PROCEEDINGS

The 9th Conference of the International Committee for the Conservation of Mosaics, Hammamet, Tunisia, November 29–December 3, 2005

Lessons Learned: Reflecting on the Theory and Practice of Mosaic Conservation



The Getty Conservation Institute

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Leçons retenues :
Les enseignements tirés des expériences passées dans le domaine de la conservation des mosaïques

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Proceedings of the 9th ICCM Conference
Hammamet, Tunisia, November 29–December 3, 2005

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The Getty Conservation Institute

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Foreword

The triennial conferences of the International Committee for the Conservation of Mosaics (ICCM) have been an essential source of information for professionals about mosaic conservation since the ICCM's founding in 1977. We are pleased to augment this distinguished tradition with the publication of the proceedings of the 9th ICCM Conference, held in Hammamet, Tunisia, November 29–December 3, 2005.

The 9th ICCM Conference was co-organized by the Institut National du Patrimoine (INP) of Tunisia and the Getty Conservation Institute (GCI), with the support of ICCROM (International Centre for the Study of the Preservation and Restoration of Cultural Property) and the University of Cyprus. The theme of the conference was "Lessons Learned: Reflecting on the Theory and Practice of Mosaic Conservation," and the four-day program included more than sixty papers and posters by professionals in the conservation of ancient mosaics and art historians and archaeologists of the Roman world. The organization of the conference in Tunisia was supported by His Excellency Mohamed El Aziz Ben Achour, Minister of Culture, and facilitated by the Agence de Mise en Valeur du Patrimoine et de Promotion Culturelle (National Agency for the Promotion of Cultural Patrimony) and the National Tourism Office.

The location of the conference, in Tunisia, provided an opportunity to attract participants from countries in the Middle East and North Africa, places that are rich in mosaic heritage but whose professionals have not been well represented at ICCM conferences. To make the most of this opportunity, the Getty Foundation awarded the ICCM a grant that enabled the participation of forty-nine professionals from these regions. We are grateful to the University of Cyprus, through the good offices of Demetrios Michaelides, for administering the grant on behalf of the ICCM. As a result of this participation, two members from Arabic-speaking countries were elected to the board of the ICCM at the end of the conference. Although the languages in official use during the conference were limited to French and English, an Arabic translation of the abstracts was made available by ICCROM through the support of its director-general, Nicholas Stanley-Price.

The fruitful partnership among the organizers of the 9th conference builds on many years of cooperation. The GCI and the INP have long collaborated to promote the conservation of ancient mosaics through training, documentation, and publication initiatives. The INP hosted the second meeting of the ICCM, in 1978, and under the leadership of the ICCM's president since 1996, Demetrios Michaelides, the GCI partnered with the University of Cyprus on the 6th ICCM Conference, held in Nicosia, Cyprus, in 1996. The INP and the GCI owe special gratitude to Dr. Michaelides, Aïcha Ben Abed, and Jeanne Marie Teutonico for their support of the partnership and their active engagement in the organization of the 9th Conference.

An enriching complement to the conference sessions was a program of visits to mosaic sites in Tunisia organized by the INP. These visits allowed participants to see the sites firsthand and to confront the many realities of conserving and managing mosaics in different cultural, environmental, and social contexts. The participants visited the sites of Thuburbo Majus, Jebel Oust, Neapolis, and Carthage and attended a magnificent reception at the Bardo Museum in Tunis, which houses the world's largest collection of ancient mosaics. At Thuburbo Majus, Jebel Oust, and Neapolis participants were able to meet and view the work of the mosaic maintenance technicians (undergoing training in Tunisia by the INP and the GCI). The new regional archaeological museum in Nabeul offered the opportunity to

view the splendid figurative mosaics, which had been removed from the site many years ago following its excavation.

The conference ended with an optional three-day tour of mosaic sites in Libya, which was an exceptional opportunity to experience the scale and extraordinary artistic and historic significance of Libya's archaeological heritage. The tour included visits to the Archaeological Museum in Tripoli and the ancient cities of Sabratha and Leptis Magna, as well as to Villa Silene and other sites normally closed to the public. We are grateful to Dr. Giuma Anag, director of Libya's Department of Antiquities, for facilitating access to these sites.

The proceedings of the 9th ICCM Conference reflect the breadth and diversity of issues and perspectives that have come to characterize mosaic conservation. We express our gratitude to the volume editors for shepherding these proceedings through to publication.

Timothy P. Whalen
Director
The Getty Conservation Institute

Mohammed Béji Ben Mami
Director-General
Institut National du Patrimoine, Tunisia

Avant-propos

Les conférences triennales du Comité International pour la Conservation des Mosaïques (ICCM) constituent, depuis la création de l'ICCM, en 1977, une source essentielle d'information pour les professionnels sur la conservation des mosaïques. C'est avec satisfaction que nous poursuivons cette tradition bien établie en y ajoutant la publication des actes de la 9e Conférence de l'ICCM, tenue à Hammamet, en Tunisie, du 29 novembre au 3 décembre 2005.

La 9e Conférence a été organisée conjointement par l'Institut National du Patrimoine (INP) de Tunisie et l'Institut Getty de Conservation (GCI) avec le soutien de l'ICCROM (Centre International d'Études pour la Conservation et la Restauration des Biens Culturels) et de l'Université de Chypre. La conférence a eu pour thème « Leçons retenues : Les enseignements tirés des expériences passées dans le domaine de la conservation des mosaïques » et le programme de quatre jours comprenait plus de soixante communications et posters présentés par des professionnels du domaine de la conservation des mosaïques anciennes ainsi que des historiens de l'art et des archéologues du monde romain. Son Excellence Mohamed El Aziz Ben Achour, Ministre de la Culture, a accordé son soutien à l'organisation de la conférence en Tunisie et celle-ci a été facilitée par l'Agence de Mise en Valeur du Patrimoine et de la Promotion Culturelle ainsi que par l'Office National du Tourisme.

La tenue de la conférence en Tunisie a été l'occasion d'encourager la participation des pays du Moyen-Orient et d'Afrique du Nord, des régions qui possèdent un riche patrimoine culturel mais dont les professionnels n'ont pas été suffisamment représentés aux conférences de l'ICCM. Afin d'optimiser cette opportunité, la Fondation Getty a accordé une subvention à l'ICCM qui a permis la participation de quarante-neuf professionnels provenant de ces régions. Nous sommes reconnaissants à l'Université de Chypre, et particulièrement à Demetrios Michaelides, d'avoir bien voulu gérer cette subvention au nom de l'ICCM. Cette participation a eu pour résultat l'élection de deux membres provenant de pays arabophones au bureau de l'ICCM à la fin de la conférence. Si les langues de la conférence ont été limitées au français et à l'anglais, une traduction en arabe des résumés à été prise en charge par l'ICCROM grâce au soutien de son Directeur général, Nicholas Stanley-Price.

Le partenariat fructueux entre les organisateurs de la 9e Conférence repose sur plusieurs années de coopération. Le GCI et l'INP collaborent depuis de nombreuses années pour promouvoir la conservation des mosaïques anciennes à travers des initiatives de formation, de documentation et de publication. L'INP a accueilli la deuxième réunion de l'ICCM en 1978 et, sous la direction du président de l'ICCM depuis 1993, Demetrios Michaelides, le GCI a organisé en partenariat avec l'Université de Chypre la 6e Conférence de l'ICCM à Nicosie, Chypre, en 1996. L'INP et le GCI sont particulièrement reconnaissants au Dr Michaelides, Aïcha Ben Abed et Jeanne Marie Teutonico pour le soutien qu'ils ont apporté à ce partenariat et pour leur engagement actif dans l'organisation de la 9e Conférence.

Les sessions de la conférence ont été enrichies par un programme de visites aux sites comportant des mosaïques, organisé par l'INP. Ces visites ont permis aux participants de prendre connaissance des sites et de constater personnellement les multiples réalités de la conservation et de la gestion des mosaïques dans des contextes culturels, environnementaux et sociaux différents. Des visites ont été organisées aux sites de Thuburbo Maius, Jebel Oust, Neapolis et Carthage et les

participants ont assisté à une magnifique réception au Musée du Bardo de Tunis, qui renferme la plus grande collection de mosaïques anciennes au monde. A Thuburbo Maius, Jebel Oust et Neapolis, les participants ont pu rencontrer et observer le travail des techniciens d'entretien des mosaïques (formés en Tunisie par l'INP et le GCI). Le nouveau Musée archéologique régional à Nabeul a permis aux participants de découvrir les magnifiques mosaïques figurées qui avaient été transférées hors du site après les fouilles il y a de nombreuses années.

La conférence s'est achevée avec une visite facultative de trois jours en Libye. Cette visite a constitué une occasion unique de constater l'ampleur et l'importance artistique et historique du patrimoine archéologique libyen. Ce tour comprenait des visites au Musée archéologique à Tripoli, aux cités antiques de Sabratha et Leptis Magna, ainsi qu'à la Villa Silène et autres sites normalement fermés au public. Nous sommes reconnaissants au Dr Giuma Anag, directeur du Département des Antiquités de Libye, pour nous avoir facilité l'accès à ces sites.

Les Actes de la 9e Conférence de l'ICCM reflètent l'étendue et la diversité de la problématique et des perspectives qui désormais caractérisent la conservation des mosaïques. Nous exprimons nos remerciements aux rédacteurs de ce volume pour avoir mené à bien la publication de ces actes.

Timothy P. Whalen
Directeur
Institut Getty de Conservation

Mohammed Béji Ben Mami
Directeur général
Institut National du Patrimoine de Tunisie

Acknowledgments

The successful organization of the 9th ICCM Conference and the publication of the proceedings were the result of the efforts and dedication of many individuals. In the planning stage, the ICCM Scientific Committee of the Board (Demetrios Michaelides, Jeanne Marie Teutonico, Roberto Nardi, Évelyne Chantriaux, and John Stewart) provided their time and expertise in conceptualizing the themes of the conference and selecting papers.

In Tunisia, through the support of the INP's director, Mohammed Béji Ben Mami, INP staff Saloua Zangar, Fathi Bejaoui, Habib Ben Younes, Tahar Ghalia, Mounir Fantar, and Féthi Chelbi took an active role in the conference arrangements and visits to mosaic sites and museums. Archaeologist Jean-Pierre Darmon provided his insights, acquired through many years of experience, during site visits. INP mosaic maintenance technicians also contributed to the site visits by demonstrating techniques and results of their mosaic work.

Kathleen Louw (GCI) skillfully took on the onerous task of coordinating the conference arrangements and the postconference tour. She was ably assisted in the preparatory stages by Niki Savvides on behalf of the ICCM and the University of Cyprus; and in Tunisia, by INP staff Lotfi Cherif, Lotfi Kahloun, Mohamed Charfa, Hamdi Dridi, Fatma Ghanem, and Habiba Chebil, and GCI staff and consultants Niki Savvides, Elsa Bourguignon, Sibylla Tringham, and Kenza Kahrim.

Conference interpreters Anne-Marie Driss, who also translated the preconference abstracts, Mohamed Ali Ben Yedder, and Mourad Boulares expertly facilitated communication between French and English. Elsa Bourguignon, Sibylla Tringham, Niki Savvides, and Kenza Kahrim acted as session rapporteurs and provided summary points for inclusion in the final presentation.

Kathleen Louw and Cynthia Godlewski undertook coordination of the proceedings for the GCI, and Tevvy Ball and Pamela Heath managed the project and coordinated production, respectively, for Getty Publications. Gary Hespenheide guided the design of the book. Elsa Bourguignon assisted with editing the discussion transcripts. Preliminary editing of papers was done by Anne Kurashige; final copyediting of the entire proceedings volume was undertaken by Sheila Berg (English) and Sabine de Valence (French). The summaries and introductory material were translated from English and French by Anne-Marie Driss.

On behalf of the GCI and the INP, we express our sincere thanks to all these individuals for their contributions to bringing the conference and its publication to a rewarding completion.

Aïcha Ben Abed
Martha Demas
Thomas Roby

Remerciements

La réussite de l'organisation de la 9e Conférence de l'ICCM ainsi que la publication des actes ont été réalisées grâce à l'engagement et aux efforts de nombreuses personnes. Au cours de la phase de planification, le Comité scientifique du Bureau (Demetrios Michaelides, Jeanne Marie Teutonico, Roberto Nardi, Évelyne Chantriaux et John Stewart) ont consacré à la fois leur temps et leur compétence à la conceptualisation des thèmes de la conférence ainsi qu'au choix des communications.

En Tunisie, grâce au soutien de son directeur, Mohammed Béji Ben Mami, les cadres de l'INP, Saloua Zangar, Fathi Bejaoui, Habib Ben Younes, Tahar Ghalia, Mounir Fantar et Féthi Chelbi, ont participé activement à la préparation de la conférence et des visites aux sites à mosaïques et aux musées. L'archéologue Jean-Pierre Darmon a partagé ses connaissances approfondies, acquises après de nombreuses années d'expérience, pendant les visites sur le terrain. Les techniciens d'entretien des mosaïques de l'INP ont également contribué aux visites sur les sites en fournissant une démonstration des techniques et des résultats de leur travail sur les mosaïques.

Kathleen Louw (GCI), a assumé avec compétence la lourde tâche de la coordination de l'organisation pratique de la conférence et du tour post-conférence. Elle a été efficacement aidée lors de la phase préparatoire par Niki Savvides au nom de l'ICCM et l'Université de Chypre ; et en Tunisie par le personnel de l'INP, Lotfi Cherif, Lotfi Kahloun, Mohamed Charfa, Hamdi Dridi, Fatma Ghanem et Habiba Chebil ainsi que par le personnel du GCI et les consultants Niki Savvides, Elsa Bourguignon, Sibylla Tringham et Kenza Kahrim.

Les interprètes de conférences Anne-Marie Driss, qui a également traduit les résumés pré-conférence, Mohamed Ali Ben Yedder et Mourad Boulares, ont facilité avec compétence la communication entre le français et l'anglais. Elsa Bourguignon, Sibylla Tringham, Niki Savvides et Kenza Kahrim ont assumé le rôle de rapporteur de séance en rédigeant les résumés pour inclusion dans la présentation finale.

Kathleen Louw et Cynthia Godlewski ont assuré la coordination des Actes pour le GCI et Tevvy Ball et Pamela Heath ont respectivement géré le projet et la coordination de la production pour le service des publications du Getty. Gary Hespenheide a dirigé la conception du livre. Elsa Bourguignon a fourni son assistance pour la mise en forme de la transcription des débats. Le travail éditorial préliminaire des communications a été fait par Anne Kurashige ; le travail éditorial final sur l'ensemble des Actes a été assuré par Sheila Berg (anglais) et Sabine de Valence (français). Les résumés et textes introductifs ont été traduits de l'anglais et du français par Anne-Marie Driss.

Au nom du GCI et de l'INP, nous tenons à exprimer nos sincères remerciements à toutes ces personnes pour leur contribution à la réussite de la conférence et de cette publication.

Aïcha Ben Abed
Martha Demas
Thomas Roby

Opening Remarks of the President of the ICCM on the Occasion of the 9th Conference

In the three years since the 8th ICCM Conference, in Thessaloniki, Greece (2002), more has been achieved by the ICCM than ever before in its history. It is heartening and encouraging to see how much has been accomplished, especially considering that the ICCM has little steady funding and everything is done on a voluntary basis. Since Thessaloniki, the proceedings of three conferences have appeared. In fact, we are now entirely up to date with our publications. First, there was the long-overdue publication of the 6th ICCM Conference, in Nicosia, Cyprus. Thanks to the offer of assistance from Nicholas Stanley-Price, director-general of ICCROM and board member of our committee, the volume appeared in 2003. Then came the proceedings of the 7th ICCM Conference, held in Arles and Saint-Romain-en-Gal, France, in 1999. Due to the hard work of our board member Patrick Blanc, in collaboration with Véronique Blanc-Bijon, Évelyne Chantriaux, and Marie-Laure Courboulès, the proceedings of that conference were also published in 2003. Finally, another of our board members, Charalambos Bakirtzis, has managed to get the proceedings of the 8th ICCM Conference published in time for the Tunisia conference—a real achievement.

Another milestone has been the creation of an official ICCM Web site, www.iccm.pro.cy. Thanks to the assistance of Niki Savvides and technical support from the University of Cyprus, this long-overdue public face of the ICCM has been achieved. We hope this will serve as a means of outreach to the larger conservation community and the general public, as well as an important source of information to our membership. But beware: memorize the address, because a search for ICCM on the Internet will lead to, among other sites, the International Center for Cosmetic Medicine, the International Congress on Cognitive Modelling, the International Congress of Chinese Mathematics, and the Institute of Cemetery and Cremation Management!

The creation of the Web site was one step toward giving the ICCM a more permanent and official character, which was one of the recommendations of the Thessaloniki conference. The next step in the same direction was the official registration of the ICCM as an organization with legal status. The committee was founded in 1977, and not having legal status did not matter so much at the beginning, when membership was moderate and our activities limited. With improvement in both these directions, however, and with stricter controls on international financial transactions, it became imperative to settle this matter. After exploring several alternatives with board members, all of which proved legally and financially problematic, I moved forward with registering the ICCM on the Cyprus Register of Companies. This now provides full legal status for the ICCM as a nonprofit organization with the ability to open an account to receive and disburse funds.

Attendance at the ICCM conferences has been building steadily over the years, and these meetings have become one of the most important international forums for the discussion of all issues related to mosaic conservation. The Tunisia conference is, in fact, the largest conference ever, with 244 participants representing thirty countries. This is the best proof of the ICCM's success.

No doubt the location of the meeting in Tunisia, a country with an enviable cultural heritage, especially in ancient mosaics, has encouraged participation. For this I would like to thank the Institut National du Patrimoine and its director-general, Mohammed Béji Ben Mami, as well as our board member Aïcha Ben Abed, for undertaking to host this meeting and encouraging participation from the Maghreb and

North Africa as a whole, a region that hitherto was poorly represented at our conferences. Although this is the first of our international conferences to take place in Tunisia, the involvement of this country with the ICCM goes back to the very beginnings of the organization. Tunisia has always been represented on the board, first by Mongi Ennaïfer and since 1992 by Aïcha Ben Abed. Through them and the support of the Institut National du Patrimoine, Tunisia hosted the second meeting of the ICCM, in 1978, and two meetings of the board, combined with Roundtables, in 2001 and 2004. I am delighted that this long collaboration has continued with the 9th conference.

Another agent without which this meeting would not have been possible is the Getty Conservation Institute, which I would like to thank in the person of its director, Timothy Whalen, and its associate director and ICCM board member, Jeanne Marie Teutonico. The GCI's role in the organization of this conference has been invaluable. The éminence grise in this affair is Martha Demas, senior project specialist at GCI, who, whether from Los Angeles or China, has been involved with and kept a watchful eye on every step in the organization process. Kathleen Louw, senior project coordinator, has taken most of the brunt of the organization and logistics of this conference, and I am grateful to her for doing a superb job. I also thank the GCI for supporting Niki Savvides, who assisted me during the organization of this conference. Niki has been my right hand over the past few months. My infinite thanks go to all of them for their good work.

As in the past, the spiritual mother of the ICCM, ICCROM, through its director-general, Nicholas Stanley-Price, has given its support, this time by providing the translations of the abstracts into Arabic—most important for this meeting taking place in North Africa.

I would like to express my deep gratitude to the Getty Foundation for giving us a generous grant, with which it has been possible to invite a considerable number of colleagues from the Arab-speaking world (both North Africa and the Near East) and from Turkey. It is wonderful to have such good representation from many countries that were either underrepresented or not represented at all at previous conferences.

Finally, I wish to acknowledge the contribution of the University of Cyprus, which provided all office and equipment support for the ICCM Secretariat and, above all, agreed to manage the grant money without overhead charges.

The theme of this year's conference is "Lessons Learned." After twenty-eight years of discussions and conferences on specific themes, the time was ripe for casting a look backward and reflecting on what has been happening, both in theory and in practice, during all these years in the world of mosaic conservation. We have a stimulating program in front of us, with some forty-five papers, twenty-five posters, and three video presentations. But don't worry; there is plenty of fun, too. Thanks to our hosts, you will enjoy some superb receptions that, judging by my past experience, will be truly unforgettable. And there are also the excursions to Thuburbo Majus, Jebel Oust, Neapolis, Carthage, and the mythical Bardo Museum.

I wish you all a most profitable and enjoyable stay in Tunisia and, above all, thank you all for coming and supporting the work of the ICCM.

Demetrios Michaelides
President, International Committee for the
Conservation of Mosaics
November 29, 2005

Allocution d'ouverture du Président de l'ICCM à l'occasion de la 9e Conférence

Au cours des trois années qui se sont écoulées depuis la 8e Conférence de l'ICCM tenue à Thessalonique, Grèce (2002), l'ICCM a accompli plus qu'il n'a jamais fait auparavant. C'est à la fois rassurant et encourageant de constater ce qui a été accompli, sachant notamment que l'ICCM ne dispose pas d'un financement régulier conséquent et que tout est basé sur le volontariat. Depuis Thessalonique, les actes de trois conférences ont été publiés et nous sommes maintenant à jour avec nos publications. Tout d'abord a paru la publication tant attendue des actes de la 6e Conférence à Nicosie, Chypre. Grâce à l'offre d'aide de Nicholas Stanley-Price, Directeur général de l'ICCROM et membre du bureau de notre comité, le volume est paru en 2003. Puis ce fut le tour des actes de la 7e Conférence de l'ICCM tenue à Arles et Saint-Romain-en-Gal, France, en 1999. Grâce aux efforts considérables du membre de notre bureau, Patrick Blanc, en collaboration avec Véronique Blanc-Bijon, Évelyne Chantriaux et Marie-Laure Courboulès, les actes de cette conférence ont été publiés en 2003. Finalement, un autre membre de notre bureau, Charalambos Bakirtzis, a réussi à assurer la publication des actes de la 8e Conférence à temps pour la conférence, véritable tour de force.

La création du site web officiel de l'ICCM (www.iccm.pro.cy) a marqué une autre étape importante. Grâce à l'aide de Niki Savvides et au soutien technique de l'Université de Chypre, cette vitrine publique de l'ICCM est enfin devenue réalité. Nous espérons que ce site constituera le moyen de s'ouvrir plus largement sur la communauté de la conservation ainsi que sur le grand public, et s'avérera une source d'information importante pour nos membres. Seulement, veillez à bien vous souvenir de l'adresse car si vous faites une recherche sur l'Internet pour trouver le site de l'ICCM vous allez vous retrouver, entre autres, sur le Centre international pour la médecine cosmétique, le Congrès international de la modélisation cognitive, le Congrès international des mathématiques chinoises et l'Institut pour la gestion des cimetières et de la crémation !

La création du site Web marque un pas en avant dans nos efforts pour doter l'ICCM d'un caractère plus permanent et officiel, conformément à une des recommandations de la conférence de Thessalonique. L'étape suivante a été l'enregistrement de l'ICCM pour lui donner un statut juridique. Le comité a été fondé en 1977, et au départ l'absence de statut juridique importait peu car les membres n'étaient pas nombreux et les activités étaient limitées. Cependant, ces deux aspects ont évolués avec le temps et de plus, les contrôles sont devenus beaucoup plus stricts en matière de transactions financières internationales. Il est donc devenu urgent de trouver une solution. Après avoir étudié, avec les membres du Bureau, les différentes possibilités qui posaient toutes des difficultés juridiques et financières, j'ai décidé d'enregistrer l'ICCM au registre des sociétés de Chypre.

L'ICCM dispose désormais d'un statut juridique en tant qu'organisation à but non lucratif qui lui permet d'ouvrir un compte pour recevoir et débourser des fonds.

La participation aux conférences de l'ICCM augmente régulièrement et ces réunions constituent désormais un des forums les plus importants pour discuter des problématiques liées à la conservation des mosaïques. Cette conférence en Tunisie est en effet la plus importante de toutes, avec 244 participants représentant trente pays. C'est bien la preuve du succès de l'ICCM.

Il est certain que le fait que la réunion se tienne en Tunisie, pays au riche patrimoine culturel, tout particulièrement en ce

qui concerne les mosaïques anciennes, a encouragé cette participation. A cet égard, je tiens à remercier l'Institut National du Patrimoine et son Directeur général, Mohammed Béji Ben Mami, ainsi qu'Aïcha Ben Abed, membre de notre bureau, pour avoir entrepris d'accueillir cette réunion et encouragé la participation de l'Afrique du Nord dans son ensemble, région qui jusqu'ici n'était pas bien représentée à nos conférences. Même si cette conférence est la première de nos conférences internationales à être organisée en Tunisie, l'implication de ce pays dans les travaux de l'ICCM remonte aux tous débuts de l'organisation. La Tunisie a toujours été représentée au sein de notre bureau, d'abord par Mongi Ennaïfer et depuis 1992 par Aïcha Ben Abed. Grâce à eux et au soutien de l'Institut National du Patrimoine, la Tunisie a accueilli la deuxième réunion de l'ICCM, en 1978, et deux réunions du bureau en même temps que des tables rondes, en 2001 et 2004. Je me réjouis que cette longue collaboration se poursuive avec la 9e Conférence.

Une autre organisation sans laquelle cette réunion n'aurait pas été possible est l'Institut Getty de Conservation, que je tiens à remercier à travers son directeur Timothy Whalen et son directeur associé et membre du Bureau de l'ICCM, Jeanne Marie Teutonico. Le rôle du GCI dans l'organisation de cette conférence a été primordial. Martha Demas, spécialiste de projet en chef auprès du GCI, est l'éminence grise dans cette affaire et, que ce soit de Los Angeles ou de Chine, elle s'est impliquée et a surveillé chaque étape du processus d'organisation. Kathleen Louw, coordinatrice de projet en chef, s'est chargée d'une grande partie de l'organisation logistique de cette conférence et je lui suis reconnaissant pour le travail formidable qu'elle a fait. Je souhaite également remercier le GCI pour le soutien apporté à Niki Savvides, qui m'a aidé pour l'organisation de ce congrès. Niki a été mon bras droit au cours des derniers mois. Je les remercie tous pour leur travail remarquable.

Comme par le passé, la mère spirituelle de l'ICCM, l'ICCROM, à travers son Directeur général, Nicholas Stanley-Price, a apporté son soutien, cette fois en fournissant la traduction des résumés en arabe, essentiel pour cette réunion en Afrique du Nord.

Je souhaiterais exprimer ma profonde reconnaissance à la Fondation Getty pour nous avoir octroyé une généreuse subvention qui nous a permis d'inviter un nombre important de collègues du monde arabophone (aussi bien d'Afrique du Nord que du Proche-Orient) et de Turquie. Nous nous réjouissons de voir une représentation aussi large de plusieurs pays qui auparavant étaient soit sous-représentés soit pas représentés du tout à nos conférences.

Finalement, je souhaiterais noter la contribution de l'Université de Chypre, qui nous a fourni tout le soutien matériel pour le Secrétariat de l'ICCM et surtout, s'est chargée de gérer la subvention sans prélever de frais.

Le thème de la conférence cette année est « Leçons retenues ». Après vingt-huit ans de discussions et de conférences sur des thèmes spécifiques, le temps est venu de regarder en arrière et de réfléchir sur l'évolution qui a eu lieu, au cours de ces années dans le monde de la conservation des mosaïques, du point de vue de la théorie et de la pratique. Un programme stimulant nous attend : environ quarante-cinq présentations, vingt-cinq posters et trois présentations vidéos. Mais ne vous inquiétez pas, nous allons également nous distraire. Grâce à nos hôtes, vous allez assister à de superbes réceptions qui, si je me réfère à mon expérience, seront inoubliables. Nous aurons également une excursion à Thuburbo Maius, Jebel Oust, Neapolis, Carthage, et au mythique Musée du Bardo.

Je vous souhaite tous un séjour intéressant et agréable en Tunisie et surtout, vous remercie tous d'être venus soutenir le travail de l'ICCM.

Demetrios Michaelides
Président, Comité International pour
la Conservation des Mosaïques
29 novembre 2005

Introduction

Aïcha Ben Abed, Martha Demas, and Thomas Roby

The theme of the 9th ICCM Conference in Tunisia was "Lessons Learned: Reflecting on the Theory and Practice of Mosaic Conservation." It seemed appropriate that after almost thirty years of ICCM conferences, the mosaic conservation field should look back on its experiences and begin to draw conclusions about what has been accomplished and where the field needs to go to improve conservation of our ancient mosaic heritage. To this end, the organizers sought papers that would reflect on theory and practice, addressing how and why they have changed and what has been learned over the years, or present results of an evaluation of the many aspects of mosaic conservation: documentation, training, site management, maintenance, in situ conservation treatments, lifting and re-laying, and interventions such as sheltering and reburial.

The four days of conference papers were organized according to seven subthemes, which have been retained in this publication of the conference proceedings: Evaluating Mosaic Practice, Caring for Mosaics in Museums, Documenting and Assessing Sites at Risk, Managing Sites with Mosaics, Sheltering Mosaics, Training of Conservation Practitioners, and Case Studies, in which specific interventions or projects were presented. The discussions following each theme, which animated the conference and provided valuable insights, have been edited for clarity but otherwise remain unchanged.[1] Sixteen posters presented at the conferences have also been incorporated in the proceedings. The main points that emerged in the themed sessions were summarized in the closing session of the conference and are included here as Part Eight, Summary Conclusions and Recommendations.

The conference, which invited reflection on mosaic conservation as practiced over the past several decades, did not always achieve the hoped-for level of analysis and critical evaluation. It did, however, bring to the fore the great strides that have been made in the field of mosaic conservation, as well as the weaknesses that remain to be addressed. The keynote speech, by Gaël de Guichen and Roberto Nardi, surveyed the history and development of mosaic conservation over the past fifty years. In the half century since it began to emerge as a distinct field of endeavor, mosaic conservation has broadened its scope and deepened its awareness of the mosaic in its context, the need for holistic planning, the types of training required for managing and conserving sites with mosaics, and the importance of documentation and compatible treatment materials, in particular the use of lime.

The ICCM conferences have been instrumental in effecting the theoretical shift from conservation of mosaics by detachment to conservation in situ. The divisions of the past between those who practiced conservation through lifting of mosaics and those who advocated in situ conservation have diminished, as practitioners have come to accept that lifting should happen much less often than it still does but that in certain instances it is the last and only option for the future conservation of a mosaic. As pointed out in the session on documenting and assessing sites at risk, some of those circumstances—mainly in the form of development pressures and looting—are unfortunately still prevalent and even increasing in many countries. Nevertheless, it is a true sign of maturation that the discourse on mosaic conservation has been able to move beyond the in situ/ex situ debate to a more nuanced approach to decision making in which an assessment of the mosaic's significance, its physical condition, and its management context are considered.

Despite the change in attitude in relation to the systematic detachment of mosaics, participants in the session on

caring for mosaics in museums drew attention to the problems that are often faced by museums possessing those mosaics that were detached long ago and frequently relaid on cement support panels or otherwise stored in poor conditions. To ignore this situation means to condemn thousands of mosaics stockpiled both at sites and in museums. The session provided examples of comprehensive assessment of museum collections to reverse this situation through new initiatives of conservation, study, and display.

While in situ conservation is now strongly advocated by the profession, the means of achieving it remain problematic for both technical and managerial reasons. As a technical intervention, in situ conservation requires an understanding of the physical condition and the causes of deterioration of mosaics in their original setting and the ability to mitigate the often complex factors at play. A review of the literature on deterioration and treatment presented in the first session revealed that most published work focuses on description of treatments carried out; there is a dearth of comprehensive and systematic accounts of deterioration processes leading to the development and implementation of mitigation strategies.

The lack of evaluation of the effectiveness of previous treatments or preventive measures such as sheltering and reburial of mosaics is another frequently cited issue in the field if we are to achieve a better understanding of what is effective for in situ conservation. It was in part to remedy this situation that the organizers selected the theme of the conference. The response, however, especially with regard to evaluating treatment, was disappointing. One reason may be that practitioners, especially those working in private practice, rarely have the opportunity and means to critically assess prior work.

The session devoted to shelters did include evaluation initiatives that are currently under way, and the case studies and posters dealing with reburial of mosaics attest to the strong interest in these methods. Both sheltering and reburial are important measures for preserving mosaics in situ, but they have different aims and require different management responses. Especially concerning reburial, however, there are divergent opinions about efficacy and appropriateness. It is a topic that warrants further in-depth discussion at future ICCM conferences in order to achieve more informed opinions and consensus.

The importance of context for understanding mosaics and the centrality of mosaics in "making a site," especially when linked with the growth in tourism to archaeological sites, was highlighted at the 6th ICCM Conference, in Nicosia. While the values that warrant in situ conservation are now well recognized and advocated, deciding whether a mosaic is lifted or left in situ, and what type of treatment or storage it receives, is equally influenced by the management context in which the site exists. The increasing attention to the role of maintenance and monitoring for successful in situ conservation has been evident in previous ICCM conferences, but to be successful, new profiles of personnel working on sites (from technicians to site managers) and training opportunities are required. Several papers in the training session presented recent initiatives for mosaic conservation technicians in the Middle East and in Tunisia, reflecting the growing recognition that in situ conservation requires personnel with the skills to maintain mosaics in a stable condition. This in turn requires a government authority willing and able to establish the requisite management organization and commit the resources to hire and sustain a corps of conservation technicians and conservators. It was also noted during the training session that there is no coordination among the initiatives, so there is little learning from the experiences of others.

Bringing these assessments of values, physical condition, and management context together in the decision-making process is the role of site management. The need for better site management and sustainable solutions loomed large in many of the presentations at the 9th conference. A common view expressed in the papers from the management session was that the field must address mosaic conservation as an element of overall site management while also taking a more long-term approach to ensure the sustainability of conservation interventions.

An essential aspect of a long-term and sustainable approach to preserving our ancient mosaic heritage in the best possible condition will be for national authorities to establish policies for conservation and public awareness, taking into account their personnel and financial resources. The international community of mosaic conservation professionals will also need to assume a more active role in coordinating the many positive experiences of mosaic conservation carried out in different regions to move the field forward. We feel confident that the publication of the papers from the ICCM conferences is one important step in that direction.

Notes

1 The transcripts of the discussions from session 3, Documenting and Assessing Sites at Risk, were unfortunately not recorded due to mechanical failure of the taping equipment.

Introduction

Aïcha Ben Abed, Martha Demas et Thomas Roby

La 9e Conférence de l'ICCM organisée en Tunisie a eu pour thème « Leçons retenues : Les enseignements tirés des expériences passées dans le domaine de la conservation des mosaïques ». Après près de trente ans de conférences de l'ICCM, il semblait utile de permettre au domaine de la conservation des mosaïques de faire le point sur son expérience passée et de commencer à tirer des conclusions par rapport à ce qui a été réalisé tout en envisageant les orientations qui permettraient d'améliorer la conservation de notre patrimoine de mosaïques anciennes. A cette fin, les organisateurs ont sollicité des communications qui soit proposeraient une réflexion sur la théorie et la pratique, sur la manière et les raisons de leur évolution et sur les leçons retenues au fil des années, soit qui présenteraient les résultats d'une évaluation d'un des nombreux aspects de la conservation des mosaïques : documentation, formation, gestion des sites, entretien, traitements de conservation *in situ*, dépose et repose et interventions tels que les abris et le réenfouissement.

Les quatre jours consacrés à la présentation des communications ont été organisés selon sept sous-thèmes qui ont été retenus également dans cette publication des Actes de la conférence : Évaluation de la pratique des mosaïques, Entretien des mosaïques dans les musées, Documentation et évaluation des sites à risque, Gestion des sites à mosaïques, Mise sous abri des mosaïques, Formation des praticiens, et Études de cas, réunissant les interventions spécifiques ou les projets. Les débats faisant suite à chaque thème, animant la conférence en y apportant une réflexion précieuse, ont fait l'objet d'un travail de mise en forme[1] pour assurer davantage de clarté, sans pour autant subir de modification. Les seize posters présentés à la conférence ont également été inclus dans les actes. Les points principaux qui ont émergé des sessions à thème ont été résumés lors de la session de clôture de la conférence et sont présentés ici dans la Partie VIII, Résumé des Conclusions et Recommandations.

La conférence, qui invitait à une réflexion sur la conservation des mosaïques telle que pratiquée au cours des dernières décennies, n'a pas toujours atteint le niveau d'analyse et d'évaluation critique souhaité. Toutefois, elle a mis en évidence les progrés accomplis dans le domaine de la conservation des mosaïques, ainsi que les faiblesses auxquelles il conviendrait de remédier. Dans leur discours-programme Gaël de Guichen et Roberto Nardi ont passé en revue cinquante ans d'histoire et d'évolution de la conservation des mosaïques. Pendant ce demi-siècle, depuis que le domaine a commencé à affirmer sa spécificité, la conservation des mosaïques a élargi son champ d'application et approfondi sa prise de conscience de la mosaïque dans son contexte, du besoin d'adopter une planification globale, des types de formation nécessaires pour gérer et conserver les sites à mosaïques, et de l'importance de la documentation et des matériaux de traitement compatibles, en particulier l'utilisation de la chaux.

Les conférences de l'ICCM ont joué un rôle décisif pour opérer un changement de cap théorique et passer de la conservation des mosaïques par dépose vers la conservation *in situ*. Les divisions qui existaient entre ceux qui pratiquaient la conservation en déposant les mosaïques et ceux qui prônaient la conservation *in situ* ont diminué. Les praticiens ont commencé à accepter que le recours à la dépose ait lieu beaucoup moins souvent mais que dans certains cas cela puisse constituer la dernière et unique option pour la conservation d'une mosaïque. Comme il a été dit lors de la session sur la documentation et l'évaluation des sites à risques, certaines circonstances – principalement des pressions dues au

développement ou au pillage – subsistent malheureusement toujours et gagnent même de l'ampleur dans de nombreux pays. Cependant, c'est un véritable signe de maturation que le discours sur la conservation des mosaïques ait pu dépasser le simple débat pour préparer une prise de décisions beaucoup plus nuancée tenant compte de l'évaluation de l'importance de la mosaïque, de son état matériel et du contexte de sa gestion.

Malgré l'évolution des attitudes par rapport à la dépose systématique des mosaïques, les participants à la session sur l'entretien des mosaïques dans les musées ont attiré l'attention sur les problèmes auxquels font souvent face les musées qui abritent des mosaïques déposées depuis longtemps et souvent reposées sur des supports en ciment ou alors stockés dans de mauvaises conditions. Ne pas reconnaître cette situation signifie la condamnation de milliers de mosaïques stockées à la fois sur les sites et dans les musées. Les sessions ont proposé des exemples d'évaluations complètes de collections de musées pour remédier à cette situation à travers des nouvelles initiatives de conservation, étude et exposition.

Si la conservation *in situ* est à présent fortement préconisée par la profession, les moyens d'y parvenir demeurent problématiques pour des raisons à la fois techniques et de gestion. En tant qu'intervention technique, la conservation *in situ* nécessite une connaissance de l'état matériel et des causes de détérioration des mosaïques dans leur cadre d'origine et la capacité d'atténuer les facteurs souvent compliqués qui entrent en jeu. Une étude de la documentation sur la détérioration et les traitements présentée au cours de la première session a montré que la majorité des travaux publiés sont consacrés à la description des traitements effectués ; il existe peu de comptes rendus complets et systématiques des processus de détérioration qui conduisent au développement et à la mise en œuvre de stratégies d'atténuation.

Le manque d'évaluation de l'efficacité des traitements précédents, ou des mesures préventives telles que la mise sous abri ou le réenfouissement des mosaïques est souvent évoqué. Cela permettrait une meilleure compréhension des approches les plus efficaces pour la conservation *in situ*. C'est en partie pour remédier à cette situation que les organisateurs ont choisi le thème de la conférence. Toutefois, la réponse, particulièrement en ce qui concerne l'évaluation des traitements, a été décevante. Cela pourrait s'expliquer, entre autres, par le fait que les professionels, notamment privés, ont rarement l'occasion ou les moyens d'entreprendre une évaluation critique des travaux précédents.

La session consacrée aux abris a fait état de quelques initiatives en cours en matière d'évaluation et les études de cas et posters se rapportant aux réenfouissements des mosaïques témoignent du grand intérêt porté à ces méthodes. La mise sous abris ainsi que le réenfouissement sont des mesures intéressantes pour préserver les mosaïques *in situ*, mais ils répondent à des objectifs différents et requièrent des mesures de gestion différentes. Notamment en ce qui concerne le réenfouissement, les avis sont partagés sur son efficacité et sa pertinence. C'est un sujet qui mérite d'être davantage approfondi lors des prochaines conférences de l'ICCM afin de permettre des opinions mieux informées et susciter un consensus.

L'importance du contexte pour comprendre les mosaïques et le rôle central des mosaïques qui « font un site », particulièrement en conjonction avec la croissance du tourisme sur les sites archéologiques, sont des aspects évoqués lors de la 6e Conférence à Nicosie. Alors que les valeurs justifiant la conservation *in situ* sont désormais reconnues et prônées, la décision de savoir si une mosaïque doit être déposée ou laissée *in situ*, et quel type de traitement ou de stockage lui appliquer sont des questions qui sont également influencées par le contexte de gestion du site. L'attention de plus en plus grande accordé à l'entretien et au suivi pour assurer une conservation *in situ* réussie a été évoquée lors des conférences précédentes de l'ICCM mais pour assurer la réussite il est nécessaire de disposer de nouveaux profils de personnel travaillant sur les sites (des techniciens jusqu'aux gestionnaires de site) ainsi que d'opportunités de formation. Lors de la session consacrée à la formation, plusieurs communications ont fait état d'initiatives récentes concernant les techniciens pour la conservation des mosaïques au Moyen-Orient et en Tunisie, reflétant ainsi le constat de plus en plus partagé que la conservation *in situ* requiert un personnel capable de maintenir les mosaïques dans un état stable. Cela exige aussi une autorité de tutelle avec la volonté et la capacité de mettre en place une organisation de gestion adéquate et d'engager les ressources nécessaires pour embaucher et maintenir un corps de techniciens de la conservation et de conservateurs-restaurateurs. Il a également été constaté lors de la session sur la formation qu'aucune coordination existe entre les initiatives, empêchant ainsi la transmission de l'expérience.

