our decision was to document as much as possible, recover what would suffer damage if left on site and to prepare the rest for a long sleep attending eventual future generations of archaeologists. In practical terms this means that during the excavation campaign of July-October 2000, 240 square meters of mosaics and 70 square meters of mural paintings have been consolidated and protected on site; against 60 square meters of mosaics that have been lift because their destruction would have been certain in case of flooding. This data become indicative if compared to what happened during the previous spring campaign when 700 square meters of mosaics and more than 100 square meters of mural paintings have been lift in only a couple of months.

The strategy applied at Zeugma essentially is based on the following principles:

- Cleaning and integral documentation of all the archaeological structures;
- Removal of the small finds and those structures which for their state of conservation did not guaranty their survival after inundation;
- Conservation in situ, without disassembly or destruction of complete contexts, of all the structures able to receive the treatment of protection and safeguard before reburial and inundation;
- Protection of the original surfaces by the application of lime-whitewashes and hydraulic, lime-based mortars, copying late antique and mediaeval techniques, which have proved in varies occasions their efficiency in terms of protection;
- Reburial of the protected and consolidated structures;
- Realisation of a protective barrier of the reburial to the wave action and implementation of a shore maintenance programme.

The system applied should preserve the archaeological context as a whole. Beyond that once under water there will be stabile environmental conditions: termo-hygrometric and chemical-physical conditions will be stable, no risk of unauthorised excavations will be present, and most important no destructive operations of excavation or restoration will have been committed.

The project

The archaeological project was a full sized massive excavation campaign conducted for the Packard Humanities Institute (PHI) by the Oxford Archaeological Unit (OAU) featuring at its top 100 archaeologists, about 300 workers, 3 hydro-mechanical excavators and various tractors and trolleys.
A total surface of 8.700 m^2 have been excavated in 20 different trenches. This took about 6000 archaeologists working days. The entire conservation process took 1000 working days for the operations on site during excavation, 1800 working days in laboratory on finds and mosaics lift from the site, 600 working days for the maintenance of the shore line.
This has obviously significant impact on the conservation strategy on the field and after. To understand the choices made on site we should briefly analyse the various stages of possible deterioration and the main risk factors involved during these stages.

There were 4 different stages of ambient conditions for the archaeological remains during the project:

- Excavation, the moment of uncovering itself;
- Open air exposure, after being excavated;
- Inundation, during the flooding;
- Submerged, after the flooding;

When an archaeological site is buried, generally it is preserved for centuries without suffering substantial alterations.(de Guichen, 1984) This is because without air and light, the stable conditions slow down the natural ageing process and the tendency of all materials to return to their chemical primitive state. This is why the majority of archaeological excavations reveal, objects, structures and decorated surfaces still in a reasonable state of preservation and intelligibility. All materials have a favourable environment for preservation and will react in a different manner to external stress. In general, organic materials like leather

and wood are most at risk and liable to disintegration immediately after excavation, but inorganic materials such as metal and stone may also suffer irreparable damage. In fact all excavated objects, whatever the material, are fragile and potentially liable to physical damage. In general the biggest danger for all types of material, occurs during excavation, when there is a change in the equilibrium of the ambient and conservation parameters. It is by now certain that stable environmental conditions are more important than the environmental parameters themselves. In fact the same objects can survive in such different ambient conditions as desert tombs, permafrost tundra burials, muddy riverbeds or salt-water environments: as long as they reach a stable condition, they may last for millennia.

However once exposed the materials suddenly encounter changes in atmospheric conditions, temperature, and humidity and light drastically different from their previous state. A process of interaction with the surrounding environment begins so the material can reach a new equilibrium, which in the majority of cases means a change in the physical and chemical structure of the material itself. Once unearthed, beside the processes of chemical and physical deterioration, the materials might be subject to other kinds of damage: mechanical damage during excavation or handling, neglect, theft and vandalism, poor or erroneous restoration, wind erosion or water damage, rain, earthquakes and floods, biological deterioration through plants, insects or other animals, etc.

To preserve archaeological structures and objects, conservation treatments must be carried out during and immediately following excavations. This obviously requires a considerable investment of resources and energy. From the moment the archaeological excavation begins and the recovery of structures and finds start, the ratio in terms of energy required for digging and then for preserving is 1:20 (Nardi 1986). From the point of view of conservation we might say that the less we excavate the more we preserve for the future.

