

THE CONSERVATION OF A CHALCOLITHIC MURAL PAINTING
ON MUD BRICK FROM THE SITE OF TELEILAT GHASSUL, JORDAN

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A 4.14m² section of a Chalcolithic (c. 3000 B.C.) mural painting on mud brick was recovered in 1977 from the excavation of Teleilat Ghassul, the Hashemite Kingdom of Jordan.

The mural painting was in 33 major pieces and many fragments. The conservation treatment carried out is described.

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INTRODUCTION

The site of Teleilat Ghassul is located about five kilometers north of the Dead Sea, in the Hashemite Kingdom of Jordan. Discovered in the early 1920's, Teleilat Ghassul was initially excavated between 1930-36. Other campaigns were carried out in 1960, 1967 and 1975-77. Now known to cover at least 30-40 hectares, Teleilat Ghassul is recognized as one of the largest and most important sites of the Neolithic and Chalcolithic periods in Palestine (1). Of major importance are the mural paintings which have come to light since the 1931-32 excavation. With the exception of the mural paintings found at Çatal Hüyük, Turkey, those of Teleilat Ghassul, dating from about 3,500 - 3,000 B.C., are the earliest known paintings on a specifically architectural surface, as opposed to paintings executed directly on the walls of caves and rock shelters (2).

In 1977, a major area of mural painting was discovered lying face-down and still attached to a section of fallen wall. Although broken into 33 major pieces and many fragments, this 4.14 m² section presented the first opportunity to conserve a large and representative example of Ghassulian mural painting. Despite its fragmentary state, this mural painting is particularly significant because of its unique subject matter: at least three figures, apparently in ceremonial dress and moving toward a structure, have been postulated (Figure 1).

Under the direction of supervising archaeologist Dr. Basil Hennessy, University of Sydney, the mural painting was lifted and transported from the excavation to Amman. Dr. Adnan Hadidi, Director General, Department of Antiquities, immediately initiated plans to conserve the mural painting, requesting aid from UNESCO. ICCROM, the International Centre for Conservation, Rome, was contacted by UNESCO for technical assistance. In January, 1978, a team from ICCROM examined the mural paintings in Amman.

Following further studies to test materials for consolidating the mud brick and mounting the pieces, two missions under UNESCO contract were carried out by ICCROM (3). The conservation treatment was concluded in April, 1979, with the installation of the mural painting in the Amman Museum (4).

2. PHYSICAL CHARACTERISTICS OF THE TELEILAT GHASSUL MURAL PAINTING

Masonry of sun-dried mud bricks, about 13 cm in thickness, composed the structural support for the mural painting. The wall surface was primed by applying a cream-coloured preparation whose charge consisted largely of crushed sea shells. The naturally occurring pigments, limited to carbon black, sea shell white, yellow and red ochres, were applied to this preparation. The mural painting treated by ICCROM has at least three superimposed strata; each stratum, composed of preparation and pigments, is about 2 mm thick (5).

3. STATE OF PRESERVATION WHEN DISCOVERED AND CONSERVATION INTERVENTIONS PRIOR TO THE ICCROM MISSIONS

Although the mural painting was lying face-down and obscured by dirt, the fractured and friable condition of the mud brick was clearly evident during excavation. Several interventions were thus undertaken to permit the lifting of the pieces and their orderly transport to Amman.

3.1 Documentation

A plan of the mural painting in its original face-down position was made in scale 1 : 10. Each of the pieces was numbered. Obvious lacunae were indicated on the plan (Figure 2). Fragments were labelled and boxed according to their proximity to a numbered piece. In all, ten boxes of fragments, each box measuring about 25 cm x 30 cm were recovered.

3.2 Reinforcement and Lifting

The pieces were reinforced by applying dental plaster, sometimes with the inclusion of gauze or polyethylene to the dusted backs. A border of gauze,

adhered with polyvinyl acetate emulsion, was also applied to the edges of many pieces.

3.3 Initial Cleaning

The reinforced pieces were transported to the British School of Archaeology, Amman, and arranged face-up according to the field plan. The painted surface, obscured by dirt and surface accretions, was mechanically cleaned.

3.4 Reattachment of Paint

During cleaning, the very fragile state of the paint became more evident. Powdering and flaking paint was reattached by applying a 7 percent solution of Paraloid B72 in acetone (6).

4. CONSERVATION TREATMENT ENACTED BY THE ICCROM MISSIONS

The aims of the conservation intervention were to ensure the survival of the mural painting fragments and to devise a mounting system which would allow the painting to be exhibited. The successful completion of these two goals was complicated by the highly deteriorated state of the mural painting. The mud brick was so lacking in cohesive strength that the pieces cracked if handled and crumbled if immersed in a consolidant (Photograph 3). Moreover, the pigment layer was completely devoid of binder and any consolidant employed changed to some degree the tonality of the painting.