Le rôle du gestionnaire de site est de rassembler ces évaluations des valeurs, de l'état physique et du contexte de gestion pour les intégrer dans le processus décisionnel. Plusieurs communications présentées à la 9e Conférence ont insisté sur la nécessité de mettre en place une meilleure gestion des sites

et de trouver des solutions durables. Lors de la session sur la gestion, il y a eu un accord général pour dire que la conservation des mosaïques doit être considérée comme un élément de la gestion d'un site dans son ensemble tout en adoptant une approche à plus long terme afin d'assurer la durabilité des interventions de conservation.

Un aspect essentiel d'une approche à long terme et durable à la préservation du patrimoine de mosaïques anciennes dans le meilleur état possible serait que les autorités nationales mettent en place des politiques de conservation et sensibilisation du public, en tenant compte de leurs ressources financières et humaines. La communauté internationale des professionnels de la conservation des mosaïques devra aussi assumer un rôle dans la coordination des nombreuses expériences positives en ce domaine dans différentes régions pour le faire avancer. Nous sommes confiants que la publication des communications des conférences de l'ICCM constitue un pas important dans cette direction.

Notes

1 La transcription des débats de la session 3, Documentation et évaluation des sites à risque, n'a malheureusement pas pu aboutir à cause d'un problème technique du matériel d'enregistrement.

PART ONE

Evaluating Mosaic Practice

Mosaic Conservation: Fifty Years of Modern Practice

Gaël de Guichen and Roberto Nardi

Abstract: *The practice of mosaic conservation has evolved significantly over the past several decades. Fifty years ago mosaics were approached as isolated objects, without context, and interventions were undertaken without adequate planning. There were limited options for conservation strategies (detachment was the main option available); the workforce consisted mainly of artisans, craftspersons, or carpenters; and materials were limited to cement, gypsum, or adhesives. This paper reviews the changing philosophy and practice of mosaic conservation, leading to the current state of the art.*

Résumé : *La pratique de la conservation des mosaïques a considérablement évolué au cours des dernières décennies. Il y a cinquante ans, la mosaïque était abordée comme un objet isolé et sans contexte et les interventions étaient effectuées sans planification adéquate. En décidant d'une stratégie de conservation les options étaient très limitées (la dépose constituait l'option principale), les intervenants étaient principalement des artisans tels que les menuisiers et les matériaux se limitaient au ciment ou au plâtre. A partir de ces débuts, la présentation retrace l'évolution de la philosophie et de la pratique de la conservation des mosaïques, pour arriver aux « méthodes de pointe » actuelles.*

In a sense the conservation of mosaics is a practice as old as the making of mosaics themselves. Today one can find ancient mosaics with patches made as part of maintenance when the floors were still in use. In more recent centuries restoration was widely practiced on objects of antiquity, including mosaics. And from the first decades of the twentieth century we have fine examples of restorations.

Before the mid-twentieth century, discoveries of mosaics occurred primarily during archaeological excavation of known sites. During the postwar period in Europe massive construction and reconstruction was undertaken, and discoveries of mosaics occurred more frequently throughout the continent. This does not mean, however, that these artifacts were ultimately preserved. According to a 1971 study by the French engineer Claude Bassier, of 660 pavements found in France since 1870 and published by archaeologists, at least 83 percent were abandoned, destroyed, or lost (Bassier 1975). The remaining pavements—those whose subjects were figurative and considered valuable—were, according to the traditional techniques of the time, systematically removed from archaeological sites. Some were relaid on concrete slabs; others were abandoned in storage, where many remain today (fig. 1).



FIGURE 1 Mosaics lifted from their original sites and placed in storage. Photo by Roberto Nardi.

In the early postwar period strategies for mosaic conservation were very limited; detachment was the primary option available. Interventions were typically undertaken without adequate planning and with a workforce that consisted mainly of artisans, craftspersons, or carpenters. Conservation practice was based solely on empirical knowledge, and the materials used by practitioners were limited to cement, gypsum, and adhesives. In addition, documentation was lacking. Practitioners worked in isolation, without the benefit of professional associations. An exception in the late 1950s to the typical treatment of excavated mosaics was the completion of the excavation of the Villa del Casale in Piazza Armerina, Sicily (fig. 2); there Cesare Brandi introduced the solution of conserving the villa's remarkable mosaics in situ and protecting the entire site (Brandi 1956; Stanley-Price 1997).



FIGURE 2 The mosaics of the Villa Romana del Casale in Piazza Armerina, Sicily, were conserved in situ and sheltered in the late 1950s. Photo by Guillermo Aldana 1993. © J. Paul Getty Trust.

In the 1960s a dramatic evolution in mosaic conservation began. Two important professional figures came to prominence in this decade: Rolf Wihr in Cologne, Germany, and Claude Bassier in Périgueux, France. Wihr was a conservator-restorer, working at the Rheinisches Landesmuseum in Trier. Bassier, in private practice, was called in on rescue excavations when mosaics were discovered. He was able to arrive within two days, with trucks, a crate, and a tent with heating systems, ready to work, even in winter. Both Wihr and Bassier introduced new approaches, which included systematic documentation, new supports (honeycomb aluminum instead of concrete), and new adhesives (resins instead of glues and cement) (Bassier 1978). But they also continued the established practice of polishing the mosaic surfaces.

A third significant figure who advanced the field technologically at an early date was Antonio Cassio of the Istituto Centrale per il Restauro in Rome. Cassio, a mosaicist from a family of mosaicists, preferred a more sensitive and controlled method for detaching mosaics. He used a system typical of mosaic making itself, which permitted the detachment of mosaics in pieces averaging 25 square centimeters (Cassio 1982). This method substantially reduced cutting stresses—and therefore reduced damage to mosaics being lifted.

In the late 1960s, again in Italy, a different field—mural painting—was undergoing a theoretical and practical reevaluation, which would have a direct and important impact on mosaic conservation. In 1968 the International Center for the Study of the Preservation and Restoration of Cultural Property (ICCROM) joined with the Istituto Centrale per il Restauro to initiate an annual four-month course on the conservation of wall paintings. At first the highlight of the course was the detachment of a wall painting, but very quickly in situ consolidation was embraced as a more appropriate method, as wall paintings came to be considered an integral part of the buildings in which they occurred. This evolution in wall paintings conservation led to the publication in 1977 of the fundamental book for the profession, *Conservation of Wall Paintings* (Mora, Mora, and Philippot 1977).

Establishing the International Committee for the Conservation of Mosaics

All this was in the air in 1977 when the first meeting on mosaic conservation—with forty-five participants—was organized in Rome. At the end of this conference ten of the participants decided to establish the International Committee for the Conservation of Mosaics (ICCM) and to act as its first board.

The publication of the proceedings of the meeting, addressed to archaeologists, conservator-restorers, technicians, administrators, and the public, was titled *Mosaics, No. 1: Deterioration and Conservation* (Selvig 1978). Another important result of the meeting was the recommendation to launch a course on mosaic conservation.

The 1977 meeting in Rome was the starting point for a series of regular conferences. The following year, the Institut National du Patrimoine in Tunisia hosted the second conference and went on to host subsequent meetings of the ICCM board. The latest conference, the ninth, took place in Hammamet, Tunisia, in 2005. Following each of these meetings, the proceedings were published. In addition to the proceedings, twelve newsletters have been published. These materials represent for the profession a basic source of information that did not exist fifty years ago.

The evolution in the thinking of the ICCM—and, indirectly, the trend in its professional principles—is reflected in the themes of each of its conferences:

Rome, Italy, 1977: *Deterioration and Conservation*
Tunis and Carthage, Tunisia, 1978: *Safeguard*
Aquileia, Italy, 1983: *Conservation in Situ*
Soria, Spain, 1986: *Conservation in Situ*
Palencia, Spain, 1989: *Conservation in Situ*
Faro-Conimbriga, Portugal, 1992: *Conservation, Protection, Presentation*
Nicosia, Cyprus, 1996: *Mosaics Make a Site: The Conservation in Situ of Mosaics on Archaeological Sites*
Saint-Romain-en-Gal and Arles, France, 1999: *Mosaics: Conserve to Display?*
Thessaloniki, Greece, 2002: *Wall and Floor Mosaics: Conservation, Maintenance, and Presentation*
Hammamet, Tunisia, 2005: *Lessons Learned: Reflecting on the Theory and Practice of Mosaic Conservation*

It is evident that by 1983 the ICCM was pointing out the importance of in situ conservation and encouraging its use whenever possible. In this way, it mirrored an evolution that had already occurred among wall paintings specialists.

Another principle that ICCM has come to strongly support is the rejection of the use of cement in the conservation and restoration of mosaics. It had been clear for some time that the use of cement in the conservation of ancient monuments brought the risk of an increase in damage. In response, the Italian conservation scientist Giorgio Torraca launched research in 1980 to replace cement with, paradoxically, one of the oldest construction materials known—lime-based mortar (Ferragni et al. 1984). However, even within the ICCM, almost ten years of heated debate took place before lime-based mortars were generally accepted and before cement applied in direct contact with mosaics was replaced. The use of lime-based mortars has allowed the development of in situ consolidation and furthered the practice of maintenance in situ when possible. (Unfortunately, despite the abundant evidence of destruction caused by cement in conservation interventions, this material is still used on mosaics—and worse, its use is still taught as a technique in some countries.)

Another important advance that can be credited to discussion and reflection at several ICCM conferences was the acceptance by conservation practitioners of a planned approach to safeguarding mosaic floors. In 1996 a question-driven flowchart was developed to help practitioners determine which of several options would be most appropriate to a particular context and set of problems (fig. 3). The questions related to risk, visitation, significance, available resources, and archaeological investigation, and they led to consideration of a range of options, including backfilling, lifting and transferring to a museum, lifting and re-laying in situ, and consolidation in situ.

The standard practice of leaving a mosaic on-site without protection—or of lifting the pavement and abandoning it in storage—was clearly the result of a lack of planning, as well as demonstrative of the attitude of some archaeologists, insensitive to conservation, who felt that their work ended the day they published their findings. A systematic analysis of practical conditions can help to determine different and more appropriate approaches for dealing with an excavated mosaic. With any of these options, serious planning before implementation is required.

The four ICCM conferences following those dedicated to in situ conservation referenced in their titles the issues of public presentation of mosaics. As early as 1978 it was suggested in *Mosaics, No. 1*, that the public be involved "so that specialists responsible for conservation receive support from both groups and individuals. It is the public, after all, that benefits and is served by the world-wide conservation movement" (Selvig 1978: foreword). This approach established in the mosaic conservation field recognition that an objective of the conservation profession is to present and to interpret for the public the cultural properties that we are engaged in conserving (fig. 4).

To influence the actual practice of mosaic conservation, these new ideas and approaches required adequate training at all levels. Yet the development of training did not happen

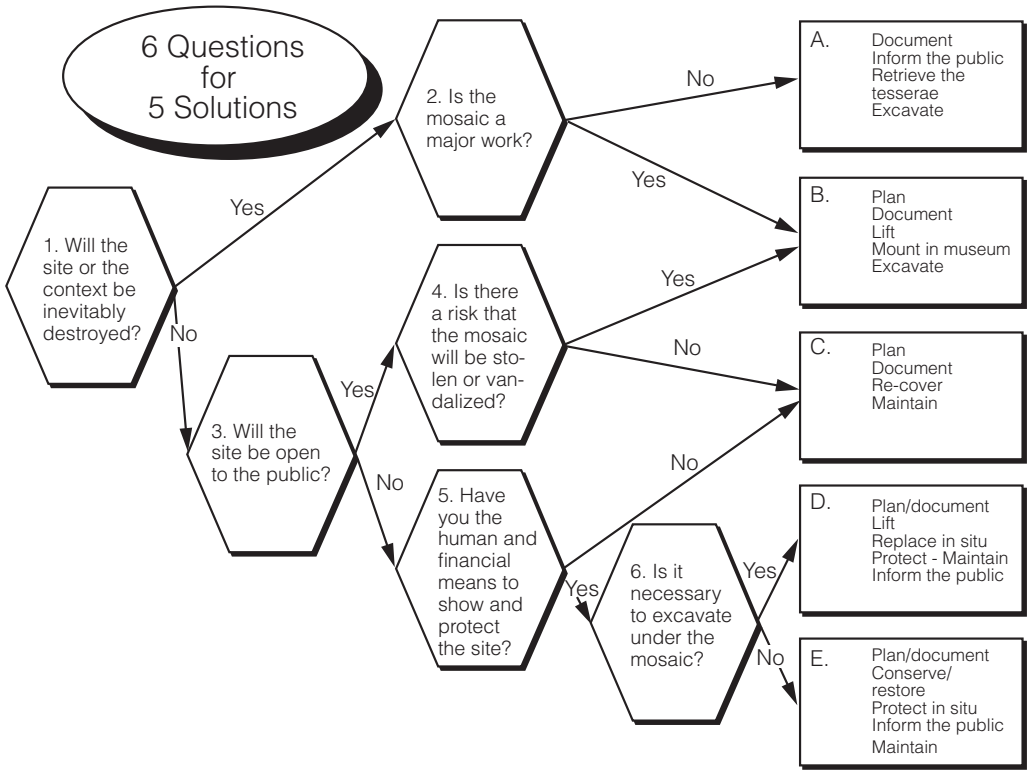


FIGURE 3 Question-driven flowchart developed in 1996 to guide decision making.



FIGURE 4 Visitors watching conservation activities at the site of Zippori, Israel. Photo by Roberto Nardi.

quickly. Twelve years passed after the 1977 recommendation for training before the first course for decision makers was initiated. The one-month course—organized by ICCROM in 1989 in Rome—was attended primarily by archaeologists (Melucco Vaccaro, de Guichen, and Nardi 1994). Today some of the participants of that early course are members of the ICCM board.

Since that time several courses at various levels have been—and continue to be—organized. While this activity is generally welcome, certain doubts exist regarding their efficacy. Some of the sessions are considered too short—a few weeks at most—or it is felt that the trainers lack the necessary teaching ability. In some instances the production of new mosaics is taught simultaneously with conservation techniques—a questionable pairing.

An example of training appropriately adapted to the challenge faced is the technician training program launched by the GCI and Tunisia's Institut National du Patrimoine in 1998 (fig. 5). This long-term involvement in training technicians in the care and maintenance of in situ archaeological mosaics is attempting to enhance the ability of cultural authorities in Tunisia to preserve the country's wealth of mosaic heritage.



FIGURE 5 Technicians-in-training stabilizing a mosaic pavement at the site of Thuburbo Majus, Tunisia. Photo by Kristin Kelly 2003. © J. Paul Getty Trust.

Maturing of the Profession

For the mosaic conservation field, the past fifty years constitute a period of great change and maturation. The establishment and development of the ICCM has advanced the work begun by the Association Internationale pour l'Étude de la Mosaïque Antique (AIEMA) and later developed by the Association for the Study and Preservation of Roman Mosaics (ASPROM) in Great Britain and the Associazione Italiana per lo Studio e la Conservazione del Mosaico (AISCOM) in Italy.

Unlike three decades ago, the scope of mosaic conservation is no longer restricted to a few square meters of tesserae recently excavated or on exhibit in a museum. It has expanded to include entire mosaic complexes or sites where thousands of square meters of mosaics are in danger. And the conservator has been joined by other professionals in the field of conservation in addressing the problems of mosaic conservation. Among them are conservation scientists who share an interest in finding solutions to mosaic conservation globally—and not simply through the lens of a microscope. That 250 colleagues from thirty countries—and with many different backgrounds—attended the 9th ICCM Conference indicates that common problems exist and that the interest in solving them collectively is very high.

At the same time it is evident that there are issues that have not been resolved, and a great deal of work remains to be done. There is an urgent need to properly conserve and store hundreds, if not thousands, of mosaics previously relaid on reinforced concrete or abandoned in storage. Reburial of mosaics is an important tool for preserving mosaics, but it requires clear protocols and a technical and financial assessment. Further research on the protection of mosaics from biological growth would contribute to resolving a widespread problem confronting the preservation and presentation of mosaics. Studies of the cost of maintenance of mosaics in situ are needed to help promote this approach. Assessments of training needs for archaeologists, conservator-restorers, and technicians are essential to ensuring long-term protection of mosaics. And finally, the publication of a major book on the conservation and restoration of mosaics is long overdue.

These are only some of the challenges faced by the professionals charged with responsibility for conserving and exhibiting mosaics. There is still a long way to go. Nevertheless, it is not unrealistic to look to the future with optimism. With the help of the ICCM, the great vitality demonstrated by the profession has resulted in standards of mosaic conservation practice today that appeared almost unreachable thirty years ago. Much has been accomplished, and those accomplishments form an essential foundation for the work that lies ahead.

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Learning from Past Interventions: Evaluation of the Project to Conserve the Orpheus Mosaic at Paphos, Cyprus

Martha Demas, Thomas Roby, Neville Agnew, Giorgio Capriotti, Niki Savvides, and Demetrios Michaelides

Abstract: *In 1988–89 a project to lift and re-lay the Orpheus mosaic at Paphos, Cyprus, was undertaken by the Getty Conservation Institute and the Department of Antiquities, Cyprus. The project was evaluated in 2004 to determine whether it had met its intended goals and contributed to the field of mosaic conservation. This paper presents the methodology for evaluation of the project as a whole, poses the main issues and questions raised during the in situ assessment, and provides an overview of results and the three main lessons learned, which relate to the importance of values in decision making, the critical role of documentation, and the need for effective management for sustainability.*

Résumé : *En 1988–89 la dépose et la repose de la mosaïque d'Orphée à Paphos, Chypre, a été effectuée par l'Institut Getty de Conservation et le Département des Antiquités de Chypre. En 2004, ce projet a fait l'objet d'une évaluation pour déterminer dans quelle mesure il avait atteint ses objectifs et contribué au domaine de la conservation des mosaïques. Cette communication présente la méthodologie d'évaluation, évoque les problématiques survenues lors de l'évaluation* in situ *et résume les résultats ainsi que les trois principaux enseignements, à savoir l'importance des valeurs dans la prise de décisions, le rôle essentiel de la documentation et la nécessité d'une gestion efficace pour assurer la durabilité.*

In 1988–89 an exceptional figural mosaic of Orpheus and the Beasts, dated to the late second/early third century C.E., was lifted and relaid in situ on a new support in Paphos, Cyprus. The technique and materials used—rolling of the mosaic and re-laying on a lightweight honeycomb aluminum support (Aerolam® panels)—had been employed in the detachment of mosaics, but on a smaller scale and mainly for preservation in a museum context.[1] The relaid mosaic was further protected with what was intended to be a temporary shelter, pending construction of permanent shelters by the Department of Antiquities over all the mosaics at the Paphos site.

The project to lift and re-lay the mosaic was a joint undertaking by the Getty Conservation Institute (GCI) and the Department of Antiquities, Cyprus, and constitutes one of the GCI's earliest field projects. As part of a larger initiative of the GCI to assess some of its previous projects, it was decided in 2003 to evaluate the Orpheus project. The purpose of evaluation is to determine whether the project has met its intended goals and contributed to the advancement of the theory and practice of conservation (and if not, why not?). Evaluation may be thought of as an interface between the past and the future, since it involves a systematic investigation of a past activity in order to inform and improve future activities. The goal, then, is to learn lessons, both the lessons of success and those of failure.

This paper presents the basic methodology developed for evaluation of the project as a whole, poses the main issues and questions raised during the in situ assessment, and provides an overview of the results obtained and the three main lessons learned from the assessment.

The Project to Lift and Re-lay the Orpheus Mosaic

The Orpheus mosaic (4.25 by 5.10 m) was excavated in 1984 by one of the authors under the auspices of the Department

of Antiquities, Cyprus.[2] It suffered from root intrusion that resulted in a few large lacunae and dislocation and loss of tesserae along the top part of the mosaic, destruction of its edges from ancient robbing of the walls of the room, subsidence caused by the presence of earlier structures below the mosaic, which became more pronounced as the subsoil dried out following excavation, and lack of cohesion of the mortar of the bedding layer (fig. 1) (Michaelides 1991).

For these reasons, particularly lack of cohesion and subsidence of the bedding layers, and in line with common practice of the Cypriot Department of Antiquities, the Orpheus mosaic was to be conserved through lifting and re-laying. The technique of rolling the *tessellatum* on a large wooden cylinder (or drum) was selected because the mosaic was largely intact, without structural cracking, was accessible to large machinery, and, most important, could be lifted as a single intact, pictorial composition. The project began in 1988, under the general direction of Paolo Mora, as consultant to the GCI, and entailed three main components: lifting and re-laying of the mosaic, training of conservators in the technique, and temporary sheltering of the mosaic (see Stanley-Price 1991 for details of the project implementation, participants, and costs).

Lifting of the mosaic using the rolling technique and re-laying it on an isolating support of Aerolam® panels with epoxy adhesive and fiberglass sheets constituted the core of the project. Other aspects included analysis of tesserae and mortars and a yearlong environmental monitoring of the site. Lifting and re-laying took place over two years, 1988–89, but since the details of the technique are not the subject of this evaluation, we will compress the complexity and technicalities of the undertaking into a very brief review of the steps involved:

- documentation and preparation (facing and consolidation) of the mosaic;
- detachment of the *tessellatum* from the bedding layers and rolling it on a wooden cylinder as it was detached;
- cleaning of mortar from the back of the *tessellatum* while on the cylinder (and again after it was laid facedown) (fig. 2);
- transport of the rolled mosaic by bulldozer to its temporary storage, where it was unrolled facedown;
- application of new mortar to the back of the *tessellatum*, followed by epoxy adhesive and fiberglass sheets;
- construction of the new support, consisting of an Aerolam® panel (with aluminum honeycomb core), adhered to the prepared mosaic with epoxy;
- preparation of the original site with a concrete slab;



FIGURE 1 Orpheus mosaic (foreground) prior to being lifted in 1988, with the Amazon and Heracles mosaic (background) already partially lifted and relaid. Photo by Guillermo Aldana 1998.
© J. Paul Getty Trust.

- reinstallation of the mosaic with panel in its original location using a crane to lift it in place; and, finally,
- removal of the facing and filling of lacunae with mortar.



FIGURE 2 Mortar being removed from the back of the Orpheus mosaic while it is rolled on the drum. Photo by Paolo Pastorello 1998. © J. Paul Getty Trust.

Figure 3 shows the mosaic on its Aerolam® panel after it was relaid in its original position.

The project was designed with a didactic component. It would provide conservators with hands-on experience in the rolling technique, which was infrequently used at the time but was believed to have potential for greater use as a method for lifting and re-laying figural mosaics to avoid the potentially destructive aspects of cutting a mosaic in sections. Nine conservators from the Mediterranean region took part in the project. During Phase 1, training was divided between formal classroom lectures on other aspects of and approaches to mosaic conservation and on-site work on the Orpheus and other mosaics at Paphos. Phase 2 training was exclusively hands-on work, aimed at implementation of the project.

The construction of a shelter to protect the Orpheus mosaic was a later addition to the original project objectives (fig. 4). It arose out of a GCI initiative to develop a lightweight, modular, and temporary shelter for protection of archaeological sites. The so-called hexashelter began as an experimental design by Neville Agnew that was field-tested and evaluated in 1988 at Fort Selden, New Mexico (Agnew and Coffman 1991; Agnew et al. 1996). In 1989 it was decided to apply the prototype to protect the Orpheus mosaic temporarily (no more than five years) pending permanent sheltering and site



FIGURE 3 Orpheus mosaic on the Aerolam® panel relaid in its original position but before final cleaning, filling of lacunae, and rebuilding of the surrounding walls of the room. Photo by Guillermo Aldana 1989. © J. Paul Getty Trust.



(a)



(b)

FIGURE 4A, B The "hexashelter," a modular system designed as temporary protection for the Orpheus mosaic, as seen from the exterior (a) and interior (b). Photos by Martha Demas 1992. © J. Paul Getty Trust.

development for Paphos, which was at that time under discussion as part of a World Bank loan.[3]

The Orpheus Mosaic Project was completed in 1989 and published soon after (Stanley-Price 1991). The decision to evaluate the project was prompted in part by an experts' meeting on mosaic conservation held in Cyprus in 2002, at which evaluation of previous projects was raised as an important need in the field. Because the Orpheus project was the second field project of the GCI (founded in 1985) and the GCI was again involved with mosaics, it was decided that an evaluation of the Orpheus project would serve both institutional needs and those of the field of mosaic conservation.

Methodology for Evaluation

The methodology used for evaluation of the project consists of two parts. The first is simply collection of background information and documentation, and needs no elaboration or explanation, except to note that gathering such information can be time-consuming and frustrating if the documentation has not been archived in an orderly and accessible manner.

The second part, the analytic component, is the crucial one. Cultural heritage conservation has not developed models for project evaluation, but nature conservation offers plenty, as do the educational and corporate worlds. The models from nature conservation were generally more compatible with the aims and ways of working in cultural heritage conservation, and we thus adapted the methodology of the World Conservation Union,[4] formerly the International Union for Conservation of Nature and Natural Resources.

The methodology is based on what are defined as "key questions of evaluation." These are broad and generic, but they bring to the fore the most salient aspects of project evaluation: relevance, effectiveness, impact, and sustainability. In our evaluation the key questions were answered by considering the following:

- the history of the project and all supporting documentation;
- a new condition survey of the Orpheus mosaic and shelter;
- comparison with the condition of the adjacent Amazon and Heracles mosaic;
- a review of the literature on lifting and citation searches of the Orpheus publication;
- professional input from colleagues involved in the original project;
- an analysis of the values of the Orpheus mosaic; and
- informal on-site assessment of the mosaic and shelter over the years since implementation of the project.

The remainder of this paper focuses on a selection of the issues that emerged from the evaluation and were judged to be of most interest to and with broad implications for the mosaic conservation field. The review is structured according to the key evaluation questions.

Relevance: Was the Project a Good Idea Given the Situation Needing Improvement?

How was the "situation needing improvement" defined eighteen years ago? The issue was never made explicit in those terms, but there were several assumptions and entrenched practices that were implicit in determining the goals of the project. These were as follows:

- The artistic value of a mosaic is paramount or at least takes precedence over historic and scientific values.
- Mosaics cannot be left in situ without risking their destruction (hence the common practice of lifting and re-laying).
- Lifting of mosaics in sections, though standard operating procedure at the time, could not be accomplished because the Orpheus mosaic—a single pictorial composition—could not be easily subdivided into smaller panels to enable lifting. Further, were it to be lifted in that manner, the result would be substantial loss of tesserae and difficulties in aesthetic reintegration.
- Archaeological excavation below the mosaic, to investigate earlier use of the site, was highly desirable (from the archaeologist's perspective) and was common practice at the time.

In light of these assumptions and ways of operating, the situation needing improvement might be formulated in retrospect as a method to lift and re-lay the mosaic in a manner that would cause least damage, ensure aesthetic integrity, and allow excavation below it. Given that limited situation to improve, we can conclude that the project had relevance and was a reasonably good idea. But was this really the situation that needed improving?

While acknowledging that methods of lifting and re-laying are still a challenge, we now recognize far more significant challenges in conserving mosaics. In 1987, when the decision on the project was made, the field of mosaic conservation was on the cusp of moving toward a much broader concept of conservation and the values attributed to archaeological sites. It is not without some irony that the year after the Orpheus project was completed, the GCI organized the first of its two international courses on conservation and management of archaeological sites in Paphos, which encapsulated this larger vision.

Certainly today we would define the "situation needing improvement"—at Paphos and indeed at most archaeological sites—very differently:

- regular maintenance of sites;
- conservation and management planning for archaeological sites;

- a management structure responsive to the needs of conservation;
- a better understanding of causes of deterioration to mosaics left in situ in relation to treatment options;
- trained and dedicated personnel to conserve, manage, and monitor sites; and
- the continuing excavation of archaeological sites in the absence of all the above.

Thus we would have to acknowledge that the aims of the project were soon made obsolete and are today not highly relevant given changed circumstances and approaches to conservation.

Effectiveness: Have the Planned Results Been Achieved? Were the Methods Used Effective?

Effectiveness can be measured in many ways, and we propose two ways for the Orpheus intervention: the effectiveness of the technique in preserving the materiality and the values of the mosaic.

As an intervention, the rolling and re-laying procedure was complex, technically and logistically challenging, and risky. It was carried out with professionalism and skill, and it was largely successful inasmuch as it demonstrated that the *tessellatum* could be lifted and relaid in its entirety, with relatively little loss or damage. This is not to suggest that there were no problems and difficulties,[5] but it is to recognize that the rolling proved an effective technique for lifting a mosaic in one piece.

But how effective was the intervention in preserving the material object (i.e., the relaid *tessellatum*) over time? To answer this question, an assessment of the physical condition of the mosaic was undertaken in 2004 by the authors of this paper.[6] The assessment was also an opportunity to determine whether documentation carried out during the project was adequate to permit a meaningful evaluation of the interventions to the mosaic fifteen years later. In addition to rephotographing and recording the condition graphically,[7] we used the rapid assessment form developed for the initiative to assess the performance of shelters over mosaics (see Stewart, this volume).

In summary, the survey revealed that after fifteen years the Orpheus mosaic was in good condition. The most significant deterioration that could be attributed to the years after the re-laying in 1989 were as follows:

- loss of tesserae: approximately seventy-five tesserae had been lost since 1989, most from border areas (mainly those embedded in polyester resin after re-laying in 1989) (fig. 5), as well as a few loose or detached tesserae;
- continued erosion and exfoliation of the glass tesserae;
- detachment and extensive loss of the infill mortar in the large lacuna and around the edges of the mosaic; and
- detachment of the new bedding: detachment occurred between the epoxy layer and the panel (not where one might expect it, between the mortar and epoxy layers) and was documented over approximately one-fifth of the area of the mosaic but was particularly noticeable in the southeast corner.[8]

With the exception of the loss of tesserae, these are correctable problems. Certainly the overall good state of preser-

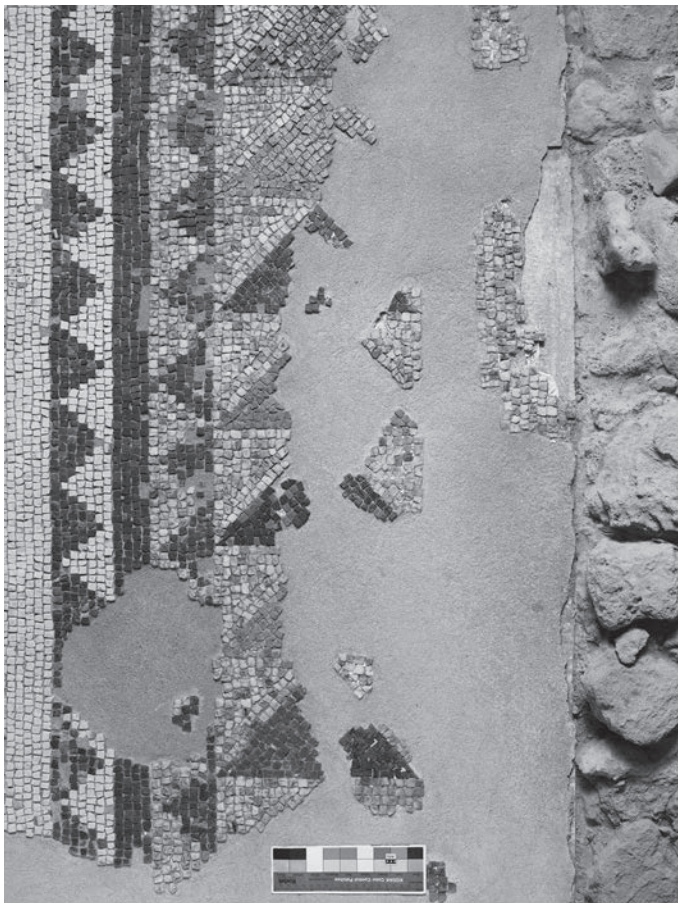


FIGURE 5 Loss of tesserae that had been embedded in polyester resin soon after the re-laying; loss of infill mortar is visible on the right. Photo by Vassos Stylianou 2004. © J. Paul Getty Trust.

vation of the mosaic can be attributed to its isolation from the ground, but it is also important to remember that the mosaic had been sheltered for the entire period of its relaid life. It is difficult to assess the effectiveness of the re-laying on Aerolam® panels as distinct from the protective function of the shelter.[9] What is clear, however, is that the majority of post-1989 conditions can be attributed to lack of maintenance and monitoring of the mosaic and the shelter, whose materials were allowed to degrade to a point where it was no longer serving a protective function (fig. 6). It should also be noted that despite a simple barrier, there was no supervision of visitors, allowing direct access to the mosaic. All these conditions could have been reversed or corrected had routine monitoring and maintenance been undertaken.

The Amazon and Heracles mosaic is located in the room adjacent to that of the Orpheus mosaic (see fig. 1). It has had a complicated life, with several episodes of excavation and reburial (beginning in 1942) and partial lifting and re-laying in 1984. Since 1990 the mosaic had been protected, in a fashion typical at the site, by a shallow covering consisting of green netting and a layer of sand (4–5 cm) and expanded clay pellets; the covering became shallower as the years passed. The assessment of the Orpheus mosaic entailed a comparison of its condition with that of the Amazon and Heracles mosaic; and the latter was uncovered and inspected for this purpose. However, due to uncertainty regarding its treatment history and the techniques and materials used (there was no documentation available), and the many variables, it was not possible to make a meaningful comparison. It is of interest to note, however, that many of the tesserae (red, blue-gray, and white limestone) were actively flaking, which was exacerbated by the infiltration of rootlets from vegetation that grew in the shallow covering (as micro-cracks developed in the tesserae, the rootlets penetrated these). We believe this is the result of the very shallow covering leading to wetting/drying cycles and perhaps salt crystallization.[10]

A more challenging, less quantifiable measure of effectiveness is the success of the intervention in preserving the values of the Orpheus mosaic. As noted earlier, aesthetic considerations were uppermost in the decision to use the rolling technique to lift this figural mosaic. All methods of lifting a mosaic privilege certain artistic and historic values that reside in the *tessellatum*—such as artistic composition, iconography, and attribution to mosaic schools, makers, and patrons. Such information and appreciation, which is found in the surface of a mosaic (fig. 7), can, however, also be gleaned from mosaics removed to a museum. The decision to re-lay the mosaic in its original location (rather than a museum) was a recognition that mosaics do indeed "make a site" and contribute significantly to the architectural ensemble of which they are a part.

These are all critically important values to preserve, but other aspects of the mosaic's significance have been lost through



FIGURE 6 The covering materials of the hexashelter had severely degraded by 2004, fifteen years after the shelter was erected. Photo by Martha Demas 2004. © J. Paul Getty Trust.



FIGURE 7 The Orpheus mosaic after re-laying on its new support in 1989 (before infilling lacunae) retains aspects of artistic and historic value—artistic composition, iconography, and attribution—that are most prized in mosaics. Photo by Guillermo Aldana 1989. © J. Paul Getty Trust.

the lifting and re-laying process. The historic and scientific information that resided in the stratigraphy of the bedding layers, including evidence of the preparatory design drawing and layout, was destroyed by this procedure. The stratigraphy was photographed and drawn, but other evidence was only noted and not otherwise documented. Whether such basic recording is sufficient compensation for the loss of information is debatable. Another aspect of historic value is the object as an authentic testament to its physical history—its patina of age. As has been observed, however, one person's patina is another's damage (Muñoz Viñas 2005: 104), and this is well illustrated in the differing opinions about the rigidity and extreme flatness of the relaid Orpheus mosaic—its appearance of having been ironed: some would argue that it helps reinstate the artistic significance; others, that it detracts from both its aesthetic and historic values, especially in its ruined architectural context. Ultimately, this is a question of values—and a conflict of values—that needs to be better articulated, defended, and justified in every intervention we make to a mosaic.

Impact: To What Extent Has the Project Contributed (Intentionally or Unintentionally) to Longer-Term Goals and Benefits to the Field?

Impact is an especially important parameter in the field of conservation, where financial resources are limited. The Orpheus project was intended to have a larger impact on the field. Paolo Mora's message in the foreword to the 1991 publication expresses the intention:

> While the rolling technique used for lifting the Orpheus mosaic will not be applicable to all mosaics, and the cost or unavailability of specialized materials might be prohibitive in some cases, we consider it very important that conservators be made aware of this method. Increased familiarity with the technique will not only allow conservators to make more educated decisions in mosaics preservation, it may also serve as the basis for future developments and improvements in the technique. (Stanley-Price 1991: vi)

Despite the training component and the timely publication of the project, this intention of achieving wider impact was not realized. A literature and citation search,[11] and an assessment of unpublished practice to the extent that we know it, has not revealed any discernible influence on conservation thinking; on the use, development, or improvement of the rolling technique; or on the lifting and re-laying of mosaics generally.

This, we believe, can be attributed to two factors. One is the technical and logistical difficulties and cost implications of this technique. The second, more important factor is the changing approach to mosaic conservation (the trend toward conservation in situ and a broader understanding of what conservation entails), which was beginning to be felt just about the time the project was undertaken.

Nor did the project have any impact on the authorities responsible for the site; indeed, an unintended consequence of the project may have been to encourage the notion that because the mosaic was relaid on an isolating support, it required little or no maintenance. Certainly little was done over the fifteen years to maintain or monitor the mosaic, its setting, and its shelter (fig. 6).

And finally, there was no impact on the visiting public. This is because the project had not been integrated into a

larger vision for the site. The result was a lost opportunity to interpret the conservation intervention to the public. We have all experienced the fascination of the public with conservation activities; if visitors can be engaged watching people clean a mosaic, how much more engaged might they be by the rather dramatic story of the rolling and re-laying of the mosaic, and what more impressive didactic tool than the large wooden cylinder that lay just outside the shelter for thirteen years until it was removed in the initial stage of landscaping the site?

Sustainability: Was the Project Design Adequate to Ensure a Sustainable Result?

Technical conservation solutions that do not take into account the larger context in which they are being undertaken are ultimately not sustainable. For cultural heritage conservation, *context* means the cultural context that contributes to significance; the management context in which the object is cared for and interpreted; and the physical and environmental context in which the object exists. The only reasons to preserve a mosaic in its original location (rather than place it in a museum) are to present it in a cultural context and, increasingly, to attract visitors, but in the absence of a management context that would ensure maintenance, protection, and interpretation, that purpose is compromised, if not defeated. The Orpheus project provided conservators with a technical solution for an object seen in isolation, but over the years the architectural setting of the mosaic and its protective shelter deteriorated due to the absence of effective management. One might argue that in the face of ineffective management and maintenance, the lifting and re-laying proved a more sustainable result than conserving the mosaic in situ, since it "hardened" the mosaic against the vicissitudes of humans and nature. That may well be true, and there may be situations that require such an approach, but for a site of World Heritage stature, such as Paphos, sustainability should be the result of good management rather than of fortifying a site against lack of management.

Another important aspect of sustainability pertinent to conservation projects is documentation. Baseline documentation is fundamental to assessing change in the future and determining whether deterioration is ongoing. Documentation of the Orpheus mosaic was undertaken in 1988, 1989, and 2004 (fig. 8), but over the years condition terminology changed, technology evolved, grids shifted, and cameras and lighting differed, making it difficult to replicate and be consistent. Nevertheless, baseline documentation of the Orpheus mosaic was actually quite good, and the close-up photography was especially useful for assessing change in surface conditions. But even the best documentation is useless if it is not properly archived, accessible, and used. Most project materials were archived, some were lost, not all the necessary documentation was provided to the partner institution, and what was provided could not always be found.



FIGURE 8 Graphic recording of the condition of the Orpheus mosaic in 2004, used for comparison with documentation undertaken in 1988 before re-laying and in 1989 after re-laying. Photo by Neville Agnew 2004. © J. Paul Getty Trust.

Although photodocumentation was well archived and cared for, it was never subsequently used or consulted, precisely because it was archival. A duplicate set of photographs was never prepared in a form to be used (and accessed) by site personnel for future monitoring.

Conclusion

The answers to the evaluation questions do not tell us whether the project aims were right or wrong, a success or a failure. That is not the objective of evaluation. What is important are the messages from the past that should inform our present and future actions. The results of the evaluation converge toward three key messages.

The first pertains to values and decision making. Values should be central to deciding whether to move a mosaic to a museum (for exhibition or storage), lift and re-lay it in situ, or conserve it in situ. Assessing values is not a purely subjective undertaking, although it sometimes seems so; consensus among stakeholders matters, and it is the reason the field of mosaic conservation has moved toward in situ preservation. Nevertheless, whatever the conservation intervention, we need to be more effective at assessing and communicating those values we are trying to preserve and what the implications of our intervention decisions are for significance. While the primary response should be to seek solutions that preserve as many of the mosaic's values as possible, the secondary response, when we destroy aspects of significance, must be to compensate as fully as possible for that loss, especially if the intervention, like the Orpheus one, is irreversible.

The second message concerns the importance of accurate, precise, and repeatable documentation that is archived and accessible. Accessibility is a function of how widely the documentation is published and disseminated and the medium in which it is recorded, especially for digital recording. However, even if archived and accessible, documentation will not be routinely used for monitoring unless it is specifically tailored for that purpose. This requires monitoring protocols that define the indicators of change, such as photographs of specific conditions to be monitored over time, which are placed in the hands of those charged with using them.

Undoubtedly the most important lesson to be learned is that conservation interventions require effective management (assessment and planning, trained personnel, a maintenance regime, good leadership) if they are to be sustainable. Effective management demands holistic approaches but does not seek final solutions; there is never a final solution for cultural sites. Orpheus and its shelter (and the adjacent Amazon and Heracles mosaic, with its few centimeters of protective sand) hung on valiantly for fifteen years waiting for such a solution[12]—permanent shelters and landscaping—and during this period, our values changed, the site deteriorated, documents were lost, personnel moved on, thousands of visitors came and went without being informed and educated, and innumerable opportunities were lost for incremental change for the better. Surely, these are situations we can improve by taking them into account whenever we embark on a new project and must decide how to conserve and how best to use the limited resources that are available to conservation.

Notes

1 Aerolam® panels are more commonly used for exhibiting detached mosaics in a museum, and rolling is generally done with smaller cylinders; for a recent review of the history of lifting and current trends, see Podany 2006: 115–28.

2 Demetrios Michaelides, archaeological officer in Paphos at the time. See Michaelides 1986 for discovery and excavation of the Orpheus mosaic.