In the first stage, excavation, when the archaeological remains are unearthed, they pass from a stabile microclimatic condition to a new, continuously changing outdoor environment. Under the local excavation conditions this meant a dramatic temperature change and a rapid loss of moisture content with risks of loss of surface layers, especially if decorated, formation of difficult to remove insoluble surface deposits, cracks and deformation in fragile organic materials, cracks and rapid, massive corrosion through oxidation and hygrometric variations in metal objects, etc; furthermore there are the "usual" risks of loss of information through the fragility of many ancient artefacts and material evidences (crumbling of wall plasters and wall paintings cause of detachment from their original substrate, loss of tesserae in areas with lacunae and/or disruption, crumbling of fragile objects during lifting, etc).

In the second stage, open air exposure, there are still microclimatic risks due to the exposure to an outdoor environment, but as this was a rather brief period (the project started in July and the excavation area was completely flooded by the 15th of October) with relatively stabile conditions, this was not the main risk. A much higher risk was the anthropologic damage to the structures more through neglect rather than vandalism. It is in the human nature to find the easiest and/or straightest passage from one point to another. This passage might not coincide with the proposed passage; a phenomenon we all have observed in public gardens, near subway stations or other points of public interest. We are normally accept a certain amount of damage to be suffered by the environment we pass to obtain this natural passage. The archaeological excavation is no exception to this rule. It is a rather common phenomenon that the level of awareness has a significant drop once the excavation work is finished and the drawings have been made. The sense of abandon is tangible all around the place and especially fragile structures on or near "useful" passages are at the utmost risk of being "consumed" in very short time.

The third stage, inundation, is carrying a very high risk of complete destruction of the archaeological remains as the wave action may undermine the structures themselves, leading to complete cave-ins of walls and floors, the wash-out of earth-stone walls, the detachment of plasters and frescos, disruption of tesserae and tumbling of pillars, hydro-metric shock by rapid soaking of materials with water, etc.

The fourth stage, submerged, is possibly the least concerning one from a conservation point of view as the materials will be once more in a stabile underwater environment, which as we know has a much higher ability to create a suitable conservation environment than any outdoor situation. Through its high density the temperature variations will be minimal and obviously enough there will be no hygrometric variations. The

water movement can be considered non-existent as the flow speed of 500 m^3 per second will be distributed over the whole section of the reservoir – approximately 40.000 m^2 resulting in a nominal speed of 1,25 cm/s - and most probably concentrated to the central area , both in longitude and altitude of the section.

There will be a 2m-altitude area below the maximum level, which is interested, in continuous fluctuation through the normal exercise of the dam. Anything in this area is obviously running a very high risk of complete destruction.

Thus to summarise our main concerns:

- **Excavation**: a rapid evaporation of the moisture content of the unearthed materials had to be avoided at all costs. The crystallisation of soluble salts should not occur on the original surfaces, but on a sacrificial layer. Endangered structures or decorative surfaces should be consolidated in contemporary with the excavation. Small finds should not be exposed to direct sunlight and pass slowly to their new moisture content in a controlled environment. All highly perishable artefacts should receive treatment as soon as possible. Uncorrected or inexperienced handling of delicate artefacts had to be avoided.
- **Open air exposure**: access to the excavated areas had to be limited. Delicate or perishable structures had to be secured and easy passages near them had to be blocked efficiently. Small finds of all kind had to be moved to the finds store on a daily basis.
- **Inundation**: the archaeological inquiry had to be finished in time to permit the in situ conservation treatments and the reburial program to be completed. The conservation treatments had to be finished in time, so that the used materials had the time to set up and harden. All fragile structures had to be prepared with a protective layer in order to mitigate the transition phase from humid to water saturated status inside the materials and a sufficient adherence between the substrate and the artefact had to be secured. All excavated areas had to be back filled and protected efficiently from erosion by the wave action.
- **Submerged**: the protective measures had to be controlled and where necessary additional work had to be put in place in order to stabilise the shore line in proximity of important archaeological remains just above the water line or in the fluctuation level.