The white pigment, obtained from sea shells, was found to be particularly delicate. The overall treatment was further complicated by the shortness of time available and the handicaps of working under "field" conditions.

After preliminary tests it was decided that to safely treat the fragments the following major operations were required:

A clear documentation of all of the pieces to ensure their identification as the treatment progressed.

A thorough support for the pieces during each step of the treatment.

Removal of the plaster backings applied in the field and a reduction of the thickness of the mud brick, to decrease overall weight and bulk and to facilitate maximum absorption of the consolidant (7).

Retention of as much of the original support and aspect as possible consistent with maximum penetration of the consolidant.

Mounting and reassembly of the pieces.

Installation of the mounted mural painting in the Amman Museum.

The treatment proceeded as follows:

4.1 Documentation

A 1:1 tracing of the entire mural painting as found by the ICCROM team in Amman was made with transparent paper (Figure 3 and Photographs 1 and 2). In addition, individual 1:1 tracings were made of each of the 33 pieces. These tracings ensured the identification of each piece throughout the treatment and its exact repositioning according to the 1:1 master tracing. Moreover, the individual tracings permitted an accurate daily record to be kept of the condition and treatment of each piece as the work progressed.

4.2 Emergency Consolidation to Permit Handling

A 7 percent solution of Paraloid B72 in acetone was used to strengthen the considerable remaining areas of friable paint (Photograph 3).

4.3 Detached Areas

Detached areas were treated by injecting Paraloid B72 (15 percent in acetone) between strata with a syringe.

4.4 Reattachment of Fragments

Detached small fragments along the fractured borders of the pieces were glued into place with polyvinyl acetate emulsion, Vinavil, (50 percent in water).

4.5 Thinning and Consolidation of the Pieces

Each of the 33 pieces required individual consolidation. This entailed six steps:

- 4.5.1 The paint surface of each fragment was protected by applying a double facing of Japanese paper and surgical gauze adhered with a water-soluble cellulose paste (8). A supportive mold of plaster of Paris was then made to fit the faced surface and protect the perimeter of each piece.

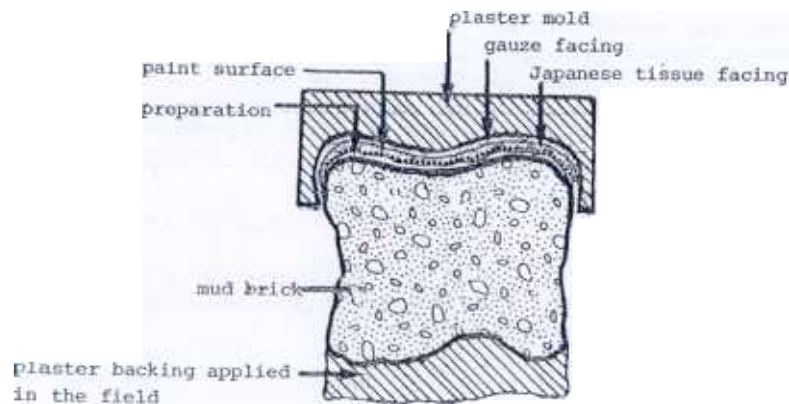


Diagram 1. Stratigraphy of a representative piece of the mural painting following protection of the pigment layer.

- 4.5.2 Supported by the facing and plaster mold, the piece was held rigid and could thus be safely turned face-down to permit removal of the plaster backings applied at the excavation. A bit and a mechanical shaft were used. Each piece was reduced to a uniform thickness of 3 cm to ensure maximum penetration of the consolidant; however, a 5 cm thick border was kept to retain as much of the original edge as possible.



Diagram 2. Section of mural painting after reduction of the mud brick.

- 4.5. A new plaster mold was then made to fit the reduced back of the piece to ensure full support during handling and to make an individual receptacle in which the piece would continue to be supported during impregnation with the consolidant. Prior to turning, a piece of polyethylene was placed between the back of the mud brick and the plaster mold to create an impermeable seal.

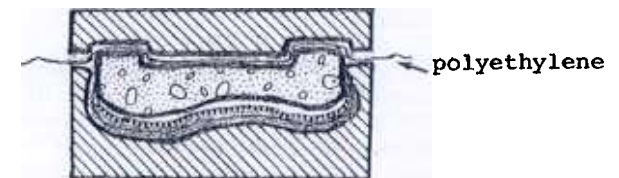


Diagram 3. A new plaster mold made to support reduced back.

4.5.4 The front mold, facings, and any traces of the paste were removed prior to consolidation to ensure that the facings did not become saturated with Paraloid B72 through the action of the Wäcker solvent, which might have prevented their safe removal. The back mold was then filled with a 50% solution of Wäcker Stone Strengthener H, an ethyl silicate, in Wäcker solvent (9). Total absorption of the consolidant occurred through the capillarity of the very porous mud brick. The piece was covered with aluminium foil overnight to retard the speed of solvent evaporation. The consolidated piece was allowed to dry for three days.