3 For a journalistic overview of the need for a master plan at Paphos and the origins of the World Bank project, see Wigg 1994: 1–24. For a more recent description of the plan, from the perspective of the Cypriot authorities, see Hadjisavvas 2003.

4 For the IUCN methodology, part of its Global Monitoring and Evaluation Initiative, see Woodhill 2000. The methodology was selected based on research carried out by David Myers (project specialist, GCI).

5 For example, shallow linear indentations in the *tessellatum*, seen only in raking light, are attributed to creasing of the plastic sheeting on which the *tessellatum* was unrolled, and there were small areas of tesserae loss, most noticeably around the neck of the partridge. These conditions were recorded by conservator J. Claire Dean in a post-re-laying assessment.

6 The condition assessment was carried out September 4–11, 2004, with the permission of the Department of Antiquities, Cyprus. In addition to the authors of this paper, participants in the fieldwork were conservator Andreas Georgiades and technician George Tapakoudes (Department of Antiquities) and Maria Ktori and Evi Charalambous, students from the Department of History and Archaeology, University of Cyprus. The report on the field assessment with recommendations was sent to the Department of Antiquities.

7 The condition photography was undertaken by Vassos Stylianou using a Hasselblad camera fitted with a digital back and followed the grid established for the 1989 photography. Giorgio Capriotti, who had undertaken the original condition recording and

participated in the project in 1988–89, undertook the 2004 recording with Thomas Roby.

8 We cannot be certain, however, that the detachment occurred in the fifteen years after re-laying. It may have been present in an incipient state upon re-laying in 1989.

9 See Agnew et al. 1996 for the effectiveness of the hexashelter prototype in modifying the environment under the shelter.

10 The Amazon and Heracles mosaic was reburied by the Department of Antiquities after the 2004 assessment under a deep (50 cm) covering of soil.

11 A literature search was undertaken through 2004 using the major conservation databases (e.g., AATA, ArtIndex, BCIN, ICCROM library catalogue); citation searches were done in the Arts and Humanities database and through the Web. Dissemination of the Orpheus publication was searched through Worldcat, which searches some 53,000 libraries in 96 countries, although the majority are in the United States; only 135 libraries contained the Orpheus mosaic. The authors are grateful to Valerie Greathouse (reference librarian, GCI) for undertaking the searches and Sibylla Tringham (GCI graduate intern in 2004) for compiling the information.

12 The lightweight materials of the shelter (an impermeable membrane and a permeable woven fabric) held up far beyond their intended life but were severely degraded by the time of the assessment in September 2004. The Department of Antiquities attempted to repair the membrane in late 2004, but unsuccessfully, as during winter storms in 2005 rainwater was observed falling on the mosaic and pooling. The membrane developed a large tear, necessitating its removal in February 2006. The Orpheus mosaic has since been reburied, pending construction of the permanent shelters.

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Bilan d'opérations réalisées par l'Atelier de Saint-Romain-en-Gal

Évelyne Chantriaux, Marion Hayes, Christophe Laporte, Andréas Phoungas et Maurice Simon

Résumé : *Le thème de cette 9e conférence générale, et cette année 2005, qui marque pour l'Atelier de Saint-Romain-en-Gal 25 ans de fonctionnement, fournissent l'occasion de dresser des bilans et de s'interroger : que sont devenues les mosaïques que nous avons traitées ? Et comment juger aujourd'hui certaines opérations qui ont suscité des controverses ? Cet exposé se propose de présenter un tableau des interventions réalisées depuis 1980, en développant quelques cas spécifiques, choisis pour les constats et les enseignements qui peuvent en être tirés.*

Abstract: *The theme of this 9th conference and the year 2005, which marks twenty-five years of work for the Saint-Romain-en-Gal workshop, provide an opportunity for evaluation and posing some questions: What has become of the mosaics we have treated? How can some of the controversial operations undertaken in the past be judged today? This presentation seeks to review the interventions carried out since 1980, going into detail with a few specific cases chosen for the findings and the lessons that can be learned from them.*

Le thème proposé pour cette 9e conférence de l'ICCM fournit l'occasion de dresser un bilan des travaux réalisés par l'atelier depuis sa création en 1980. Le propos n'est pas de mettre l'accent sur les quantités traitées au cours de ces vingt-cinq ans, mais de s'intéresser à l'état actuel des mosaïques sur lesquelles l'atelier est intervenu et de s'interroger : que sont devenues les 1600 m² de surfaces déposées ? Dans quelle mesure sont-elles accessibles aux chercheurs ou au public ? Quelle fraction reste exploitable, et à quelles conditions ? Quelle appréciation peut être faite des 1 300 m² de mosaïques restaurées, présentées en musée ou *in situ* ? Ces questions, qui ramènent aux notions récurrentes de documentation, de conservation préventive et de maintenance, permettront de préciser le rôle et la part de responsabilité des différents acteurs de la conservation.

Par ailleurs, le bilan de certaines opérations particulières liées à des contextes archéologiques peut donner lieu à une évaluation critique : en faisant apparaître la position de l'atelier par rapport aux demandes des commanditaires et des instances décisionnelles, puis en précisant la nature des interventions matériellement réalisées et en concluant par le constat que l'on peut aujourd'hui établir, avec le recul d'une ou deux décennies.

Bilan des opérations réalisées depuis 1980

L'atelier est intervenu sur plus de deux cents pavements totalisant près de 3 000 m². La surface globale est essentiellement composée de mosaïques, les autres pavements tels que *opus sectile*, sols de *terrazzo-signinum* et dallages divers représentant un peu plus de 5 % de la totalité. Le tiers de ces opérations correspond à des interventions *in situ* d'études diagnostiques, de nettoyages, de consolidations (fig. 1), et d'établissement de documentation descriptive, graphique et photographique. Les 2 000 m² restants se répartissent en 1 300 m² restaurés – dont 900 m² issus de déposes réalisées par l'atelier – et 700 m² déposés qui n'ont pas fait l'objet d'une restauration.

Sur l'ensemble des restaurations qui concerne cent vingt pavements, le tiers correspond à des reprises de restaurations anciennes ou récentes. Ces mosaïques scellées sur des supports de ciment, de plâtre ou de résine – près d'une cinquantaine totalisant une surface de plus de 400 m² – posaient des problèmes de conservation ou de présentation qui ont entraîné leur remontage sur des supports de nid d'abeille et une remise en valeur de leur état de surface ; citons à titre



FIGURE 1 Consolidation d'une mosaïque conservée *in situ* sur le site de Plassac (Gironde). Cliché : atelier.

d'exemple la reprise du traitement de la mosaïque funéraire de Pelagius (Tabarka, Tunisie) (Chantriaux et al. 1994) , incorrectement reconstituée en 1884 après avoir été brisée lors de son transport au Musée du Louvre (fig. 2, 3). Au vu des difficultés et de la lourdeur de certaines de ces opérations, le premier constat peut être de rappeler l'importance de bien mesurer l'incidence du choix des techniques et des matériaux sur le devenir des mosaïques traitées ; ce qui revient à souligner l'importance de respecter la règle de la réversibilité dans les interventions aujourd'hui mises en œuvre.

La situation des mosaïques restaurées est variable. Plus de la moitié est exposée en musée (fig. 4), ou en attente de l'être dans des salles en cours de création ou de réaménagement, mais une fraction non négligeable reste inaccessible. Près du cinquième des mosaïques traitées n'ont en effet pas encore trouvé d'emplacement pour leur exposition au public. L'absence de lieux de présentation peut traduire une insuffisance de moyens, quand il existe une disproportion entre la richesse des collections archéologiques et la taille de certaines petites communes, ou une absence de volonté commune de la part des instances concernées : collectivités, services patrimoniaux, associations locales. Ce type de situation concerne surtout les grandes mosaïques, ou les ensembles de plusieurs pavements, pour lesquels la lourdeur des dispositifs à mettre en place en vue de leur présentation constitue un obstacle : ainsi certains musées saturés ne permettent pas de les intégrer, comme à Aix-en-Provence, où les découvertes archéologiques des trente dernières années restent en réserves. Dans ce cas, le projet d'une vaste exposition temporaire initié par le service archéologique municipal pourra peut-être convaincre les autorités locales de la nécessité de créer un lieu de présentation. Ailleurs, ce sont les aléas politiques qui empêchent l'émergence d'un musée, comme à Saint-Paul-Trois-Châteaux où le changement de municipalité a entraîné l'abandon du projet mené par l'équipe précédente. Ou c'est la complexité des problèmes à régler qui est en cause, dans les cas de reposes *in situ* notamment, comme à Saint-André-de-Rosans, où la réintégration des mosaïques à leur emplacement d'origine suppose la restauration des vestiges du prieuré dont elles proviennent, l'édification d'une structure de protection et la programmation de mesures d'entretien.

Le tiers restant regroupe les mosaïques pour lesquelles des solutions autres que la présentation intégrale en musée ou le *statu quo* ont été trouvées. Certaines mosaïques sont

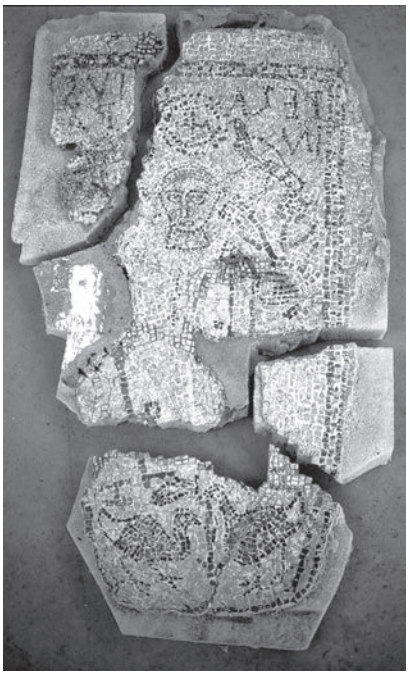


FIGURE 2 Mosaïque funéraire de Pelagius (Tabarka, Tunisie) ; démontage de la restauration datant de 1884. Cliché : Paul Veysseyre.

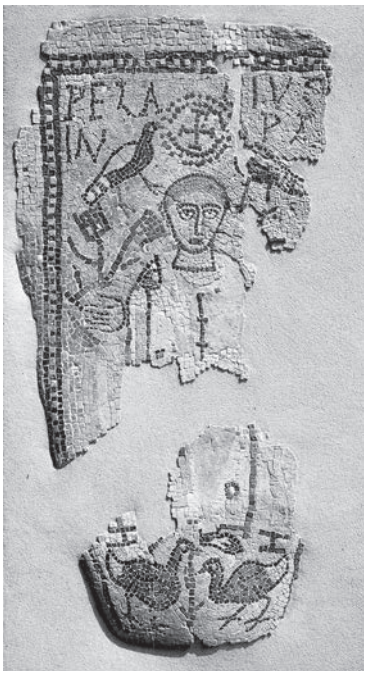


FIGURE 3 État après la restauration effectuée en 1993 pour le Musée du Louvre. Cliché : Paul Veysseyre.



FIGURE 4 Mosaïque de l'Enlèvement d'Hylas (dépôt de la ville de Grenoble) présentée au Musée de Saint-Romain-en-Gal. Cliché : Paul Veysseyre.

ainsi présentées partiellement, faute de place suffisante pour les exposer entièrement, ce qui évidemment constitue un pis-aller, mais sans doute préférable à l'oubli total au fond d'une réserve. Quelques pavements sont présentés dans des lieux autres que sites et musées ; il s'agit le plus souvent d'espaces publics : mairies, offices de tourisme, qui suppléent l'absence de musées et évitent la dispersion du patrimoine local. Une autre partie des mosaïques est présentée dans le cadre d'expositions temporaires, et conservée en réserve le reste du temps ; à Saint-Romain-en-Gal, les mosaïques entreposées dans la réserve équipée de châssis coulissants restent accessibles sur demande aux professionnels, et au public dans le cadre de visites spécifiques donnant accès aux « coulisses » du musée. Le dernier groupe correspond aux mosaïques reposées *in situ*, de manière permanente ou saisonnière, comme à Saint-Romain-en-Gal selon le système d'exposition estivale présenté à la conférence de Thessalonique (Chantriaux et al. 1994).

Bilan des opérations de dépose

Si l'on observe maintenant le bilan des opérations de dépose, le constat est plutôt positif puisque 900 m² ont été restaurés et présentés pour la plupart au public sur les 1 619 m² déposés. Certaines restaurations suivent immédiatement le prélèvement, comme la mosaïque de Méduse découverte à Besançon[1] en 2004, restaurée en 2005 pour une exposition prévue en 2006 ; ou le panneau de Métrodore appartenant à la mosaïque des Auteurs grecs d'Autun[2], restauré dès après sa découverte à l'état de fragments en 1990 (fig. 5, 6). D'autres attendent plus longtemps la programmation de leur traitement.

La majorité des déposes, effectuées dans le cadre de fouilles de sauvetage (fig. 7), permettent en effet de sauvegarder le moindre vestige de pavement découvert. Mais si aucune sélection ne s'applique à ce stade, ce qui – il faut le souligner – constitue une réalité qu'il convient d'apprécier à sa juste valeur, les commandes de restauration ne suivent pas systématiquement. Dans le cas d'ensembles importants, le choix des mosaïques destinées à être présentées, donc à restaurer, se porte en priorité sur les pavements les plus remarquables, délaissant les pavements les plus « ingrats », parce que trop fragmentaires, ou redondants dans des séries déjà bien représentées ; le tri s'impose alors pour des raisons de saturation des espaces de présentation, ou par limitation des sources de financement, parfois affectées à d'autres objectifs, culturels ou non, en tout cas plus médiatiques. Ce type de situation conduit d'ailleurs au constat qu'une nouvelle politique de conservation des vestiges se met en place, qui limite les fouilles à des sondages d'évaluations et s'accompagne du réenfouissement des pavements repérés.

Il n'empêche que toutes les mosaïques déposées constituent des témoins d'histoire. Même non restaurées, elles représentent un fonds répertorié et documenté, accessible aux chercheurs. Et elles restent potentiellement exploitables à des fins de restauration et de présentation, si les conditions de leur stockage assurent leur préservation. On peut citer à titre d'exemples la mosaïque de Passins (Isère), déposée en 1983 et restaurée vingt ans plus tard[3] (Lavagne 2000) ; ou une mosaïque à décor géométrique prélevée en 1876 lors de travaux de terrassement pour la construction d'une ligne de chemin de fer à Sainte-Colombe-lès-Vienne, restaurée cent vingt ans plus tard. À l'inverse, certaines mosaïques récemment déposées ont été endommagées à des degrés divers par suite de négligences, alors qu'elles avaient été laissées par l'atelier dans un parfait état de conservation : déformées et fragmentées après avoir été démunies de leur support de contreplaqué, leur entoilage moisi pour avoir été stockées en extérieur, exposées aux intempéries, ou encore la moitié des tesselles détachées à la suite d'un transport vertical. Le constat, amer, serait dans ce cas d'intervenir dans le cadre des formations en conservation préventive organisées dans divers cadres institutionnels de manière à rappeler les règles de base du stockage et du transport des mosaïques.



FIGURE 5 Fragments du panneau de Métrodore à leur découverte en 1990 à Autun (Saône et Loire). Cliché : atelier.

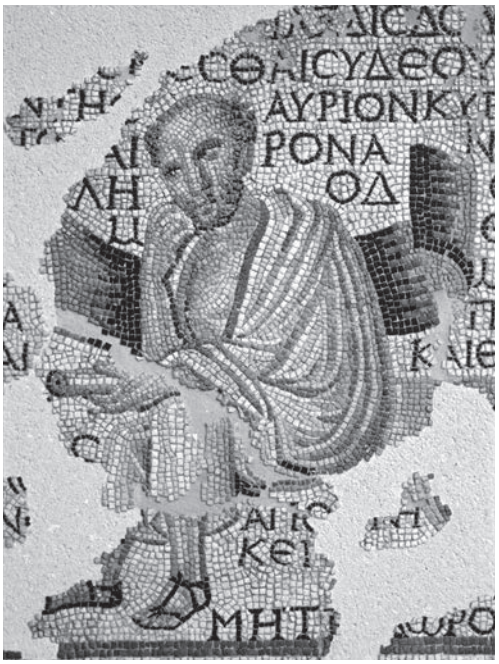


FIGURE 6 Détail du panneau après sa restauration en 1992. Cliché : Paul Veysseyre.

Cas particuliers

Parmi les déposes et les interventions effectuées sur des mosaïques conservées *in situ,* quelques opérations se distinguent par les controverses qu'elles ont suscitées. Les déposes sont en effet réalisées quand elles sont justifiées par une nécessité de sauvegarde ; mais l'atelier a refusé d'en exécuter certaines. Un premier exemple concerne la mosaïque médiévale de l'église de Cruas[4] (Ardèche) ; dans ce cas, la dépose initialement prévue à des fins de remontage sur un nouveau support a été remplacée par une consolidation *in situ,* après que l'atelier ait diagnostiqué un état de conservation qui permettait de maintenir la mosaïque sur son mortier d'origine. Quinze ans après l'opération, la mosaïque ne présente aucun signe d'altération.

Dans un autre cas, celui d'un dallage médiéval en carreaux de terre cuite conservé dans la basilique Notre-Dame de Paray-le-Monial (Saône-et-Loire), l'architecte des Monuments Historiques demandait une dépose partielle des parties les mieux conservées, sans finalité de sauvegarde puisque le réenfouissement du carrelage devait en assurer la conservation, et alors même que les archéologues avaient mené leur fouille de manière à éviter les zones dallées. L'atelier a refusé d'intervenir, mais le prélèvement a quand même été réalisé, par un autre restaurateur.

Une autre opération a permis de retrouver le même architecte pour le traitement de la mosaïque romane du déambulatoire de l'église St-Philibert de Tournus[5]. Dans ce cas, le conflit ne concernait pas la dépose, l'état du pavement autorisant sans conteste son maintien *in situ*, mais portait sur les choix de mise en valeur. En premier lieu, l'architecte a décidé de limiter la présentation à la partie la mieux conservée de la mosaïque, alors qu'un collège de conservateurs, d'historiens, de chercheurs – auxquels l'atelier s'est associé – défendait le projet d'une présentation exhaustive de l'ensemble du pavement. Malgré l'argumentation développée autour du caractère réducteur de ce choix, l'architecte a maintenu son projet et les ⅔ du pavement, conservés dans un état fragmentaire, ont été réenfouis après consolidation.

Une deuxième polémique, cette fois à l'instigation de l'atelier, s'est déclarée, à l'issue des opérations de consolidation et de nettoyage, à propos du traitement des lacunes. L'architecte souhaitait un comblement uniforme de toutes les parties de *tessellatum* disparues – avec restitution du tracé de la composition géométrique –, ce qui impliquait de détruire les réparations en mortier de tuileau effectuées pendant le temps d'usage du pavement, et de recouvrir les couches supérieures du support d'origine, conservées par endroits (fig. 8).



FIGURE 7 Dépose d'une mosaïque à Orange (Vaucluse) en 1990. Cliché : atelier.

L'application systématique d'un enduit moderne aurait par ailleurs masqué certaines marques de facture – des limites de reprise de travail notamment – et fait disparaître les zones de *tessellatum* érodées qu'il était également question de recouvrir. Diplomatiquement géré par la Direction des services municipaux, qui – par chance – suivait scrupuleusement le déroulement des opérations et a bien voulu considérer le point de vue de l'atelier, le désaccord s'est soldé par une intervention minimale, limitée au comblement des lacunes profondes et des zones fragiles par un enduit de chaux chargé de tuileau.

L'atelier n'a pas toujours eu gain de cause, et le dernier cas présenté concerne une opération que nous avons réalisée contre notre volonté. Précisons que s'il nous est possible de refuser certaines opérations dont la nature est contestable, l'atelier effectue – sans facturation – toutes les déposes demandées par le service régional de l'archéologie dans le Rhône et en Isère, les deux départements fondateurs et gestionnaires de notre structure. Dans le cas du baptistère de Grenoble, découvert Place Notre-Dame en 1989[6] à l'occasion du chantier du tramway, les archéologues souhaitaient effectuer une fouille sous le dallage conservé autour de la cuve baptismale, ce qui imposait de le déposer. Ce dallage, conservé sur une trentaine de m^2, est constitué d'une partie centrale en dalles de calcaires ocre et rose, encadrée par des blocs de brèche rouge et de poudingue gris dans les quatre absides. Son état de conservation aurait permis de le consolider *in situ*, au même titre que la cuve baptismale qui, elle, est restée en place. L'atelier a donc proposé que les fouilles soient limitées aux parties lacunaires du pavement, puis a essayé de limiter l'intervention à une dépose partielle, mais a finalement dû s'exécuter et réaliser le prélèvement total de cet ensemble monumental, avec l'objectif de reposer le dallage dans l'exacte configuration qu'il présentait à sa découverte.

L'opération a été lourde, dans tous les sens du terme, et s'est échelonnée sur six années. La dépose a été effectuée en 1992, après la réalisation d'une empreinte de toute la surface, avec un système de mousse de polyuréthane coulée dans un coffrage de bois établi selon un niveau de référence parfaitement plan. Ces contreformes ont permis de réaliser, au dos des éléments du dallage, des coques en résine époxy armée de fibres et de toile de verre, avec un repérage, en près de 300 points, de toutes les dénivellations du revers. L'ensemble, coques et dalles de pierre, a ensuite été reposé dans le baptistère avec un système de tiges filetées réglées en chaque point relevé, de manière à restituer les niveaux d'origine. Seule l'une des absides a été remontée sur un support plan en vue de son accessibilité au public. Le bilan de l'opération, à son achèvement en été 1998, a été celui d'une réussite technique, avec l'amertume d'avoir dû céder à d'autres exigences que celles dictées par des objectifs de conservation. Mais il a évolué depuis. Des problèmes de développement de micro-organismes sont en effet apparus par la suite dans la crypte aménagée pour la présentation du baptistère et de son contexte archéologique. Seul le dallage, isolé par ses coques synthétiques est resté intact, ce qui oblige à réviser le constat initial, en reconnaissant que finalement, la dépose et le remontage sur un nouveau support se sont avérés justifiés, *a posteriori*.



FIGURE 8 La mosaïque médiévale de l'église Saint-Philibert de Tournus (Saône et Loire) lors de sa découverte en 2002. Cliché : Paul Veysseyre.

Conclusion

La conclusion de cet exposé pourrait être de présenter le bilan des essais de vieillissement mis en place en 1990 pour la conférence de Palencia (Chantriaux et al. 2005). En réalité, le constat de cette expérimentation ne peut être développé pour diverses raisons : par manque de temps pour s'attacher à suivre régulièrement l'évolution des échantillons de mosaïque placés en examen, mais surtout par manque de conviction sur la portée des résultats recueillis, à savoir que les mosaïques se dégradent quand elles ne sont pas protégées ! L'opération a été engagée avec l'intention louable d'apporter une contribution à la conservation *in situ* des mosaïques. Mais l'ensemble se comporte comme une unité dont les variations constatées ne seraient sans doute pas d'une grande utilité pour être exploitables dans d'autres conditions. Ainsi, pour conclure cette présentation de bilans, la seule règle absolue dans notre domaine d'intervention, comme l'a écrit René Huyghe (1950 : 199) à propos de la restauration des peintures, est « qu'il n'existe que des cas d'espèces ».

Notes

1 Fouille du Collège Lumière réalisée à Besançon (Doubs) en 2004 par l'INRAP (Institut national de recherches archéologiques préventives) sous la direction de Claudine Munier.

2 Fouille réalisée rue de la Grille à Autun en 1990 sous la direction de Pascale Chardron-Picault, archéologue municipale. Voir le Catalogue de l'exposition : Musée Rolin. 1992. *Métrodore : un philosophe, une mosaïque.* Autun : Musée Rolin.

3 Fouille réalisée en 1981 à Passins (Isère), sous la direction de Michel Colardelle (Centre archéologique de l'Isère).

4 Campagnes de fouilles de sauvetage menées de 1983 à 1988 par Joëlle Tardieu (Service régional de l'archéologie). Travaux de restauration de l'église réalisés en 1989 et 1990 sous la direction de Francesco Flavigny, architecte en chef des Monuments Historiques.

5 Fouille réalisée en 2002 sous la direction de Benjamin Saint-Jean Vitus (INRAP). Travaux de restauration réalisés en 2001 et 2002 sous la direction de Frédéric Didier, architecte en chef des Monuments Historiques. Voir C. Sapin, ed., *Le décor retrouvé à Saint-Philibert de Tournus : Regards sur la mosaïque médiévale. Tournus 18 et 19 sept. 2003*. Tournus : C.I.E.R., 2004.

6 Fouille réalisée de 1990 à 1992 sous la direction de François Baucheron (Direction des Antiquités historiques de la région Rhône-Alpes). Travaux d'aménagement de la crypte archéologique réalisés de 1992 à 1998 sous la direction de François Botton, architecte en chef des Monuments Historiques.

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Learning from the Literature: A Review of Published Works on Mosaic Deterioration and Conservation Treatments

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Abstract: *This paper summarizes the review of the literature on causes of deterioration, treatment, and maintenance undertaken as part of the Getty Conservation Institute's Mosaics in Situ project. The literature review indicates progressive developments in methods and approaches to the preservation of mosaic pavements on archaeological sites over the past four decades. It reveals also, however, that the understanding of mechanisms of deterioration remains largely intuitive, with a significant lack of diagnostic studies. Treatments are rarely developed in response to specific deterioration or diagnostic investigations, and there is little evaluation of their efficacy over time. However, interventions are increasingly emphasizing the use of compatible (lime-based) materials, with a focus on preventive preservation and regular maintenance of mosaics in situ.*

Résumé : *Cette communication résume la documentation étudiée dans le cadre du projet sur les mosaïques* in situ *de l'Institut Getty de Conservation sur les causes de détérioration, les traitements et l'entretien. La revue évoque l'évolution des méthodes et des approches concernant la préservation des pavements en mosaïques sur les sites archéologiques depuis quarante ans. Elle constate que les connaissances sur les mécanismes de détérioration demeurent intuitives et que les études diagnostiques sont rares. Les traitements sont rarement conçus pour répondre à une détérioration spécifique ou à des investigations diagnostiques et leur efficacité dans le temps est rarement évaluée. Les interventions soulignent de plus en plus l'utilisation de matériaux compatibles (à base de chaux), et insistent sur la préservation préventive et l'entretien régulier des mosaïques* in situ.

The Getty Conservation Institute's Mosaics in Situ project was initiated in 1997, with the aim of improving understanding of the causes of deterioration of in situ mosaic pavements and developing strategies and methods for their preservation (Demas 2003). A review of literature concerning the conservation of mosaics was begun with the primary objective of informing and guiding the research, testing, and training components of the project. As the review progressed, it was considered a useful resource to the mosaic conservation field as a whole.[1]

Categories were established to reflect the principal issues related to mosaic conservation: deterioration; treatment and maintenance; reburial; sheltering; mosaic inventories and corpora; and training. A critical review was written for each category in order to establish the current state of knowledge and identify areas in need of further research. This paper summarizes the review of the literature on causes of deterioration and on treatment and maintenance. While we recognize that the published literature will never mirror exactly the reality of current practice and that many conservation projects and some research initiatives remain unpublished, we believe that a review of the literature is nevertheless a valid reflection of the current state of the field. A critical review of the literature through 1988 was published in 1994 (Nardi 1994a); the present literature review includes that material plus the literature that has been published since (1989–2005).

Published works on mosaics were searched on several Web-based reference databases.[2] Those that provided the most information were the Bibliographic Database of the Conservation Information Network (BCIN); AATA Online: Abstracts of International Conservation Literature; the ICCROM library catalog; and SciFinder®, a subscription-based research interface that allows access to Chemical Abstracts, a large collection of scientific publications. This search, limited

to articles in English, Italian, Spanish, French, and German, produced over a thousand references, which were organized according to the subject categories listed above.[3] The digital record of the references was compiled using the reference management software ProCite®. The largest group of references reviewed was published in the proceedings of the International Committee for the Conservation of Mosaics (ICCM); another main source was the biennial proceedings of the Associazione Italiana per lo Studio e la Conservazione del Mosaico (AISCOM; Italian Association for the Study and Conservation of Mosaics) and other recent Italian conference proceedings. Most of the remaining references were found as individual papers in the more general conservation literature. Only one small book devoted specifically to mosaic conservation (materials and techniques for treatment) was found for inclusion in the review (Fiori and Vandini 2002).

Causes of Deterioration as Discussed in the Published Literature

The review has been divided into four categories that relate to causes of deterioration occurring in the "life cycle" of a mosaic, from its construction, through abandonment, reburial, and excavation, up to its present condition:

1. Intrinsic qualities: deterioration engendered by original construction technique and original choice of materials
2. Historic events: deterioration engendered by abandonment, burial, and excavation
3. Environmental impact: deterioration engendered by exposure to the environment
4. Human action: deterioration engendered by modern interventions and mismanagement

This categorization is far from perfect given the overlap and interrelationship of the causes of deterioration in different moments of the life cycle of a mosaic. However, it highlights and distinguishes deterioration factors that cannot be prevented (i.e., intrinsic factors and historic events) and those that can be improved through better research and management (i.e., environmental and human factors).

Intrinsic Qualities

Mosaics are composed of foundation layers of diverse types of mortars and a surface of tesserae generally made of several types of stone and, less frequently, of ceramic and glass. Different foundation layers and variations in the different chemical and physical properties of their constituent materials can result in variable types of deterioration (under the same conditions).

Explicit correlation between the chemical-physical nature of material components and their deterioration can be found in very few publications. Examples of work in which this correlation is made are mosaics from Thebes, Greece, where the low binder (lime) to filler (sand) ratio in the mortars is reported as one of the causes of their deterioration (Karatasios, Watt, and Colston 2003: 125); and the friable mortar layer rich in ashes and charcoal at the site of Horvat Minim in Israel which is preferentially penetrated by plant roots (Neguer 2004: 251). Similarly, the mineralogical nature of the tesserae has been used to explain preferential deterioration (Lopreato, Fiori, and Perpignani 2003: 185–86 [ceramic tesserae]; Menicou, Fiori, and Macchiarola 2003: 228; García del Cura et al. 1992; Aoyagi and Foschi 1997: 820) and preferential biological attack (Altieri, Poggi, and Ricci 2003: 254; Lazzarini et al. 2004: 397).

Preferential colonization of more porous substrates by algae has been quantitatively demonstrated (McStay et al. 2001: 381). There is also a small corpus of articles presenting scientific studies characterizing stone (Bergamini and Fiori 1999) and glass tesserae (Verità 2000: 72; Fiori, Lorusso, and Vandini 2000: 23), but rarely are the studies related to causes of deterioration or to selection of treatment materials and methods.

The foundations of a mosaic play an important role in its long-term stability, and there are several examples of the differential settling of mosaics attributed to underlying archaeological features such as hypocausts, walls, or earlier hearths (Neal 1997; Michaelides 1991: 11; Novis 1985: 104); or to the original construction of the floor itself (Chlouveraki and Politis 2003: 150).

Historic Events

This category includes deterioration during abandonment and collapse or destruction, gradual natural burial, and archaeological excavation.

It is difficult, perhaps impossible in most instances, to identify when damage visible today has occurred to a mosaic. For example, many articles describe the problem of deformation of the *tessellatum,* but it is seldom evaluated in terms of when and how damage occurred. Evidence of damage caused during the initial destruction or abandonment of a site is suggested in a few examples, such as subsidence of the mosaic and

presence of lacunae attributed to the impact of architectural elements at the time of collapse due to seismic activity (e.g., Gambogi, Fontanelli, and Tuccino 1998: 154; Chmielewski 2005: 149).

Once in their buried state, mosaics may be considered to exist in a stable environment where deterioration is very slow compared to an exposed situation (Sease 2003: 69). However, various types of deterioration can occur to buried mosaics (summarized in Stewart 2004: 238–43). Mechanical deformation of the *tessellatum,* caused by differential resistance of constituent layers (*tessellatum,* bedding layer, nucleus, rudus, and statumen) to lateral and perpendicular forces may also occur during burial, and stresses exerted by overburden and surrounding structures or later rebuilding causing deformations such as bulging, sinking, and cracking have been much reported (Bassier 1978: 69; Chantriaux-Vicard 1990: 294; Cenciaioli et al. 1998: 179; Roby 1995: 51; Manconi and Scaleggi 1995: 115).

The chemical composition of archaeological deposits has been reported to potentially affect the condition of a mosaic (Mingarro Martín and López de Azcona 1986). It has been shown that the nature of the soil, in particular its pH, and microorganisms present in the soil can affect the predominantly calcareous mosaic components as well as other pH-sensitive materials such as glass tesserae (Fernandez 1987: 284; Chantriaux-Vicard 1990: 295; Lazzarini et al. 2004: 397). A few authors have emphasized the potential negative role of agricultural chemicals on mosaics, notably, by producing free potassium, nitrate, and phosphate ions (Aoyagi and Foschi 1997: 819; Weidmann 1987: 13; Fernandez 1987: 284; Foschi 2000: 720); and in the formation of insoluble salt crusts (Chantriaux-Vicard 1990: 286).

Even planned and professional archaeological excavations are acknowledged to cause immediate damage and also to set up conditions for future deterioration, and over the past twenty years the literature has reflected the conservation community's concern with excavation methods and the importance of conservators' involvement in archaeological activities (Costanzi Cobau 1990: 130; Muceli 2004: 357)—indeed, that conservation should be an acknowledged part of the archaeological process (de la Torre, comment in Sease 2003: 77). Upon excavation, the mosaic is suddenly exposed to abrupt changes of environmental conditions, which bring about rapid responses that often result in deterioration (Chantriaux-Vicard 1990: 296; Sease 2003: 69). The *tessellatum* becomes the interface between atmosphere and soil, where damaging processes, such as crystallization of salts and biological colonization, take place (García del Cura et al. 1992: 473; Costanzi Cobau 1990: 130). A few articles address methods of excavation and the mitigation of damage during excavation (Roby 1995; Nardi 2004: 147); and there have been calls to halt or minimize excavation until training of conservators specialized in conservation in situ is possible (see, e.g., Al-Azm 2004: 200). Despite the general awareness of the negative effects of excavation on mosaics, actual examples of deterioration of a mosaic during or immediately after excavation are not frequently reported in the literature. A dramatic example is the rapid bulging and detachment of the *tessellatum* of a mosaic at the site of Tel Itztaba in Israel soon after excavation (Neguer 2003: 204).

One of the earliest and continuing concerns in the published literature was damage to sites from development and building construction (Bassier 1978: 68; Nardi 1986: 96; Gambogi, Fontanelli, and Tuccino 1998: 153; Karivieri 2005: 193), and both accidental discoveries and construction and redevelopment can cause considerable and irreversible damage to mosaics. The literature confirms the problem is ongoing. Accidental discovery and damage by activities such as plowing are reported (Bassier 1978: 68; Aoyagi and Foschi 1997: 819; Neal 1997: 18; Foschi 2000: 720). Although the literature indicates a move away from wholesale detachment of mosaics, dramatic large-scale detachments of mosaics still periodically occur, notably, the recent examples of the redevelopment of the Central District of Beirut, which included the lifting of more than 700 square meters of Roman-Byzantine mosaics over several years starting in 1993 (Skaf and Roby 2003: 221–28) and the emergency work at Zeugma in Turkey in advance of flooding of the ancient city by a reservoir in 2000 (Nardi and Schneider 2004).

Environmental Impact

Following the unearthing of a mosaic, many causes of deterioration from the environment (e.g., water and salts, thermal variation, and biological factors) come into play. Water and salts are the most frequently mentioned factors. Salt efflorescence on the surface of a mosaic is a phenomenon often reported in the literature, and salts in association with water are commonly identified as causing mechanical disruption of the porous materials making up mosaics (Mingarro Martín 1989: 28; Abd El-Hady 1990: 33–35; Cosh 2002: 4; Edwards et al. 2003: 103; Cenciaioli, Botti, and Scaleggi 1998: 178; Menicou, Fiori, and Macchiarola 2003: 228; Yiannouli, Anastasatou, and Papastamatiou 2003: 55; Fiori 2004: 11).

The source and nature of salts, the mechanism for their movements and crystallization, and their role in the

disaggregation, exfoliation, and fracturing of tesserae, and the disaggregation of mortars is, however, absent from the published literature apart from a few exceptions. Movement of water throughout a site (hydrology) has been investigated only in a few cases, including a long-term project for the monitoring of the moisture content of the mosaics and surrounding environment at Chedworth, United Kingdom (Stewart, Berry, and Staniforth 2003). The importance of the relationship between a mosaic and its subterranean environment once a mosaic is exposed through excavation has been explored in Switzerland at Orbe-Boscéaz (Weidmann et al. 2003: 173–74), where hydrological studies have been carried out to investigate the effect of groundwater and of soluble salts. At this site, testing on simulated mosaic samples and direct measurements on the mosaics identify temperature fluctuations as the principal cause of the dilations and contractions and subsequent deterioration observed on the mosaic (Flatt, Girardet, and Weidmann 1997; Weidmann et al. 2003).

The diagnostic research at the sites of Orbe-Boscéaz and Vallon in Switzerland and at Chedworth in the United Kingdom are among the best and most complete examples of integrated scientific research and are reported in groups of articles published over a period of several years on the various steps of the investigations (Weidmann et al. 2003; Guex 2003; Stewart, Julien, and Staniforth 2004). Promising and worth mentioning is the recently begun interdisciplinary research and conservation work at the important site of Piazza Armerina (Cosentino et al. 2004; Lazzarini et al. 2004; Palla and Anello 2004; Santalucia 2004).

Thermal fluctuations around freezing point associated with presence of water are an important cause of deterioration. Considerable damage can occur after only a few days of freeze–thaw cycling when water is present in the porous components and in the layered structure of a mosaic (Mingarro Martín 1989: 29) and in terracotta tesserae of *opus signinum* floors (Roncuzzi Fiorentini et al. 1985: 345). However, specific references to this type of deterioration were surprisingly few (see Bassier 1978: 69; Chantriaux-Vicard 1990: 296; Fernandez 1987: 284; Weidmann et al. 2003: 170).

The irregular surfaces of most excavated mosaics are particularly suited to microbiological colonization as they provide for localized buildup of moisture and soil and nutritive mineral sources. A general overview of biodeterioration of mosaics has been published (Monte Sila 1989). A large body of scientific literature concerning biological causes of deterioration comes from fieldwork carried out at the site of Italica in Spain. These studies have shown that microorganisms can change the physical (notably, porosity) and chemical characteristics of the mortar and tesserae, and thereby render the mosaic more susceptible to deterioration by other factors, for example, water-related mechanisms. In addition, through ecological succession, algae or lichen can provide nutrition, moisture, and humus buildup for moss colonization, which in turn paves the way for higher plant colonization (Garcia-Rowe, Saiz-Jimenez, and Sameño 1989; Puertas et al. 1994; Saiz-Jimenez, Garcia-Rowe, and Rodriguez-Hidalgo 1991; Altieri, Poggi, and Ricci 2003: 256). Physical disruption of pavements by roots, from weeds to trees, is reported by several authors as one of the principal causes of deterioration on in situ mosaics (Villa 1978; Veloccia 1978; Bassier 1978; Chantriaux-Vicard 1990) and is mentioned often in treatment case studies.

Penetration of roots into the *tessellatum* may lead to detachment and loss of individual tesserae (Aoyagi and Foschi 1997: 819) or loss of whole areas of the *tessellatum* and deterioration of the bedding layer (Foschi 2000: 722). More significant structural damage caused by roots of shrubs penetrating below the bedding layer and causing bulging and subsequent detachment of tesserae is also found (Gambogi, Fontanelli, and Tuccino 1998: 155). Mechanical root damage leaves the mosaic open to further deterioration through the creation of voids and the disruption of the cohesion of mortar layers, including structural weakness when roots subsequently decay, and soil accumulation in cracks and voids, which leads to further plant invasion (Roby 2003: 212).

Human Action

Human factors affecting the preservation of mosaics in situ can be seen as having the greatest significance in relation to the current condition of a mosaic, as they principally concern human mismanagement of the mosaic, and are hence an avoidable form of deterioration. Human impact on mosaic preservation includes deterioration related to both the lack of preventive actions to avoid or mitigate environmental causes of deterioration[4] and the introduction of inappropriate treatment materials and methods.

The increase of mass tourism is a danger for all sites, and its regulation should fall under site management (Melucco Vaccaro 2003: 19). Experience shows that people walking on mosaics can cause accidental damage by dislodging or abrading/eroding the tesserae, especially the softer and more porous ceramic, clay-based, and glass tesserae, but there is little documentation of this well-known process. An additional consequence of tourism is the use of water by tourist guides and tourists themselves to saturate the colors of mosa-

ics and increase their legibility (Costanzi Cobau and Nardi 2003: 331), with negative impact on the mosaics through the increase in wetting and drying cycles.

Perhaps the most insidious cause of deterioration is neglect. There are numerous examples of the abandonment of mosaics immediately after their excavation, or even after extensive conservation treatments. The lack of regular maintenance, although infrequently discussed in the published literature until two decades ago,[5] has gradually become a concern and is now recognized as a major contributor to the rate and extent of deterioration and loss of excavated mosaics. The 1996, 1999, and 2002 ICCM conferences include references to maintenance programs now being carried out at individual sites (Nardi 2003; Margalit 2003; see also Zizola 2005), as well as initiatives for the on-site testing of maintenance methods (Piqué, Neguer, and Lucherini 2003) and the on-site training of maintenance technicians (Roby, Alberti, and Ben Abed 2005). The need for "a plan of long-term maintenance" was included as one of the recommendations of the 1999 conference (ICCM 2001, 2003).

Another human factor reported as a cause of deterioration is past interventions. While the use of inappropriate materials in the past, notably, reinforced cement supports (Bassier 1978: 70) and cement mortar repairs (Gambogi, Fontanelli, and Tuccino 1998: 154; Tripodi 1997: 238, 240), is represented in the literature, published observations of the detrimental results of such practices are in fact few in number. The use of acids for cleaning is known to have been a common practice, but only very occasional reference to their use is found (Menicou, Fiori, and Macchiarola 2003: 229; Pastorello and Schmid 1991: 59–60; Chantriaux-Vicard 1990: 286).