The Strategy

Based on the principle of minimum intervention, the methods used were as fast and simple as possible. This meant having the maximum result in the least time.
In the first stage the main activities were concentrated on the risk mitigation for the structures and objects, in then second on securing the already treated artefacts and areas and prepare them for inundation. Obviously this stages occurred in contemporary as the lower parts of the site started to be reached by the water, while in the higher up parts the excavation still proceeded.
All our priorities were discussed with the archaeological missions and a basic division of responsibilities was agreed. The basic measures of find protection were carried out directly by the members of the archaeological missions, while the conservation professionals cured the more complex, technical operations and assisted with advice. With handouts, written information material, lectures, personal contact and collaboration the awareness of basic preventive conservation measures was risen and disseminated. The trench responsible acted as contact persons with which to communicate, discuss the respective programs and priorities.

The program of conservation

For clearness sake the activities on the site will be presented by category rather than in chronological order. In the appendix you will find flowchart diagrams for the most important activities, which will show the interaction between different professions. We would like to underline that the careful planning and timing of the single operations was a critical point in the whole operation as at the end of the timeline the rising water did not care for delays of whatever nature. So the first step was to set up a interactive time schedule for all the trenches, where every single artefact in need of treatment was included with preliminary and final operations. Needless to say that these timetables needed continuous updating as the excavation evolved. These timetables beyond the times for treatment of the single artefacts contained a bottom line for the archaeological inquiries in order to have the necessary time to carry out the back filling operations on the trenches before flooding.

The conservation program was carried out in the entire area of excavation and has been divided in the following operations:

1. First aid on finds and conservation treatment (safe excavation, stabilisation and recovery of fragile small finds):
2. Lifting of mosaics and architectural elements;
3. Documentation thorough moulds of graffitti and inscriptions;
4. In situ conservation and protection of mosaics, wall paintings and plasters
5. Temporary preventive protection measures
6. Planning and management of the reburial program of the excavated areas;
7. Post excavation maintenance of the shore line.

1. First aid on finds and conservation treatment

During the Zeugma 2000 Excavations thousands small finds mostly in bronze, iron, glass and some organic materials (ivory, wood, bone, etc) have been retrieved. As generally known most of these items suffer from the dramatic microclimatic changes when passing from their buried damp condition to the hot and dry open-air exposure. Furthermore due to archaeological needs for drawing, photography and documentation they often have to stay in place for a prolonged period of time. This means exposure to direct sunlight with all negative effects associated to direct sunlight on humid objects – loss of surface due to mechanical stress by the rapid volume increase of the contained water, deformation and/or cracks of organic materials like ivory or bone, etc.
The main goal of the first aid for the small finds on site was to minimise the amount of damage suffered by the objects between their uncovering until their recovery in the conservation laboratory and to save the maximum amount of information coming along with the objects. In general there were two categories of objects:

- Objects which were sufficiently stable to be picked up and stored without additional support;
- Objects which were too heavy or too fragile to be lifted without prior stabilisation and/or additional support;

For the first category some very basic – simple, but efficient – techniques were adopted to mitigate the impact of the changing climatic conditions:

- Direct exposure to bright sunlight was avoided by storing the recovered objects in ready-made geo textile bags.
- Iron and bronze objects were put in zip-lock polyethylene plastic bags with holes punched in to permit a slow migration of the microclimatic conditions from the former to the present state. The holes were necessary to avoid the formation of condensation inside the rather small volume of the bags.

These punched plastic bags where than put as well in the before mentioned geo textile bags in order to avoid that they would be "stored" in the shadow of some wall, and to finish in bright sunlight a couple of hours later. These operations were carried out by the archaeologists.

In the case of large or fragile objects a block lift was carried out by the conservation team. The methods and materials used, varied according to the kind of artefact recovered. For every block lift a recovery record sheet was made to keep track of all materials used. This was necessary to identify the materials, which might have come in direct contact with the artefacts and therefore might interfere with the further archaeological inquiry. Furthermore a hand drawn sketch was made to record the exact position of all lifted fragments.

All artefacts where moved to the finds store on a daily basis for data processing and further conservation treatment.