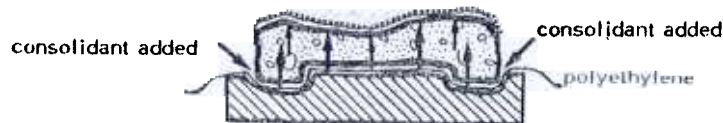


Diagram 4. After turning face-up, the plaster mold of the reduced back is utilized as a receptacle for the infusion of the consolidant.

4.6 Mounting and Assembly

Polyurethane foam was applied to each of the consolidated pieces, reconstituting the original 13 cm support of the painting (10).

4.6.1 The consolidated piece was fitted with its front mold to ensure support during turning. The reduced back of the mud brick was isolated with a 20 percent solution of Paraloid B72 in acetone. Plasticine walls were built around the piece and polyurethane foam was applied to the back to create an individual supportive mount. Thus consolidated and mounted, each piece could be moved and positioned without risk of damage.

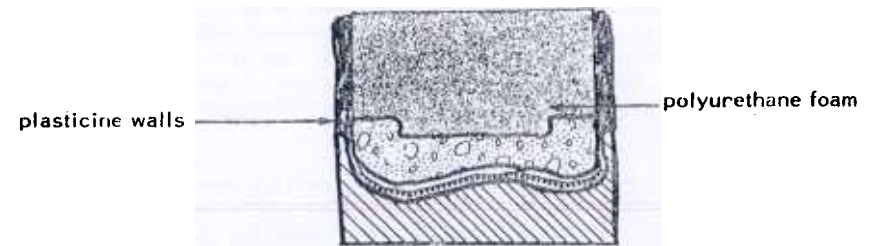


Diagram 5. Polyurethane foam applied to the reduced back of the mud bricks.

4.6.2 To facilitate reassembly, the 33 pieces of the mural painting were mounted into five separate blocks. The pieces composing each block were exactly positioned face-up and temporarily secured in place with wedges of plasticine. A master plaster mold was then made of the surface of the block.

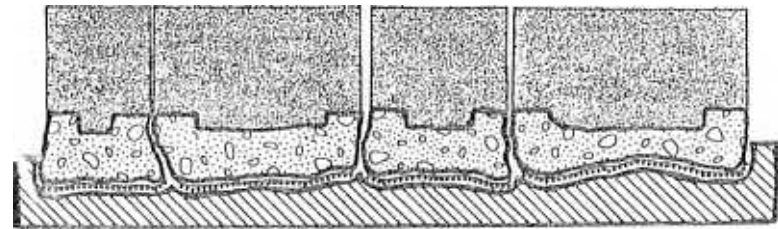


Diagram 6. A master plaster mold is made for each block of pieces.

4.6.3 When dry, the master mold was removed and reversed. Each piece of the block was fitted face-down in its respective position in the mold. Plasticine was used to fill all gaps and to make retaining walls between pieces. Polyurethane foam was then applied to the backs and in gaps, thus securing the pieces together as a block (Photograph 4). To make

the mount more rigid, plastic rods were inserted in channels cut into the foam. A second layer of polyethylene foam was then applied to incorporate the rods. The foam mount of each block of pieces was then uniformly reduced by mechanical means to 13 cm, the thickness of the original mud brick wall

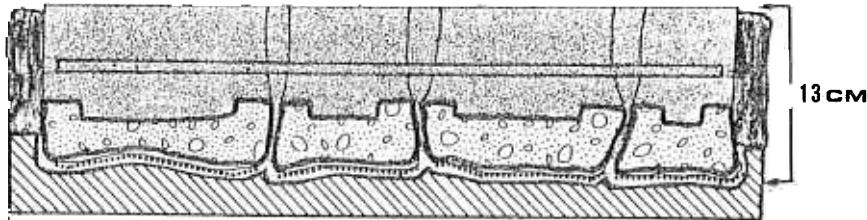


Diagram 7. The pieces fitted face-down in the master plaster mold and secured together as a block by the application of polyurethane foam and with reinforcing plastic rods.

To increase the rigidity of the support, the edges of the polyurethane mount were externally reinforced with a layer of fiberglass mat adhered with polyester resin. Mounting brackets made by laminating four strata of fiberglass with polyester resin were also incorporated (Photograph 5).

- 4.6.4 A wooden mount for the mural painting was constructed in the Amman Museum. The entire painting was then reassembled, each of its component blocks being independently secured in place by wooden screws inserted through the mounting brackets. The 80° angle of the mount was chosen to provide maximum support (Photograph 6).