Treatment Interventions as Discussed in the Published Literature

Treatment is any "direct" intervention on the materials of the mosaic to clean, stabililize, and improve its aesthetic appearance; as such, treatment here does not cover the wider preventive measures of preservation in situ, such as sheltering and reburial.

At the time of the first ICCM meeting in 1977, the common response to the need to preserve pavement mosaics was their detachment followed by transfer to a museum or re-laying them on new foundations (see, e.g., Bassier 1978; Veloccia 1978). At that meeting, however, discussions about in situ conservation were already under way, and a trend away from detachment can be seen in the literature from then onward. Facilitated by improvements in in situ treatment techniques and repeated expressions of the destructive aspects of detachment, in situ conservation is today much more common.

Over the past twenty years, there have been few articles synthesizing current practice; instead, they have focused instead on the "bigger picture," addressing what is seen as an overriding priority: developing management strategies for archaeological sites, most notably, to address inadequate planning and the lack of resources for maintenance (Melucco Vaccaro 2003; Nardi 1994b). A schematic diagram, which both highlights the importance of following a decision-making process and emphasizes that management decisions have to be made in the wider site and regional context of a mosaic, presented at the 6th ICCM conference in 1996, illustrates this shift in perspective from the micro to the macro level (de Guichen 2003: 14; see also Nardi and de Guichen, this volume).

Treatment methods and materials historically have not been reported on in any detail in the literature, and a review of published case studies shows that this has changed only in the past ten years or so. This period also sees overall an increasingly uniform approach to the in situ treatment of mosaics. Methods for intervention seem to be restricted largely to mortar repairs, grouting, and cleaning, with very few references to interventions more common in the related fields of wall painting and stone conservation (e.g., surface protection, consolidation, and desalination).

The majority of treatment detail found in the literature describes the use of lime-based materials for mosaic stabilization, indicating widespread use of slaked and hydraulic limes. These materials are used for a variety of stabilization operations, including infilling of lacunae and tesserae interstices, resetting of detached tesserae, and injection grouting (e.g., Roby 1994; Aoyagi and Foschi 1997; Demitry 1994; Nardi 2004). The publication of ICCROM's testing of a grout for stabilizing mosaics in the 1980s (Ferragni et al. 1985) not only helped to turn the tide toward in situ conservation by providing the technical means to do so as an alternative to detaching them, but was also the precursor to case studies reporting the use of injection grouting (Demitry 1994: 166; Roby 1994; Albini, Costanzi Cobau, and Zizola 1996: 4).

The use of synthetic materials for stabilization treatments is only occasionally mentioned and is limited to the reattachment of tesserae and occasionally as an additive for grouting (Roby 1994: 35; Ferragni et al. 1985: 93). Experimentation with synthetic organic materials seems to have been in general brief (see, e.g., Bassier 1988). Recently, the first handbook devoted to mosaic conservation was published; it includes a comprehensive list of materials potentially suitable for use in mosaic

conservation and a brief description of the processes of documentation, preconsolidation, cleaning, repairs, stabilization, and protection (Fiori and Vandini 2002: 69–74); however, few of these materials appear in the literature on in situ mosaics.

Materials that do occur infrequently in the literature include aqueous cleaning solutions (EDTA, ammonium carbonate, the disinfectant/surfactant NeoDesogen (benzalconium chloride) (e.g., Cenciaioli, Botti, and Scaleggi 1998: 179); adhesives and consolidants, including acrylic copolymers and silicates (e.g., Di Stefano 1997: 11); and, very rarely, surface hydrorepellants (e.g., Tripodi 1997: 242). Biological activity, from microbiological growth up to plant roots, has over time been controlled by a variety of chemical methods. Of particular interest are two projects comparing the efficacy of biocides during in situ testing (Monte and Roncuzzi Fiorentini 1989; Altieri, Poggi, and Ricci 2003) and laboratory testing of the effect of different biocides on tesserae of various stone types (Mambelli et al. 1989).

The presentation and reintegration of losses, or lacunae, in mosaics has been a subject of much debate over the years, although confined largely to practitioners in Italy. The subject is responsible for a significant proportion of the literature on mosaic conservation, including the proceedings of a meeting dedicated to the subject in Italy in 2002 (Foschi, Lugari, and Lucagni 2003). While the issue of compatibility of materials, and their possible performance and durability over time, is occasionally mentioned (e.g., Laurenti 2003), most articles are concerned with aesthetic and historical issues of presentation (e.g., Philippot 1978; Lugari 1998; Foschi, Lugari, and Lucagni 2003).

Testing programs to develop treatment interventions are rarely discussed in the literature. In addition, very few articles that evaluate past treatment interventions have been published. The performance over time of repair work and the impact of any treatments on the original mosaic materials are rarely evaluated but of extreme importance. Mention should be made of the enormous potential of noninvasive tools for both diagnostic investigations and monitoring of condition and treatments over time (techniques adopted from the field of geophysics such as georadar, tomography, and thermography have been used to assess condition but, again, with no specific link to subsequent treatment choices) (Iannucci et al. 1997; Schirripa Spagnolo, Ambrosini, and Paoletti 2003; Cosentino et al. 2004).

Conclusion

Review of the large and heterogeneous body of literature on mosaic deterioration and treatment has indicated that some significant changes have taken place in the past three decades. First, there has been a general increase in the number of articles dealing with mosaic conservation not only in terms of treatment case studies, written for the most part by conservators and art historians, but also in terms of scientific research, protection interventions, and site management, written by managers, archaeologists, scientists, architects, and engineers. This reflects the increased interest and attention to this type of heritage and the emergence of a more multidisciplinary approach to mosaic conservation.

The more striking trends in the field as reflected in the literature over the past few decades can be summarized as follows:

1. Publications on the conservation of mosaics in situ, on their original bedding foundations, have become predominant over those discussing detachment and treatment of detached mosaics.
2. Treatment interventions in situ reported in the literature over the past two decades are almost exclusively limited to lime-based interventions (mortars and grouts) and localized use of synthetic polymer adhesives, with little use of consolidants, surface protectants, or other materials found commonly in the allied fields of stone and wall painting conservation. The use of cement is no longer reported in the literature.
3. There has been an increase in publications on scientific aspects linked to the study of deterioration, reflecting increasing awareness of the need for diagnostic studies to address deterioration problems. However, few studies that integrate analytic studies with on-site management and treatment interventions have been published. Exceptions, notably at Orbe-Boscéaz and Vallon in Switzerland, at Chedworth in the United Kingdom, and, most recently, at Piazza Armerina, are noteworthy for multidisciplinary teamwork and long-term commitment to research and conservation (given the difficulty and the scale of research required for diagnostic investigation at sites, a good case study requires extensive multidisciplinary research and can seldom be represented in a single article).
4. There have been an increased number of articles advocating more holistic, preventive approaches to mosaic conservation, stressing the importance of planning and management of a site, and attempting

to move the emphasis away from single-site treatment of mosaics to viewing the mosaic resource as a whole, on both the site and the regional scale.

5. "Lack of maintenance" has become predominant in the published discussions on causes of deterioration, especially over the past ten years, and examples of research and training initiatives to support regular maintenance cycles have recently appeared in the published literature—although few examples of programs of maintenance have as yet been reported on.
6. The evaluation of the efficacy of treatment interventions over time is noticeably lacking in the published literature, and studies for the selection of suitable materials and methods for treatment are extremely rare.

In many aspects, mosaic conservation as seen through the literature is following the trends of immovable heritage conservation and slowly shifting toward better site management and planned conservation maintenance. It is hoped that this will include more widespread training of conservation and maintenance professionals and the development and application of objective scientific techniques to support diagnostic studies and to monitor mosaic conditions over time.

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Notes

1 The literature review in its entirety will be available online in the near future.

2 The literature search intentionally focused on mosaics, thus excluding the literature on stone and wall paintings conservation that would be relevant to mosaic conservation. This choice was made in order to understand the state of in situ mosaic conservation. Also, while the project bibliographic database includes a large number of publications concerning the lifting and re-laying of mosaics and the treatment of detached mosaics, these were not included in the literature review given its focus on in situ conservation of floor mosaics. For the same reason, the literature on wall mosaic conservation has generally been excluded, with the exception of illustrative articles focusing on analysis of constituent materials and deterioration of excavated fragments.

3 Over two hundred references to one or more of the categories of deterioration, treatment, and maintenance were reviewed in detail for these parts of the literature review.

4 Sheltering and reburial of mosaics are dealt with separately in other sections of the literature review; recent publications that discuss these interventions are Aslan 2003; Solar 2003; Stewart, Berry, and Staniforth 2003 (shelters); Roby 2003; Stewart 2004: 240; Neguer 2004 (reburial).

5 Only 2 out of 400 titles reviewed by Nardi (up to and including 1988) mentioned lack of maintenance as a cause of deterioration (Nardi 1994a: 345).

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Orbe-Boscéaz (Canton de Vaud, Suisse) 1975–2005 : 30 ans de réflexions sur la conservation d'anciennes et de nouvelles mosaïques

Denis Weidmann

Résumé : *Les mosaïques d'une villa romaine au nord des Alpes ont été découvertes, maintenues in situ sur leur support d'origine et mises sous abri dès 1841. Des menaces sur le site et la dégradation des mosaïques ont nécessité des interventions dès 1975. Les conditions de conservation et les altérations sont étudiées méthodiquement depuis 1993. Le résultat des études définit les programmes individuels d'intervention sur les pavements, ainsi que les modifications apportées aux abris.*

Abstract: *The mosaics from a Roman villa in the northern Alps were discovered, maintained in situ on their original support, and sheltered in 1841. In 1975, threats to the site and the degradation of the mosaics made interventions necessary. The conditions under which the mosaics are conserved and the alterations they have suffered have been methodically studied since 1993. The results of the studies determine the individual intervention programs on the pavements, as well as the modifications made to the shelters.*

Les neuf mosaïques de la villa gallo-romaine d'Orbe constituent un ensemble caractéristique des situations de conservation *in situ* au nord des Alpes (Von Gonzenbach 1961: 173–199). Découvertes dès le milieu du 19e siècle, la plupart ont aussitôt fait l'objet de mesures de protection et de conservation qui apparaissent aujourd'hui comme très en avance sur leur temps (Weidmann 1987). Pour garantir la préservation d'un patrimoine important dans un paysage rural, il a été décidé en 1841 et 1862 de déplacer le tracé d'une route et de construire deux bâtiments de protection en maçonnerie pour soustraire les mosaïques aux influences climatiques, assurer leur sécurité et permettre leur présentation (fig. 1). Les mêmes interventions de protection ont été répétées à deux reprises sur le site au 20e siècle, mais avec une moindre qualité et efficacité.

Des travaux d'entretien et de conservation ont été effectués à diverses reprises sur les mosaïques *in situ* au cours du 19e et du 20e siècle, avec des méthodes et matériaux en usage dans les périodes correspondantes. Leur bilan fait apparaître que les interventions du 19e siècle – réalisées par des artisans des métiers traditionnels de la maçonnerie et de la pierre – conservent une remarquable compatibilité avec les matériaux et structures antiques. En revanche, les travaux de la première moitié du 20e siècle ont entraîné une partie des problèmes d'altération observés.

La conservation du site

A partir des années 70, le projet d'un tracé d'autoroute affectant la région des mosaïques a fait reconsidérer la situation locale. La nature du site et son extension étaient encore indéterminées, l'exploration archéologique du périmètre n'ayant jamais été entreprise. Des photographies aériennes réalisées à la faveur de la sécheresse de l'été 1976 ont livré très opportunément le plan complet du site, d'une superficie de 16 hectares, ainsi que la disposition générale de l'immense résidence à laquelle appartiennent les diverses mosaïques (Flutsch, May Castella et Paratte 1997). Le constat de l'existence d'un site de grande ampleur, préservé dans le terrain et doté de plusieurs mosaïques de haute valeur, encore *in situ*, a suscité une politique générale de conservation de la villa, avec la perspective d'une mise en valeur. Le premier effet de cette orientation a consisté en un choix de tracé routier ménageant le site, et permettant à la même occasion de supprimer la route qui l'oblitérait encore. Ces travaux ont été associés à un programme d'exploration de la *pars urbana* de la villa (environ 250 × 80 m), conduit par l'Université de Lausanne. Le site, entièrement arasé et conservé

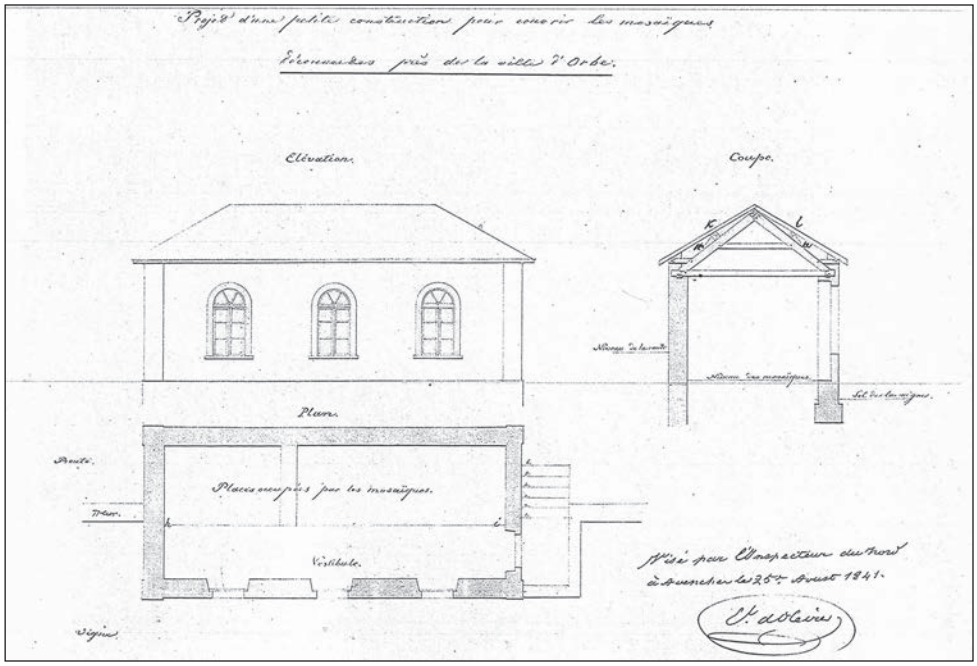


FIGURE 1 Projet du premier bâtiment de protection des mosaïques réalisé en 1841 par l'ingénieur des Ponts et Chaussées du Canton de Vaud.

sous une très faible épaisseur de terrain labouré, a été fouillé en 19 étapes annuelles, de 1986 à 2004. L'état de conservation des vestiges exposés aux activités agricoles a été contrôlé et il a été procédé au réenfouissement méthodique des structures dégagées. La protection du site a été résolue en faisant acquérir l'emprise de la villa par l'État et en proscrivant dorénavant le labourage et la culture du terrain.

Pour les mosaïques, en plus de la protection générale, les acquis directs sont la découverte d'un nouveau pavement (Achille à Skyros), la connaissance de leur contexte archéologique et architectural, ainsi que leur datation (fig. 2).

La conservation des mosaïques

On a vu que les questions de conservation ont constamment préoccupé les responsables. Des décollements et cloquages sont régulièrement apparus une vingtaine d'années après la mise au jour de chaque mosaïque, appelant des interventions ponctuelles. La reprise en main du site, dans les années 1970, a été associée à un nouvel examen de l'état des pavements, qui présentaient tous des signes inquiétants de dégradation. Avant toute intervention, il a été procédé à un inventaire des connaissances et documents relatifs au site, et en particulier aux interventions et restaurations antérieures. Les insuffisances documentaires et l'imprécision des descriptions font qu'il a rarement été possible d'identifier les emplacements des travaux et leur justification.

Notre inexpérience en ce domaine nous a amenés à solliciter des expertises extérieures, dont celle de Claude Bassier, de Périgueux, en 1978.

Il a aussitôt identifié les principaux facteurs de dégradation, liés à l'évaporation et à la concentration des sels. La solution préconisée a été de procéder à une dépose générale et à un transfert sur panneaux, assurant à la fois la sécurité des pavements et leur indépendance des conditions du sous-sol.

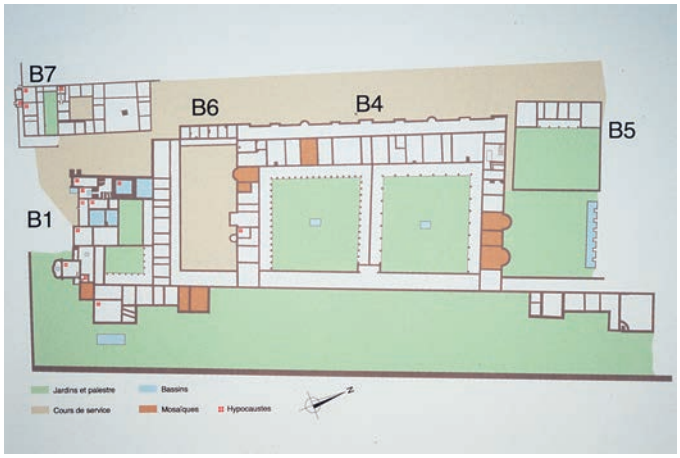


FIGURE 2 Plan d'interprétation de la *pars urbana* de la villa après les fouilles méthodiques. En foncé : pièces à mosaïques conservées. Longueur du bâtiment : 250 m.

La proposition n'a pas été suivie, en raison de son coût élevé et du changement considérable de l'aspect des mosaïques qui en aurait résulté si elles avaient été mises à plat sur des supports modernes. Les pavements *in situ* présentent en effet des tassements et irrégularités qui témoignent de leur longue histoire et de leur authenticité.

Simultanément, la prise de connaissance générale du site environnant et de sa qualité donnait beaucoup plus de cohérence à la recherche d'un maintien général des éléments dans leur contexte. Nous avons ainsi suivi les résolutions de la 4e conférence ICCM de Soria (1986).

Études, analyses et décisions

Les méthodes de traitement pour une conservation durable dans la situation spécifique d'Orbe n'étant pas établies d'emblée, nous avons engagé une analyse générale de la situation et de l'état des mosaïques, pour comprendre les causes des altérations constatées. La découverte d'une nouvelle mosaïque en 1993, qui n'avait pas subi l'évolution historique de ses voisines longuement exposées, incitait à définir des conditions de conservation non dommageables et durables.

De nombreuses études et expérimentations ont été conduites, sur plusieurs cycles annuels (Weidmann et al. 2003). Elles ont conduit à une définition de certains paramètres limites pour la conservation visible (Flatt, Girardet et Weidmann 1997) ainsi qu'à des décisions d'intervention et de traitements, selon l'évolution individuelle de chaque mosaïque et les conditions que peuvent offrir les abris (Fischbacher et al. 2003 ; Flatt et Girardet 2000 ; Weidmann et Girardet 2005).

Un premier groupe d'études a eu pour objet l'évolution des cycles climatiques, sur plusieurs années, sur le site, dans l'ambiance des abris et dans une des mosaïques sujette à d'importantes déformations (fig. 3). La corrélation des mouvements du pavement et des variations climatiques a montré la nécessité de stabiliser les conditions dans les pavillons, par des travaux d'isolation et par la suppression de l'insolation directe sur les pavements.

Simultanément, les caractéristiques des matériaux et des mosaïques (calcaires et mortiers) ont été analysées, pour apprécier l'importance des variations de l'humidité et de la température pour leur dilatation ou contraction.

L'étude des teneurs en sels et en eau, à diverses profondeurs dans les sols et dans les mosaïques, ainsi que l'hydrogéologie du site, ont mis en évidence les différents états physico-chimiques actuels (fig. 4). Il en a résulté un modèle explicatif des phénomènes qui ont conduit à l'état des différents pavements et à une description des évolutions en cours. Des indications précises ont ainsi pu être données pour éviter les conditions critiques amenant les altérations constatées.

Ces résultats ont bien entendu conduit aux différentes décisions d'interventions, dont le programme se poursuit depuis plusieurs années. Les mesures générales qui ont été prises concernent avant tout le drainage du site et des abris, la stabilisation climatique et la limitation des taux d'évaporation dans les mosaïques.

Deux installations expérimentales de gestion des flux d'humidité atmosphérique fonctionnent dans les deux anciens abris, stabilisant l'état de deux importantes mosaïques.

Les nouvelles conditions sont suivies par des mesures de contrôle et par des analyses, pour vérifier les effets souhaités.

Un processus de séchage lent est en cours depuis plusieurs années pour la mosaïque nouvellement découverte, pour permettre sa consolidation en place et sa présentation. Un abri répondant aux conditions de conservation adéquates est à définir et à réaliser pour cet objet. Les mesures particulières de conservation et d'intervention ont pris la forme soit de dépose et de transfert sur de nouveaux supports, pour les trois mosaïques ou fragments qui avaient dépassé les seuils critiques (taux de salinité, altération des matériaux, décollements généralisés), soit de conservation *in situ*, sur support d'origine (fig. 5). À ce jour, la situation de six des mosaïques du site est rétablie et permet leur présentation au public.

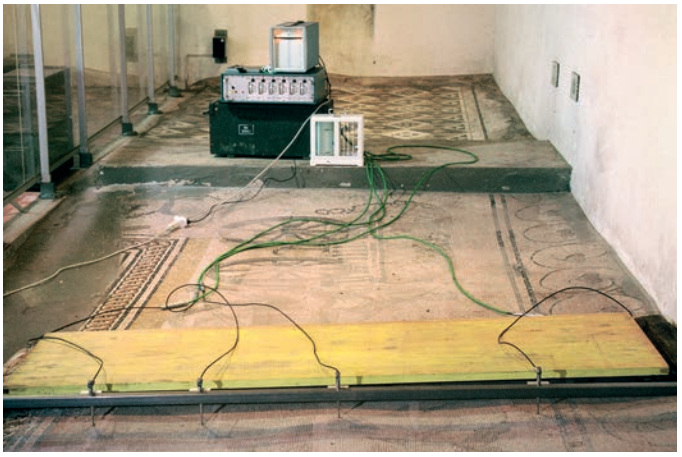


FIGURE 3 Enregistrement des déformations d'une mosaïque et des variations climatiques en 1993.

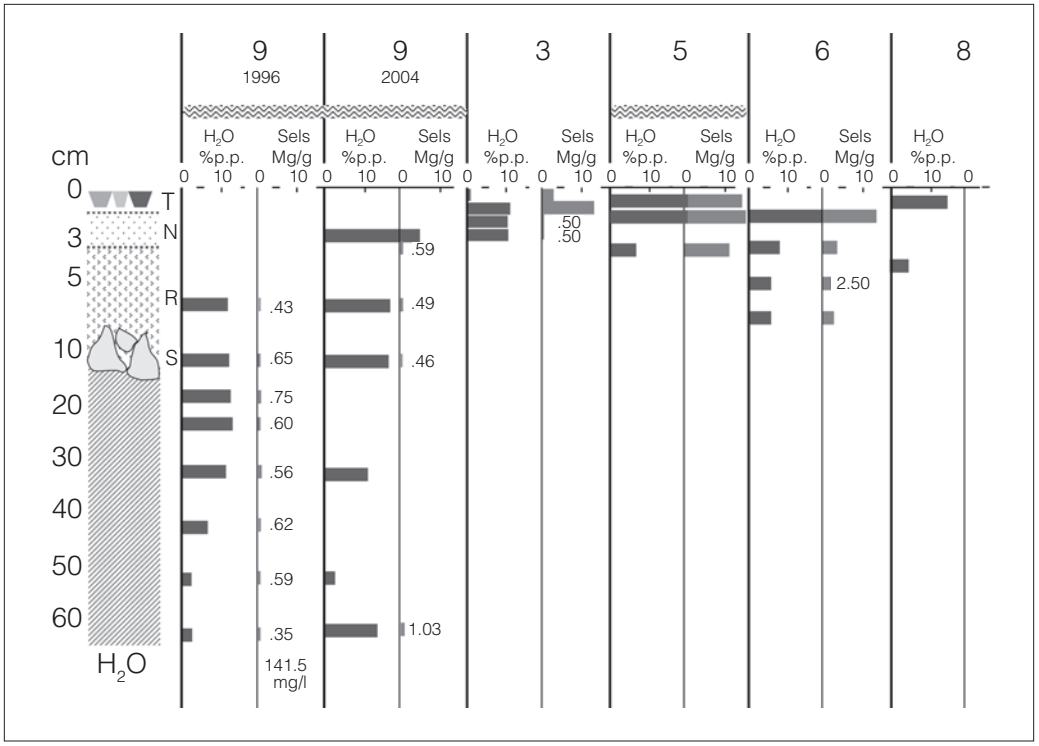


FIGURE 4 Tableau général des analyses des teneurs en eau et en sels solubles (SO_4^{--}, NO_3^-, Cl^-, K^+, Na^+) pour les mosaïques n° 3, 5, 6, 8 et 9 et pour diverses profondeurs. Les mosaïques 3, 5 et 6 ont été déposées.



FIGURE 5 Après consolidation par injections, nettoyage des surfaces par micro-sablage pour éliminer les restes des anciens traitements.

En conclusion de cette expérience d'intervention continue sur trois décennies, nous dégageons le bilan suivant :

- Le traitement des mosaïques est indissociable de celui du site dans son ensemble ;
- Seule une analyse approfondie de la situation et de l'état des objets peut orienter les mesures à prendre ;
- La complexité des phénomènes qui affectent les objets à conserver *in situ* impose de considérer les cas individuellement ;
- La lenteur des processus dans le terrain impose un suivi et des contrôles à long terme.

Nos partenaires et mandataires pour ce projet sont les responsables et collaborateurs des institutions suivantes :

- Expert-Center pour la conservation du patrimoine bâti, Lausanne et Zurich ;
- Laboratoire de géologie de l'École polytechnique fédérale de Lausanne (EPFL) ;
- ABA Geol - Payerne ;
- Weinmann - Énergies - Echallens ;
- Laboratoire du Musée Romain - Avenches.

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Villa of the Birds Five Years Later: Early Roman Mosaics in Alexandria, Egypt

Jarosław Dobrowolski

Abstract: *In 1998–99 the mosaic floors of an early Roman villa in Alexandria, Egypt, were conserved in situ. This was a project of the American Research Center in Egypt, financed by USAID and carried out in cooperation with the Egyptian Supreme Council of Antiquities and the Polish Center of Archaeology in Cairo. This paper addresses the position of the mosaics as a part of the larger archaeological site five years after their conservation was completed. Included are a review of the mosaics' display, the design principles of the protective shelter compared to the actual visitation patterns, the maintainance needs for the mosaics and the shelter, and the condition of the mosaics after five years.*

Résumé : *En 1998–1999, des pavements en mosaïques appartenant à une villa romaine à Alexandrie, en Égypte ont été conservés* in situ. *Ce projet de l'American Research Center en Égypte a été financé par l'USAID et mis en œuvre avec le Conseil Suprême des Antiquités d'Égypte et le Centre archéologique polonais du Caire. Cette communication aborde les mosaïques dans le contexte plus large du site archéologique cinq ans après leur traitement de conservation, ainsi que la mise en valeur des mosaïques, la conception de l'abri par rapport à la fréquentation actuelle, les besoins d'entretien des mosaïques et de l'abri et l'état des mosaïques cinq ans plus tard.*

For many centuries after its founding by Alexander the Great in 332 B.C.E., Alexandria, then the capital of Egypt, was one of the world's finest and most important cities. In the Middle Ages, however, it was reduced to the status of a small and insignificant harbor town. When the city regained its importance in the nineteenth and twentieth centuries ancient Alexandria was buried deep beneath the expanding modern town. It is for this reason that the site of Kom al-Dikka, under excavation by the Polish Center of Mediterranean Archaeology since 1960, is so important: it is the only fragment of the ancient city that can be seen today. The site covers about 40,000 square meters (4 ha) in the center of both modern and ancient Alexandria. From the fourth or fifth century C.E. onward, it housed public buildings, including a huge bath complex complete with gymnasia and service facilities and a series of academic auditoriums, the biggest of which is the "Roman Theater." The site also includes part of a district composed of modest residential houses and workshops. Below these monuments lies a district of rich urban villas dating from the first to the third century C.E. These buildings were destroyed in antiquity and their rich mosaic floors buried under rubble, which preserved them.

In 1998–99 the American Research Center in Egypt conserved and displayed in situ a set of mosaic floors from one villa. The project was financed by the U.S. Agency for International Development (USAID) and carried out by a team from the Polish Center of Archaeology in Cairo in cooperation with the Egyptian Supreme Council of Antiquities (SCA). The technical aspects of the conservation were presented by Ewa Parandowska, the project's chief conservator, at ICCM's seventh conference, in Arles in 2000 (Parandowska 2003). More than five years after completion of the project, the displayed mosaics have become a fixture within the broader landscape of the site.

The mosaics were first discovered in the 1970s in trenches excavated in the area of late Roman (Byzantine) buildings and reburied (fig. 1). The first important decision to be made before the work started in 1998 was choosing which mosaics to display. The decision to present a set of mosaics belonging to a single house determined the extent of the reexcavation as well

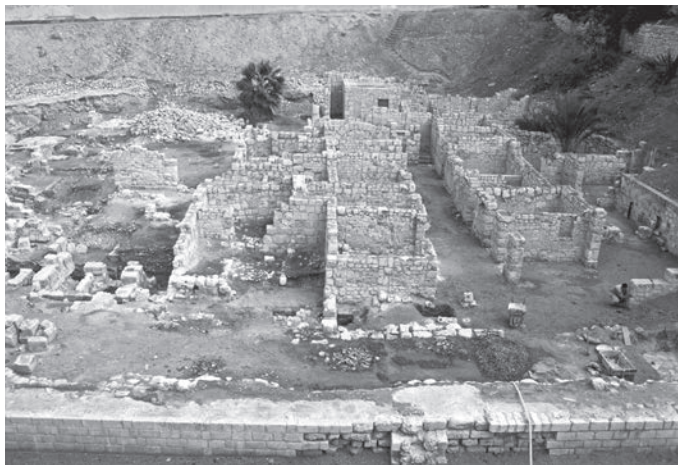


FIGURE 1 The site in 1997, before the inception of the mosaics conservation project. Photo: Robert (Chip) Vincent.

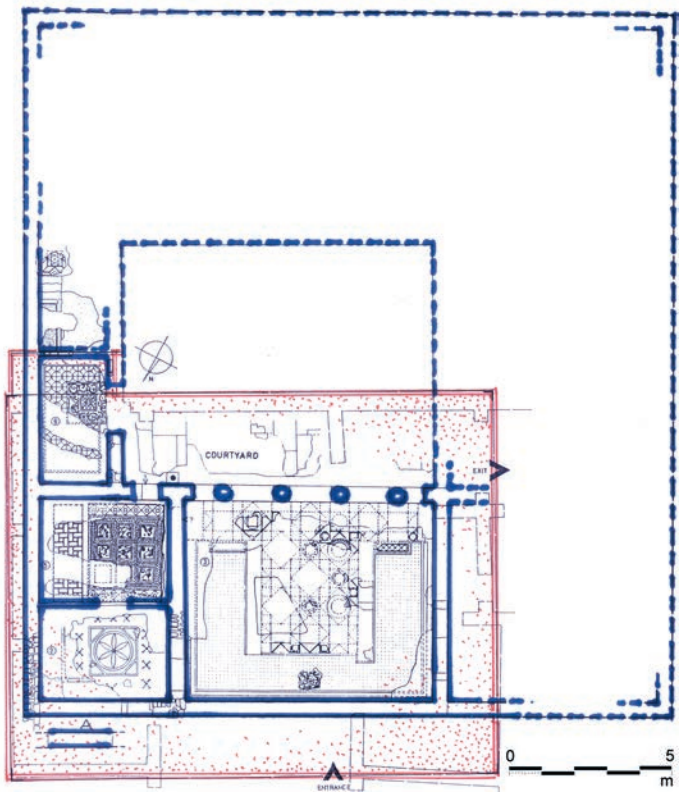


FIGURE 2 A sketch plan of the original extent of the house (in blue) and the shelter over the excavated mosaics (in red). Sketch: Jarosław Dobrowolski, based on a plan by Wojciech Kołątaj.

as the location and size of the protective shelter to be built. It was not possible to excavate the entire house, as more than half of it lies buried under a tall escarpment, on top of which stands Alexandria's main Fire Brigade compound. The area ultimately excavated and included within the shelter measures 15 by 12 meters and covers less than one-third of the original building, the extent of which can be determined from the grid of regular streets and building lots identified during the excavations (fig. 2). Because of the subject matter of a spectacular mosaic floor in it, the house was named Villa of the Birds (fig. 3). Other floors included animal, floral, and geometric decorations in mosaic, as well as a partially preserved *opus sectile* floor in the house's onetime triclinium. Ruins of late Roman houses, restored in the 1980s, stood over the remnants of the villa. These houses were built about one hundred years after the villas were abandoned and follow a different street grid. Their foundations stopped just short of reaching the earlier floors, which made the survival of the mosaics possible.

The design of the shelter over the mosaics, which are presented in situ, is a crucial element of the presentation. The architect, Wojciech Kołątaj, a conservation architect who was also the project director and had overseen restoration work on the site for many years, decided to incorporate the late Roman structures into the shelter by using some of them as its walls. Although some structures located directly above the mosaics had to be removed, this design permitted the preservation of many of the later walls, thus retaining their relationship to the



FIGURE 3 Mosaic floor panel with purple gallinule (*Porphyrio porphyrio*). The Egyptian subspecies is depicted. Photo: Robert (Chip) Vincent.

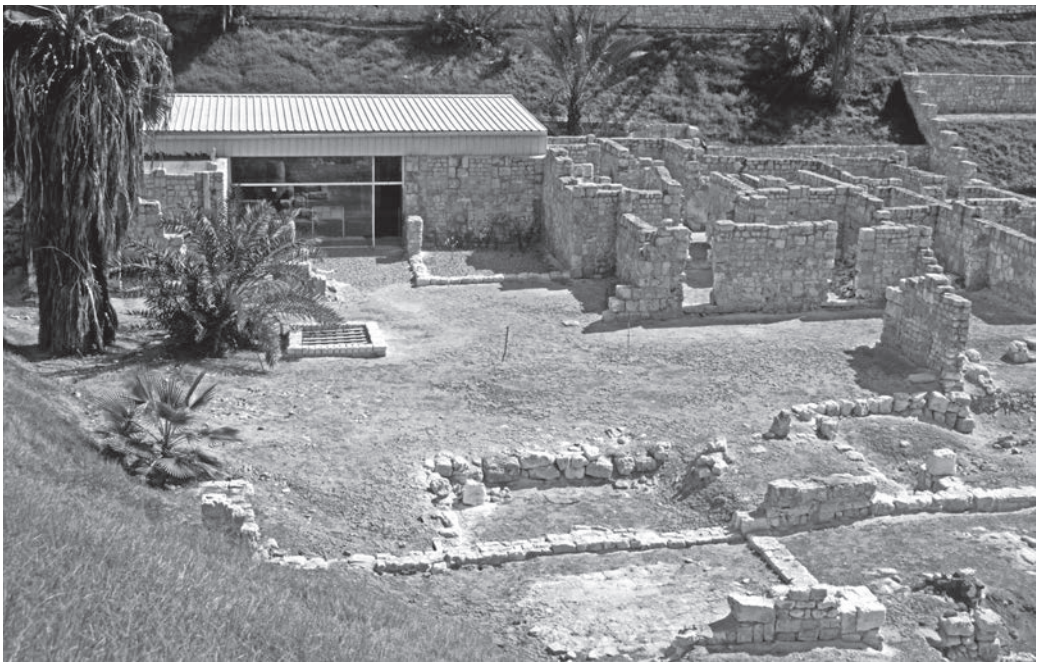


FIGURE 4 The shelter over the Villa of the Birds. Photo: Jarosław Dobrowolski.

earlier villa. It also allowed for the sizable structure of the shelter to be less obtrusive in the landscape of the site (fig. 4).

An important consideration was to make the shelter a single undivided space without internal columns. This was important for the presentation of the mosaics, as well as for the aesthetic appeal of the interior. Building a roof over a span of 12 meters requires the use of girders or similar structural elements, which in most circumstances is not a big engineering challenge. In this case, however, because it was not possible to bring heavy equipment to the site, innovative thinking was required to build the roof over the fragile mosaics, which, adding to the difficulty at hand, were simultaneously under conservation. The girders were welded from smaller pieces on a platform built at the level of the roof and then rolled one by one into their positions over steel beams that served as rails for this operation, later being used as supports for the finished roof. The grade outside the shelter corresponds to the late Roman level, and it is from this level, about 1.50 meters above the mosaic floors, that visitors see the mosaics from viewing galleries constructed of steel beams. This, in addition to the walls made of huge glass panels that are discreetly framed and the lightweight structure of the roof, has resulted in a light and spacious interior that does not overwhelm the displayed mosaics (figs. 5, 6).

The design and construction of the shelter was a continuous process of discussion among the architect, the conservation team, and the American Research Center, as well as USAID, the funding body. Various aspects of the overall design were discussed and refined in numerous on-site meetings, usually requested by the architect. This concerned a multitude of questions, for example, the exact size and position of the shelter, the advantages of a single-space interior versus the increased difficulty of constructing it, and even the color of the roof cover. In the latter case, the options discussed were a roof that would be reminiscent of ancient roof tiles or one that would be neutral and unimposing in the landscape while clearly recognizable as a modern structure. The latter option was chosen.

Conservation always includes an element of surprise that requires flexibility on the part of the conservation team. In this case, a previously unknown mosaic of superb quality was discovered outside the limit of the designed shelter (fig. 7). To include it in the display, an extension to the shelter was built, its reinforced concrete walls forming a cave under the tall escarpment behind the shelter. Safety considerations determined how much of the mosaic could be displayed.

Protecting the mosaics from dampness was a major issue. Waterproof insulation protected the shelter from water coming down the escarpment. However, though a rainwater disposal system using the ancient sewage channels was thoroughly designed, moisture from the ground remained a problem. This was mitigated by an aeration system of perforated



FIGURE 5 Interior of the shelter. Photo: Robert (Chip) Vincent.



FIGURE 6 Interior of the shelter. Photo: Robert (Chip) Vincent.

pipes buried in trenches filled with nonporous gravel that was installed around the excavated mosaics. This allows moisture to evaporate from the ground through the pipes rather than through the mosaics' surface.

With the conservation completed, an opening ceremony was held on January 21, 2000, and the mosaics display was opened to the public. The exact number of visitors to the Kom al-Dikka site is difficult to obtain, but according to the SCA's on-site inspectors, more than ten thousand people visited in 2004, most of them foreigners. In peak season about three hundred people arrive per day. Only some sections of the huge Kom al-Dikka site can be visited at present, and the main attraction continues to be the Roman Theater. Tickets for the Villa of the Birds are sold separately at the same counter that dispenses tickets for the Roman Theater, but only a fraction of the tourists—one thousand per year, or roughly 10 percent—include the villa in their itineraries. The SCA assigned five inspectors to be responsible for both the mosaics display and the excavations carried out by the Polish team elsewhere on the site. This reflects the fact that the maintenance of the mosaics is largely considered the responsibility of the Polish Center, and indeed the Polish team has continued to care for the mosaics after the USAID-funded project ended.

The shelter performs well and requires only routine maintenance or small-scale improvements, such as those made to the water disposal spouts and introducing one more operable window for better ventilation. Penetration of moisture from the ground remains a persistent problem, however. In 2004 the Polish Center replaced the aeration drainage around the mosaics with perforated pipes of a bigger diameter, which greatly reduced the scale of the problem. However, soluble salts, carried by water and left on the surface when water evaporates, continue to form light efflorescence in some areas. Periodically, the Polish team removes the salts mechanically,



FIGURE 7 Floor mosaic with an *emblema* of a panther. The ancient repair may reflect an intentional change from a hunting scene into a Dionysiac emblem. Photo: Robert (Chip) Vincent.



FIGURE 8 Eastern part of the Kom al-Dikka site after completion of the project in 2000, with the shelter over the Villa of the Birds mosaics. Photo: Robert (Chip) Vincent.

by gently brushing them away. The mosaics are then cleaned with ethyl alcohol to protect against fungi. The SCA takes care of the daily operation of the display, which requires only minimum maintenance. It is worth noting that smoking is not permitted in the shelter, which is important in a country where cigarette smoking is an omnipresent custom.

In addition to the threats posed to the mosaics by natural factors such as rainwater and moisture in the ground combined with the presence of soluble salts, the location of the site in the center of the modern city poses some problems. The Alexandria Fire Brigade, itself located in a fine historic building (although younger by some eighteen hundred years than the Villa of the Birds), can be a troublesome neighbor. Its barracks, bordering on the site, have in the past been the source of massive water leakage and of a considerable amount of garbage thrown onto the site. Huge amounts of water discharged by the firefighters during their training drills also end up on the site. These problems have significantly diminished in recent years, largely as a result of persistent explanations to the firefighting authorities of the value and importance of the site and the potential threats to it. This is an example of the crucial importance to preservation of raising awareness of issues related to the protection of cultural heritage among people who live in proximity.

Another factor that might have contributed to reducing the abuse of the site was the change in its perceived status brought about by the landscaping of the area next to the Villa of the Birds. As part of a large-scale upgrading of the city district, the governor of Alexandria stepped in and had grass planted on the slopes of the deep excavated pit in which the ancient ruins stand. This change, prompted by the work on the Villa of the Birds, radically transformed the appearance of the site (fig. 8).

In conclusion, the lessons learned from the experience of conserving and displaying the Kom al-Dikka mosaics can be summarized as follows:

- When mosaics are conserved and displayed in situ in a shelter, the shelter's architectural design is vitally important. It is not just an appendage to the conservation project but also a crucial element of the display. It requires a highly skilled professional architect, preferably one with knowledge of the site and local conditions. The project must also allow for some flexibility

in the implementation of both the conservation and the design. Conservation work inevitably involves elements of surprise and experiment, and this has to be taken into account when structuring the project.

- It is essential that the long-term preservation of the conserved mosaics be overseen by permanent custodians who are both physically and institutionally present on-site. Conservation is a continuous process rather than a onetime effort with definitive and permanent results.
- Conservation projects, in this case a display of mosaics, are not isolated from their surroundings and their human environment. This can be an advantage, but it can also pose dangers.
- Finally, the flow of tourist traffic is governed by its own rules, making it difficult to predict the number of visitors and patterns of visitation.