Right from the beginning it has been our policy not to leave at the end of the excavation an overcrowded finds store to an uncertain future. Therefore during and after the excavation most of the excavated metal

objects have been treated. The stabilisation of the objects had the priority over any other considerations. The bronze objects have been cleaned and than washed in demineralized water to remove all active chlorides. The iron objects have been cleaned, micro sandblasted to remove incoherent corrosion layers and than treated with a professional rust converter on tannic acid basis.
The finds store was organised in manner that all fragile artefacts, were preserved in Polyethylene boxes with a stabilised microenvironment obtained by silica gel with a colour index indicator. The state of the silica gel and the objects is controlled up today on weekly basis.

A total of 1,200 objects have been treated. This took 8 month of work with a total of 1,200 conservation working days.

2. Lifting of threatened mosaics and structures

Some structures and not mobile artefacts that would have not survived the flooding were removed during the excavation
These were 3 figured mosaics plus one geometrical being removed from site in these days for a total of 75 square meters, a stone fountain and some architectural stone elements.

The stone elements where protected with geotextile before being moved by heavy mechanical gear under the assistance of a conservator in order to control the positioning of the ropes (and not chains).

The lifting of the mosaics was a much more complex operation. The intervention sequence was as follows. The first step to take was the accurate cleaning of the whole surface. Special care was taken to remove the deposits of soluble salts on the surface as these hamper the adherence of the canvas covering needed to secure the tesserae.
Then the lines for cutting were determined applying as general rule the respect of the design of the mosaic. The cutting of figured scenes was avoided.

The documentation was carried out using transparent paper. This proved to be more accurate than the acetate or similar synthetic materials, as these shrivelled under direct sunlight and temperatures above 45° C. Once finished the paper rolls were scanned and transferred to the computer for CAD elaboration.

While this operation was underway the surface of the mosaics was glued over with a double canvas layer, applied cross wise. The first layer was slightly less tight woven than the second one to improve adherence to the single tesserae. Both layers were washed and trimmed before being applied in order to reduce differential shrinkage when the glue was setting up. The glue used was a polyvinyl one. The glue was brushed on the surface and than the canvas was lay on top. Now the canvas was beaten with sturdy hand brushes to squeeze the canvas into the joints between the single tesserae. While the first layer was setting up the cutting lines were drawn on the canvas. After the second canvas layer has been applied identically to the first, these lines were copied to the second layer as guide during the cutting.

The cutting was carried out with a modified angular cutter. Instead of the normal abrasive, cutting disks a ready-made diamond enforced glass cutting blade was used. The resulting cuts had a widths of approximately 1 mm.
Now the actual lifting process began. Starting from a free side, normally the entrance, long iron chisels were driven underneath the mosaic. The dividing point was between the preparatory layer and the final mortar layer which holds the tesserae.
Once completely detached the fragment was turned upside down on a readymade wooden support covered with geo textile. Every fragment was immediately identified by its number and orientation according to the documentation. At the end of the day the whole material was moved to the laboratory for the restoration treatment.

As with the small finds, all the 4 lifted mosaics have been cleaned, reset and reassembled, after the excavation. 1 of them is by now already on display at the Gaziantep museum, the others are in deposit ready for display.

3. Documentation thorough moulds of graffitti and inscriptions

In the case of inscriptions and graffiti, which stayed in situ or were to heavy or fragile to be easily handled a latex mould was carried out.
The first step in this process was the careful cleaning of the original, whether this was an inscription, a stone carving or graffiti on wall plaster. This was to remove any surface dirt so that all three dimensional features would be clearly recognisable; this involved removing soil, sand, small stones, etc. from within letters, incisions and so on. The next step was to check for any fragile parts in need of consolidation, which might have got damaged by the process itself. These were consolidated before the mould was made. Now the actual process was carried out. With a soft brush the latex was distributed over the original surface; special care was taken to fill all letters and/or incisions. The latex rapidly sets, forming a thin layer. Depending on the dimensions and kind of inscription further layers were applied to reinforce the mould and to guarantee an optimum rendering of the three dimensional features of the original. Once completely set the mould was peeled off carefully. The mould was a perfect negative of the original, and was then scanned. In the case of inscriptions the latex moulds proved highly useful, because it is possible to read them in transparency on a luminous table - even the right way round - and they are readily accessible for further consultation by specialists in the post excavation process.