- 4.6.5 Large lacunae in the assembled mural painting were filled with polyurethane foam for additional support. Joins between the blocks and lacunae were treated to simulate the

surface of the original mud brick mortar by applying a stucco composed of a 10 percent solution of polyvinyl acetate emulsion and a powder of the original mud brick, retained during the reduction of the pieces. No re-touching was carried out (Photographs 7 and 8).

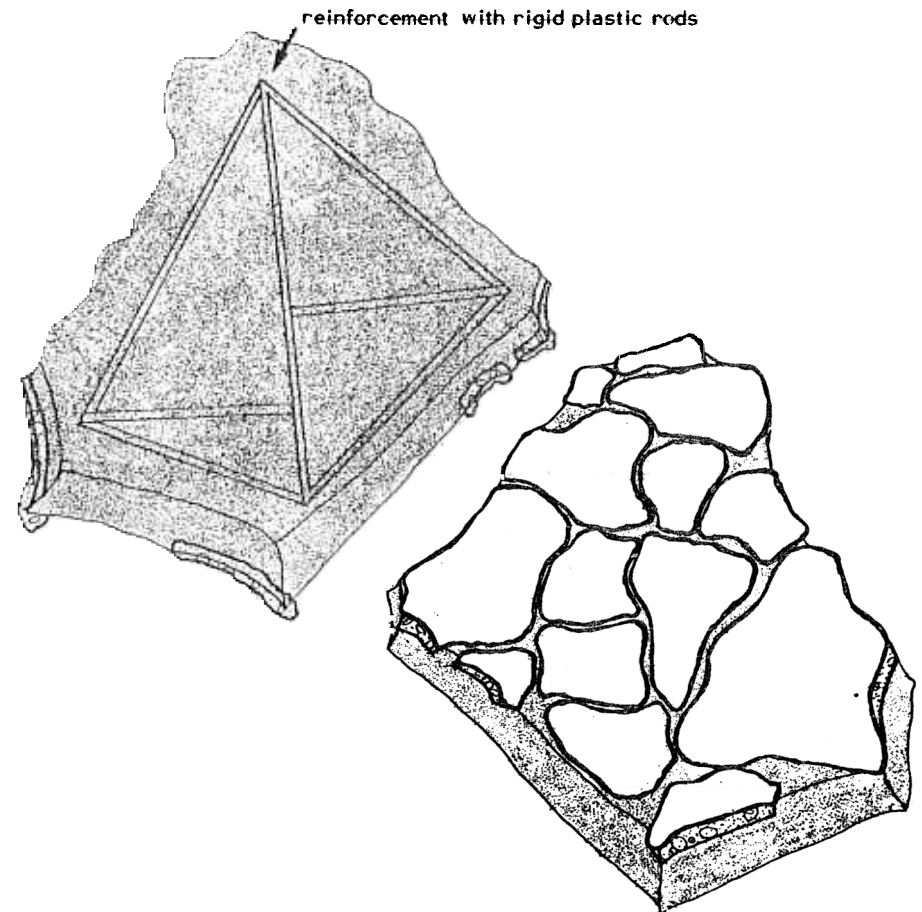


Diagram 8. A block of pieces after mounting with polyurethane foam and prior to reinforcement with fiberglass mat and polyester resin.

FOOTNOTES

The term Chalcolithic is applied to the culture horizon which followed the Neolithic.

Çatal Hüyük, located in central Anatolia, is an important Neolithic site, constructed from mud brick. Many of the mural paintings which adorned the walls were removed to the Ankara Museum.

- 3 Tests of consolidating materials were carried out at ICCROM by Mr. Christopher Wheatley under the direction of Dr. Giorgio Torraca.

- 4 Three missions were undertaken by ICCROM:

Inspection Mission, February 7 - 9, 1978

Dr. Harold J. Plenderleith, Director Emeritus, ICCROM;
Prof. Paolo Mora, Chief Restorer, Istituto Centrale del Restauro, Rome;
Dr. Giorgio Torraca, Assistant Director, ICCROM;
Paul M. Schwartzbaum, Chief Conservator/Restorer; Coordinator, Conservation of Mural Paintings Projects, ICCROM.

Mission I, November 7 - 30, 1978

Mr. Paul M. Schwartzbaum;
Mr. Christopher Wheatley, Conservator, ICCROM;
Ms. Constance S. Silver, former Assistant, ICCROM;
Ms. Ann Searight, British Museum.

Mission II, April 6 - 17, 1979

Mr. Paul M. Schwartzbaum;
Mr. Christopher Wheatley;
Ms. Isabelle Dangas, Monuments Historiques, France

A laboratory analysis of the component materials of the Teleilat Ghassul mural painting was carried out by Drs. D. Artioli, C. Meucci, M. Tabasso, Chemical Laboratory, Istituto Centrale del Restauro, Rome.