These conclusions are hardly surprising, since the conservation of mosaics is not fundamentally different from other forms of protection of cultural heritage.

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Lessons Learned in Theory and Practice of Mosaic Treatments: The Case of the Wall Mosaics in the Church of the Holy Apostles, Thessaloniki, Greece

Charalambos Bakirtzis, Pelagia Mastora, Styliani Vassiliadou, and Nikos Pitsalidis

Abstract: *This paper examines the theory and practice of small-scale, noninvasive, and mostly reversible interventions carried out on the mosaic decoration in the Church of the Holy Apostles in Thessaloniki. These interventions involved strengthening the mosaics' attachment to the masonry using Plexiglas anchor rivets and solvent cleaning of the surface to remove grime and soot. In addition to improving the condition of the mosaics, the results have enhanced the spiritual atmosphere of this Byzantine church.*

Résumé : *Cette présentation traite de la théorie et de la pratique des interventions à petite échelle, non invasives et pour la plupart réversibles, réalisées sur le revêtement en mosaïque dans l'église des Saints Apôtres à Thessalonique. Ces interventions ont amélioré l'état des mosaïques en renforçant leur adhésion à la maçonnerie par moyen de rivets en Plexiglas et en procédant au nettoyage de la surface avec un solvant pour éliminer l'encrassement et la suie. Les résultats ont renforcé l'atmosphère spirituelle de cette église byzantine.*

The mosaics in the Church of the Holy Apostles in Thessaloniki, Greece, are among the few surviving mosaic ensembles of the Palaiologan era (1261–1453) and some of the last examples of that genre in Byzantium. The church, a cross-in-square ambulatory type, was the *katholikon* of a large Byzantine monastery dedicated to the Virgin Mary that stood beside the west wall of the city. Its founding and mosaic decoration are attributed to Niphon, patriarch of Constantinople (1310–14), though more recent views by Peter Kuniholm and Cecil Striker, based on dendrochronology carried out on some of the church's timbers, bring the date forward to 1329 (Diehl, Tourneau, and Saladin 1918: 189–200; Xyngopoulos 1953b: 726–35; Rautman 1984: 312–19; Demetriades 1985: 307–8; Nikonanos 1986: 10–12; Kuniholm and Striker 1990: 1–25). The mosaics covered the superstructure of the *naos* above cornice level, more or less following the established iconographic program of Byzantine churches (Xyngopoulos 1932: 133–56; Xyngopoulos 1953a; Nikonanos 1986: 34–55). Parts of the following mosaics survive today: Christ Pantokrator and the prophets in the main dome; the evangelists in the pendentives (fig. 1); six *dodekaorton* scenes in the barrel vaults (fig. 2); the Dormition of the Virgin on the west wall; and saints, singly or in pairs, at the west end of the *naos.* The mosaics are characterized by the use of the *style mignon,* mainly in the figures in the *dodekaorton* scenes of the elegant, beautiful, expressive prophets, reminiscent of ancient Greek sculptures, and in the vivid colors used in the decorative vegetal motifs, which bring to mind models of Hellenistic and early Christian art.

Previous Interventions

When the church was converted into a mosque in 1520–30, the mosaics were concealed beneath a thick layer of plaster (Demetriades 1985: 307–8). They were uncovered gradually during restoration work on the church conducted in 1926–28 (Xyngopoulos 1932: 133) and again in winter 1941–42 (Xyngopoulos 1953a). Large areas of the mosaic surface were found to have been destroyed by natural causes. It was also ascertained that almost all the gold tesserae had been removed from the mosaic background before the mosaics were plastered over, as evidenced by their imprints, most of which were still preserved in the setting bed, which had survived in a few places.

The mosaics were restored in 1952 by the artist and restorer Fotis Zachariou (Xyngopoulos 1953a). He filled in the

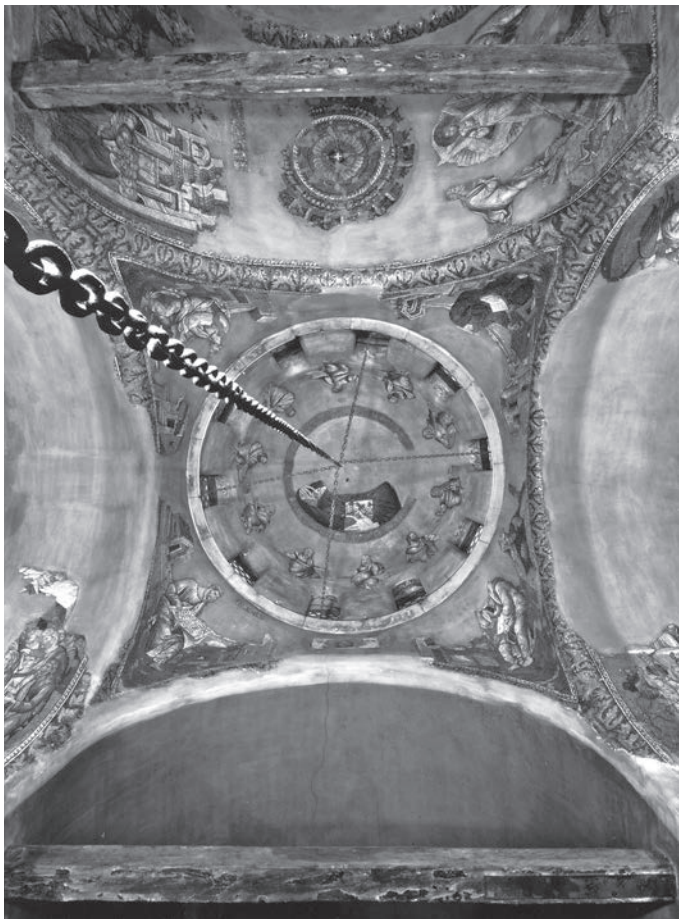


FIGURE 1 General view of the dome and the pendentives after maintenance treatment. Photo by C. Bakirtzis.



FIGURE 2 The west barrel vault after maintenance treatment. Photo by C. Bakirtzis.

areas of mosaic surface loss and covered the surviving mortar bed with a brownish red plaster; consolidated the detached mosaic surface with black cement, which he applied in the interstices between the tesserae and in some areas around the mosaic surfaces as an "edging"; and cleaned the mosaic surface and coated it with a specially made glossy varnish.[1]

Current Investigations

Half a century later it was deemed necessary to examine the condition of the mosaics and improve their aesthetic appearance since they were covered by a thick layer of soot and grime. In fall 2002, with funding from the Third European Community Support Framework, the mosaics underwent preparatory cleaning. They were closely examined and their condition described, as were the visible results of the 1952 interventions. The aim was to detect, investigate, and interpret any related problems so that it could be decided whether the mosaics should undergo further conservation treatment and, if so, to what extent.

The main problems identified during the examination of the mosaics fifty years after they had been restored were the following: (1) partial detachment of the mortar bedding layers from the masonry; (2) partial detachment of the later "neutral" plaster layer from the masonry and the mortar bedding layers beneath it; (3) partial detachment of areas of the mosaic surface from the setting bed; (4) a network of hairline cracks penetrating both the setting bed and the neutral plaster; (5) superficial cracks and a few deeper ones that, like the hairline cracks, go through both the setting bed and the neutral plaster; (6) detachment of a large number of individual tesserae; and (7) deposits of grime and soot both on the mosaic



FIGURE 3 The Resurrection before the removal of grime and other deposits. Photo by C. Bakirtzis.

surface and on the neutral plaster (fig. 3). These are common problems with wall mosaics but difficult to resolve in this case because of the irreversible procedures undertaken in 1952.

The 1952 interventions stabilized the mosaics, but the choice of cement (owing to its durability and color) as a material for conserving and presenting mosaics and the use of plaster to fill in the areas of surface loss and cover the surviving parts of the mortar bed have created a situation that is technically and aesthetically difficult to reverse, and one in which both the original work and the previous treatments fall prey to the same causes of deterioration. Furthermore, the interventions have impaired the mosaics' aesthetic appearance: they filled the interstices and concealed the shape of the tesserae in some places, obscured their colors with the dull gray of the cement, and marooned the mosaic representations in a sea of neutral brownish red. There has thus been considerable debate about the most appropriate treatment method[2] for the consolidation of the mosaics and the possibility of taking any action regarding the neutral plaster. These two parts of the problem are physically interlinked, for any intervention that globally addresses one necessarily affects the other.

In a bureaucratic approach, this information would have been sufficient for the mosaics to be subjected to a new conservation intervention. However, the mosaics' condition—with only limited and slight detachment, grime, and fine cracking—did not justify another immediate in-depth retreatment. Furthermore, the brownish red areas are quite extensive and have, in the course of half a century, become an established part of the mosaics' aesthetic appearance. Indeed, in some places the grime softens their stark outlines and creates convenient shadowy areas. Similarly, in other examples modern interventions have become an established part of a mosaic's aesthetic appearance (Ardovino 2005: 63–72; Maguire and Terry 2005: 101–9). To remove the extensive brownish red areas and expose the masonry would create new competing surfaces that would detract from the presence of the finely crafted mosaic representations. Given the chronological and economic planning of the project, together with the fact that the Holy Apostles is a functioning parish church, it was decided that the work done in 2004 would not go as far as a complete conservation treatment but would be limited to maintenance, with the principal aim of improving the mosaics' stability on the masonry and removing the grime and other deposits from the mosaic surface over a period of ten years.

Mosaic Maintenance Program

Improvement of the Mosaics' Stability

The question of consolidating the mosaics on the masonry aroused considerable concern because the usual method of in situ consolidation using grouting posed the dual risk of the neutral plaster either unifying with the mortar bed of the mosaics or solidifying on the masonry at those points where the mortar bed had been totally destroyed. Although in the current phase of the work the plaster would receive special care and attention, it was decided to avoid "binding" it to the monument, based on the belief that as a foreign body it might one day be removed due to the risk that should the monument fall during an earthquake it would take the mosaics with it. Additional reasons for not grouting with hydraulic mortar were (1) the tesserae are very densely laid, especially in the *dodekaorton* scenes, which meant that the grout would have to be injected only through the existing areas of damage on the mosaic surface; and (2) the grouting process involves considerable activity on the mosaic surface, as holes have to be bored and the grout almost invariably emerges onto the mosaic surface. The leaks are stopped up with clay, which presents an additional problem with regard to the cleaning and presentation of the mosaic. It was thus decided not to use grouting, but the following work was carried out.

- A small number of Plexiglas anchor rivets were inserted to improve the stability of the mortar bed on the masonry. This method had first been used in Thessaloniki to consolidate the mosaics in the



FIGURE 4 Stabilization of the mortar bedding on the masonry with Plexiglas anchor rivets. Photo by C. Bakirtzis.

east barrel vault in the Church of Hagia Sophia (Kanonides and Mastora 2003: 408–9). In the case of the dome mosaics in the Church of the Holy Apostles, the anchor rivets were inserted around the figures into the neutral plaster and into the underlying mortar bed (fig. 4). In the *dodekaorton* scenes, which survive more extensively, the rivets were inserted primarily into existing areas of damage of the mosaic surface.

- In very small areas of the mosaic, where the setting bed was badly destabilized and the mosaic surface detached, grouting was carried out with Primal® acrylic emulsion (40 percent v/v in water).
- To fix the tesserae surrounding the damaged areas more securely, the decayed neutral plaster applied during the 1952 intervention was replaced with lime plaster of the same shade.
- Great attention was devoted to re-adhering individual detached tesserae, which frequently came away at a touch owing to the network of fine cracks and the tiny crevices in the setting bed beneath them as well as the weakening of their adhesion to it. Detachment and loss of individual tesserae has always been a problem, for the lime plaster that covered the mosaics during the Ottoman period has been found in blemishes caused by loss of individual tesserae. Furthermore, a comparative study of the mosaics' present condition and photographs taken after the 1952 restoration confirms that detachment of the tesserae is a chronic rather than a new or occasional problem. The detached tesserae were affixed to their own imprints in the setting bed with Primal® (40 percent v/v in water).

Removal of Grime and Other Deposits from the Mosaic Surface

The mosaic surface was cleaned of its heavy layer of grime and soot by the simple expedient of removing the varnish applied during the 1952 restoration (figs. 3, 5). The varnish was a thickly laid mixture of wax and caseine, which had absorbed the soot and grime, preventing both from penetrating the interstices. It was solubilized with acetone, applied with soft brushes and, as soon as the varnish had dissolved, removed with a sponge soaked in deionized water. The clean surface was then immediately dried with an absorbent cloth. The removal of the varnish revealed the bright, vivid colors of the tesserae without the need to use large quantities of water or mild chemicals to clean the mosaic (fig. 6). No cleaning was done where white stone and colorless glass tesserae were observed to have been painted with green color in the background of the representations of single saints at the west end of the *naos,* so as not to remove this interesting structural finishing feature of the mosaics.

Superficial mechanical cleaning was carried out using a scalpel and dentistry tools to remove, mainly from the surface of the tesserae, remnants of the plaster applied in the Ottoman period that had not been completely removed in 1952, as well as other plaster remnants that had covered the mosaic surface when major and minor damage was restored in 1952. Very little pressure was applied in removing the foreign materials from the interstices for fear of detaching even more individual tesserae. After cleaning, the mosaic surface was finely sprayed with a colorless matt solution (Paraloid® B72, 2–4 percent v/v in acetone), not to enhance the lus-



FIGURE 5 The Resurrection after cleaning. Photo by C. Bakirtzis.



FIGURE 6 Detail of the prophet Elias during cleaning. Photo by C. Bakirtzis.



FIGURE 7 Trial cleaning of the neutral plaster (dome, prophet Isaiah). Photo by C. Bakirtzis.

ter of the mosaic surface—which is not necessary—but to protect the mosaics from deposits, based on lessons learned from 1952.

"Neutral" Plaster

The appearance of the plaster was improved by dry and wet cleaning, which removed the deposits of grime and soot and revealed faint shadows corresponding to the underlying materials (fig. 7). These mitigated the undifferentiated appearance of the void and enhanced its neutrality (fig. 8). Cracks and blemishes in the plaster were selectively filled in with plaster of the same shade. No other improvements were made (such as renewing the color or attending to the network of fine cracks) so as not to cursorily conceal the associated problems and so that the plaster too would show the effects of time, which, in its mute monotony, serves the superb art of the Holy Apostles mosaics.

Current Maintenance Plan

The current maintenance plan includes the following:

- ensuring the appropriate conditions for the proper maintenance of the mosaics: monitoring of temperature and humidity, regular ventilation of the monument, control of watertightness of roofs and windows, and protection of mosaics from exposure to artificial light; and
- reinspecting the condition of the mosaics' maintenance at regular intervals, on the basis of the detailed documentation of both the mosaics' and the neutral plaster's condition compiled during the recent maintenance treatments; such inspections will consist of the frequent monitoring of the reattached tesserae by touch.



FIGURE 8 Detail of the Dormition of the Virgin after maintenance treatment of the mosaic and the neutral plaster. Photo by C. Bakirtzis.

Conclusion

The knowledge gained from the recent maintenance treatment of the Holy Apostles mosaics may be summed up as follows:

- The large-scale interventions performed in the past, which were acceptable at that time in the framework of total consolidation and restoration, ensured the mosaics' stability. However, they created a situation that constrained subsequent interventions while also affecting the mosaics' aesthetic appearance. Any new intervention must first address the problems of the earlier conservation, and it is thus clear that there are no total, definitive solutions for conserving and maintaining mosaics (Russell 2004: 35).
- Because individual tesserae had become detached, the stability of the tesserae needs to be monitored by touch at regular intervals.
- It was ascertained that covering the mosaic surface with varnish has a protective effect, as it collects grime and soot, preventing them from settling directly on the surface and making it possible to clean easily without mechanical or chemical means.

On completion of the work the mosaics' appearance was greatly improved without being dramatically changed, and their attachment to the masonry was strengthened. Furthermore, the new panes of absorbent, honey-colored glass that were fitted in the existing window frames in the dome and in the tympana of the arms of the cross have enhanced the spiritual aspect of this superb Byzantine church and show that where mosaics are concerned there is no substitute for natural light.

Notes

1 Stavros Baltoyannis, a colleague of Fotis Zachariou, informed us that the varnish was a secret recipe devised by Zachariou himself, though he believes it was a mixture of wax and casein.

2 We want to thank Francesca Piqué, formerly of the GCI, for defining the term *treatment* in English. It must be pointed out, however, that the English term does not encompass the constant maintenance that mosaics in Greece receive from the Archaeological Service in accordance with the letter and the spirit of the Archaeological Law (No. 3028/2002).

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Discussion—Session 1: Evaluating Mosaic Practice

Président/Chair: Demetrios Michaelides

Discussion following Martha Demas Presentation

NICHOLAS STANLEY-PRICE: I would first like to thank all the speakers this morning for an exceptionally interesting series of talks. I have some comments and then questions in terms of the Orpheus project, and I thank Martha Demas very much for a wonderfully self-critical account of the project. A comment when talking about the cost of conservation: hidden in the appendixes of the Orpheus report are the costs at least of the equipment and materials, which were included especially because the rolling technique was likely to raise some questions about costs involved. My question concerns dissemination of information. The dissemination of all this work that we do and publish through the papers of this committee and through other means—and this also concerns the other paper by Francesca Piqué—how do we know how well this will be distributed? For instance, if you search for literature, or in library catalogs around the world, are you able to get some idea as to whether these publications reach, on the one hand, the large libraries of the world, universities, and, on the other, the large international citation databases?

MARTHA DEMAS: As you know, there are many ways of searching to discover the answer to that question. We did in fact look at where the Orpheus publication was in libraries around the world and found that it was in very few of them. We also did literature and citation searches that show you where the book is being cited and how often it's being cited. And that was the basis on which we judged whether it had some sort of impact within the conservation literature. As I mentioned, it was very poor. So, at one level, it seems like the publication is not getting into libraries. Obviously, we cannot track what is getting into individual hands. We can track our own publications and know how many copies are sold, but we don't really know where they're going.

FRANCESCA PIQUÉ: That's a very interesting question, and I must say that the searches we did were not aimed at determining dissemination of information. But, just a comment, we felt that the fact that you could retrieve online so many records is an incredible improvement in disseminating information, and it's also extremely helpful to have keywords and abstracts in these reference collections. On the other hand, once you determine the reference that's interesting, and you want to look at it in detail, it's not easy to find. For instance, I was trying to find ICCM publications in Florence. These were available only at the Opificio delle Pietre Dure library, which, because of lack of personnel, cannot provide public access. So I had to travel to Rome to ICCROM's library for these. Just as an example, then, even in a country like Italy, it was rather difficult to find some of the most basic literature.

AMR NAWAR AL MUAYYAD AL-AZM: I'd like to thank Martha for a wonderful presentation. I have a query. I noticed that you used Aerolam® to place the mosaic on, and considering its cost, what was the reason for that? I can see it used in a museum, but I was a bit surprised, considering the mosaic would be put back in its place anyway, laid on a concrete surface. Why not just use an isolating layer and unroll the mosaic on it?

MARTHA DEMAS: The reason for the use of Aerolam® was that it would be a good isolating barrier, it was lightweight, and it would allow the mosaic to be lifted, as you saw, with the crane. The whole project was expensive; it wasn't just the Aerolam® panel. I think they saw it as the best way to isolate the mosaic

and also make it portable so that it could be transported back and relaid in situ.

PATRICK BLANC: Oui, je voulais juste avoir une précision sur le problème de l'entretien. Est-ce que vous avez pu définir pourquoi l'entretien n'a pas fonctionné après votre intervention? Parce que c'est un problème très important que l'on rencontre tous.

MARTHA DEMAS: This is probably a better question for Demetrios, but I'll give it a try. I think it didn't take place for a number of reasons. One is that this mosaic was situated in a gray zone—it wasn't quite open to the public, but it was accessible to the public—and so it didn't get the same level of maintenance as the rest of the site. I think it was also due to the fact that nobody was given the particular responsibility to maintain and monitor the site on a regular basis. And that goes back to my point about effective management. The management structure was really not there to make these things happen, and that's the reason they didn't.

DEMETRIOS MICHAELIDES: I am the person responsible, so I will also answer the question. Maintenance is one of the weakest points of the Department of Antiquities. The Orpheus mosaic and shelter are not the only victims, just very obvious because the structure is separate from the rest. Also, we have to bear in mind that the shelter was built to be temporary, with a life span of three or four years, and replaced by a permanent shelter. This was in the 1980s; we are now in 2005, and it's still a temporary shelter that is waiting to be replaced and that is not maintained. All the same, it's not an excuse; it should have been replaced because it is becoming a safety matter.

AÏCHA BEN ABED: Dans le cas de la mosaïque d'Orphée, considérant l'effort et le coût qui, si mes souvenirs sont bons, furent très élevés pour cette opération, sachant qu'il n'y avait pas de suivi, qu'il n'y allait pas avoir d'entretien et de véritable gestion de la mise en valeur de cette mosaïque et de la dépose, pensez-vous que cela valait la peine de faire ce projet ?

MARTHA DEMAS: One of my main conclusions is that we were not really thinking in that direction. It was an intervention to resolve a particular problem of the mosaic, one mosaic, and we were not thinking holistically. The project wasn't conceived holistically. And on the other side of it, there was not a vision by [site] management to think holistically either, so the groundwork wasn't there for it to have been an effective, integrated outcome.

General Discussion

HASSAN LIMANE: Ce n'est pas une question mais plutôt une invitation à une réflexion à travers deux exemples qui nous ont été présentés ce matin, et surtout en ce qui concerne les couvertures des espaces mosaïqués. Nous avons vu deux exemples, celui d'une toiture légère qui n'a pas été maintenue et celui d'une toiture solide, l'exemple d'Alexandrie. Ce sont deux cas isolés, c'est intéressant. Il est tentant de couvrir les mosaïques parce que ça contribue au travail du restaurateur et ça permet de donner une certaine durée à la conservation, mais lorsqu'on a l'espace d'une ville toute entière, avec à peu près soixante ou soixante-dix mosaïques, la couverture ne pose-t-elle pas un problème et quels choix doit-on faire ?

JAROSŁAW DOBROWOLSKI: I guess the question is for me. I think it's a question of the general presentation program for the site. We have a huge site at Alexandria, and mosaics are just a part of what is to be seen there. I have to be specific about our contribution to this whole proposal. I think it was a very valuable and viable project because it enriched the presentation of the site as a whole with a completely new component, with a modern component. But preservation of certain mosaics on a much larger scale on-site was not to be considered. This site is a concession of the Polish Center, and it is responsible for the overall problem of conservation, together with the Supreme Council of Antiquities. So, yes, this project was, in a sense, isolated, but it was never meant to be anything else.

DENIS WEIDMANN: Le problème avec les abris, sans entrer dans le débat général sur les abris qui sera, je pense, ouvert ces prochains jours, est qu'il faut trouver ici une limite de la gestion de l'abri lui-même. Nous avons vu à Paphos, un abri léger c'est une illusion, du moins pour quelques années. Dans nos climats du Nord des Alpes, les abris peuvent être lourds, c'est de la construction traditionnelle, mais la limite est plutôt trouvée dans la possibilité future de gérer et d'entretenir ses propres abris. L'abri ne doit également pas devenir une machine à détruire la mosaïque, c'est un phénomène que l'on trouve très souvent. On part d'une bonne intention, mais après, par effet architectural, par effet constructif ou par effet de pollution, on s'aperçoit que l'on a accéléré la destruction. C'est plutôt une question de collaboration entre les architectes et les conservateurs.

FEDERICO GUIDOBALDI: This is a question that can be directed to more than one of this morning's speakers. When I see a mosaic before the *dépose*, I don't directly see the reasons for removing it. When we see the Orpheus mosaic for the first time in its

original situation, or other mosaics for which the archaeological context and what exists below remain, and how lifting destroys the mosaics, I ask myself if it's not better to leave them in the soil. It is important, I think, in the conference recommendations to advocate in situ conservation and to study the mosaics better, because they are not studied very well.

Discussion following Charalambos Bakirtzis Presentation

FRANCESCA PIQUÉ: The meaning of *maintenance* is not always clear or consistently used by the profession. Could you define what you mean by maintenance in Greece?

CHARALAMBOS BAKIRTZIS: *Maintenance* is not a Greek term. We used to say, as you've seen in the proceedings of the Thessaloniki congress, that maintenance is translated as διατήρησις (*diaterese*). But this is actually the word for "preservation." So maintenance does not have a specific Greek translation. Anyway, we use maintenance to speak about repairs, to speak about care.

ROBERTO NARDI: A simple comment on this paper. Part of it is a few small, technical details that I would be interested in discussing in more depth. It was extremely interesting to see an attitude applied that is based on actions implemented according to cautious and careful decisions. This is not the result of technical decisions taken six months ago; this is obviously the result of a long process, a long political process that started years and years ago. I am not involved with this [project], but I imagine this [was the case], because if we compare similar interventions carried out in similar regions, the decisions are very different. This demonstrates the fact that technical decisions, even the best technical decisions, need strong political support that has to be initiated far in advance. So I was very pleased and impressed by your work.

PART TWO

Caring for Mosaics in Museums

Conservation et restauration des mosaïques romaines au Portugal – Quelques exemples dans les collections de musées

Maria de Fátima Abraços

Résumé : *Étant donné qu'il n'existe aucun relevé complet des mosaïques figurant dans les collections des musées du Portugal, nous avons décidé de procéder à ce travail pour quantifier et caractériser leur état de conservation. Nous avons choisi de présenter dans ce colloque quelques-unes des mosaïques de la collection de deux musées : le Musée National d'Archéologie, fondé en 1893, qui, du fait de son ancienneté, abrite le plus grand nombre de mosaïques, et le Musée Régional d'Archéologie D. Diogo de Sousa à Braga, créé en 1918 mais ultérieurement installé dans un nouveau bâtiment dont la construction a débuté en 1991.*

Abstract: *As there exists no complete record of mosaics included in museum collections in Portugal, we decided to undertake the work of quantifying and describing the condition of these mosaics. This paper presents a few of the mosaics in the collections of two museums: the National Archaeological Museum, founded in 1893, which, as one of the oldest museums, contains the greatest number of mosaics; and the D. Diogo de Sousa Braga Regional Archaeological Museum, founded in 1918, which has recently been moved to a new building whose construction began in 1991.*

Musées portugais possédant des mosaïques dans leurs collections

Au Portugal, trente-cinq musées possèdent des fragments de mosaïques dans leurs collections, soit quatre cent vingt-neuf pièces au total. Au nord du Tage, cent quatorze mosaïques font partie des collections de dix-neuf musées, et

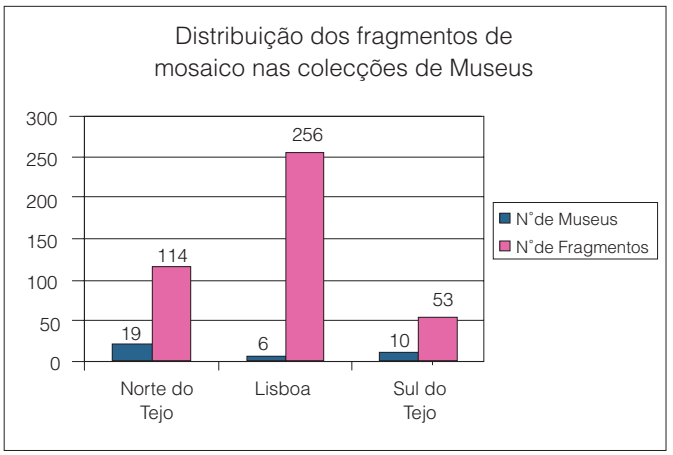


FIGURE 1 Répartition des fragments des mosaïques dans les collections des musées.

proviennent pour la plupart de sites proches de leur zone d'influence (fig. 1).

Six musées de Lisbonne abritent dans leurs collections des fragments de mosaïques, mais, à lui seul, le Musée National d'Archéologie renferme deux cent cinquante fragments provenant de tout le pays (Abraços 1999), dont vingt et un du nord du pays et cent quatre-vingt-dix-huit de sites archéologiques au sud du Tage. Quant aux autres, cinq viennent de sites romains à l'étranger, en Syrie, et vingt-six sont de provenance inconnue. Au sud du Tage, dix musées possèdent au total cinquante-trois mosaïques.

Les mosaïques dans les collections de musées : quelques exemples de pratiques de conservation et restauration

Musée National d'Archéologie de Lisbonne

Le Musée National d'Archéologie a reçu jusqu'en 1947 des mosaïques provenant de 45 sites de l'actuel territoire portugais, dont deux du *Conventus Bracaraugustanus*, dix de l'aire de juridiction du *Conventus Scallabitanus* et trente-trois de sites sous la juridiction du *Conventus Pacensis*[1](fig. 2).

Les premières tentatives de dépose de mosaïques n'ont pas eu beaucoup de succès, ce qui explique que beaucoup de mosaïques aient en grande partie perdu leur aspect d'origine. Au Portugal, on ne pratique que depuis 1947 la dépose des mosaïques et leur replacement sur un support en ciment, à la suite des contacts de nos professionnels avec l'équipe de restauration de Florence appelée pour procéder à la dépose et à la restauration des mosaïques de Torre de Palma. Appliquée pour les mosaïques de Conimbriga par une équipe dépendant de la Direction des Édifices et Monuments, ainsi que pour d'autres mosaïques, cette nouvelle méthode, enseignée par l'équipe de Florence et défendue par les restaurateurs européens, s'est cependant révélée négative. C'est pourquoi, dans les années soixante, nous avons assisté à un changement technologique avec l'application de supports légers. Au Portugal, cette nouvelle technique a commencé à être appliquée à partir des années quatre-vingts sur les mosaïques de la collection du Musée National. L'expérience a tout d'abord été réalisée sur les mosaïques de Torre de Palma avec application de la première méthode au moment de la dépose en 1947, et l'application de la seconde méthode, au moment où, en 1982, en raison du réaménagement du Musée, les mosaïques ont été déposées et retirées de leurs supports de ciment. C'est dans l'atelier de Conimbriga que la mosaïque des Muses et la mosaïque des Chevaux ont été dotées d'un nouveau support léger et réversible. Le financement assuré par l'Institut du Patrimoine a non seulement permis d'intervenir sur ces deux mosaïques, mais aussi de doter de supports légers l'ancienne collection de fragments provenant de l'Algarve, de l'Alentejo et de l'étranger (5 fragments de Syrie).

Au Musée National d'Archéologie, nous soulignons l'importance de deux mosaïques provenant de sites situés au nord du Tage : la mosaïque de Martim Gil[2] et celle de Póvoa de Cós[3].

La mosaïque de Martim Gil, plus connue sous le nom d'Orphée II, est en très mauvais état de conservation. En 2001, nous avons signalé au directeur du musée l'urgence d'une intervention de sauvetage. La mosaïque aurait une superficie totale d'environ 54 m² si elle avait subsisté en totalité. La surface actuellement conservée (en mars 2005) atteint à peine 47,16 m². La mosaïque a subi des pertes au cours des différentes interventions de dépose et de restauration. Aujourd'hui, il n'en reste que 87 %. de la surface initiale. Elle a été déposée en 1897, puis transférée au Musée National où elle a été dotée d'un support de ciment en 1951 pour faire partie de l'exposition permanente. Au début des années 80, elle a été prélevée et découpée en plusieurs fragments pour être conservée dans la réserve du musée. Le panneau central, figuratif, fragmenté en quatre parties, fait partie de l'exposition inaugurée en 2002 sur le thème des « Religions de la Lusitanie ». Les autres panneaux figurant dans la réserve sont en très mauvais état. L'oxydation de la structure de fer à l'intérieur du support de ciment a provoqué sa dilatation et la désagrégation de l'*opus tessellatum*.

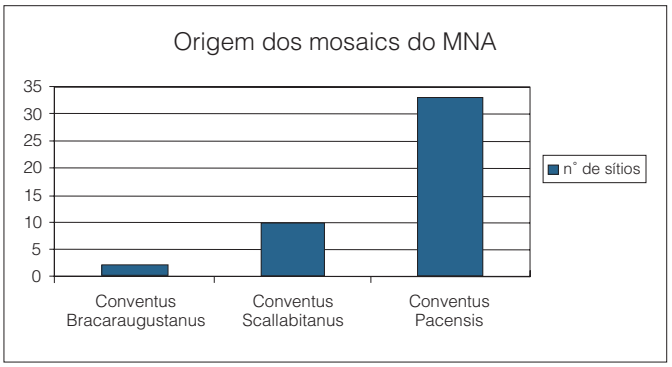


FIGURE 2 Provenance des mosaïques du Musée National d'Archéologie de Lisbonne (MNA).

La mosaïque de Póvoa de Cós, découverte en 1902, a été déposée et également placée au Musée national ; elle s'y trouvait encore lors de sa restauration et de l'installation d'un support en ciment armé, au début des années 50. Dans les années 80, on l'a prélevée et fragmentée en dix-neuf panneaux conservés dans la réserve du musée. Elle est actuellement présentée dans l'exposition « Mosaïques romaines dans les collections du Musée National d'Archéologie », inaugurée le 26 octobre 2005. Restaurée en 2005, elle a été dotée d'un nouveau support plus léger. Après division en quatre plaques, les lacunes et coupures ont été colmatées par des tesselles de résine synthétique magnétisées.

Nous estimons que l'utilisation de tesselles de résine synthétique pour le comblement des lacunes est peu scientifique car cela ne nous semble pas compatible avec les matériaux d'origine. Comme le soutient Claudia Tedeschi, « Il faut repren-

dre la manualité de la technique muséale, qui aujourd'hui est en voie d'extinction et assurer une parfaite compatibilité entre les matériaux originaux, en essayant de restituer la lisibilité de l'œuvre ».

Le Musée National d'Archéologie conserve aussi dans sa collection 59 fragments de mosaïques provenant de l'Algarve, à la suite du relevé effectué par à la fin du XIX[e] siècle par Estácio da Veiga, pour l'élaboration de la *Carte archéologique* de cette région. Il s'agit de petits panneaux, généralement décorés d'éléments figuratifs. En 1988, la majorité de ces fragments ont été restaurés et ont reçu un support léger de résine époxy. Cette intervention a beaucoup changé l'aspect et le dessin des motifs de certaines mosaïques et a provoqué sur d'autres la désagrégation de tesselles. Le fragment de Pedras d'El-Rei (inv. : 18685) se trouve très endommagé et les tesselles continuent à se désagréger (fig. 3a, b).

Les mosaïques de Montinho das Laranjeiras ont été également assez endommagées (fig. 4a–c). La mosaïque du Poisson[4] a perdu une partie de son *opus tessellatum* sur l'angle supérieur gauche et la mosaïque du *Cantharus*[5] a perdu presque la moitié de ses tesselles d'origine.

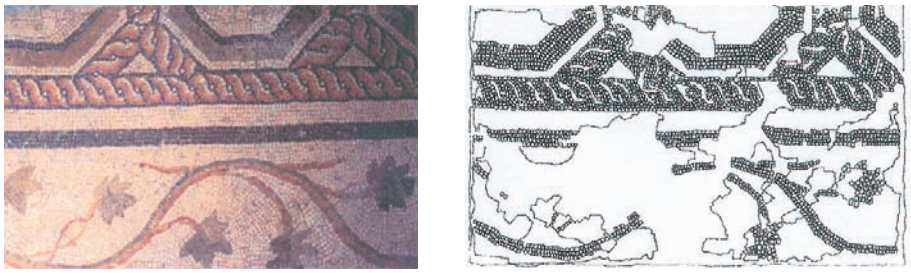
Parmi les mosaïques de l'Algarve ayant subi une intervention en 1988, nous avons choisi un ensemble de 22 fragments et avons effectué une étude comparative des dimensions des mosaïques, avant et après restauration (tableau 1).

Nous avons constaté que l'intervention faite au niveau du support de la mosaïque modifie les dimensions de l'*opus tessellatum*. Sur les vingt-deux fragments, la restauration a entraîné une augmentation des dimensions de quinze fragments et la diminution des dimensions de cinq fragments.

Musée Régional d'Archéologie D. Diogo de Sousa, Braga

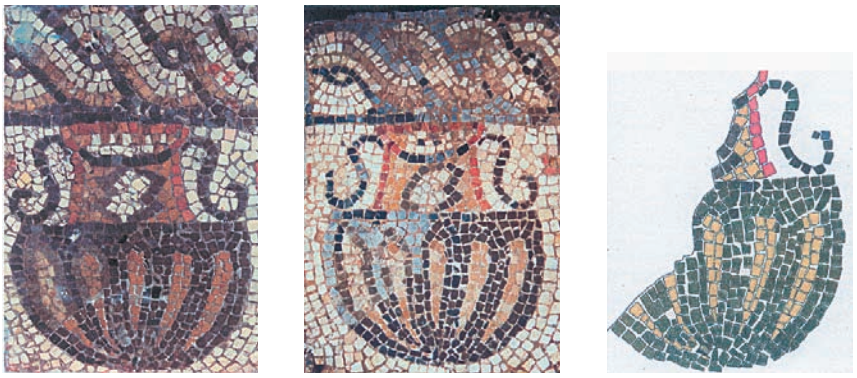
Lors de la construction du nouveau bâtiment destiné à accueillir les collections du vieux Musée D. Diogo de Sousa, on a procédé à une fouille en 1990–1991 qui a permis de découvrir un pavement de mosaïque, qui, du fait de ses caractéristiques, a été intégré à l'espace de la crypte de l'édifice. Il a été protégé par du sable pour être ultérieurement minutieusement restauré afin de pouvoir être exposé par le Musée.

Comme notre projet d'étude de cette mosaïque coïncidait avec sa préparation en vue de son intégration au parcours



(a) (b)

FIGURE 3A, B Mosaïque de Pedras d'El-Rei, Algarve. Collection Musée National d'Archéologie, inv. : 18685 ; (a) Photo (AFMNA) avant restauration, 1988 ; (b) Dessin de la mosaïque. F. Abraços et C. Viegas, 2005.



(a) (b) (c)

FIGURE 4A–C La mosaïque de Montinho das Laranjeiras, Algarve. Collection Musée National d'Archéologie, inv. : 18697 ; (a) Avant restauration. AFMNA ; (b) Après restauration. Photo F. Abraços, 2000 ; (c) Dessin de la partie originale du *cantharus*. F. Abraços, 2005.

Tableau 1 Dimensions des mosaïques avant et après restauration.

MNA Nº inventaire	Dimensions avant la restauration (cm)	Dimensions après la restauration (cm)	Augment. (+) Diminuit. (–)
18687	26 × 24	27 × 25	(+)
18681	38 × 22	36 × 20	(–)
18695	36 × 28	39 × 30	(+)
18752	46 × 30	47 × 31	(+)
18690	47 × 24	48 × 25	(+)
18755	45 × 26	47 × 28	(+)
18686	72 × 26	69,5 × 22	(–)
18693	48 × 30	45 × 27	(–)
18699	49 × 30	50 × 28	(+) x (–)
18691	50 × 52	49 × 45,5	(–)
18702	52 × 49	53,5 × 50,5	(+)
18748	51 × 44	52 × 45	(+)
18698	55 × 42	58 × 43	(+)
18705	42 × 31	43 × 33	(+)
18688	47 × 34	47 × 35	(+)
18756	47 × 34	50 × 35	(+)
18684	44 × 23	43 × 24	(–) x (+)
18703	56 × 39	56,5 × 40	(+)
18749	85 × 49	88,5 × 49	(+)
18750	42 × 25	44,5 × 27,5	(+)
18751	49 × 32	49 × 34,5	(+)
18754	74 × 44	64 × 42	(–)

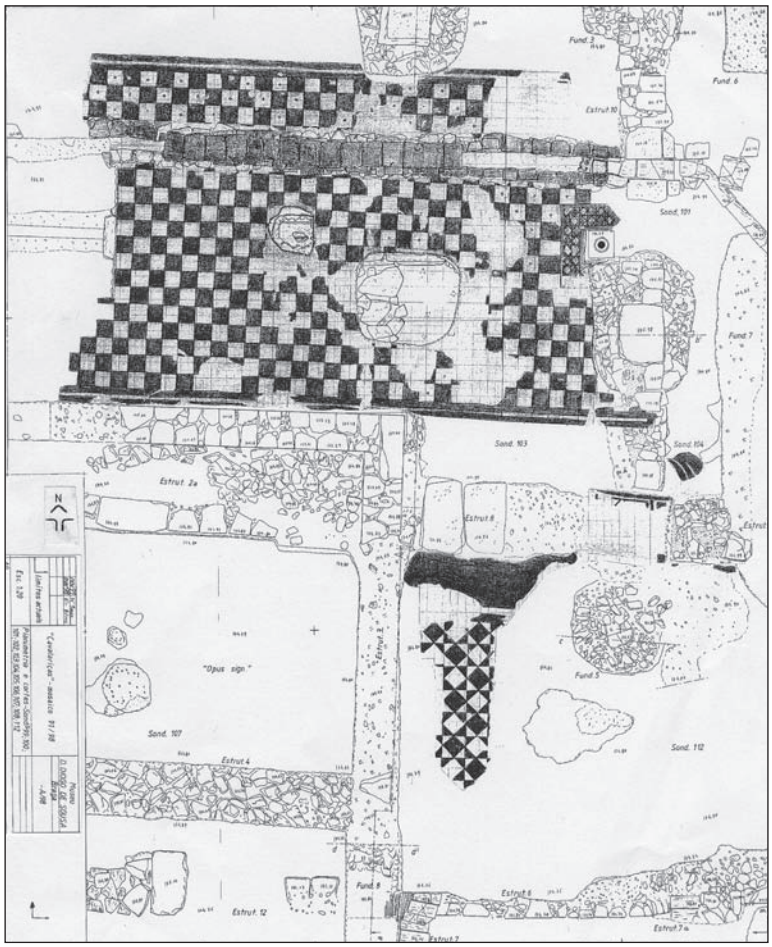


FIGURE 5 Les mosaïques de la crypte du Musée D. Diogo de Sousa. AFMDDS.

muséologique, nous avons pu en suivre le nettoyage et le traitement de conservation (fig. 5).