4. In situ conservation and protection of mosaics, wall paintings and plasters

During excavation conservation advice have been provided to the archaeologists to prevent damages to surfaces. In particular, in the case of the discovery of mosaics and wall paintings it has been asked to leave a 10 cm layer of soil on the surface in order to be able to mitigate the effects of a rapid exposition to the atmospheric conditions and to avoid the formation of layers of insoluble salts and soil congregations on the surface due to crystallising salts. (COSTANZI COBAU 1986 e 1990). This layer has than been removed by the conservators during the cleaning operations.

The decorated surfaces discovered during the excavation have been treated and cleaned by the conservation team to avoid that damage occurred and to prevent the formation of difficult to remove deposits on the surface. The proper and fast treatment of the surfaces immediately after uncovering, meant as well that the original colours showed up without being blurred by dust or deposits. Inscriptions, graffiti and any other detail were clearly recognisable. This permitted a more accurate documentation and interpretation of the archaeological information contained in these artefacts.

The operations implemented during a total of 1000 working days are:

- microclimatic control during the cleaning
- removal of soil layer on the surface and cleaning
- documentation
- edging, consolidation of detached areas and removal of roots
- surface protection prior to the reburial

Microclimatic control during the cleaning
During the cleaning the surfaces under treatment have been shaded in order to slow down the evaporation process of the contained humidity. This has been necessary because of the climatic conditions, which would have suggested not to uncover these surfaces. The highest risk was the evaporation of the humidity contained in the layers just unearthed with the consequent crystallisation of soluble salts contained and all its devastating effects.

Removal of soil layer on the surface and cleaning
In order to avoid the complete exposure of the original surfaces beyond 30 minutes, the removal of the soil layer on the surface and the final cleaning of the parts just uncovered have been carried out at the same time, proceeding with levels of about 20 cm. This technique permitted the control of the times of exposure to the air and the ambient heat, producing a controlled dry out process of the original structures. In this manner we

managed to avoid the formation of insoluble surface deposits prior to their complete removal and the partial removal of the soluble salts.

To soften the earth, dried out rapidly thorough the exposure to the air and by the high ambient temperatures, prior to removal, vaporised water applied with hand chargeable sprayers was used. This was done in order not to damage the original layers, which often were softer than the material to remove. The removal of the soil was accomplished with the help of scalpels, until the last layer directly in contact with the original surfaces. The subsequent cleaning was carried out by using brushes, dental brushes, cotton buffers and a slightly biocidal solution of water and *neodesogen* at 2%.
At the end of the cleaning, as precaution in case of mural paintings, the dry out of the surface was controlled by the application of tissue paper wetted with water, on which the remaining soluble salts were directed to crystallise.

Documentation
A complete graphic and photographic documentation was taken after the cleaning. A 1 to 1 relief was taken on sheets of polyethylene by tracing all the lines of the figures and the geometric patterns. All the hand drawings combined with photographs were processed using computer assisted design (CAD)software to produce a detailed drawing for the documentation of the conservation process.
All the data about the general state of conservation of the floors, the areas of lacunae or degradation were traced on the graphic maps .

Edging, detachment consolidation and removal of roots
This operation has been carried out in order to re-establish the cohesion between the single layers and between the plaster and the wall and between loose tesserae. It has been accomplished by the appliance of a consolidating material, which by penetrating in depth has improved the physical characteristics of the plasters. In the case of frescos and plasters in imminent danger of crumbling , the excavation has been carried out by the conservators in contemporary with the consolidation. Where necessary in case of mural paintings temporary props were realised. Areas at risk were secured with cotton gauze linings applied with high concentration acrylic resin (*Acryloid* in acetone, 15%), while in the mean time the exposed areas were consolidated.

The normal procedure for the consolidation was as follows:
- Mechanical removal of soil deposits and roots along the borders or in lacunae with the help of scalpels and a vacuum cleaner;
- Rinsing of the detached areas with a 1:1 solution of water and ethyl alcohol with complete removal of soil deposits in between the different layers and between loose tesserae;
- Infiltration with the help of hypodermics of a mixture of hydraulic, lime based consolidant (hydraulic lime/Lafarge and sieved brick powder in a 1:1 mixture);
- Mending of the cracks along the borders with a lime based mortar (Hydraulic lime/Lafarge, lime, sieved brick powder, calcareous stone dust in 0,5/0,5/1/1)