Mud Brick and Preparation

The mud brick and preparation were examined by X-ray diffraction to analyze the crystalline phases present. The numbers of the + signs indicate the relative abundance of the compound. The \pm signs indicate the presence of traces of a compound.

<u>Mud Brick</u>	<u>Preparation</u>
Calcite +++	Calcite +++
Quartz +++	Quartz +++
Dolomite ++	Aragonite +
Gypsum +	Dolomite +
Feldspars +	Gypsum +
Muscovite-Illite \pm	Feldspars \pm
Chlorites \pm	

The X-ray diffraction analyses strongly suggest a similar provenance for the raw materials of both the mud brick and preparation. However, the mud brick is considerably richer in clay minerals, feldspars and chlorites, while the aragonite is found exclusively in the preparation. A white material, the source of the aragonite, was thus intentionally added to the basic mud brick mortar to create a suitable light-colored preparation for the painting.

Calcium carbonate, in this crystalline phase known as aragonite, is less diffused in nature than calcite and is present often as a constituent of crustaceans and the calcareous shells of animals. Further analyses were undertaken to test this hypothesized origin for the aragonite. The preparation was observed with an electron scanning microscope equipped with a system for micro-analyses by non-dispersive X-ray fluorescence. Many conical forms and fibrous structures characteristic of organic aragonite were clearly observed, thus confirming pulverized shells of animal origin as its source.

The general elemental composition of the white preparation as results from the analyses is:

Mg+, Al+, Si++, P+, S+, K+, Ca+++, Fe+

In some areas, traces of chloride are also present. These results accord perfectly with those of the X-ray diffraction.

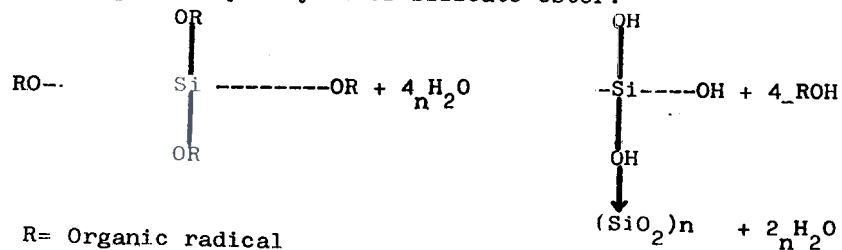
Pigments

The analyses by non-dispersive X-ray fluorescence with a source of Promethium 147 of an area of red color have shown essentially the presence of iron, indicating the use of simple ochres for the colored pigments.

6. The initial cleaning of the surface and reattachment of the paint were carried out by Ms. Ann Searight, December, 1977.

The dental plaster applied in the field was extremely hard, much stronger than the mud brick original material. Its removal which was necessary for facilitating the absorption of the consolidant and reassembly could be accomplished only after a complex rigid facing system had been applied to protect and support the weak painting fragments.

8. A water-soluble paste was employed because the paint surface, after consolidation with Paraloid B72 in the field, proved to be partially soluble in solvents but not in water. Moreover, paste remains easily removable with a light application of water.
9. Wacker Stone Strengthener H is an ethyl silicate. Its consolidating action is based on the formation of SiO_2 through the hydrolysis of silicate ester:



Technical data provided by the Wacker Co. Technical Data Sheet BHS/C/179/A.