Les structures qui subsistent de la maison, ainsi que les mosaïques qui lui sont associées, se trouvent au niveau de la nappe phréatique. Pendant la construction du bâtiment du Musée, cette zone a fait l'objet d'un isolement spécial mais cela s'est révélé insuffisant pour éviter plusieurs inondations. Une couche de boue s'est déposée sur les pavements et ce milieu humide a contribué à une altération de la surface de l'*opus tessellatum*.

En 2003, le mur de protection des structures de la maison dont faisaient partie les deux panneaux de mosaïque a été renforcé et on a procédé, à partir d'avril 2004, au déblaiement des sables et des boues qui recouvraient les mosaïques. Ce milieu humide a altéré l'aspect des différents matériaux et arraché ou fait disparaître la majorité des tesselles. Lorsque nous avons voulu caractériser les matériaux de ces pavements et de leur support, il nous a été difficile de les identifier. Nous avons donc décidé de prélever les échantillons suivants pour analyse en laboratoire :

1. Une tesselle qui, apparemment, semblait faite d'argile très compactée, de couleur gris foncé ;
2. Un petit fragment de tesselle blanche ;

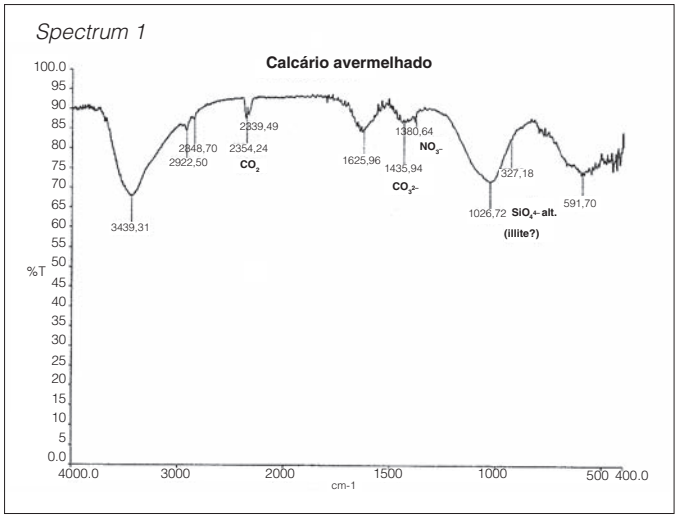


FIGURE 6 Spectre 1. Formules : CO_3^{2-} – carbonate; NO_3^- – nitrate ; SiO_4^{4-} alt. – silicate altéré ; SiO_4^{4-} – silicate ; SO_4^{2-} – sulfate. Résultat : calcaire.

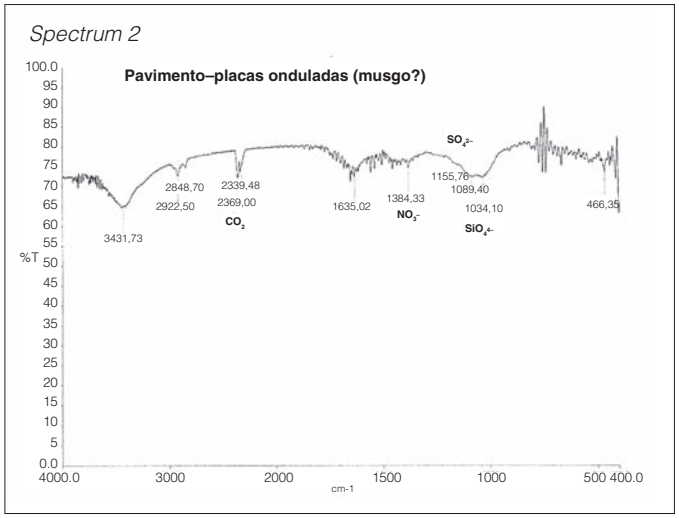


FIGURE 7 Spectre 2. Résultat : sulfate, nitrate et silicate avec du matériel organique. Analyses réalisées au Laboratoire de Minéralogie de l'IST, Lisbonne.

3. Des échantillons pris à différents points du lit de pose des pavements ;
4. Des échantillons de mortier pris à un endroit qui ne présentait que les négatifs des tesselles.

Résultat de l'analyse des échantillons :

1. La tesselle qui semblait faite d'argile compactée de couleur sombre a été examinée au microscope et cela n'a laissé aucun doute quant à sa constitution : il s'agissait d'un granit de la région, de couleur rose et au grain fin, provenant de Conde, Braga.
2. Le petit fragment de tesselle blanche n'a suscité également aucun doute lorsque nous avons versé dessus une goutte d'acide chlorhydrique ayant provoqué une effervescence. Il s'agissait d'un calcaire.
3. Nous avons procédé également à l'analyse d'échantillons de mortier du lit de pose, pris à différents endroits, et qui ont été signalés sur le terrain. Les échantillons – qui avaient l'apparence d'une pâte épaisse et jaunâtre, et que nous pensions être une pâte contenant des carbonates – ont été observés à la loupe binoculaire *Wild* au grossissement 50, et n'étaient en fait que des sables de granit.
4. Quant à l'échantillon de mortier provenant d'un endroit ne présentant que des négatifs de tesselles, nous avons décidé de procéder à une analyse minéralogique par spectroscopie d'absorption de rayons infrarouges par transformée de Fourier, qui nous a permis de caractériser la composition de cet échantillon, prouvant, ainsi, l'existence de calcaire, comme nous pouvons le voir sur le spectre 1 (fig. 6).

Les résultats de ces analyses permettent de certifier que *l'opus tessellatum* de ces mosaïques est constitué de tesselles de granit rose au grain très fin et de tesselles de calcaire blanc, qui ont pratiquement toutes disparu, et que la couche du lit de pose est constituée de sable de granit.

Comment se sont comportés les panneaux de mosaïque après suppression du sable qui les recouvrait et nettoyage ?

Nous avons constaté qu'une couche verte se formait peu à peu à la surface des pavements.

Nous en avons prélevé quelques échantillons et avons procédé à une nouvelle analyse minéralogique dont nous présentons les résultats sur le spectre 2. Nous avons déterminé l'existence de sulfate, de nitrate et de silicate ainsi que d'une grande quantité de matériau organique (fig. 7).

Devant ces résultats nous proposons de retirer les impuretés et les moisissures des mosaïques par nettoyage mécanique avec application préalable de sels d'ammonium quaternaire, ou simplement d'eau oxygénée. Étant donné que la lumière

accélère le développement des moisissures, il faut procéder à une étude de la luminosité de la pièce de façon à diminuer l'incidence de la lumière sur les structures et les pavements.

Dans la salle où se trouve la mosaïque sera présentée l'histoire de sa découverte et les techniques utilisées lors de sa création et l'on pourra également suivre le travail de maintenance et de contrôle permanents qu'exige sa préservation.

Hormis les interventions archéologiques de sauvetage d'urgence, la pratique des différentes équipes qui travaillent à Braga est de conserver *in situ* les structures et les mosaïques découvertes pendant les fouilles, comme nous avons pu le constater avec les mosaïques de la maison romaine, actuellement présentées dans la crypte du Musée D. Diogo de Sousa.

Le Musée de Braga abrite, outre les panneaux *in situ* de la crypte du Musée, un ensemble de 26 pièces provenant de fragments d'une mosaïque de Braga (Abraços 2005b).

Il s'agit de découvertes récentes, qui n'ont pu être conservées *in situ*. Ainsi, un ensemble découvert sous la Place S. Paulo en 1993 a été détaché par morceaux et a donné lieu à la construction d'un nouveau bâtiment.

Il s'agissait d'une mosaïque qui recouvrait le fond d'un bassin. D'après la description de la fiche de restauration, la méthode utilisée pour sa dépose a consisté en un nettoyage de surface, consolidation de toute la superficie avec du Plextol B500, collage de gaze sur toute la mosaïque à l'aide de Plextol B500, collage d'une toile écrue sur la gaze et réalisation de moules en polyuréthane expansé. Le travail a été exécuté sous la supervision de la Direction Régionale Nord de l'Institut du Patrimoine. Cette mosaïque se trouve dans la réserve du Musée D. Diogo de Sousa[6]. La mise au jour et la technique de dépose ont laissé la mosaïque très fragmentée et elle est actuellement en très mauvais état et irrémédiablement perdue.

De nombreuses interventions sont pratiquées à des fins de conservation et de restauration du patrimoine mais les techniques choisies ne sont pas toujours les meilleures et le résultat laisse souvent à désirer.

Notes

1 Voir notre carte p. 490 des *Actes de la VIIIe Conférence de l'ICCM*, 2005.

2 N° d'inv. : 999.142.1.

3 N° d'inv. : 999.141.1.

4 N° d'inv. : 18754.

5 N° d'inv. : 18697.

6 N° d'inv. : 1995.0530.

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Conservation d'un ensemble d'*emblemata* du Musée Archéologique National

Carmen Dávila Buitrón et M. Antonia Moreno Cifuentes

Résumé : *Le groupe de dix* emblemata *en* opus vermiculatum *appartenant à la Collection Royale et abrité au Musée National d'Archéologie à Madrid possède une grande valeur intrinsèque, historique et artistique. Les mosaïques ont été découvertes à Rome puis acquises par le Cardinal Massimi. Depuis leur arrivée au musée, les mosaïques ont subi plusieurs restaurations. À défaut de documentation, les traitements ont été déduits à partir des informations livrées par les mosaïques elles-mêmes. Des tesselles de marbre ou de calcaire ont été utilisées pour combler les vides. Les mosaïques ont fait l'objet de plusieurs études historiques et iconographiques mais leur importance mérite une recherche exhaustive sur leurs qualités techniques et de conservation.*

Abstract: *The group of ten* opus vermiculatum emblemata *mosaics from the Royal Collections housed in the National Archaeological Museum in Madrid are of great intrinsic, historic, and artistic value. All were found in Rome and later purchased by Cardinal Massimi. Since they arrived in the museum, the mosaics have undergone several restorations. In the absence of documentation, the treatments have been deduced from the information provided by the mosaics themselves. Marble or limestone tesserae were often used to fill empty spaces. Several historical and iconographic studies have been published on the mosaics, but because of the mosaics' importance, they merit exhaustive research into their technical qualities and state of conservation.*

Depuis nos débuts comme restauratrices au sein du Musée Archéologique National de Madrid, nous nous sommes intéressées à l'étude de l'histoire de la conservation et de la restauration à travers ses pièces. Le fait qu'il s'agisse d'un centre de presque cent quarante ans (il a été créé en 1867) avec une présence continue de professionnels de la restauration, et donc de la réalisation de cette activité, en fait un élément très important pour la recherche que nous exposons ici (Dávila Buitrón et Moreno Cifuentes 1993). L'étude concrète des mosaïques est survenue à partir de l'information, relativement abondante en comparaison avec d'autres matériaux, que nous avons pu trouver dans les Archives historiques du Musée (Moreno Cifuentes et Dávila Buitrón 1995). Cela a été à l'origine du travail dont nous avons présenté la première phase documentaire lors de la VI[e] Conférence du Comité International pour la Conservation des Mosaïques, à Nicosie, Chypre (Dávila Buitrón et Moreno Cifuentes 2003).

Cette communication constitue un état de la question des premiers résultats du projet concernant les supports des mosaïques. Malgré les difficultés qu'ont les restaurateurs de musées historiques pour associer recherche et information sur les anciennes interventions, nous souhaitons pouvoir réaliser cette tâche à moyen terme en étudiant la réintégration des lacunes et des protections de surface.

Méthodologie

Documentation

Cette première phase est pratiquement terminée et c'est celle dont nous allons essentiellement traiter. Pour conserver ou restaurer un objet avec les meilleures garanties, il est nécessaire d'en connaître tous les aspects, grâce à une bibliographie spécifique de différentes disciplines et aux archives historiques. Une fois les données connues, il est nécessaire de les analyser et de les interpréter du point de vue du conservateur-restaurateur afin d'en tirer toute l'information possible susceptible de nous révéler l'histoire de la conservation de la mosaïque en question. À travers la documentation ancienne conservée, nous avons établi une première séquence des interventions réalisées sur ces pièces et nous l'avons ensuite complétée par l'analyse des

photos archivées depuis 1925, préalablement numérisées pour faciliter la comparaison. Nous avons ainsi pu identifier, à travers des petites différences, quelques restaurations successives et, dans certains cas, les dater.

Examen

Il s'agit de l'étude individualisée de chaque mosaïque par le relevé, la réalisation de calques et l'observation directe avec une loupe binoculaire et différents éclairages. La prise de photos, leur traitement numérique et l'analyse des images ont été très utiles.

Analyse

Nous sommes à l'étape de l'étude de l'identification des produits utilisés pour la restauration des supports, l'analyse des mortiers et des adhésifs accessibles depuis l'extérieur, afin de déterminer la structure des ensembles des *emblemata*, avec des éléments originaux et ajoutés par les différentes restaurations[1] ; les techniques utilisées sont la microscopie électronique à balayage (SEM), la spectrométrie à infrarouges (FTIR) et la chromatographie gazeuse – spectrométrie de masses (CG-MS).



FIGURE 1 *Emblema* représentant une scène de quadrige (N° d'inv. 3603). Photo Archives Photographiques M.A.N.

Les mosaïques

Nous avons sélectionné un ensemble de mosaïques du Musée Archéologique National, provenant des Collections Royales, ce qui leur confère un énorme intérêt vu que, à part leur valeur intrinsèque, historique et artistique, elles bénéficient d'une documentation bibliographique, archivistique et graphique essentielle pour la reconstruction historique de la conservation et de la restauration depuis le XVII[e] siècle, au moins. Il s'agit de dix *emblemata* (sept sont pratiquement carrés et de plus grandes dimensions que les trois autres qui sont rectangulaires). Ils sont réalisés en *opus vermiculatum* avec des tesselles en marbre, en calcaire et en verre. Cinq représentent des thèmes de cirque[2]. Deux autres, de tailles différentes, représentent des scènes avec des pêcheurs[3]. Un homme attaqué par un crocodile figure sur un troisième[4] ; les trois derniers sont habituellement considérés comme « nilotiques » et les deux plus petits comportent des motifs végétaux et géométriques[5].

Les cinq premiers (fig. 1, 2) paraissent être des *emblemata* originaux et pourraient provenir de la même mosaïque ou, plus probablement, de deux ou trois mosaïques différentes (Rada y Delgado 1874). Des trois quadriges[6], celui qui est orienté vers la gauche représenterait la faction bleue, celui qui vient de face, la rouge et celui qui se dirige vers la droite, la verte, ce qui



FIGURE 2 *Emblema* représentant une scène de gladiateurs (N° d'inv. 3601). Photo Archives Photographiques M.A.N.

contribue à établir la chronologie des mosaïques. Le troisième (fig. 1) a quelques caractéristiques qui, comme pour le prototype du cheval, indiqueraient qu'elle serait plus tardive et probablement nord-africaine. La découpe de la pièce, laissant une partie des chevaux en dehors de l'ensemble, pourrait confirmer une origine différente des deux autres (Blázquez 1993). Les deux représentations de scènes de pêche, qui correspondent au même style et où les personnages portent des vêtements similaires, en particulier les coiffes pointues, devaient faire partie de la même mosaïque (Rada y Delgado 1874). C'est aussi le cas pour la pièce représentant l'homme et le crocodile (Cabrera 2001). Ces pièces présentent des similitudes avec la fameuse mosaïque nilotique de Palestrina où apparaissent des motifs comparables, notamment les coiffes, les crocodiles et le type de paysage. En raison des différences thématiques et stylistiques ainsi que de leur petite taille, il nous est difficile d'identifier l'éventuel rapport des fragments avec une guirlande[7] et un arc à motifs végétaux[8], ou encore avec les autres éléments. Selon la plupart des auteurs, ces mosaïques dateraient du III^e^ siècle (Balil 1976 ; Blázquez 1993 ; Castellanos 2001). Cependant, pour certains, les nilotiques remonteraient à la fin du II^e^ siècle (Cabrera 2001 ; Lachenal 2000) alors que pour d'autres le quadrige de la faction verte pourrait être du IV^e^ siècle (Blázquez Martinez 1993 ; Negueruela 1993).

Histoire

Une partie des mosaïques a été trouvée à Rome en 1670 et a été achetée par le cardinal Massimo (Castellanos 2001). Dans l'inventaire de sa collection de 1677, les dix *emblemata* figurent déjà et constituent un ensemble unique pour cette époque et qui restera complet jusqu'à nos jours. À part les inventaires, nous disposons aussi de dessins de l'époque, comme celui réalisé par Pietro Sante Bartoli, d'avant 1700 (Lachenal 2000). Ces emblèmes ont été acquis pour la Couronne Espagnole, à Rome, en 1764, à la demande du roi Charles III (Alonso Rodriguez 2003) qui, vingt ans plus tard, a offert son recueil, y compris les *emblemata*, au Cabinet d'Antiquités de la Bibliothèque Royale (Rada y Delgado 1874). Enfin, en 1867, à l'occasion de la création du Musée Archéologique National, ils sont entrés dans cette institution comme collections constitutives.

Techniques de fabrication

Un *emblema* est une représentation de mosaïque insérée dans une autre, plus grande (Balil 1976). Habituellement, ils étaient réalisés suivant la technique de l'*opus vermiculatum* sur des plaques de pierre (soit marbre, calcaire, travertin) ou de terre cuite pour faciliter leur transport depuis les ateliers où ils étaient fabriqués (Blanco Freijeiro 1950). Les supports s'adaptaient normalement aux unités de mesure, comme le pied, et plusieurs apparaissent montées sur des briques bipédales (Balil 1970, 1976). Les exemplaires de Zliten en Libye sont spécialement intéressants car ils faisaient tous partie d'un seul pavement et nous conservons une documentation écrite et graphique de leur état juste après les avoir trouvés, de leur extraction et de leur première exposition au Musée de Tripoli (Aurigemma 1926).

Entre les supports des dix *emblemata* du Musée Archéologique National de Madrid, nous trouvons quelques différences. Ceux des gladiateurs[9] (fig. 3, 4) ont une plaque de céramique, apparemment collée avec un adhésif organique sur l'envers des tesselles ; l'un d'eux avait le revers achevé avec une plaque d'ardoise qui ne se conserve plus (fig. 3). Vu que ses côtés se trouvent occultés par des restaurations modernes de polyester, il a été impossible d'étudier les supports des trois qui correspondent aux quadriges et celui du chariot avec les pêcheurs, sauf pour les photographies anciennes, mais sur le revers on peut voir encore l'ardoise. La base de la mosaïque avec le crocodile se trouve totalement occultée par une structure en aluminium ; il avait probablement un support similaire. La petite mosaïque du groupe des pêcheurs avait un support formé par une grosse couche de mortier, collée à une lame d'ardoise et avec les côtés recouverts d'un matériel organique (fig. 5) ; elle a également été récemment restaurée à l'aide d'un produit similaire (une résine de colophane), il semble donc difficile de distinguer l'original.

L'exemplaire décoré d'une guirlande[10] comportait un support antique de céramique en très mauvais état. Ce support a été récemment remplacé par une structure métallique qui permet de voir le revers original, dans lequel on aperçoit une couche de 3 cm de mortier romain. L'autre exemplaire, comportant un arc[11] a le support de terre cuite et aussi de la plaque d'ardoise occultés par une couche de ciment.

Pour faciliter l'adhésion des tesselles, on dégrossissait généralement le fond du support et on le nivelait ; on y aménageait parfois un petit rebord qui lui donnait la forme d'une boite (Aurigemma 1926 ; Fischer 1971). Une fois cette surface préparée, on étalait une couche de stuc (Balil 1976) de plâtre ou de ciment sur laquelle étaient placées les petites tesselles. Aurigemma nous décrit ce qu'il appelle *mastice* (adhésif ou mastic) des *emblemata* de Zliten – mélange de chaux, de poussière de marbre et de cendre. Pour les mosaïques de



FIGURE 3 Envers de l'*emblema* de gladiateurs (N° d'inv. 3600).



FIGURE 4 Envers de l'*emblema* de gladiateurs (N° d'inv. 3601).

FIGURE 5 Support original de l'*emblema* de pêcheurs (N° d'inv. 3607) avant les dernières interventions. Photo Jerónimo Escalera.



Madrid, selon la description de Blanco Freijeiro, les tesselles « *(...) sont superposées à une fine couche de chaux soutenue par un mélange de chaux et de poussière de brique (sans sable) qui repose à son tour sur une plaque d'ardoise. Cependant, le vrai support des tesselles est la cohésion que celles-ci maintiennent entre elles grâce à un film d'une substance collante qui n'est pas la chaux sous-jacente* ».

Après la restauration déjà citée du fragment avec la guirlande, les restes du support ont été conservés, ce qui nous a permis de les étudier et de prélever des échantillons pour en analyser les composants (fig. 6). Il s'agit d'une plaque de céramique, de la même taille que la mosaïque, avec une grande quantité d'adhésif organique et différents types de plâtres et de mortiers. On a analysé un fragment de terre cuite qui présentait une composition basique de silice et de carbonate de calcium et de magnésium.

Conservation

Cet ensemble se trouve, en général, en bon état, bien qu'il ait de nombreuses lacunes et interventions, certaines déjà mentionnées. Il peut exister différentes causes d'altération des



FIGURE 6 Support original de l'*emblema* avec guirlande (N° d'inv. 3608) avant les dernières interventions. Photo Jerónimo Escalera.

mosaïques au cours des siècles : leur propre composition, les techniques de fabrication, leur usage postérieur, une longue période d'enterrement, leur arrachage toujours traumatique, les divers déplacements et les restaurations successives. Le fait d'être transportable leur a toujours porté atteinte, puisqu'il a anciennement favorisé leur réutilisation et, actuellement, il permet de les prêter fréquemment pour être exposées temporairement dans différents lieux. Dans tous les cas, il se produit une manipulation qui, malgré tout le soin apporté, risque toujours de leur causer préjudice, comme nous avons pu le constater tout au long de leur histoire. Nous allons maintenant considérer les différents aspects qui ont influé sur l'apparence et sur la conservation de ces mosaïques.

Aspects muséographiques

Le cardinal Massimo exposait cet ensemble dans une salle spécialement aménagée de son *Palazzo alle Quatro Fontane*, présentant des tableaux et des petites sculptures. Ensuite, dans la première moitié du XVIII[e] siècle, les pièces sont arrivées au *Palazzo alle Colonne*, dans une pièce dite « salle des mosaïques » (Lachenal 2000). Sur le revers de plus de la moitié des pièces, on peut encore voir un nombre de deux chiffres écrit à grands traits rouges, qui pourrait correspondre à leur classification dans cette collection. À la Bibliothèque Royale, elles ont été présentées en 1783 en pleine vue, autour d'un portrait de Charles III. Plus tard, les dix tableaux ont été exposés sur les murs de l'ancienne salle des monnaies. Castellanos de Losada, alors Directeur de l'Institution, a publié en 1847 le premier catalogue de sa collection dans lequel figurait l'ensemble des *emblemata* avec leur chiffre d'inventaire, corrélatifs de 191 à 200, encore conservés à l'encre blanche sur l'avers (Castellanos 1847). Après leur arrivée au Musée Archéologique, ils ont été exposés dans l'une des ailes de la cour romaine à partir de 1895 (fig. 7) ; de nouveaux chiffres y ont été ajoutés – de 3 600 à 3 609 – en les organisant par matière. Ils ont été déplacés plusieurs fois par la suite.

Quant aux montages réalisés pour les exposer, on peut voir deux encoches particulières situées sur le revers d'une des mosaïques avec les gladiateurs (fig. 4). Elles sont, de toute évidence, antiques puisqu'elles ont les mêmes concrétions que le reste de la surface, et pourraient donc correspondre à un type de système de fixation – ou peut-être de transport – de l'époque romaine.

Sur les photographies les plus anciennes, nous voyons les mosaïques montées sur des cadres en bois doré (fig. 7) qui pourraient être les mêmes que ceux qui figurent dans l'inventaire du Cardinal Massimo mentionnant un reçu qui correspond à leur encadrement. Plus tard, tout au long du XIX[e] siècle, ces cadres sont mentionnés à plusieurs reprises (Rada y Delgado 1874 ; Castellanos de Losada 1847 ; Alonso Rodriguez 2003). En 1950, on a réalisé les premières photographies individuelles des mosaïques où l'on peut voir, malgré l'intention d'ajuster l'image à la mosaïque elle-même, une partie du périmètre intérieur de ces cadres. La même année, ils ont été remplacés par des lattes en bois blanc que nous voyons dans les installations inaugurées en 1954 (Blanco Freijeiro 1950). Lors de la réforme des années soixante-dix, les cadres ont été retirés et les mosaïques directement accrochées au mur avec des angles en fer auxquels elles étaient vissées. À ce moment, elles ont été percées sur leurs côtés pour y fixer des chevilles en bois et, par la suite, en plastique. Actuellement, seuls les trois *emblemata* décorés de courses de quadriges sont exposés dans les salles avec le même système, mais sur des panneaux de bois.

Les premières interventions

Évidemment, la première intervention dont ont souffert les mosaïques a été leur propre arrachage et le montage ultérieur pour leur donner un aspect commercialement acceptable et nous n'en connaissons que la date approximative. Pour tout le reste nous aurons à le déduire de l'étude directe des propres pièces, dont nous analyserons les éléments par parties.

Par les techniques et les parallèles connus, nous pouvons considérer que les supports de céramique sont d'époque romaine ; aucun des chercheurs ne remet ce fait en cause (Blanco Freijeiro 1950 ; Balil 1976). Il est possible que les supports ne



FIGURE 7 Les *emblemata* exposés dans la cour romaine du Musée Archéologique National en 1925. Photo Archives Photographiques M.A.N.

soient pas tous d'origine, notamment ceux qui viennent des grandes mosaïques coupées, mais comme il existe aussi beaucoup de parallèles, il peut s'agir de réutilisations de la même époque. Bien entendu, les caractéristiques morphologiques de l'*emblema* facilitaient son exécution et son transport mais aussi sa réutilisation. Balil considère que c'est le cas des *emblemata* de Zliten, par exemple.

Les plaques d'ardoise posent un plus grand problème. Leur existence entre les exemplaires qui nous occupent est assez singulière. Des deux mosaïques de gladiateurs[12], l'une possédait encore sa plaque d'ardoise il y a quelques années – malheureusement retirée dernièrement, pour cause de rupture, lors d'une intervention de restauration – tandis que l'autre ne l'a pas conservée (fig. 3, 4). Comme les chiffres rouges d'inventaire existaient sur l'envers dans ces deux cas, il est fort probable que l'une de ces plaques a été perdue lors de l'arrachage de l'*emblema*. Comme a observé le restaurateur qui a retiré la plaque d'ardoise brisée, celle-ci était collée au support céramique avec une résine de colophane, bien que, malheureusement aucune analyse n'ait été réalisée (fig. 3). Il est bien possible que les différentes couches du support aient été détachées pendant l'arrachage et ensuite collées. Les trois mosaïques de quadriges ont aussi une plaque d'ardoise avec son chiffre rouge, bien que celle correspondant à l'emblème de la faction verte[13] soit plus épaisse et d'un aspect différent. Il en est de même pour les deux *emblemata* nilotiques présentant une scène de pêche[14], ainsi que pour celui décoré d'un arc[15].

La question de savoir si la bordure en damiers noirs et blancs est originale ou correspond à une reconstruction postérieure semble difficile à résoudre car aucun auteur ne le mentionne. Cet ornement est présent sur les deux mosaïques de gladiateurs, les trois de quadriges et le petit fragment avec un arc. Notre étude nous permet de supposer qu'ils sont originaux, excepté celui de la série de chariots qui est incomplet. Cette hypothèse découle du fait que nous avons trouvé des parallèles avec des *emblemata* encadrés d'autres types de bordures, documentés graphiquement avant leur extraction, comme ceux de Zliten en Libye. D'autre part, nous possédons d'autres éléments comme la main du personnage de gauche de la faction rouge[16], qui se superpose à la bordure, ou encore la bordure partielle dans la partie supérieure, en rouge et blanc, de la petite mosaïque avec un arc, et qui, selon nous, correspondait à la limite originale de la pièce complète. Cependant, aucune des mosaïques coupées n'a rien de similaire ; s'il s'agissait d'un élément unificateur, nous pensons qu'il aurait été appliqué à toutes les pièces de la même façon. Le cas de la pièce avec quadrige que nous avons mentionné est différent. Comme nous l'avons déjà vu, la majorité des auteurs considèrent que cette mosaïque est d'une provenance distincte et postérieure aux deux autres ; ce qui est très probable vu que

cette pièce, incomplète et de plus petites dimensions (fig. 1), aurait été encadrée pour l'unifier avec les autres, en formant une série.

Les bandes de marbre qui les encadrent ont sans doute été ajoutées au XVII[e] siècle. Nous possédons en effet un reçu relatif à la petite mosaïque avec un arc dans lequel est mentionné le paiement d'un cadre de marbre entre 1670 et 1677. Les analyses montrent que les bandes de marbre sont directement collées sur le support céramique avec une résine de colophane.

Nous disposons aussi de certaines références à propos des restaurations antiques concernant les scènes représentées, alors que nous savons qu'elles datent du XIX[e] siècle. Sur ce point, nous considérons qu'elles peuvent faire allusion à un état de conservation proche du moment de leur trouvaille. De cette mosaïque de gladiateurs[17], Rada y Delgado dit en 1847 que : « *Le mot SIMMACHIUS, apparaît coupé dans sa partie finale par une restauration ancienne* » ; il est donc réduit en SIMMACHI (fig. 2). S'agissant du tableau nilotique avec chariot[18], il mentionne une restauration très mal faite entre l'aurige et le cou du cheval. De même, Blanco Freijeiro a décrit dans son étude de 1950 des restaurations réalisées sur les pattes postérieures des chevaux et sur le fond de la mosaïque à quadrige bleu[19]. Il pensait aussi que le restaurateur avait omis une partie du chariot de celle avec la faction verte[20] qui, selon lui, se voyait derrière le cheval au premier plan dans un dessin ancien (fig. 1). Cela pourrait signifier qu'il y a eu une reconstruction antérieure.

Enfin, des investigations récentes proposent une nouvelle thèse pour la mosaïque nilotique mentionnée. Du point de vue iconographique, il semble qu'une scène classique de promenade ait été fusionnée avec une scène de travail ; cela est si singulier qu'il a été suggéré une possible superposition de fragments, due à une restauration habile formant une seule pièce à partir de deux mosaïques différentes (Lachenal 2000 ; Cabrera 2001). Cette proposition se fonde sur le fait que cette pièce était destinée à la collection du cardinal Massimo où existaient des exemplaires avec des quadriges. Nous ne pourrons vérifier cette théorie qu'avec une étude approfondie de l'envers de cette pièce.

Les restaurations du Musée Archéologique

La restauration des mosaïques a commencé dès 1871 au Musée Archéologique, ce qui implique que, très probablement, des interventions ont eu lieu sur ces mosaïques depuis leur arrivée au Musée, bien qu'il n'existe aucune documentation à cet égard. De nombreuses réintégrations ont été réalisées au niveau des lacunes à l'aide de divers matériaux. Nous nous limiterons ici à des commentaires de caractère général. Pour les restaurations les plus anciennes, nous savons qu'elles ont été réalisées avec des tesselles de marbre ou de calcaire (fig. 1, 2). Cette technique s'utilisait encore au XX[e] siècle, dans les années quarante, (comme en témoigne le volume 1947/1 des Archives du Musée Archéologique National) et même actuellement. Il y a aussi des petites interventions réalisées en plâtre qui pourraient être dater aux années soixante.

Pour le support du fragment de guirlande déjà cité, nous pouvons signaler diverses interventions successives. Le support de terre cuite s'est cassé à un certain moment et il a été collé avec une pâte teinte dans une couleur similaire, composée de silice, d'oxyde, de carbonate de magnésium, de carbonate et de chlorure de calcium (fig. 6). D'autre part, on observe que des petites parties perdues sur les côtés ont été remplies, à un moment donné, avec un matériau pierreux formé de silicate de calcium et, plus récemment, avec un mastic blanc, constitué de sulfate de calcium, de silice et de carbonate de calcium. L'un des côtés conservait des restes de mortier composé de silice, de grenat (silicate d'aluminium et fer) de plâtre, de carbonate calcique et de feldspath sodique et potassique. Dans la partie qui était unie directement avec le mortier romain il y a des restes d'un mortier de couleur ocre clair, composé exclusivement de carbonate de calcium. L'adhésif apparaît très mélangé à cette couche et, par son aspect, il semblait correspondre à une résine naturelle. Tous les résultats des analyses ont été concordants (fig. 8). La résine terpénique révélée parmi le spectre FTIR a été confirmée par chromatographie gazeuse où les abiétates indiquent qu'il s'agit de la colophane ; la présence de carbonate de calcium s'explique, soit comme charge ou bien comme contamination. Pour le moment, il est très difficile d'établir si elle faisait partie de l'union originelle entre la brique et les tesselles.

Nous venons de voir les risques potentiels de la manipulation et des déplacements des *emblemata* qui, malgré leur taille, pèsent leur poids et sont difficiles à manier. C'est pourquoi un des types d'interventions que nous avons souvent détecté – essentiellement à partir de photographies – est la réparation de petits coups sur les coins, ou celle des détachements d'une des lames de marbre du cadre (fig. 4). Certains éléments qui mettent en évidence une restauration antérieure sur l'arrière de l'ardoise, actuellement disparue, de la mosaïque des gladiateurs ; celle-ci a dû être fragmentée à une époque assez ancienne à en juger l'adhésif de type organique utilisé (fig. 3). Dans les années quatre-vingt-dix, les interventions ont été réalisées avec du polyester afin d'améliorer la résistance des

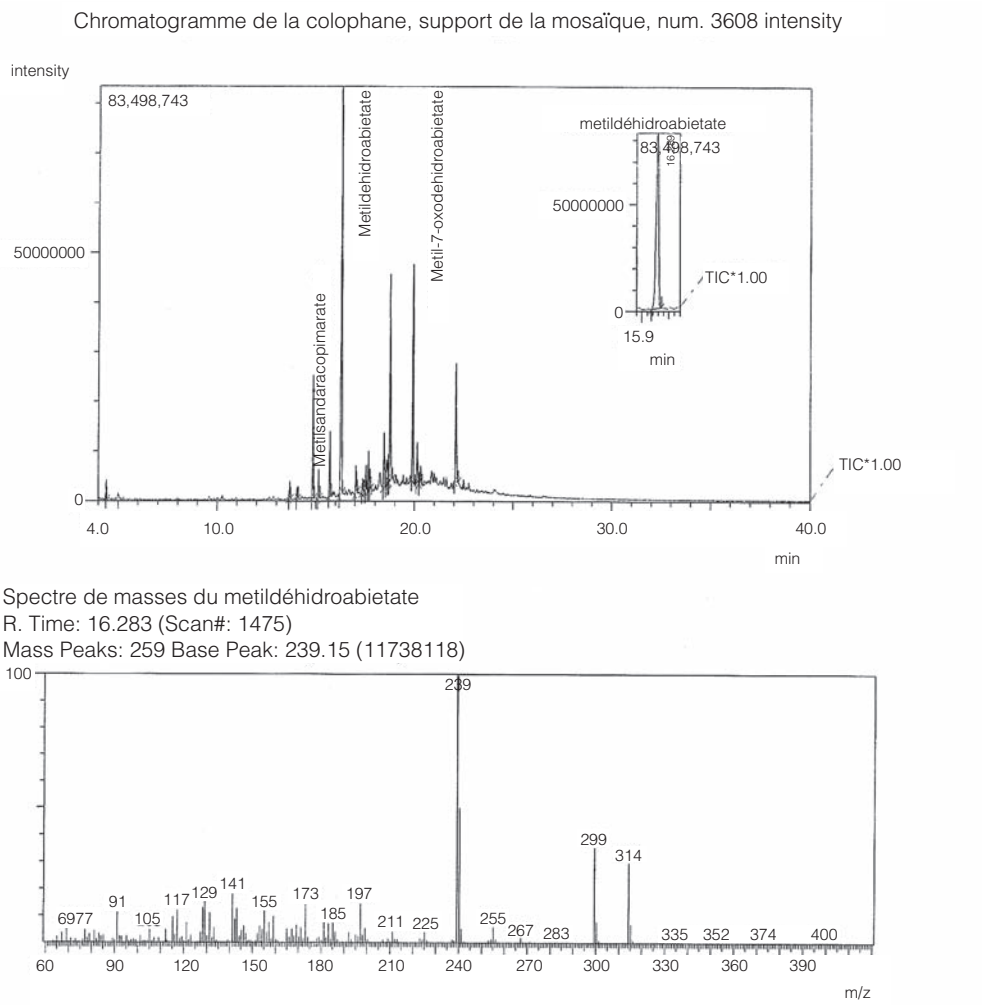


FIGURE 8 Emblema avec guirlande (N° d'inv. 3608): Chromatogramme et spectre de masses du dihydroabiétate identifient l'adhésif comme étant une résine de colophane. Images Marisa Gómez.

supports et d'unifier leur aspect esthétique dans l'exposition, au grand dam de la conservation des pièces et de la documentation historique. Ces dernières années, les inévitables interventions d'urgence similaires aux précédents ont été poursuivies, ainsi que les restaurations mentionnées au cours de ce travail.

Conclusion

Afin de conserver ces mosaïques dans les meilleures conditions techniques et de respecter la pièce et son histoire, il est indispensable de la connaître le mieux possible grâce à une étude intégrale et multidisciplinaire comportant une analyse historique, documentaire, technique et scientifique. Cela nous permettra de faire la différence entre les éléments originaux et les ajouts.

Les techniques de fabrication, les parallèles iconographiques et les précédents historiques nous conduisent à considérer que les supports de la majorité des pièces sont des originaux de l'époque romaine, bien que les *emblemata* aient pu être réutilisés. À notre avis, les plaques d'ardoise et les bordures dentées peuvent également être originales, sauf l'exception mentionnée, malgré les doutes qui persistent. Les ajouts du XVII^{e} siècle, comme les bandes de marbre qui encadrent les *emblemata*, doivent être considérés comme faisant partie intégrante de la pièce et doivent donc être conservés de la même manière que les éléments originaux.

Il est nécessaire de poursuivre la recherche sur les restaurations historiques car elles peuvent nous révéler beaucoup d'informations importantes sur l'histoire de la restauration, en général, et sur celle de la pièce en particulier. Connaître l'évolution des techniques, des matériaux et des produits, le vieillissement naturel ainsi que les critères des traitements successifs, nous permettra d'améliorer notre formation et d'intervenir de manière correcte et plus documentée pour

décider de mesures de conservation ou de l'élimination de certaines restaurations.

Enfin, les assemblages réalisés pour permettre l'exposition, ainsi que les critères et les matériaux avec lesquels ils ont été effectués, dépendaient des goûts de l'époque ou des critères muséographiques du moment. Ces aspects sont également déterminants pour la conservation des biens culturels et nous devons donc en tenir compte lors de l'étude de toute pièce, car ils sont inhérents à son histoire.

Notes

1 Analyses effectuées par J. M. Mota et R. Calabrés, du Département de Sciences et Génie des Matériaux et Génie Chimique de l'Université Charles III à Madrid, et par M. Gómez, chimiste conservateur scientifique, et A. Arteaga, Assistante technique du Laboratoire des Matériaux de l'Instituto del Patrimonio Histórico Español (IPHE).

2 N° d'inv. 3600, 3601, 3602, 3603 et 3604.

3 N° d'inv. 3605 et 3607.

4 N° d'inv. 3606.

5 N° d'inv. 3608 et 3609.

6 N° d'inv. 3602, 3603 et 3604.

7 N° d'inv. 3608.

8 N° d'inv. 3609.

9 N° d'inv. 3600 et 3601.

10 N° d'inv. 3608.

11 N° d'inv. 3609.

12 N° d'inv. 3600 et 3601.

13 N° d'inv. 3603.

14 N° d'inv. 3605 et 3607.

15 N° d'inv. 3609.

16 N° d'inv. 3604.

17 N° d'inv. 3601.

18 N° d'inv. 3605.

19 N° d'inv. 3602.

20 N° d'inv. 3603.

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Inadequate Storage Conditions: Causes of Deterioration of Mosaics in a Museum Environment

Maja Frankovic

Abstract: *Mosaics restored on plaster from the collection of the National Museum in Belgrade were kept in an improvised storage area where inadequate climate conditions caused their degradation. This paper presents an assessment of their state of conservation, which includes studying previous restoration work, climate conditions in the storage area, and the decay mechanism of the mosaics. De-restoration of the mosaics is also discussed, along with a training program in mosaic conservation and restoration, which is part of a cooperative project among the National Museum in Belgrade, DIANA Department for Preventive Conservation, and the Musée de l'Arles et de la Provence antiques.*

Résumé : *Les mosaïques restaurées sur plâtre appartenant à la collection du Musée national de Belgrade furent entreposées dans une réserve improvisée où les conditions climatiques inappropriées on conduit à leur dégradation. Cette communication fait le point sur leur état de conservation, en étudiant les restaurations précédentes, les conditions climatiques dans la réserve et les mécanismes de détérioration qui les affectent. La dé-restauration des mosaïques est abordée ainsi qu'un programme de formation pour la conservation et restauration des mosaïques dans le cadre d'une coopération entre le Musée National de Belgrade, le Département pour la conservation préventive DIANA et le Musée de l'Arles et de la Provence antiques.*

One of the most important steps in any conservation process is making a decision about conservation treatment, which critically affects the preservation of the object. Even the most prudent conservation work, however, cannot prevent an object's decay if preventive conservation is not applied. The mosaics from the National Museum in Belgrade illustrate how a lack of preventive conservation can influence the decay of objects even in museum storerooms.

These mosaic pavements from the museum's late Roman collection come from two archaeological sites, Stobi and Guberevac. All the mosaics were restored on plaster and stored under the same conditions. With reconstruction of the museum scheduled to begin in the near future, a survey of the collection was carried out in order to assess their state of conservation as well as to prepare them for transportation to temporary storage.

The mosaics from the Guberevac site were found to be in a poor state of conservation and needed urgent intervention. The mosaics from Stobi showed some decay but were more stable; immediate restoration was not required, but a few fragments needed stabilization prior to being transported. Only the mosaics from the Guberevac site are discussed here, as work on their de-restoration allows us to study them more thoroughly.