Surface protection prior to the reburial
On the consolidated and cleaned surface a protective layer of hydraulic lime based mortar has been applied. This new surface, 2 cm thick on mural paintings and 5 cm thick on mosaics, will protect the original from the mechanical stress caused by the water and will serve as a sacrificial layer. Moreover the hydraulic qualities of the mortar will slow down the saturating process and prevent an immediate soaking with water of the underlying materials. At the same time the hydraulic properties of the mortar will lead to a continuos hardening once submerged and therefore to a progressive improvement of the resistance to mechanical stress over time. In this manner any stress will be mitigated by the new layer protecting the original surface.
The choice of the protective materials has been determined by their characteristics of elevated resistance, outstanding mechanical and hydraulic qualities, by their durability over time and the complete chemical and physical compatibility with the original surfaces.

The application of the protective layer had the following scheme: in direct contact with the surface a lime whitewash was applied by brush; this was followed by the protective mortar layer.

The lime whitewash had the function of separating the original from the protective mortar layer. In the future this will allow an easier removal of the later.

Once set up the protective layer, made of hydraulic lime/Lafarge, lime, brick powder and stone dust in a 0,5/0,5/1,5/0,5 mixture, was applied.
This layer was extensively worked in order to achieve a good adherence to the underlying surface and to improve the set up process of the aerial components of the mixture.

5. Temporary, preventive protection measures

Together with the trench responsible the safest, for both people and archaeological remains, to various areas inside the trench were determined. Where necessary additional trails, especially for the wheel-barrels were established outside the excavation area. Some endangered areas were declared off limits until the conservation treatments had been finished. In order to protect the exposed structures during the conservation treatments, the working areas have been sealed off with ropes and wooden poles. Other areas were permanently sealed off and only authorised personal was admitted. “Natural” passages next to delicate artefacts were blocked and alternative passages were signed out and reinforced thorough timber planks. When in determined areas the only access to an area had to pass next to or over a delicate artefact, special care was taken to secure and protect the particular artefact. This meant edging of unprotected or damaged borders of mosaics, wall paintings and plasters, closing lacunae of mosaics, which were subject to continuos passage, protecting borders or passages with timber planks or covering already cleaned mosaics in order to prevent them from soil and dust.

6 Planning and management of the reburial program of the excavated areas;

At the end of the archaeological works all the trenches were back filled following a strategy designed on constrains dictated by time-tables (general calendar, availability of machinery and materials) and site logistics (accessibility, topography, location of trenches). The techniques and materials used during the reburial were chosen following the availability of materials in the region, the conservation needs of the archaeological remains left in situ and the topographic features in which the trenches are situated.

As outlined before, it was clear right from the beginning of the works, that all the trenches had to be back filled to ensure mitigation of the environmental changes during inundation of wall plasters, wall paintings and mosaics and to prevent the collapse of the archaeological structures unearthed.
The building techniques of the archaeological structures encountered during the excavations at Zeugma are basically of four types: massive cut-stone wall buildings, constructions made of massive stone pillars alternated by loose stone/mud infill, mud brick walls with a high gravel percentage included and loose stone constructions using a poor lime mortar as binding material. The foundations often are of poor quality, sometimes missing completely; luckily most of the more complex structures are sitting directly on the bedrock. The masonry is made of bedrock stone of the area, which is a very soft mud lime stone.
Due to the nature of the materials and the construction techniques used all of these structures are in extreme danger, if exposed to direct wave action. The water would rapidly wash out the mud used as building material or undermine the structures build not on bedrock. The complete collapse of all structures still standing would be the inevitable consequence. Even the stone structures would be subject to considerable amount of erosion considering the low resistance of the locally used stone.
Due to the wide basin in correspondence to the location of the Zeugma site, just a few hundred meters away of the Birecik Dam, the wave action proved to be particularly intense on windy days leading to considerable erosion of the soil covering the archaeological remains. This could lead to complete erosion right down to the bedrock especially on the steep slopes facing in the principal wind direction (north west) towards the valleys. Several surveys proved that the archaeological remains in these topographical zones were particularly scarce. The bedrock was covered normally with less than 1 meter of soil. Most of the existing terrace walls seemed to be already severely damaged; it remains unknown if this was due to the agricultural activity on the site o due to erosion or natural disasters. The archaeological remains retrieved in these topographical zones are mainly situated in small natural terraces or situated in rock cut rooms.