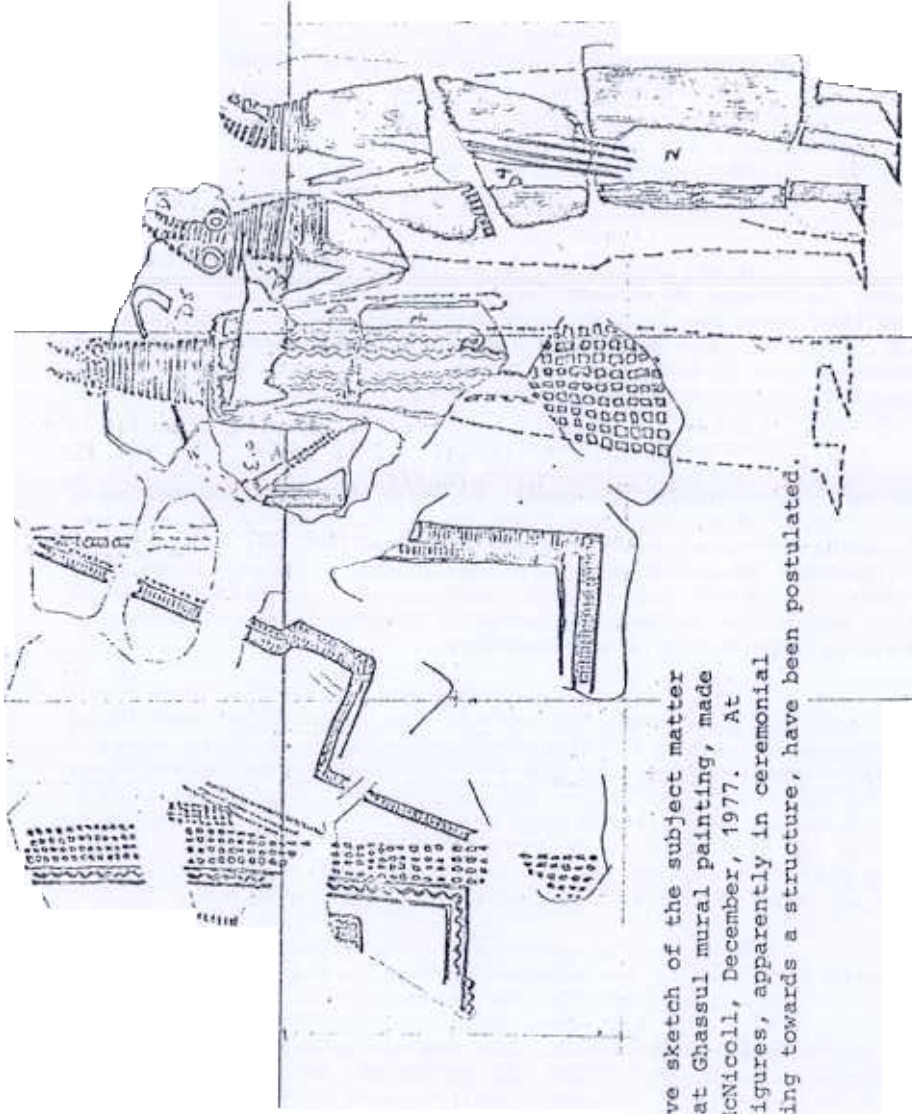
Isofoam polyurethane foam systems are used to produce a wide range of cellular materials by mixing two components:

1. RES Component, consisting of a polyol mixture blended with catalysts, foam stabilizing agents, flame retardant additives and the flowing agents which cause the mixture to expand.

ISO Component, A MDI (diphenyl methane di-isocyanate) composition.

When the two components are mixed, a chemical reaction is initiated which causes the mixture to expand and set into a homogeneous mass within minutes.

Technical data provided by the Baxenden Chemical Co. to Accrington, U.K.



An interpretive sketch of the subject matter of the Teleilat Ghassul mural painting, made by Dr. Tony McNicoll, December, 1977. At least three figures, apparently in ceremonial dress and moving towards a structure, have been postulated.

Figure 1.