Archaeological Context and Decoration of the Mosaics of Guberevac

The Guberevac mosaics were discovered in 1958 in a late Roman building on the site of the civil settlement of the *castrum* at Stojnik, in the mining district of Kosmaj. They are polychrome pavements of *opus tessellatum*, composed of stone, terracotta, and glass tesserae, dated to the mid-fourth century C.E. (Dusanic 1974: 93–96). The mosaics can be divided into three units according to their decoration.

Unit 1 consists of a pattern consisting of four-pointed stars that form lozenges alternately recumbent and upright, thus creating the effect of tangent and intersecting octagons.

The stars bear an axially inscribed square (Balmelle and Prudhomme 1985: 184b) with the six fragments forming a surface of 3.46 square meters.

Unit 2 consists of a triaxial outlined pattern of circles intersecting at six points and spaced so as to form trefoils and concave hexagons (Balmelle and Prudhomme 1985: 247a). The hexagons bear the names of donors, along with geometric ornaments and representations of a bird and a fish. The dimensions of the reconstructed part of this mosaic are 3 by 2.37 meters. There are fourteen fragments in total, four of which are isolated.

Unit 3 consists of a pattern of tangent spindles and circles that form irregular concave octagonal compartments (Balmelle and Prudhomme 1985: 150e). Donors' names and titles are placed in these compartments and in a central, rectangular one (Dusanic and Mirkovic 1976: 151–53). The mosaic was severely damaged, so six out of the nine fragments were isolated. The dimensions of the reconstructed part are 1.71 by 1.28 meters.

In addition, there are five fragments of a different geometric decoration that are not linked to the three units discussed in this paper.

The importance of these mosaics derives from the inscriptions of the donors' names and titles, which provide information about the population of Kosmaj in the fourth century. The foreign names of some of the donors, three Greek (Hermia, Theodulus, and Zinobius) and one Oriental (Malcus), attest to the fresh wave of immigration from the East, which began at the end of the third century and left its mark in Singidunum. The name Theodulus, together with other indications, makes it probable that the mosaics refer to a Christian edifice (Dusanic 1974: 97–105).

Once excavated, the site was to be reburied. Because mosaics are considered an important find, they were lifted and transferred to the National Museum in Belgrade. Except for unit 2, which was briefly presented as part of the museum's permanent exhibition, the mosaics have not been exhibited.

Assessment of the Guberevac Mosaics

Restoration

The mosaics were restored in 1959 when each fragment was transferred, separately, to a plaster (gypsum) support. Because there are no records of previous restoration work, all the information we have thus far comes from observations made during the de-restoration process. We extrapolate that the restoration was conducted in the following order.

A thin layer of colored plaster was applied to the back of each fragment. More plaster was added to form a support, and then the plaster was reinforced with iron rods and hemp fibers.

Those tesserae removed during the mosaic lifting process were reintegrated after the fragments were turned to front. First, the support for reintegration was cast in plaster; from the backs of the fragments it can be seen that the plaster in these areas overlaps the rest of the plaster, suggesting that it was cast after the turning of the fragments. Next, iron nails were used to reinforce the bond between these parts and the rest of the fragment. Finally, the tesserae were reintegrated using a mortar harder than plaster, probably a cement-based one (fig. 1). Some lacunae were reintegrated with the original tesserae, and these too were treated in the same way. However, the mosaics were rather damaged and large parts of the *tessellatum* needed retouching. The lacunae were treated in three ways:

- Some were filled with colored plaster that simulated bedding mortar.
- Larger lacunae were filled with a plaster cast to simulate *tessellatum*, especially in unit 3 (fig. 2). The tesserae with deteriorated red terracotta in unit 2 were retouched in the same way.
- Other lacunae were reintegrated with new tesserae. This method was used primarily to replace the deteriorated glass tesserae in unit 2.



FIGURE 1 Previous restoration of Guberevac mosaics: reintegration of original tesserae removed during mosaic lifting.



FIGURE 2 Treatment of lacunae in unit 3 of the Guberevac mosaics: plaster cast to simulate *tessellatum*.



FIGURE 3 Removal of plaster from the back of the fragment: reintegration with original tesserae, detail.

The method employed to restore the Guberevac mosaics proved a fairly good one, as plaster can be easily removed without damaging the *tessellatum*. Further, the way the lacunae were treated allows us to distinguish the retouched parts. Even those surfaces reintegrated with the original tesserae can be detected when removing the plaster from the back (fig. 3). However, reinforcing the plaster with iron was not a good solution given the continental climate. This is the weakest step of the method employed, as the rusting of the iron rods caused serious damage to the mosaic fragments.

Storage Conditions

The National Museum in Belgrade occupies an old bank building. The storerooms are in the basement, in old vaults that are too small to accommodate the museum's large collections. The lack of space and the steep steps leading into the basement make it especially difficult to store large and heavy objects. This was probably the reason that the mosaics had to be restored in several smaller fragments. Initially, the mosaic fragments were stored in a hallway in front of the storage area, where they were placed vertically, leaning on one other.

During the mid-1980s the mosaics were moved to a temporary storage facility in the basement of the Gallery of Frescoes, where they were placed vertically, in wooden racks without any kind of support (fig. 4). Those fragments that were damaged and broken during transportation were placed in wooden cases or on a shelf. Since the basement was not originally intended for storage there is no isolation from surrounding moisture. Two outer brick walls and the floor are directly in contact with the ground, so that capillary moisture combined with poor air circulation resulted in dampness. Climatic measurements in the storage area taken in 2005 show high levels of humidity throughout the



FIGURE 4 Manner of storing mosaic fragments in the Gallery of Frescoes.

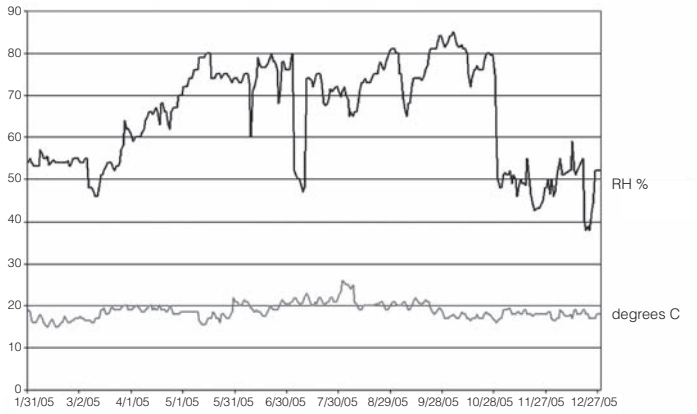


FIGURE 5 Climatic data during storage at the Gallery of Frescoes: measurements taken in 2005.

year (fig. 5). The average relative humidity (RH) was 68 percent; the average temperature was 19°C. Indoor heating during the cold season lowered the humidity, but as soon as winter ended the RH started to increase (Thomson 1986: 94). The highest RH—85 percent—was recorded in October. Prolonged periods of RH that exceeded 80 percent, along with poor ventilation, caused mold to grow on "dirty" mosaic fragments, that is, those with dust and traces of animal glue (Michalski 1993: 625). Samples analyzed at the Biological Institute in Belgrade in March 2004 showed the presence of yeast, *Aspergillus wentii, Cladosporium cladosporioides,* and *Stahibotris chartarum*.

However, the greatest damage to the mosaic fragments was caused by oscillations of RH. Although inorganic materials are considered more resistant than organic materials to deterioration influenced by RH, changes in RH can cause breakage in objects made from different materials as they respond to moisture changes. Even objects composed of pieces of the same material may crack because the material swells differently in different directions (Thomson 1986: 66). During 2005 the oscillation of RH in the storage area was 47 percent. In addition, there were sudden spikes in RH; in July it dropped from 80 percent to 52 percent in just one day, and then a week later it increased from 48 percent to 74 percent. As climatic measurements were not taken on a regular basis for the previous years, we do not have sufficient data to compare them with those for 2005. However, the mosaics' state of conservation indicates that oscillations of RH must have been repeated in cycles over many years to cause the damage we now see.

Analysis of Decay

To assess the mosaics' state of conservation, each fragment was photographed and its condition recorded on transparent plastic sheets (1:1 scale). The information detailed cracks, broken fragments, detached tesserae, missing tesserae, deteriorated tesserae, glass tesserae, and retouched parts. This information was then used to identify the decay created during storage as well as to study the decay mechanism of mosaics.

Decay Mechanisms

Climatic conditions in the storage area provoked deterioration of the material used for restoration, which subsequently led to damage of the *tessellatum*. Because plaster is a hygroscopic material, it absorbed atmospheric humidity, thus accelerating the oxidation of the iron rods. The corroded iron rods in turn swelled, causing cracking. Cracks that follow the length of the iron rods are visible on all the fragments. They vary in size from fissures to large cracks. Cracks appeared primarily in the joints between tesserae, but a few broken tesserae were also noted. In some cases the corroded iron caused deformation of fragments, even breaking (fig. 6). Oscillations in RH caused soluble salts in the plaster to move, further weakening the gypsum and detaching the tesserae. The cracking and breaking of fragments also induced degradation of the plaster support and the loss of tesserae.

The presence of identified decay effects was estimated for each unit of the Guberevac mosaics and for the total (table 1).



FIGURE 6 Fragment from unit 2 of the Guberevac mosaics: damage caused by corrosion of iron rods.

Table 1 Recorded decay effects for the Guberevac mosaics

Decay Effect	Unit 1 (%)	Unit 2 (%)	Unit 3 (%)	Isolated Fragment (%)	Total (%)
Cracks	37	30	33	36	34
Deformed fragments	3	15	17	6	11
Broken fragments	30	25	23	27	27
Detached tesserae	20	20	12	14	17
Missing tesserae	10	10	15	17	11

Given the condition of the mosaics, it was concluded that the old plaster support should be removed and the mosaics restored using stabler materials.

De-restoration of the Mosaics

Apart from preventing further decay, the de-restoration project aims to restore the Guberevac mosaics so that they can be added to the museum's permanent exhibition and to train a team of professionals in mosaic conservation and restoration. This is part of an ongoing cooperative effort among the National Museum in Belgrade, the DIANA Department for Preventive Conservation, and the Musée de l'Arles et de la Provence antiques and is supported by the Embassy of France and the French Cultural Center in Belgrade. Programs of cooperation with foreign experts, organized by the DIANA Department of Preventive Conservation, are aimed at training museum professionals and developing museum practice. DIANA's educational programs form an important part of the activities offered by the National Museum and are especially valuable in the field of conservation, which suffers from a dearth of professional staff.

De-restoration of the Guberevac mosaics started in March 2005. Stabilization measures had to be applied before moving the most fragile fragments from storage. Patches of cotton gauze and water-soluble adhesive were used to stabilize fragments prior to moving them. This temporary facing was removed later, and fragments were faced with polyvinyl-acetate adhesive. The corroded iron rods were detached from the broken fragments and the fragments put back in position before facing (fig. 7). Deformed fragments and those with large cracks were faced as they were. Any correction deemed necessary will be made after the plaster is removed. Detached tesserae were fixed back in place; those tesserae that fell out of their original positions were labeled and will be reintegrated later. Removal of the plaster support is currently in progress (fig. 8). The mosaics are to be restored on

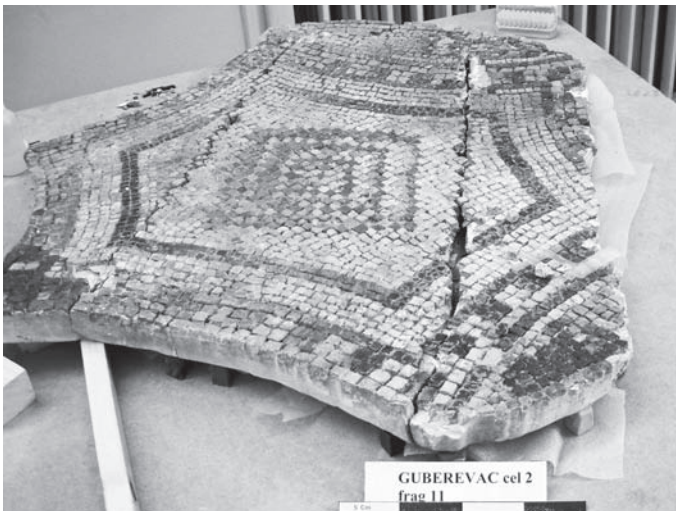


FIGURE 7 Fragment from unit 2 of the Guberevac mosaics before facing: corroded iron rods were removed and fragments put back in position; detached tesserae were fixed back in place.



FIGURE 8 Retreatment of plaster support from the backs of the fragments.

aluminum honeycomb panels, as this will facilitate both handling them and storing them on sliding panels. Fragments will be joined on panels according to their units. The presentation of isolated fragments and the treatment of lacunae need to be discussed with a curator and have not yet been determined. Completion of conservation is planned for the end of 2007.

The assessment of the Guberevac mosaics showed that in addition to the unregulated climate in the storage area, damage was caused by the manner in which they were placed in storage and by improper handling. Therefore, after conservation special care will be taken to improve climatic conditions in the storage area and to implement procedures for future storing and handling of the mosaics.

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Coopération algéro-française pour la préservation de collections anciennes de mosaïques des musées algériens

Marie-Laure Courboulès, Abdelkader Bensalah, Mouloud Derram et Mohamed Chérif Hamza

Résumé : *De 2001 à 2003, la préparation de l'Année de l'Algérie en France permit l'élaboration d'un programme de coopération pour la sauvegarde de neuf mosaïques des musées algériens. Initié par l'Atelier de conservation et de restauration de mosaïques du Musée de l'Arles et de la Provence antiques et l'Atelier de restauration des musées de Cherchell, ce projet a su associer la formation de conservateurs et de restaurateurs algériens, la coopération entre des équipes œuvrant tant en Algérie qu'en France et la diffusion auprès d'un large public de l'immense richesse de ce patrimoine. Cette opération a donné lieu à des projets entre les deux pays qui se poursuivent aujourd'hui sous diverses formes.*

Abstract: *From 2001 to 2003 preparation for the Year of Algeria in France provided the opportunity for establishing a cooperative program for the preservation of nine mosaics from Algerian museums. Initiated by the conservation and restoration workshop of the Musée de l'Arles et de la Provence antiques and the Cherchell museums' restoration workshop, the project combined training of Algerian conservators and restorers, cooperation between teams working both in Algeria and in France, and the dissemination to a wide public of this immensely rich heritage. The operation gave rise to projects between the two countries that are still ongoing today in different forms.*

Mise en place du projet et choix des mosaïques

Fin 2001, pour préparer les expositions sur l'Algérie antique programmées en 2003 dans le cadre de « Djazaïr, une Année de l'Algérie en France », l'Atelier de conservation et de restauration du Musée de l'Arles et de la Provence antiques a été sollicité pour monter un projet de coopération. Ce programme pour la sauvegarde et la présentation de neuf pavements antiques des collections algériennes a été établi en partenariat entre Patrick Blanc, responsable de l'Atelier arlésien (Conseil général des Bouches-du-Rhône) (Blanc 2003), et Abdelkader Bensalah, responsable de l'Atelier de restauration des musées de Cherchell, avec la collaboration de Mouloud Derram, responsable du service de restauration du Musée national des Antiquités d'Alger[1].

Les informations accessibles sur l'état des mosaïques étant très incomplètes, deux missions ont été organisées afin de déterminer avec nos collègues algériens les pavements susceptibles d'être intégrés au projet tant en raison de leur qualité iconographique que des risques encourus pour leur conservation. Effectuée en février 2002, la première mission a permis le repérage des pavements pouvant être exposés. Lors de cette mission, ont été visités le Musée national des Antiquités d'Alger, le Musée archéologique et le site de Tipasa, ainsi que les deux musées archéologiques de Cherchell, puis, lors d'un second séjour en avril 2002, les musées de Lambèse, Timgad, Djemila, Sétif et Constantine.

Notre démarche avait un but pratique : il fallait que les pavements répondent à certains critères. Parmi les nombreuses mosaïques algériennes au caractère iconographique remarquable, nous envisagions de ne retenir que celles qui étaient transportables et n'exigeaient pas de dérestauration complète. Cependant, devant l'extraordinaire qualité, mais aussi le danger qui menaçait la conservation de l'exceptionnelle mosaïque des Monstres marins d'Aspasios et de la mosaïque de la Nymphe Cyrène, toutes deux conservées au Musée archéologique de Lambèse, il a semblé important de les associer au projet. Pourtant, malgré le nombre de sites visités grâce à l'accueil et

la disponibilité des conservateurs et responsables, le choix des mosaïques n'a pu rendre compte de toute la diversité et de l'immense richesse de ce patrimoine algérien ; il en donne toutefois un bon aperçu. Au retour de mission, le rapport a permis de planifier l'intervention globale. Les neuf pavements sélectionnés provenaient du Musée national des Antiquités d'Alger et des musées de Lambèse-Tazoult, Tipasa et Cherchell.

Les autorités algériennes ont donné leur accord à la liste proposée. Ces mosaïques ont été présentées lors de l'exposition « Algérie antique » qui s'est tenue au Musée de l'Arles et de la Provence antiques d'avril à mai 2003. Par la suite, cinq d'entre elles ont également été exposées à l'Institut du monde arabe, à Paris ; un pavement a été présenté à l'exposition sur l'Algérie à l'époque de saint Augustin, tenue à l'automne 2003 au Musée d'Aquitaine à Bordeaux.

Les neuf pavements[2] choisis avaient été découverts à des dates très variées, s'échelonnant de 1851 à 1969. Après leur mise au jour, ils avaient été transposés sur différents types de supports : en plâtre et toile de jute avec armature en bois, en mortier de chaux et structure métallique, ou encore en mortier de ciment armé. Avec le temps, il devenait nécessaire de renforcer ces supports, de rétablir l'adhérence des tesselles, de rendre leurs couleurs d'origine aux matériaux antiques et, pour les cas les plus extrêmes, d'entreprendre une « dérestauration » complète de l'œuvre. L'Année de l'Algérie en France en a donné l'occasion, ainsi que la possibilité de monter un programme de formation d'un personnel spécialisé algérien.

Les interventions en Algérie et en France

Au Musée archéologique de Lambèse, l'état de conservation des mosaïques des Monstres marins d'Aspasios et de la Nymphe Cyrène réclamait, après diagnostic, une intervention d'urgence passant par leur retrait du mur du musée où elles étaient accrochées. Grâce à une étroite collaboration avec l'équipe de Cherchell et avec la Conservation du Musée de Lambèse-Tazoult, cette opération[3] a eu lieu en avril 2002. Après nettoyage, consolidations et encollage de toiles, la mosaïque des Monstres marins a été scindée en deux panneaux maintenus par des mousses et des plateaux en bois construits spécifiquement, puis prélevée de la paroi (fig. 1). Quant à la mosaïque de la Nymphe Cyrène, elle a été descellée du mur par introduction de minces lames d'acier à l'arrière du *tessellatum* ; cette opération a été longue et méticuleuse en raison des pierres du mur ressortant irrégulièrement dans la fine couche de mortier les recouvrant.

Ces deux pavements ont été transportés à Alger où ils ont rejoint quatre autres mosaïques du Musée national des



FIGURE 1 Intervention de l'équipe en Algérie au Musée de Lambèse-Tazoult pour le prélèvement des mosaïques des Monstres marins et de la Nymphe Cyrène. Entoilage de la mosaïque des Monstres marins. Photo © ACRM / MAPA.

Antiquités ainsi qu'une mosaïque de Tipasa. Le transfert de ces dernières avait été préparé suivant les mêmes principes par l'équipe d'Abdelkader Bensalah et par Mouloud Derram.

Il a été décidé que deux pavements seraient traités par l'équipe algérienne à Cherchell[4], alors que les sept autres iraient à Arles où les restaurations ont été effectuées pendant huit mois par une équipe de membres de l'atelier arlésien et de huit restaurateurs stagiaires algériens[5]. C'était la première fois que des mosaïques algériennes étaient ainsi restaurées à l'étranger, et en si grand nombre (fig. 2).

Après l'étude de l'état de conservation de chaque pavement, deux types de traitement ont été mis en œuvre : des interventions de maintenance pour les pavements conservés sur support de plâtre et de ciment ; la dérestauration et le transfert sur nouveau support pour les deux pavements provenant du Musée de Lambèse et la mosaïque de la Chasse de *Castellum Tingitanum*.

Maintenance des anciennes collections

Les trois mosaïques conservées sur support de plâtre de la collection du Musée national des Antiquités d'Alger ont fait l'objet de traitements de maintenance.

Le panneau figurant l'Hiver (Blanc 2003) appartenait à un pavement découvert en juillet 1851 à *Auzia* (actuel Sour el Ghozlane). Des quatre panneaux apparus en 1851, seuls deux



FIGURE 2 Vue générale de l'Atelier d'Arles pendant le traitement des pavements d'Algérie. L'Atelier a accueilli pour cette coopération huit stagiaires venus de différents musées algériens. Photo © ACRM / MAPA.

– l'Hiver et une Néréide – ont été déposés et conservés au musée d'Alger où ils sont arrivés le 8 janvier 1852 et ont été restaurés en 1854 par un sculpteur d'Alger qui a notamment fait de la figuration de l'Hiver un panneau isolé en refermant sur elle-même la bordure en méandre de svastikas. Un témoignage de ce travail est donné par l'argile qu'utilisa ce sculpteur pour combler de petites lacunes et que l'on a pu noter lors des nettoyages.

La mosaïque funéraire de Cornelia Urbanilla (Blanc 2003), découverte en juin 1918 à Lambiridi (Khirbet Ouled Arif), pavait un mausolée familial. Bien que dite « en bon état de conservation », elle présentait plusieurs lacunes importantes dès sa découverte. Elle fut déposée et restaurée par M. Tossut[6], maître mosaïste à Alger, et exposée au musée d'Alger dès 1919 (Guéné 1981 : 210).

Enfin, la mosaïque d'Achille à Scyros (Blanc 2003) a été mise au jour à Tipasa au cours de l'été 1936 par le Consul général des États-Unis à Alger et sa femme, M. et Mme Ernest L. Ives, puis déposée et exposée au musée d'Alger dès l'hiver suivant. Recouvert de plus d'un mètre de terre et partiellement détruit par des racines – ce qui explique les importantes lacunes présentées par le panneau – le pavement était unitaire ; grâce à une photographie prise lors du dégagement, on peut noter que, malheureusement, la découpe effectuée au moment de la dépose a fait disparaître des tesselles en plusieurs endroits, notamment dans la scène supérieure, et morcelé le tableau. Deux petits fragments représentant des navires ont été également conservés. L'ensemble avait été recomposé sur trois panneaux jointifs en bois et plâtre.

De 1851 à 1936, une même technique de restauration a été appliquée à ces pavements : ils reposent tous trois sur un support en toile de jute et plâtre, rigidifié par un cadre et une armature en bois. La forme des armatures en bois varie, mais le principe reste le même. Présentées au mur dans le musée depuis plus de cent cinquante ans pour la plus ancienne, ces mosaïques sont en assez bon état. Le plâtre des supports est sain et il assure encore son rôle de maintien des tesselles. Le bois présente parfois d'anciennes traces d'attaques d'insectes



FIGURE 3 Nettoyage par vapeur d'eau de la mosaïque de Lambiridi, Musée National des Antiquités d'Alger. Photo © ACRM / MAPA.



FIGURE 4 Reprise avec du plâtre des lacunes sur la mosaïque de Lambiridi, Musée national des Antiquités d'Alger. Photo © ACRM / MAPA.

xylophages mais reste néanmoins solide. La compatibilité des matériaux (plâtre, bois, jute), le fait que les panneaux de mosaïques ne soient pas collés contre le mur du musée mais qu'un espace permette une certaine ventilation, que ces mosaïques soient restées en place depuis leur restauration et n'aient pas souffert de mauvaises manipulations ou de stockage mal approprié et la stabilité climatique interne au musée ont garanti la bonne conservation de ces œuvres.

En accord avec la Conservation du Musée d'Alger, nous avons choisi de maintenir ces mosaïques sur leur support en plâtre afin d'aborder la maintenance des collections et l'application de traitements d'ordre préventif. Nous avons d'abord procédé à la consolidation des supports par la mise en place d'un renfort constitué de bandes textiles encollées sur le revers. Les structures en bois ont été nettoyées, parfois renforcées, et traitées contre le développement d'insectes xylophages. Afin de rendre une meilleure lisibilité à ces œuvres, nous avons procédé à divers traitements de nettoyage du *tessellatum*. Au moyen de scalpels, compresses de solvants, par ultrasons ou par vapeur d'eau, ces nettoyages des surfaces des tesselles ont permis de retirer les couches de vernis, de cire et de poussières accumulées (fig. 3).

Le traitement des lacunes a consisté dans le retrait du plâtre ou du mortier débordant sur les tesselles, l'élimination des traces de peinture appliquée anciennement sur le plâtre, l'ajout de plâtre si nécessaire, la pose d'un enduit de lissage, enfin la mise en place d'un enduit coloré de teinte neutre. Intentionnellement nous n'avons restitué aucun motif dans ces lacunes, ce qui n'aurait rien apporté à la lecture de ces pavements (fig. 4).

Les restaurations anciennes sur support en plâtre sont fréquentes dans les musées. Une approche par le contrôle et l'entretien permettant d'établir un programme d'intervention échelonné, élaboré selon les urgences et les conditions de conservation, permettrait bien souvent aux conservateurs des musées d'entrevoir de façon réaliste et sur le long terme la préservation de ces collections.

Pavant une *mensa* funéraire, la mosaïque chrétienne de *Pax et Concordia* (Blanc 2003 : 195–202) a été mise au jour le 23 janvier 1969 lors de fouilles d'urgence conduites par Mounir Bouchenaki sur la plage de Matarès, ayant

permis la découverte de la nécropole occidentale de Tipasa (Bouchenaki 1975). Sa dépose et sa restauration ont été menées à bien par M. Ahmed Kasdi, mosaïste du Service des Antiquités. Reposant directement sur une couche de terre, la mosaïque a été prélevée d'un bloc avec son support, une couche de mortier épaisse de 20 à 25 cm environ, retirée par la suite. Conservée au musée de Tipasa, elle repose actuellement sur un support en mortier de ciment qui a été jugée sain et n'a donc pas été remplacé. Comme un sondage préalable avait permis de vérifier la présence des joints antiques, le lait de ciment qui comblait tous les joints et recouvrait parfois les tesselles a été progressivement retiré par micro-sablage rendant ainsi une meilleure lisibilité à ce pavement (fig. 5).

Reprise de restaurations anciennes

La mosaïque de chasse de *Castellum Tingitanum* (Orléansville, El Asnam - Chlef) pavait un ensemble thermal (Blanc 2003 : 195–202). Mise au jour en juin 1883, puis déposée, elle a fait l'objet d'une première restauration en 1890, puis d'un second traitement en 1897. Cette mosaïque était conservée sur un support en mortier de chaux armé d'une structure métallique, support particulièrement lourd et fragile. Le *tessellatum* y adhérait faiblement et présentait de nombreuses fissures. Cette technique associant mortier de chaux et structure métallique est rare, car elle offre peu de résistance mécanique. De nombreuses réintégrations de tesselles ont été effectuées dans le fond, l'inscription et les figures, la plus visible est celle réalisée dans la pointe de la lance reprise avec des tesselles en pâte de verre modernes.

Pour l'exposition, l'adhérence du *tessellatum* à son support a été améliorée par des injections d'adhésif et le mortier fissuré des lacunes a été remplacé par un mortier de chaux. Après l'exposition, vu la fragilité de ce support et le danger qui en découlait, la mosaïque a ensuite été dé-restaurée et remise sur un nouveau support avant qu'elle ne retourne au musée d'Alger. Pour cela, le *tessellatum* a été entoilé et la mosaïque retournée afin de retirer le mortier de chaux puis l'armature métallique.

Au revers, il y avait une couche de plâtre sur laquelle étaient lisibles une date et un nom, signature du restaurateur incisée dans le plâtre frais. La famille Tossut a travaillé à la fin du XIX^{e} et au début du XX^{e} siècle dans toute l'Algérie. On retrouve ce nom dans les archives à Alger, Cherchell, Lambèse et Tipasa. Nous avons préservé ces signatures.



FIGURE 5 Dégagement par micro-sablage du ciment gris moderne qui recouvrait les joints antiques de la mosaïque de Pax et Concordia, Musée de Tipasa. Photo © ACRM / MAPA.

Datée de la fin du II^e^ - début du III^e^ siècle, la mosaïque des Monstres marins d'Aspasios a été découverte en 1905 sur le site de Lambèse. Réalisée en *opus vermiculatum* (au moyen de cubes de marbre, de calcaire, de pierres dures et de pâte de verre, de 2 à 4 mm de côté), elle offre – en un panneau de 4,35 m de long sur 1,26 m de large – une scène d'une qualité iconographique et d'une facture exceptionnelles représentant trois Néréides chevauchant des monstres marins (tigre, panthère, *ketos*) accompagnées d'autant de petits amours. Elle reposait sur des pilettes d'hypocauste et ornait donc une salle chauffée. Dans son *Rapport officiel sur les travaux de fouilles et consolidations des Monuments historiques de l'Algérie* concernant l'exercice 1905, Albert Ballu, architecte en chef des Monuments historiques, précise que l'effondrement des piles de l'hypocauste avait « entraîné plusieurs parties de la mosaïque et l'avait disloquée au point de la rendre difficilement visible » (Ballu 1919 : 157–59). Il signale également que le contremaître de Timgad, Dante Bertagnolio, était en train de procéder à la mise en place du pavement sur un mur du musée de Lambèse. Conservée en une centaine de fragments, cette mosaïque a été prélevée dès sa mise au jour et presque aussitôt reconstituée au mur dans le musée. Dante Bertagnolo avait prélevé tous les fragments en conservant leur support antique (*nucleus* et, parfois, *rudus*) quand il adhérait encore. Au Musée, les fragments étaient maintenus à quelques centimètres du mur à l'aide de tenons métalliques de taille et d'origine diverses, du gros clou à la râpe à bois. L'ensemble du panneau était bloqué par un épais solin en mortier de chaux recouvert d'un mortier de ciment.

Exemplaire pour l'époque, ce travail est une belle démonstration de restauration ancienne mettant en corrélation un minimum d'intervention et de moyen technique, tout en assurant l'intégrité de l'œuvre et sa conservation. Une peinture sur toile de cette mosaïque est conservée à la Bibliothèque du Musée national des Antiquités d'Alger. Réalisée à l'échelle 1, cette peinture indique avec précision le relevé des fragments, avec des annotations techniques, et illustre le soin particulier apporté à l'époque à ce travail de restauration.

Près de cent ans après, les fissures entre les fragments commencent à s'ouvrir provoquant la perte de tesselles et trahissant la grande fragilité de l'ensemble. L'état de conservation de ce pavement s'étant dégradé, il était devenu nécessaire de le retirer du mur du Musée. Après le nettoyage du *tessellatum* suivi de l'encollage des toiles, la mosaïque des Monstres marins a été scindée en deux panneaux qui ont été bloqués par des plateaux en bois et mousse construits spécifiquement, puis prélevés progressivement de la paroi. Les fragments de mosaïque n'étaient pas fixés véritablement, mais simplement maintenus contre le mur ce qui a permis aisément le passage de lames métalliques. Les tenons plantés entre les pierres du mur se sont aussi détachés facilement. Lors de cette opération, nous avons retrouvé entre la mosaïque et le mur un petit fragment de mosaïque qui était tombé – vraisemblablement lors de la recomposition – avec encore une toile de dépose, ce qui témoigne de la technique employée à l'époque.

Pour cette mosaïque des Monstres marins, toute la difficulté de la restauration résidait dans le fait que l'ensemble était particulièrement fragmenté, mais aussi que les tesselles étaient conservées sur leur support antique atteignant parfois jusqu'à 8 cm d'épaisseur.

Après le retrait de l'entoilage nécessaire au prélèvement de la mosaïque dans le Musée de Lambèse, on a procédé au nettoyage et à la consolidation du *tessellatum* et de son support. Puis les mortiers de chaux de restauration comblant les lacunes et les fissures ont été retirés, dégageant ainsi les mortiers antiques. Ce travail de démontage était indispensable car les nombreux décalages de niveaux entre les fragments empêchaient une bonne connexion de ceux-ci entre eux. On a ensuite fait un relevé à l'échelle 1 du pavement, indispensable tant pour y archiver nos différentes interventions que pour la mise en place définitive des fragments. Chaque fragment ou groupe de fragments a été traité séparément. Un nouvel entoilage de surface de chaque fragment a permis, après retournement, la mise en place des premières strates du nouveau support après avoir retiré mécaniquement une partie du support antique. Le mortier du *rudus* était devenu friable et fragile ; il ne pouvait donc être totalement conservé, mais il n'était pas non plus question de le retirer dans sa totalité, de nombreuses informations archéologiques auraient alors disparu et l'œuvre aurait ainsi perdu une grande partie de son intégrité. Nous avons choisi de préserver 3 cm de ce support antique, en conservant intégralement le bain de pose et le *nucleus*, ainsi qu'une partie du *rudus*.

Enfin, les fragments ont été rassemblés et fixés sur le support stratifié renforcé par une structure en aluminium (fig. 6). Sur un fragment témoin, toute l'épaisseur du support antique a été conservée et insérée dans le nid d'abeilles. Quelques anciennes réintégrations de tesselles défectueuses ont été reprises et les tesselles récupérées dans les anciens mortiers de restauration ont été réintégrés dans les fissures. Un traitement particulier des lacunes a été effectué sur la mosaïque des Monstres marins afin de redonner son unité à l'ensemble et d'améliorer la lecture du pavement : le mortier antique a été laissé apparent. Quand il était absent, un mortier de chaux de texture et de couleur semblables au *nucleus*



FIGURE 6 Remise sur nouveau support des nombreux fragments de la mosaïque des Monstres marins du Musée de Lambèse-Tazoult. Photo © ACRM / MAPA.

antique a été posé ; les fissures les plus fines ont été réintégrées en retrait par rapport à la surface originale, par aplats d'aquarelle un ton au-dessous des teintes des tesselles, sans chercher toutefois à restituer les formes disparues.

Mise au jour en même temps que la mosaïque des Monstres marins dans la même riche *domus*, la mosaïque dite de la Nymphe Cyrène était lacunaire dans sa partie droite. Sa mise en place au mur du musée a aussi été réalisée par Dante Bertagnolo, mais de manière plus traditionnelle : le support antique a été en partie retiré, et la mosaïque fixée dans un mortier de chaux frais recouvrant le mur.

Par la suite, des tesselles se sont détachées dans le vêtement de la nymphe et dans la bordure ; les manques ainsi formés ont été comblés avec un mortier de ciment. Des traces d'infiltrations d'eau marquent le mur et le plafond et la mosaïque elle-même présentait des risques de détachement.

Nous l'avons descellée après un entoilage par introduction de minces lames d'acier à l'arrière du *tessellatum*. Cette opération a été très délicate car les pierres du mur ressortaient irrégulièrement et le mortier qui fixait la mosaïque était relativement fin. Après son prélèvement, la mosaïque a été installée sur un panneau de bois avant son transport vers notre atelier.

À Arles, le revers du *tessellatum* a été nettoyé mécaniquement des résidus du mortier qui fixait la mosaïque au mur. Les nodules de ciment rajoutés pour bloquer les lacunes ont été amincis puis enlevés. Enfin, une partie du bain de pose a été retirée. A ce stade, les décalages dans les fissures ont pu être repris.

Un mortier synthétique réversible, posé au revers des tesselles dégagées, assure leur maintien. Sur cette couche d'intervention, une semelle en tissu de verre a permis de retourner le panneau de mosaïque, de le désentoiler et de l'implanter sur son support en nid d'abeilles alvéolé. Les lacunes ont été traitées par la pose d'un mortier proche de celui observé au revers de la mosaïque (fig. 7).

Conclusion

L'examen de ces œuvres présente un grand intérêt quant à l'histoire de la conservation et de la restauration, et à l'évolution des techniques mises en œuvre pour la sauvegarde des mosaïques depuis un siècle et demi. L'état actuel de certaines de ces mosaïques, présentées en musée et anciennement restaurées notamment sur des supports de plâtre, peut contribuer à une réflexion sur des techniques critiquées à juste titre par nos contemporains, mais qui offrent toutefois – dans les conditions que nous avons vues – des aspects positifs. Dans les exemples que nous venons de montrer, on peut même souligner le soin apporté à ces restaurations. Nous sommes loin des restaurations dites abusives et, dans certains cas, les notions de valeur du document et de réversibilité préconisées aujourd'hui ont été respectées.

Après ces interventions, les pavements sont retournés en Algérie et ont rejoint leur musée respectif. Les mosaïques présentées à Arles illustrent bien la complexité et la tâche gigantesques que constituent la conservation et la restaura-



FIGURE 7 Relevé indiquant les interventions de conservation réalisées sur la mosaïque de la Nymphe Cyrène, Musée de Lambèse-Tazoult. © ACRM / MAPA.

huit restaurateurs des musées d'Alger, de Cherchell, Lambèse et Guelma ont collaboré avec l'équipe arlésienne afin de participer activement à la conservation de leur patrimoine tout en se formant aux techniques modernes de restauration des mosaïques antiques. Cette coopération a été un des points forts du partenariat entre la France et l'Algérie. Il serait maintenant temps que la réflexion soit poursuivie quant à la formation d'un personnel qualifié afin de bien cerner la demande et d'établir des programmes progressifs pour la conservation des pavements aussi bien ceux préservés, heureusement, sur les sites que ceux, déposés et restaurés, conservés dans les musées. Préciser les urgences, pointer les pavements en danger, prévenir les risques d'altération, concevoir et mettre en œuvre des programmes de conservation préventive sur les collections dans les musées et sur les sites sont les défis qui s'offrent aux conservateurs et restaurateurs algériens.

Il suffit de penser aux salles grandioses du Musée de Timgad, aux murs couverts, en intérieur comme en extérieur, du Musée de Djemila, aux nombreuses mosaïques du Musée national des Antiquités d'Alger pour percevoir la dimension du travail qui reste à entreprendre. Il n'est pas nécessaire d'attendre un apport éventuel de moyens matériels pour s'attaquer aux problèmes. Tout restaurateur peut, et doit, commencer par une évaluation précise des besoins et intervenir, quand cela lui est possible, avec les moyens locaux. Mais là est une autre difficulté : trop souvent le manque de personnel qualifié empêche toute intervention. Devant une telle richesse de documents, il est indispensable pour un pays comme l'Algérie de former aujourd'hui plusieurs personnes-ressources, de créer de nouveaux ateliers, afin que ceux-ci soient à même d'intervenir rapidement. Ceci apparaît d'autant plus urgent que de nombreuses mosaïques sont des découvertes déjà anciennes ; restaurées peu après leur mise au jour, la plupart d'entre elles demandent au minimum des interventions d'entretien.

tion de mosaïques pour un pays comme l'Algérie, riche d'un patrimoine unique. Nous avons eu à traiter plus particulièrement, avec ces œuvres algériennes, de la sauvegarde de collections anciennes. Entre maintenance et dérestauration, la conservation de tels témoignages demande des moyens importants tant en personnel qu'en équipement et lieux de travail. C'est pourquoi, pendant toute la durée des travaux,

Notes

1 Pour leur soutien en Algérie, nous remercions tout particulièrement Mmes Ymouna Rebahi, Sabah Ferdi et Katia Djemaa, MM. Abderrahman Khelifa, A. Ghessab et Djamel Souidi, et les conservateurs des différents musées qui nous ont reçus, ainsi que M. Michel Pierre, attaché culturel de l'Ambassade de France à Alger.

2 La mosaïque des Monstres marins d'Aspasios et la mosaïque de la Nymphe Cyrène, du Musée Archéologique de Lambèse, Tazoult ; la mosaïque de la Légende d'Achille provenant de Tipasa, la mosaïque funéraire de Cornelia Urbanilla de *Lambiridi*, la personnification de l'Hiver de la mosaïque des Saisons et des Néréides d'*Auzia*, la mosaïque à scènes de chasse de *Castellum Tingitanum* (Chlef), conservées au Musée National des Antiquités d'Alger ; une mosaïque marine et la mosaïque des Vendangeurs, du Musée de Cherchell ; enfin, la mosaïque de *Pax et Concordia*, du Musée de Tipasa.

3 Ont participé à cette première opération : Abdelkkader Bensalah, Mouloud Derram, Abdelmadjid Belkares (conservateur du Musée de Lambèse-Tazoult), Ahmed Djellilahine, Moussa Djemmal. Patrick Blanc et Marie-Laure Courboulès.

4 Au Musée de Cherchell, l'équipe d'Abdelkkader Bensalah composée de Mohamed Chérif Hamza, Ahmed Djellilahine et Moussa Djemmal a préparé la mosaïque marine et la mosaïque des Vendangeurs.

5 Ont participé à ces travaux pour l'Atelier de conservation et de Restauration du Musée de l'Arles antique : Patrick Blanc, Marie-Laure Courboulès, Patricia Jouquet, Élise Devidal, Hafed Rafaï, Ali Aliaoui et Gilles Ghiringhelli ; pour la partie algérienne accueillie en France : Abdelmadjid Belkares (Musée de Lambèse), Zineb Rebzani, Ahmed Djellilahine, Moussa Djemmal et Mohamed Chérif Hamza (Musée de Cherchell et Musée de Tipasa), Hassiba Kaci (Ministère de la Culture et de la Communication, Alger) et Mourad Zerarka (Musée de Guelma). Qu'ils soient tous remerciés pour leur collaboration.

6 Italiens d'origine, les frères Tossut étaient arrivés en Algérie en 1888 et travaillèrent notamment à la restauration de mosaïques romaines découvertes à Cherchell, Lambèse, Théveste et Timgad.