Confronting these observations with the preliminary studies carried out, leaded to the following considerations:

- The critical moment for the archaeological structures is during and immediately after the inundation;
- The soil coverage alone would not be sufficient in the excavation areas which were exposed to wave action;
- The coverage of the excavated areas with geo textile could be functionally effective but would most probably attract looters in the case of exceptional low water conditions.
- The structures needed a "neat packaging" to avoid that the mud used as building material in the walls would be dissolved when they would pass from a humid to a water saturated condition.

Therefore it was decided to build up a differential covering moving from fine and soft materials applied in contact with the archaeological remains to bigger and heavier material exposed to the wave action while the water would be rising. The materials used are soil, sand, gravel and stones. The size (diameter) of these materials were as follows: soil from 0-5 mm with some major inclusions, sand 0,5-5 mm, gravel 10-30 mm, stones 50-200 mm. The exact sequence is made up according to the topographical features of the single "trench environments".
While in the softly descending valleys, a simple soil/sand filling was sufficient, more exposed or steep areas needed heavier sealing materials to withstand the wave action during inundation. Soil and sand were still used to pack the structures tightly and to avoid damage to the archaeological remains, but gravel and stones were used to hold this filling in place and to resist the wave's action.
The soil and sand in direct contact with the structures was humidified and compressed in order to avoid shrinkage, when soaked with water. Special care was taken to fill all cisterns, covered rooms and areas to prevent cave ins and terrain reassessments. These operations were carried out by manpower using wheel barrels and shovels. The remaining backfill operation was carried out by mechanical gear were ever possible. Only in some particularly difficult terrain situations the materials were transported as close as possible to the trenches and then distributed by manpower. Once all the structures in the trench were covered with soil/sand the backfill was sealed with a gravel and stones. Generally we aimed to a covering of at least 50 cm on top of the soil fill. In the case of gentle slopes the gravel and the stones were mixed, while on steep hill sides the stones were distributed as a separated layer above the gravel. This had the effect of an natural filter where the bigger parts held in place the smaller particles impeding them to be washed away. The porous structure of the stone covering, similar to a sponge, aided to disperse the wave energy by forming numerous eddies.
A total of 8700 m^2 dislocated in 19 areas was reburied. The back filling volume was of 10.500 m^3. 630 truck loads of sand, gravel and stones were used beyond the excavation soil itself. The materials required were generously provided by the dam company free of charge; as we are taking about several thousands of cubic meters of sand, gravel and stones this silent sponsorship was of the outmost importance for the success of the back filling program.

7. Post-Excavation Site Protection and Shore Maintenance program

The first post-excavation season at Zeugma has shown that due to the particular conformation of the Birecik dam basin and the prevailing winds, the shoreline of the former Zeugma 2000 excavation is exposed to major wave activity especially on windy days. The winds are channelled by the Eufrate river canyon and then build further up once they reach the enlargement of the basin in the last 2-3 km before the dam. As the prevailing wind direction and the inlet of the canyon to the enlargement coincide in direction the resulting waves can splash up to a height of 3 meters. This obviously results in major erosion activity along the exposed shore line, especially the parts facing directly the incoming waves.

A few month after the end of the excavation there was clear evidence that in some areas the protection measures implemented during the excavation alone could not withstand the continued erosion in the fluctuation zone (283 meters – 285 meters). The amount of energy build up by the waves was big enough to remove and/or disrupt the heavy pebble covering (average stone size between 10-20 cm diameter) put in place on the closing of the excavation. Furthermore the wave action continued to disturb the not excavated zones of the shore bringing up continually archaeological remains. In some parts artefacts, as wall plasters and mosaic floors protected during the excavation, were uncovered; while the protective lime based mortar layer resisted quite well to the environmental threats, the structures supporting the artefacts themselves proved of little or no resistance to the erosion activity of the waterfront. The mud stone walls (Aslar) started

crumbling away and the floors often were set on not reinforced ground undermined by the water. It was clear that further protection measures were necessary to minimise the damage of the archaeological layers in the water fluctuation zone.