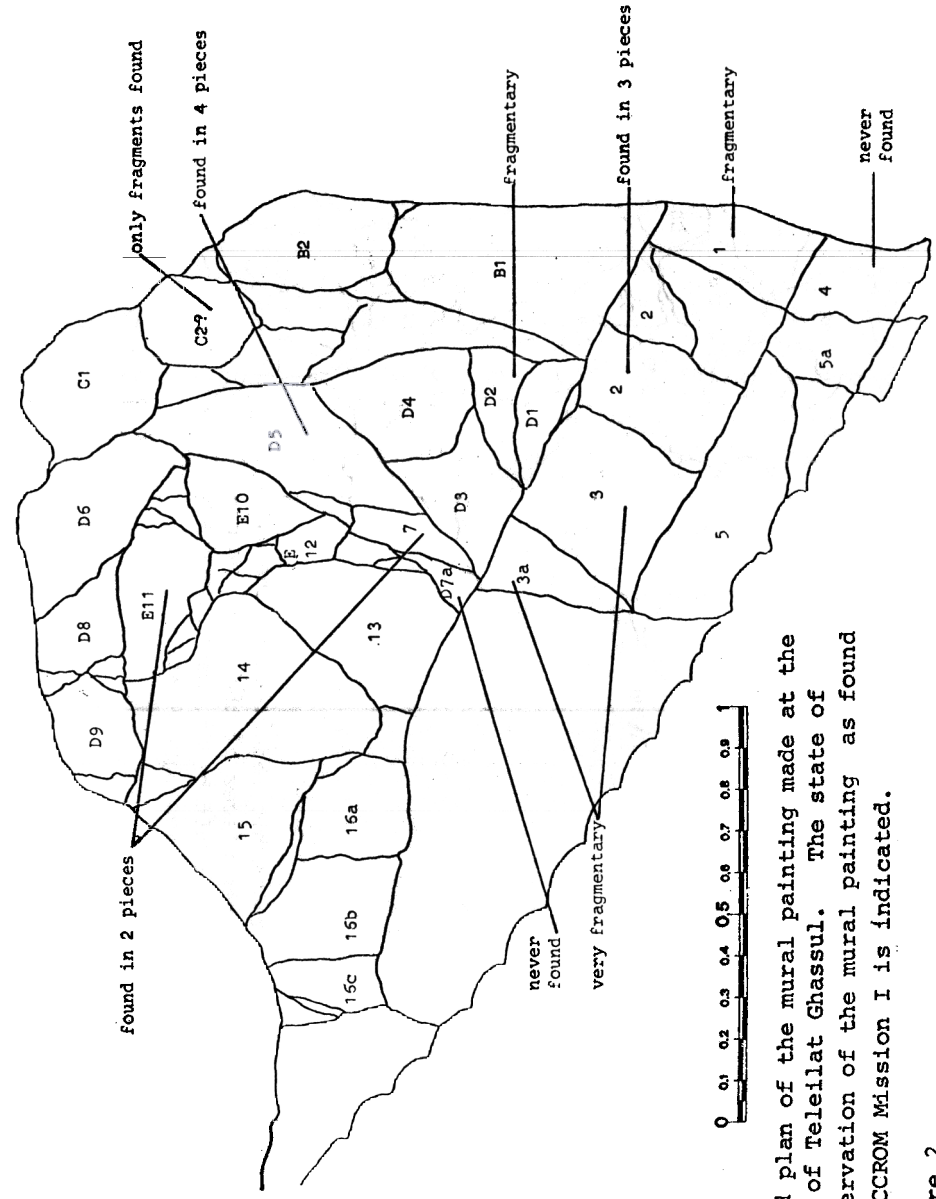
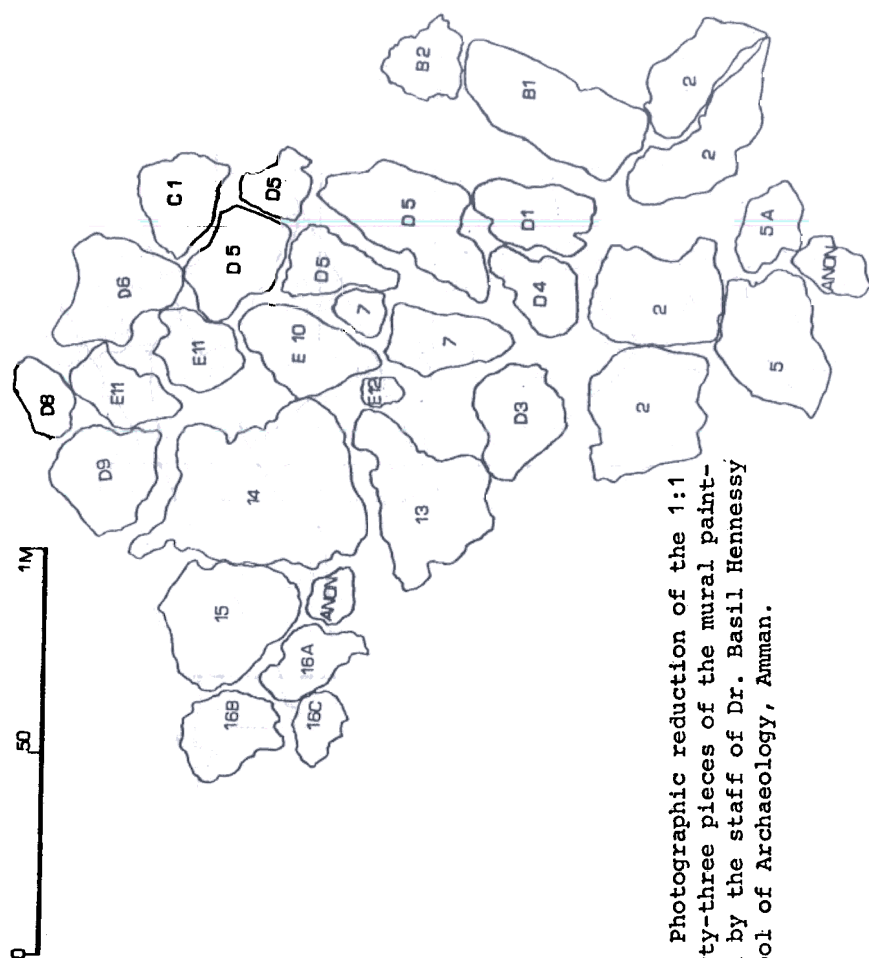


Figure 2.



ICCROM Mission I. Photographic reduction of the 1:1 tracing of all thirty-three pieces of the mural painting, as positioned by the staff of Dr. Basil Hennessy at the British School of Archaeology, Amman.

Figure 3.



The thirty-three pieces of the mural painting as found by ICCROM Mission I, November, 1978.



2. Detail of pieces 14, 15, and 16a, as found by ICCROM Mission I.



Macro-detail of piece 14 prior to treatment by ICCROM Mission I. Note the detachment of the paint layer and the severe lack of cohesion of the mud brick.



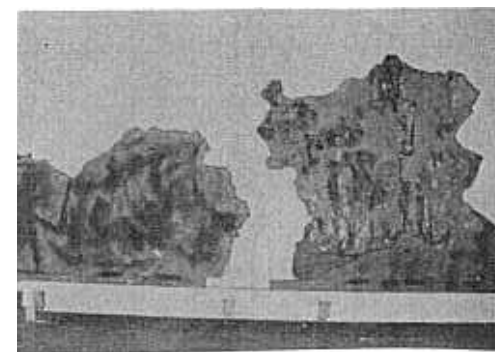
A block of pieces during mounting with polyurethane foam.

mounting bracket

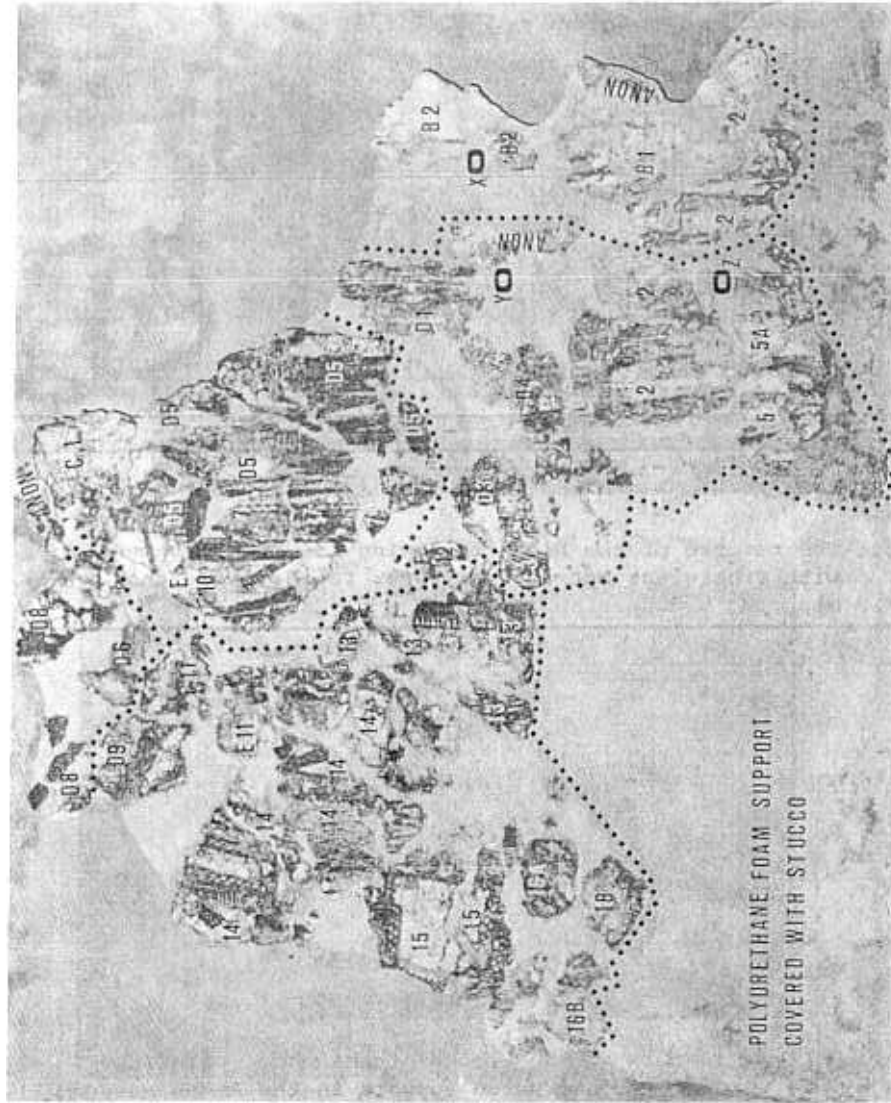
plastic rods



The reverse of the block following its reinforcement with fiberglass mat and polyester resin. Note the mounting brackets and the plastic rods.




During assembly of the blocks of the mural painting on a specially constructed support in the Amman Museum: note that the lower block (right) and the block to the left have been fabricated completely from polyurethane foam covered with a stucco composed of a powder of the original mud brick.



7. The mural painting after treatment. The joins between the five component blocks of the mural painting and the large lacunae have been filled with a stucco composed of a powder of the original mud brick.

Note: joins between the five component blocks

XYZ  location of the three blind screws

15 ,05 etc. indicate the location of each individual piece, designated by its original field number

ANON an anonymous piece found without a number by ICCROM Mission I.

8. The mural painting, after treatment.