To improve the efficiency of the protection system set in October 2000, the following measures have been implemented: rows of woven plastic (nylon) bags filled with gravel (1-3 cm diameter) have been arranged parallel to the shoreline. These were turned onto each other according to the slope of the shore between 2-4 bags high. As the nylon bags have a very limited durability in outdoor conditions as they suffer from UV radiation, the uppermost row of bags has been filled with gravel mixed with cement. Behind this barrier heavy pebbles (10-20 cm diameter) have been filled in until the high water mark in tempest conditions. In some parts were the shoreline configuration allowed it, a double row of bags has been arranged in a 2-5 meter distance. The space between the two bag walls was filled with pebbles.

After one month also this solution showed a weak point in the material of the bags. The plastic deteriorated very fast distributing the filler free in the water and polluting the environment. It was therefore decided to move toward the local traditional sacs made of canvas completely biodegradable. The durability of those sacs was intended to be the time required to the mixture gravel/cement to dry up in their final location and shape.

The protective measures were put in place by local manpower aided by tractors equipped with dump-load trailers under the supervision of conservation professionals. A total of 5000 bags and 85 truckloads – equivalent to 850 cubic meters - of pebbles have been used.
To maintain in good condition during the first year after excavation an area of 8000 square meters (the shore line, 1,5km.) it required 600 working days plus materials and machinery equivalent to a total cost of $ 20,000US, that is $ 2,5 per square meter per one year.

The maintenance will continue until evidence shows, that thanks to the measures taken, a new equilibrium has been achieved.

The need of continued maintenance, may be seen as the evidence, that the reburial will not be successful. This kind of comment reflects a still common approach, which sees conservation as a one time job. We believe, instead, that the profession nowadays gets more and more conscious, that maintenance is an integral part of conservation. No one would doubt the necessity to maintain the reinforcements of a medieval castle on the coast. And the Zeugma site by now has become an excavation on the coast of the Birecik Dam Lake.

Conclusions

We would like to open the conclusions with the following consideration: the Zeugma Archaeological Project 2000 for sure is a border line scenario:

- A huge excavation organised and carried out in a very short time with multiple needs of conservation during and after the excavation;
- The ambient conditions were extremely harsh and unfavourable both for the operators and the archaeological remains;
- More over the water, rising according to an unalterable schedule, permitted no delays;

The methodological approach chosen will allow no access to the submerged area nor to any artefact contained. Some particularly exposed, not excavated areas on the steep slopes facing north west were badly damaged by water level during windy days. And finally the area within the 2 m deep fluctuation level below the high water mark runs a high risk of complete destruction over time.

On the positive side are instead that all the excavated areas have been protected. Finds and threaten structures have been removed and conserved. The techniques used and the materials applied are inoffensive and completely compatible with the archaeological remains. The unitary contexts have been almost fully respected and the operations carried out are completely reversible. Archaeological and technical information

have been collected and diffused and at the same time the material evidences (at the moment underwater) will be transmitted to future generations.

Overcoming a great deal of difficulties, an impressive area has been protected with good chances to survive unharmed the coming centuries in a save underwater "Dornröschen Schlaf". It is likely that a certain amount of minor damage may occur to some artefacts due to terrain assessment, dissolving mud brick fills or similar. But it is in our opinion at the best ingenious to assume that an excavation of this size could not be undertaken without damage, not to consider the entity of destruction which would have been provoked by the complete lifting of structures like wall paintings and plasters, mosaics, columns and paved areas such as mosaics transformed into "removable artefacts". A similar choice would have ended with picking out of their context the most spectacular pieces like rare gems to exhibit. Just the simple fact of having avoided that in an extreme situation our "primitive" treasure hunter instinct had an easy victory over a profoundly meditated response is a success: the archaeological structures of Zeugma have returned, after protective measures have been carried out, to a stable underwater environment, which will protect them from the dangers related to exposure. An accurate, archaeological documentation enable them to be studied and the results disseminated.

Our choice is one of the possible answers; other responses have been possible and have been proposed and discussed, with other advantages and disadvantages. It is our opinion that we took the most prudence and defensive choice under the given circumstances within the limits of human judgement. A lot of people have disagreed with our choice and most probable a lot of people will still disagree.
We think if not else this project has set a land mark, which will serve to develop any further discussion on the subject and occasions will not be missing.

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