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Conservation and Display of Three Mosaics in the Greco-Roman Museum, Alexandria, Egypt

Robert (Chip) Vincent

Abstract: *This paper describes the decision-making process that led to selection of these mosaics for conservation treatment and the conservation project itself. The mosaics, two from the Hellenistic period and one from the early Roman period, are extremely valuable pieces of ancient art. They were in urgent need of conservation, in part because the conservation techniques used for their immediate preservation at the time they were transferred from the site to the museum turned out to be detrimental in the long term. All three mosaics have been put on display in the museum; one, the hunting scene, which had previously been kept in a storeroom, is on view again for the first time in over two thousand years.*

Résumé : *Cette communication retrace le processus décisionnel qui a abouti à la sélection de trois mosaïques, se penche sur les raisons qui ont présidé au choix et présente le projet de conservation de ces mosaïques. Deux d'entre elles datent de la période hellénistique et une du début de l'époque romaine. Il s'agit d'œuvres d'art d'une grande valeur qui nécessitaient des mesures de conservation d'urgence, en partie parce que les techniques de conservation employées à l'époque pour assurer leur préservation immédiate se sont avérées néfastes à long terme. Les mosaïques sont exposées au musée, y compris la scène de chasse qui jusqu'à là était stockée et qui est maintenant visible pour la première fois depuis 2 000 ans.*

Project Background and Rationale

The project for the conservation of three mosaics in the Greco-Roman Museum in Alexandria, Egypt—a stag hunt scene, a portrait of Queen Berenike, and a mythological scene of Alphious and Arethusa—was funded by a grant from the U.S. Agency for International Development (USAID) to the Egyptian Antiquities Project (EAP) of the American Research Center in Egypt (ARCE). The aim of the EAP is the "preservation of Egyptian antiquities" rather than a comprehensive urban upgrade or social development scheme in Egypt. Under its mandate to carry out cultural heritage preservation, ARCE-EAP has funded and administered more than fifty conservation projects.

An overall structure for decision making was established among USAID, the government of Egypt's Supreme Council of Antiquities (SCA), and ARCE: ARCE periodically reviews possible projects and then discusses them in principle with the SCA before submitting them to a USAID committee. Under this framework of funding and decision making, close cooperation with the Egyptian antiquities authorities on both the national and local levels was pursued in order to define the objectives and the scope of the mosaic conservation project.

At a committee meeting chaired by the secretary-general of the SCA, he suggested that we consider conducting projects in Alexandria, Egypt's second-largest city, in order to provide geographic representation in the country. Accordingly, several members of our team met with the director of the Greco-Roman Museum, visited and reviewed the sites under the museum's jurisdiction, and learned about the museum's conservation priorities. Subsequently, ARCE-EAP authored a report recommending the conservation of the three mosaics in the Greco-Roman Museum.

These detached mosaics were chosen over in situ mosaics for a number of reasons. Their conservation treatment would not only help to preserve the mosaics but also allow one of them to be put on public display for the first time

since being placed in a storeroom shortly after its discovery in 1929. In addition to being hidden from public view, the mosaic took up a great deal of space (4 by 5 m) that the museum could use for other storage needs. Moreover, this work would provide an opportunity to introduce new conservation materials, such as Aerolam® panels, to Egypt's technology. The museum's conservators would benefit from the application of these materials and a modern conservation methodology. Finally, it was determined that the other sites under consideration would not be significantly enhanced by conservation interventions. Presentation was an important consideration because, wherever possible, conservation work should result in objects and sites that can be enjoyed by a wide range of visitors and that can provide Egypt with greater economic benefit.

The Conservation Procedures

Because neither the United States (because of a scarcity of mosaics) nor Egypt (in part because the Greco-Roman period is overshadowed by Pharaonic and Islamic art and architecture) has a large corps of mosaics conservators, specialists were brought in from Italy. These specialists had previously conserved mosaics in Madaba, Jordan, and were therefore familiar with working in a Middle Eastern environment.

Team members arrived in Alexandria in winter 2002 to perform initial work. Each mosaic was lifted from the Greco-Roman Museum and taken to a temporary laboratory area at the Maritime Museum premises for the majority of the conservation work. This was possible because Douglas Haldane of the Institute of Nautical Archaeology–Egypt (INA) had previously received two grants from ARCE-EAP and, in a creative adaptive reuse project, had established a conservation laboratory for submerged artifacts there. The INA personnel provided physical space at the laboratory and liaison services. Only the final touches were performed on-site at the museum.

The conservation of these mosaics exemplifies ARCE-EAP's ethical and technical approach—to present only primary material and to avoid introducing conjectural reconstruction. In the case of these mosaics, the team employed a noninvasive approach that would conserve only original material and replace missing pieces only with lime mortar in a neutral color so as to avoid any hypothetical reintegration with tesserae. Various types of degradation were already evident at the start of the conservation project. Earlier conservation treatments had used materials available at the time (early 1900s), including cement for the bedding. Over time, iron reinforcements in the concrete oxidized and swelled, causing bulging and deformations in the mosaics' surface. Later attempts to address this condition by grouting with cement did not work, and, in addition, some of the cement washed over the tesserae, obscuring them. The cement bedding was tenacious, requiring harsh mechanical means to remove it. Similar basic procedures were carried out on the three mosaics during the course of each conservation intervention, with some variations where conditions warranted a different treatment.

The Stag Hunt Mosaic, 290–260 B.C.E.

Description and Condition

Evaristo Breccia discovered the Stag Hunt mosaic on the site of a Greco-Roman–era villa in Shatby, Alexandria, in 1921. This outstanding rectangular mosaic floor is composed of a central scene framed by a serpentine ivy border and surrounded by a frieze of fourteen realistic and mythological beasts. A panel set off-center along one side, delineated by a meander punctuated with stars and rosettes, possibly indicates where a threshold might have lain. Although most of the mosaic is made of tesserae, W. A. Daszewski points out the elaborate technique for executing the mosaic, with extensive use of pebbles, *sectile* stone pieces cut to shape, and lead strips accentuating contours, as well as frequently changing directions of tesserae rows, that were consciously used to achieve the desired visual effects (Daszewski 1985: 105).

The narrative scene depicts three *erotes* (youthful winged love gods) felling a stag. The details are impressive. The *erotes* wear gold bracelets and diadems, and special shaped stones, not tesserae, are used for the noses and fingertips. Lead is used to delineate such features as muscles and contours (fig. 1).

After the mosaic was discovered and excavated, it was removed from the site. The pavement was in relatively good condition, except for the almost total obliteration of one of the *erotes,* which had apparently been caused by digging that had occurred some centuries earlier. It was relaid into a 6-centimeter-thick cement bedding, reinforced by a metal mesh and rods. It was briefly displayed in a room in the Greco-Roman Museum until it was moved to the museum's storage area, where it remained for almost eighty years.

The mosaic suffered from various types of degradation, including bulging in various areas due to the oxidization of the iron contained in the supporting cement. In addition, various cracks and fissures were present throughout the entire panel.



FIGURE 1 Detail of the Stag Hunt mosaic showing the technique of execution: flowing lines of tesserae, the use of pebbles in representation of hair, stone pieces cut to shape, lead strips enhancing contours. Photo by Max Mandel.

Treatment

After documentation of the mosaic's condition, it was carefully washed with demineralized water to remove accumulated surface particulates, then photographed and traced 1:1 on Mylar sheets to record the existing tesserae as well as the lacunae. Areas detached from the setting bed were preconsolidated with injections of lime mortar. The most vulnerable areas—manes, tails, and the hair of the figures—were consolidated with Paraloid® B72 at 5 percent in paint thinner. After this procedure all the figures were protected with facings of cotton gauze strips applied using warm animal glue (Cervione glue supplied by the Italian company CTS). Then the mosaic was divided into twenty-two sections. Along these divisions, strips of cloth were glued and a line of tesserae was removed. The removed tesserae were numbered and retained for later re-placement. Two layers of cloth were adhered to the whole mosaic with warm animal bone glue. When the cloth dried the various sections were cut, lifted from the pavement, and turned over. The cement bedding was cut in a chessboard pattern using an angle grinder with carbide disks, and then the cement cubes were removed with a hammer and chisel before the twenty-two sections of the mosaic were transported from the museum storeroom to the conservation laboratory. A small angle grinder with diamond disks was used to carry out the final cement removal.

Once the sections were freed of cement, preparations were made to fix them to fiberglass-and-aluminum Aerolam® panels. A 0.5-centimeter-thick layer of stone grit was fixed to one side of the Aerolam® panel with polyester resin so that the new mortar bed would adhere evenly to the panel. Sections were relaid one by one over the new bedding using a mortar mix composed of sand, medium stone powder, fine stone powder, and Lafarge hydraulic lime (1:1:1:1.5 by volume) mixed with a 15 percent solution of acrylic resin in water. After some hours both layers of cloth were removed and the sections partially cleaned of the glue (fig. 2). The glue was completely removed in a later cleaning with water and plastic brushes. Tesserae that had fallen during the cement removal were reset. When the mortar had set completely, another surface cleaning was carried out, first by scalpels and then by poultices of ammonium carbonate in paper pulp that were left for a period of two hours, followed by a final washing with water.

After the remounting of the sections on the Aerolam® panel, previous restorations became more visible. At some point after the removal of the mosaic from its original context on-site in the early twentieth century, lacunae had been partially filled with stone tesserae set in a black cement mortar, which was visible in the interstices between the tesserae and in the lacunae (fig. 3). In some instances the tesserae were entirely engulfed by the mortar. This mortar was removed



FIGURE 2 One of the twenty-two sections of the Stag Hunt mosaic: removal of protective cloth facing after mounting on Aerolam® support. Photo by Jarosław Dobrowolski.

during the intervention using compressed air vibrators and microdrills and chisels. The interstices were filled using a liquid, lime-based mortar. Other material, such as light cement concretions and the remaining glue, was removed by a microsandblasting machine.

Final work was conducted after the mosaic was transported back to the museum and positioned in one of the display rooms. Section cuts were closed, and the interstices were cleaned mechanically. The section cuts, which are now invisible to the viewer, allow the mosaic to be easily dismantled and moved, which is important both for convenience of display and for the safety of the mosaic. A 4-centimeter-wide aluminum frame was fixed along the edge of the mosaic. Then lacunae were filled with a neutral-color mortar based on Lafarge hydraulic lime (fig. 4). A final photographic documentation of the mosaic, including details, completed the intervention (fig. 5).

The Berenike Portrait Mosaic

Description and Condition

The Berenike portrait is dated to 300–275 B.C.E. and is inserted into a mosaic frame from ca. 250–225 B.C.E. The circular panel, 146 centimeters in diameter, probably depicts Queen Berenike II, wife of Ptolemy III. She is wearing military attire with marine motifs. It has been suggested that her ship headdress

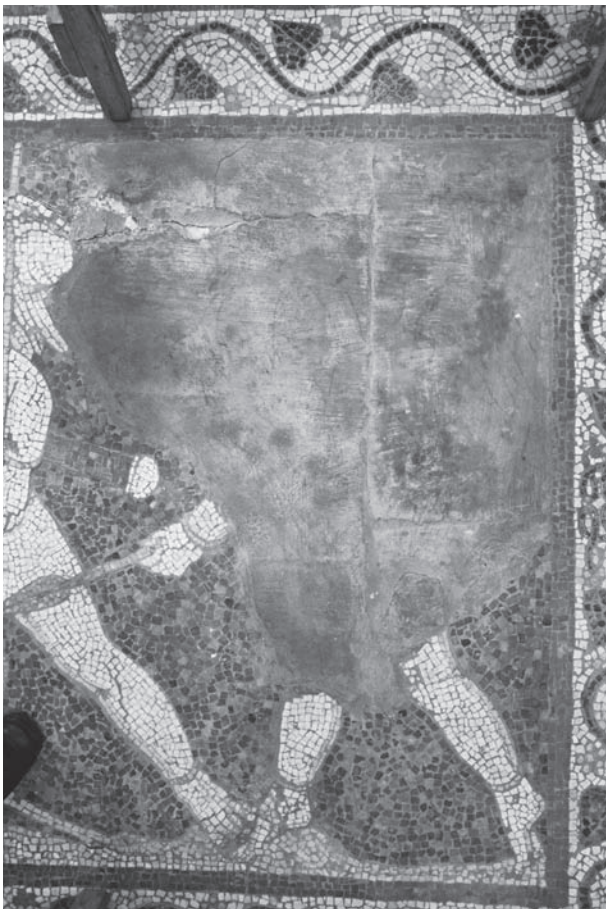


FIGURE 3 Example of black cement used in the original conservation of the Stag Hunt mosaic. Photo by Robert (Chip) Vincent.



FIGURE 4 Application of lime mortar in a neutral color used to replace the black cement. Photo by Robert (Chip) Vincent.



FIGURE 5 The completed Stag Hunt mosaic on display. Photo by Max Mandel.

flanked by dolphins, the anchor-shaped fibula on her shoulder, and her regal bearing indicate she is portrayed as the protector and personification of Alexandria; another possible interpretation is that her headdress commemorates one of her husband's naval victories (Daszewski 1985: 158–80). This portrait would have been set into a field or border of tiles on the floor that created a large frame around the image. *Emblemata* of significant personages were routinely produced by artists, perhaps artists of royal workshops in Alexandria that might have manufactured them for export, as they were of a portable size (Daszewski 1985: 89).

The Berenike mosaic was discovered in Tell Timai (Thumuis) near Mansura in Dakhaliya Province in 1918. Several years later it was detached from the archaeological site and relaid over a 6-centimeter cement bedding layer, reinforced with steel rods. It was sent to the Greco-Roman Museum in Alexandria and fixed on the wall by iron supports. After 1998 it was covered by two layers of cloth, adhered by an unknown type of resin, perhaps Paraloid® B72.

Treatment

Because some of the tesserae were loose and vulnerable to falling off and loss, this mosaic required more initial intervention than the Stag Hunt or Alphious and Arethusa mosaic. The first operation was the removal of the facing cloth using poultices of paint thinner and paper pulp, followed by the removal of the resin layer itself with plastic brushes, scalpels, and cotton swabs saturated with paint thinner (fig. 6).

Once exposed, the mosaic showed clear signs of a previous intervention. Lacunae had been filled with stone and glass tesserae, similar to the original in color but very different in technical execution. Portions of the mosaic were obscured by white cement used in these restorations, in places up to 2 millimeters thick.

Moreover, dirt and calcareous deposits had mixed with the resin used to fix the facing cloth, resulting in very tough surface crusts on the mosaic. Preliminary cleaning tests were conducted on various areas with different thicknesses of encrustation using poultices of ammonium carbonate and EDTA bi-sodium salt. The tests did not provide satisfactory results, so after the transfer of the mosaic to the conservation workshop the crusts were removed mechanically by pneumatic micro-vibrators, hammers and chisels, scalpels, and precision micro-sandblasting at low pressure. Final cleaning touches were made with poultices of AB57 left for a period of two hours, followed by a final washing with water.

After these encrustations were removed, graphic documentation was done 1:1 on Mylar. Before removal of the cement bedding, a localized consolidation was carried out over the stone material using Paraloid® B72 at 7 percent in paint thinner. Then two layers of cloth were glued onto the surface of the



FIGURE 6 The portrait of Berenike undergoing conservation by Mohamed Omar. Photo by Robert (Chip) Vincent.



FIGURE 7 Detail of the face of Berenike. Photo by Robert (Chip) Vincent.

largely cleaned and consolidated mosaic using a vinyl adhesive (Vinyvil). When the cloth dried, the mosaic was turned over. Following the same procedures used on the Stag Hunt mosaic, the cement was removed using an angle grinder and hammer and chisel. A small angle grinder fitted with diamond disks was used to complete the operation.

Using the same procedure performed on the Stag Hunt mosaic, the Aerolam® panel was prepared, except that in this case two different mortar mixes were used. One mix, in direct contact with the mosaic, was composed of sand, medium stone powder, fine stone powder, and Lafarge hydraulic lime (1:1:1:2 v/v); the support layer, applied to the Aerolam® panel, was composed of sand, fine stone powder, granular expanded glass, and Lafarge hydraulic lime (1:1:1:1.5 v/v).

Both were mixed with a solution of 15 percent Acrylic 33 resin in water. Granular expanded glass was used in the second mixture to decrease the weight of the entire panel since it was to be rehung on a wall. After some hours the first cloth was completely removed; the second cloth was only partially removed, leaving the central part, where the mosaic was composed of smaller tesserae (2–3 mm). This last part was covered with a wet cloth until the next day, when it too was completely removed.

When the mortar had set completely a few days later, the vinyl glue used to adhere the cloth was removed with mixed solvent poultices. When the glue was completely removed, a further treatment was carried out using poultices of ammonium carbonate in paper pulp and then a final cleaning by micro-sandblasting. Once the mosaic was returned to the museum, excess Aerolam® was cut away and the panel fixed in a 4-centimeter-wide aluminum frame. Then mosaic lacunae were filled using mortar similar to that used for the Stag Hunt mosaic. The entire mosaic surface was consolidated with ethyl silicate (Wacker H 100) and then protected by a reversible film of Paraloid® B72 at 5 percent in acetone. Finally, the mosaic was rehung in the museum, where its fine detail is on display once again (fig. 7).

The Alphious and Arethusa Mosaic

Description and Condition

According to the Greco-Roman Museum's records, the Alphious and Arethusa mosaic was discovered in Tell Timai (Thmuis) in 1912. The rectangular panel, once part of a larger pavement, measures 157 by 90 centimeters. The mosaic, which dates to the third century C.E., depicts the pursuit of the water nymph Arethusa by the river god Alphious, a well-known myth and an appropriate decorative theme for a villa along a branch of the Nile. Shortly after its discovery, the mosaic was detached from the site and relaid on a 6-centimeter-thick bedding of reinforced cement and then placed on display in the Greco-Roman Museum.

Treatment

The mosaic was very dirty, so initially the dirt and concretions on the surface were removed by careful washing with water and plastic brushes. Graphic documentation was then carried out by tracing it 1:1 on Mylar sheets. Then two layers of cloth were adhered to the mosaic surface using warm animal bone glue.

The cement was removed using the same techniques as with the other mosaics, and the Aerolam® panel was also prepared in the same way, using a mortar mix composed of sand, medium stone powder, fine stone powder, and Lafarge hydraulic lime (1:1:1:1.5 v/v) mixed with a solution of 15 percent Acrylic 33 in water.

The surface cleaning operations revealed signs of a previous restoration. But because the ancient tesserae had been reused, it was difficult to determine the exact limits of the restoration, except for the inscription, where original black tesserae had been replaced by stucco tesserae painted with black pigment. The stucco lost consistency when it came into contact with water, so it was completely removed. Unlike with the larger missing areas of the mosaic, in the inscription the accurate location of the missing pieces could be determined, and it was decided to fill in the gaps with stone tesserae (fig. 8). However, to distinguish from the original, the new tesserae, although similar in color to the original, were made half the size of the ancient ones and placed slightly recessed. The Aerolam® panel was framed and lacunae filled as in the previous case. The entire mosaic was consolidated with ethyl silicate (Wacker H 100) in two phases: the first phase was localized on the black tesserae, which were more degraded; the second phase was carried out over the entire mosaic. Another 1:1 tracing of the mosaic was produced to map all interventions. Finally, the mosaic was put back on display in its original location at the museum.

Evaluation of the Decision-Making Process and the Case Studies: Lessons Learned

The decision-making process made it possible to elicit and respond to the requests put forth by the SCA. Because all those



FIGURE 8 The Alphious and Arethusa mosaic during conservation. Photo by Robert (Chip) Vincent.

engaged in the project were involved in this process, everyone had a stake in its success.

In the absence of a written conservation report following the excavations of the mosaics, this conservation team needed to study and analyze the mosaics to determine subsequent interventions and to prepare an appropriate conservation plan. So far, the techniques and materials used in this intervention seem to have worked well, but a follow-up evaluation will have to wait until the Greco-Roman Museum reopens after renovation.

The mosaics were in relatively good condition, despite areas where tesserae were missing. They had suffered from extensive soiling and some earlier unsuccessful conservation attempts, which compromised their long-term safety. Thorough cleaning and consolidation revealed fine nuances of coloration, contouring, and shading in the images, all the more remarkable for their being rendered in cubes and pieces of stone and terracotta and pebbles (with the occasional addition of lead strips to refine a contour).

The colors are now brighter, and the three mosaics have been mounted on Aerolam® panels and are in appropriate protective frames. The subtle gradations and pointillistic effects achieved by the artists are once again almost as clearly visible as when they were originally created two thousand years ago in luxurious villas. W. A. Daszewski noted in a report on the conservation interventions, "The mosaics, especially the Stag Hunt and the Berenike III medallion, had been very fine before, but now they are splendid. The pleasing aesthetic effect is sure to be appreciated by tourists and interested scholars alike" (Daszewski 2004).

The Berenike and Alphious and Arethusa mosaics have returned to the same positions they occupied in the museum before their conservation treatment. The Stag Hunt has a prominent position on the floor of a main hall; with its dynamism, vividness, and beautiful colors, it forms the centerpiece of the museum. All those at ARCE-EAP who were involved in the project are pleased to have played a role in conserving the mosaics and returning them to a place of pride in Alexandria.

Acknowledgments

Recognition should be given particularly to USAID, which provided the funding for this project, and to the government of Egypt's Supreme Council of Antiquities, partners in this work. Fr. Michele Piccirrillo directed the team of conservators. The team was composed of Franco Sciorilli, head, Mario Arangio, Marco Venturi, and Antonio Vaccalluzzo, working in collaboration with Egyptian colleagues Amira Abu Bakr, Mohamed Badr, and Sameh Abdel Hamed.

Wiktor A. Daszewski provided an updated commentary on the pieces, which he had originally described in his *Corpus of Mosaics from Egypt* (1985). Fr. Antonio Raimundo coordinated logistics and oversaw expenditures.

Douglas Haldane and Adel Farouk of the Institute of Nautical Archaeology–Egypt provided work space and liaison services, including coordinating with the museum, obtaining locally available supplies, and arranging for the importation of materials such as Aerolam®.

Finally, I wish to thank the past and present boards of ICCM for the encouragement the ICCM conferences have provided. In particular, the 1996 ICCM conference on how "mosaics make the site" and on sheltering provided valuable background information that enabled Jarosław (Jarek) Dobrowolski and me to plan appropriately for mosaic conservation as part of ARCE's overall conservation project work in Egypt.

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Where Theory Meets Practice: The Conservation and Presentation of a Roman Floor Mosaic at the Museum of Fine Arts, Boston

C. Mei-An Tsu, Pamela Hatchfield, Christine Kondoleon, and Craig Barnes

Abstract: *In 2002 the Museum of Fine Arts, Boston, acquired a three-part Roman floor mosaic uncovered during the Antioch excavations led by Princeton University in the 1930s. At the time of acquisition, the mosaic was structurally unsound and in great need of stabilization and restoration. This paper presents an overview of the conservation project, which involved removing the concrete backing, remounting onto custom-designed aluminum honeycomb supports, stain removal, and restoration of losses. Approaches to presenting an archaeological artifact in the context of a fine arts museum and the technical analysis of glass, stone, and mortar are discussed.*

Résumé : *En 2002, le Museum of Fine Arts de Boston acquit une mosaïque de pavement en trois parties découverte lors des fouilles d'Antioche menées par l'Université de Princeton en 1930. Lors de son acquisition, la mosaïque était structurellement en mauvais état, nécessitant une stabilisation et une restauration. Cette communication offre un aperçu du projet de conservation qui consistait à éliminer le support en béton, remonter la mosaïque sur un support nid d'abeilles en aluminium spécialement conçu, nettoyer les taches et restaurer les lacunes. Les approches concernant la présentation des objets archéologiques, dans le cadre d'un musée des beaux arts, sont également évoquées ainsi qu'une analyse des tesselles en verre et en pierre et du mortier.*

In 2002 the Museum of Fine Arts, Boston (MFA), acquired a three-part Roman floor mosaic that had been uncovered during the Antioch excavation led by Princeton University in 1932–39. (On Antioch and the Princeton Expedition, see Elderkin 1932; Downey 1961; Stillwell 1961; Kondoleon 2000; Becker and Kondoleon 2005.) The mosaic, measuring 7 by 3 meters, paved the courtyard of the House of the Drinking Contest, located in Seleucia Pieria, the port city of Antioch, situated on the Mediterranean Sea (fig. 1).

The central panel of the mosaic depicts three fishing *erotes* on dolphins and twenty-five other marine creatures composed of limestone and glass tesserae in a palette of approximately two dozen colors (fig. 2). Panels decorated with alternating black and red diamonds frame both sides of the marine scene. (On the Antioch marine mosaic, see Levi 1947: 156–63, pl. 31c; Kondoleon 2000: 53–57; Hermann and Kondoleon 2003: 16–19; Becker and Kondoleon 2005: 60, 148, 59.) The mosaics of the house are dated to the first half of the

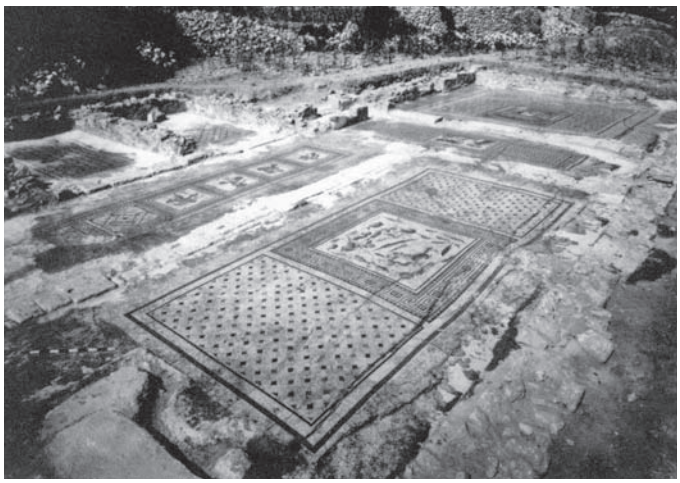


FIGURE 1 House of the Drinking Contest: overview with the mosaic in situ. Courtesy of Antioch Expedition Archives, Research Photographs, Department of Art and Archaeology, Princeton University.



FIGURE 2 Antioch marine mosaic after treatment, with reconstructed border. MFA 2002.128.1–3. Photograph © 2007 Museum of Fine Arts, Boston.

mid-third century by the Roman wares found beneath them during the excavation (Levi 1947).

The tesserae in the marine mosaic, in common with other Antioch mosaics, consist mostly of stone. Analyses of stone tesserae from other Antioch mosaics revealed that most are made from different colors of limestone (Newman 2005: 62–70); similar stones were undoubtedly the main material used in the marine mosaic. The brightly colored tesserae consist of soda-lime glass, specifically a variety often referred to as LMLK (low magnesium–low potassium), the most common type of glass produced throughout Europe and the Mediterranean region from the first millennium B.C.E. to the early Middle Ages (Wypyski and Becker 2005: 115–33). The bedding mortar, into which the tesserae were placed, is a pinkish white color and includes small specks of iron oxides.[1] It is made of lime, with the possible inclusion of hydraulic components, such as crushed ceramic and volcanic ash. The presence of aluminum and silicon at more than a trace level, as well as the identification of forsterite (magnesium-rich olivine) and enstatite, two minerals associated with volcanic igneous rocks, suggests that the mortar is hydraulic.

The MFA purchased the Antioch marine mosaic from Dumbarton Oaks in Washington, D.C., a cosponsor of the expedition, where, because of lack of display space, it had been in storage since its arrival in 1940. The acquisition by the MFA was made with the commitment to undertake a two-year conservation campaign to stabilize and restore the mosaic for display. At the time of purchase the concrete backing, applied shortly after the mosaic's excavation, had shattered into large, heavy sections held together only by the iron bars submerged in the concrete. Many of the stone and glass tesserae were dislodged and their surfaces heavily soiled and stained.

This paper presents an overview of the conservation project, which involved removing the mosaic's concrete backing, remounting the mosaic on custom-designed aluminum honeycomb supports, removing surface stains, and restoring losses. Approaches to presenting an archaeological artifact in the context of a fine arts institution are also discussed.

Excavation History

The Antioch expedition, organized by Princeton University, was supported by the Baltimore Museum of Art, Dumbarton Oaks, the Louvre, and the Worcester Art Museum. Of the hundreds of pavements found during the excavation, approximately half were distributed to the sponsoring institutions

through legal agreement of partage with the Syrian government, made under the auspices of the Department of Antiquities. The remaining pavements were housed in the Hatay Archaeological Museum in Antakya, now located in southeastern Turkey (Kondoleon 2000: 5–8).

The marine mosaic was largely intact when uncovered. Rather than cut the mosaic into small sections to make it relatively easy to lift, the excavators preserved its compositional integrity by dividing it into three sections corresponding to the main design. Unfortunately, the black border encompassing the mosaic, the entire surround, and many rows of white tesserae between the panels were not preserved.

According to excavation records, the mosaics were lifted from the ground by the following procedure (Artal-Isbrand 2005: 82–84). First, concrete was applied to the lacunae and all along the perimeter of the panels. Then the surface was faced with fabric or paper adhered with an animal-based glue. The mosaic to be lifted was covered with boards and the foundation layers beneath the *tessellatum* were excavated. Poles were slowly inserted under the pavement, and the mosaic was lifted from the ground. Once the mosaic was positioned facedown, remnants of the nucleus were removed from the backs of the tesserae and the panels were backed with about 7 centimeters of concrete reinforced with iron bars and chicken wire.[2] The facings were removed, and mineral deposits accumulated during the mosaic's burial were scraped from its surface with rocks.

Condition upon Acquisition

By the time of acquisition in 2002 the three panels were structurally unsound and in extremely poor condition. The concrete backing, originally intended to protect and support the mosaic, was severely deteriorated, and an extensive network of cracks radiated throughout the concrete and *tessellatum* (fig. 3). The iron armatures were corroded, and corrosion products had migrated to the mosaic surface. The panels had fragmented

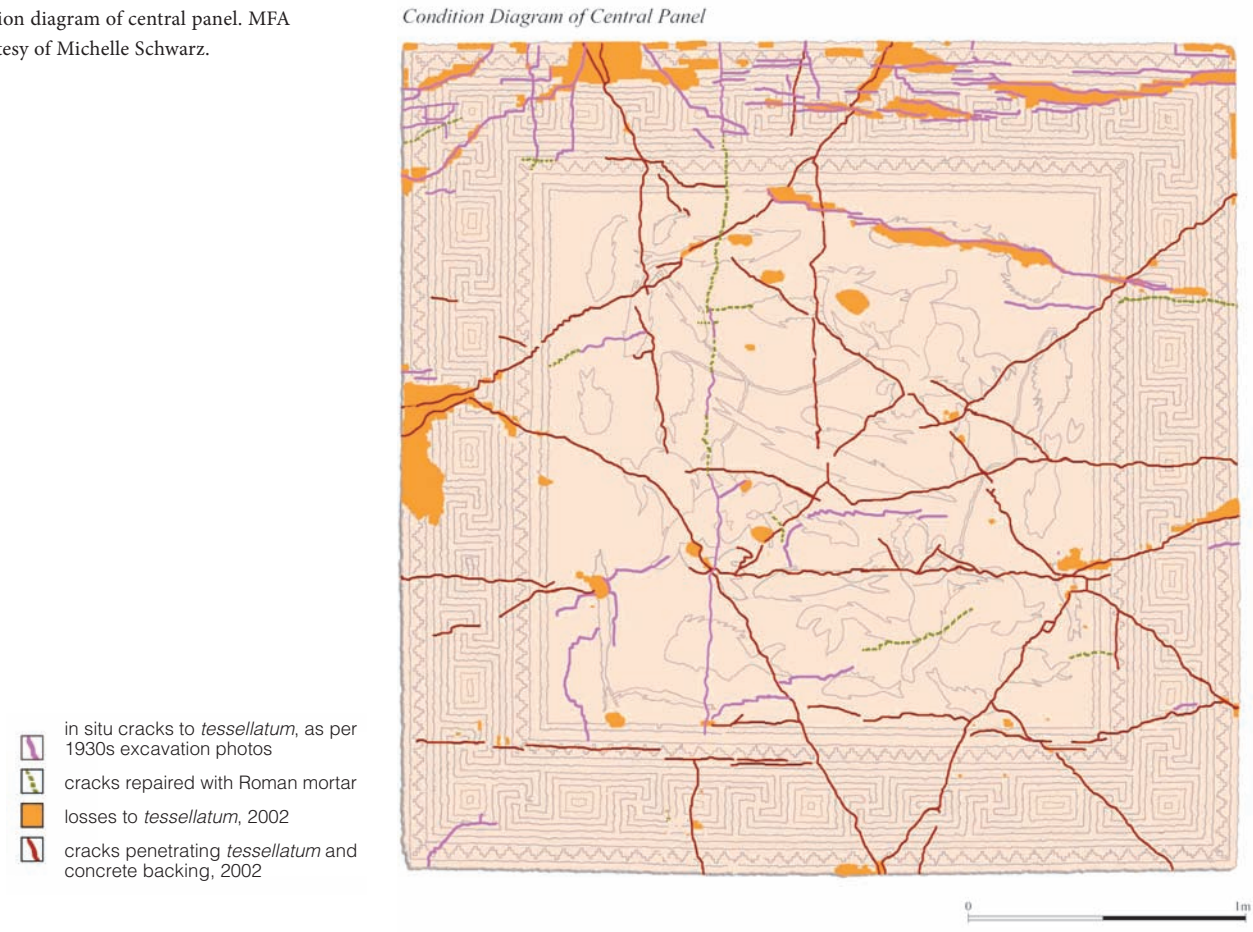


FIGURE 3 Condition diagram of central panel. MFA 2002.128.1. Courtesy of Michelle Schwarz.

into dozens of pieces and were vulnerable to continued decay if left untreated. The central panel measured about 3 square meters and weighed approximately 1350 kilograms. The side panels measured about 3 by 2 meters and weighed nearly 900 kilograms each.

There are numerous reasons for the poor condition of the mosaic. Foremost, the panels suffered from the inherent qualities of the materials used in the treatment of the 1930s. Backing mosaics of this scale with concrete, a dense and brittle material, resulted in large, heavy, composite structures that are difficult to move and prone to cracking. Crating systems used in the past did not provide adequate support, causing the panels to flex and bow during handling. This movement led to fracturing of the concrete and cleavage of the tesserae from the brittle backing. Decades of poor storage conditions also contributed to disintegration of the concrete and the rusting of the iron armatures.

In addition to these structural problems, the surface of the mosaic was severely disfigured. Dark brown stains, corresponding to the location of wooden planks used to stack the panels in storage, were prevalent on the geometric panels (fig. 4). The overall surface discoloration of the three panels was also attributed to large amounts of dirt impacted between the tesserae. More randomly positioned stains, most visible on the central panel, resulted from the corrosion of the reinforcement bars in the concrete.

Despite these significant problems, the mosaic itself suffered minimal loss, particularly in the figural areas. In total, only about 6 percent of the tesserae were missing; half the areas of loss had been present at the time of excavation, while the other half resulted from damage incurred over the past sixty years. Overall, the *tessellatum* was cohesive and in good condition.



FIGURE 4 Side panel of the Antioch marine mosaic before treatment: disfiguring stains from wooden boards used in storage. MFA 2002.128.3. Photo by C. Mei-An Tsu.

Structural Stabilization: Concrete Reduction and Rebacking

The first phase of the conservation project addressed the severe structural problems of the three panels. It was clear that the concrete and the rusted iron bars were the greatest threat to the mosaic and that their removal was imperative to ensure its long-term survival. A lightweight support was also required to provide the rigidity and strength no longer provided by the concrete.

In preparation for the concrete reduction, the mosaic was faced with two layers of cotton gauze followed by a final layer of tabby-woven jute or burlap. The facing was adhered with a solution of 25 percent (w/v) polyvinyl acetate resin (PVA-AYAF) in ethanol:acetone (1:1, parts by volume). Once faced, the panels were securely packed in reinforced wooden crates and turned facedown with a gantry.[3]

A method was then developed to safely remove the concrete from the mosaic.[4] The goal was to make highly controlled cuts into the concrete with limited amounts of water while generating the least possible amount of noise, dust, and slurry. A track saw[5] fitted to a gantry beam spanning the length of the mosaic was engineered to meet these needs. Driven by a motorized system, the saw slowly advanced along the beam, allowing conservators to monitor and adjust the blade depth during the cutting process (fig. 5). The ends of the beam were mounted on dollies, which advanced in precise increments by

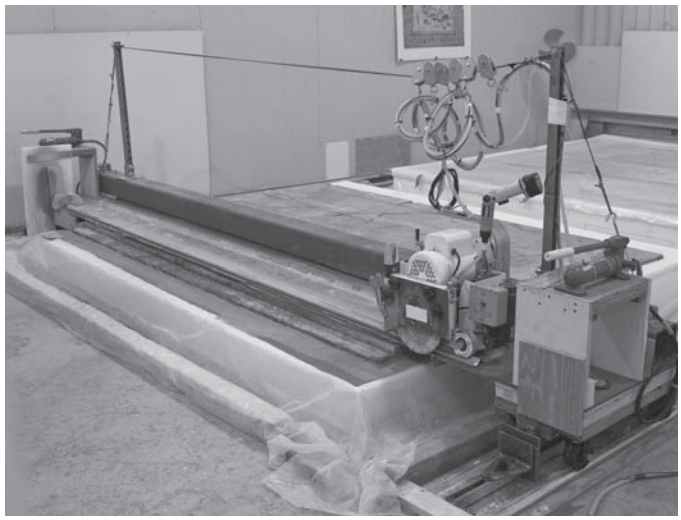


FIGURE 5 Custom-built bridge assembly used to support the track saw and cooling system during concrete reduction. Photo by Sarah Deschenes.

means of hydraulic jacks as the cutting progressed. During cutting, the blade was lubricated with Aegis,[6] a patented coolant system that allowed for minimal water use. The coolant was supplied to the blade through a water-driven pump system, which eliminated the need for electricity. The system also enabled faster cutting with reduced blade wear and produced less concrete slurry, which was removed during the cutting process with wet/dry vacuums.

Once a series of parallel cuts were made across the back of the panels,[7] the bulk of the concrete, the iron bars, and the chicken wire were removed with chisels and metal shears. In total, 2000 kilograms of concrete were removed from the three panels, reducing the weight by more than 50 percent. After the concrete reduction, approximately 0.5 to 1.5 centimeters of concrete remained on the back of the tesserae. Complete removal of the concrete was considered, but the benefit of further weight reduction was not deemed worth the risk of damaging the tesserae, which were firmly and directly bound to the concrete.

Working in the tradition of backing mosaics with epoxy resin and aluminum honeycomb panels (Bassier 1977; Blackshaw and Cheetham 1982; Uprichard, Thickett, and Lee 2000), a new rebacking method, refined to meet the specific needs of the Antioch marine mosaic, was developed in collaboration with a structural engineer.[8]

The next step after the concrete reduction was the application of a 2- to 4-millimeter-thick layer of concentrated Paraloid® B-72 in ethanol:acetone (1:1, parts by volume) to the reverse. This layer sealed the porous concrete surface and provided a reversible separation layer between the mosaic and the new backing. Next, a layer of an Araldite® epoxy, bulked with glass microballoons and fumed silica (see table 1 for formulation), was applied in order to level the irregular backs of the mosaic panels. This composite was then adhered to the aluminum honeycomb supports with an Araldite® epoxy formulated for bonding metals.[9]

The aluminum supports were fabricated from two layers of aluminum honeycomb core, faced with aluminum skins, and reinforced with an internal gridwork of rectangular aluminum tubes.[10] The fabrication diagram for the central panels illustrates the placement of the reinforcement bars within the bilevel honeycomb sandwich (fig. 6). This composite system was designed to provide the stiffness needed to support the weight and size of the mosaic, particularly during rigging and transportation. A deflection ratio of L/600 (span vs. deflection between supports), which is recognized as a higher crack limit for rigid elements such as concrete, masonry, and plaster, was selected as the design parameter. The adhesive strength of the two epoxies selected for the treatment and their application technique were also assessed with failure load testing to ensure the security of the bond between the epoxy leveling ground and aluminum panel (Barnes 2006).[11]

Cleaning and Loss Compensation

With the three panels structurally stabilized, the second phase of the project focused on improving the mosaic's visual appearance. The fabric facings were removed by placing cotton cloths soaked in ethanol:acetone:water (6:3:1, parts by volume) on the faced surface for three to twelve hours under plastic sheeting. Once the adhesive had fully softened, the fabric was taken off[12] and the adhesive residues were removed mechanically.

The disfiguring stains, prominent on the two side panels, were then addressed. The discoloration, attributed to the migration of organic acids and degradation products from the wooden planks used in storage, was removed using a poultice of cellulose powder mixed with 2 percent diammonium citrate buffered to pH 8 with triethanolamine (TEA). The poultice was placed over the stained area, allowed to dry overnight, and removed the following morning. Stains from the rusting armatures were largely but not entirely removed with chelating agents that complex with iron.[13]

The next consideration was to define the approach to restoring losses in the mosaic. While the curatorial and con-

Table 1 Treatment formulations

Application	Composition	Notes
Paraloid B-72® bedding mortar	200 ml 25% (w/v) Paraloid® B-72 in ethanol: acetone (1:1, parts by volume) 20 g 3M™ Scotchlite™ Glass Bubbles K20 35 g cellulose powder pinches of fawn yellow ochre (Kremer #40241) pinches of raw umber (Kremer #40612)	mix to putty consistency
epoxy leveling layer	3784 ml Araldite® Scotchlite™ AY103 resin 1880 ml 3M™ Glass Bubbles K20 4000 ml Aerosil® 200 2000 ml Araldite® HY991 hardener	add bulking agents to resin and let stand for several hours in order to allow Aerosil® 200 to swell, add hardener, use mixing attachment for rotary drill to ensure even distribution of components
methylcellulose grout	4 parts cellulose powder by volume 1 part sand by volume 3% methylcellulose (4,000 cP) in deionized water pinches of fawn yellow ochre (Kremer #40241) pinches of pencil clay (Kremer #40960)	mix cellulose powder and sand, add methylcellulose to putty consistency, add pinches of dry pigment to obtain appropriate color
replacement stone tesserae: red	120 g Samuel H. French dental plaster 20 g burnt siena (Kremer #40430) 6.1 g ochre avana (Kremer #40200)	mix dry ingredients and sprinkle into about 90 ml water
replacement stone tesserae: ochre	80 g Samuel H. French dental plaster 1.6 g fawn ochre (Kremer #40241)	mix dry ingredients and sprinkle into about 70 ml water
replacement stone tesserae: black	160 g Samuel H. French dental plaster 11.7 g vine black (Kremer #47000)	mix dry ingredients and sprinkle into about 130 ml water
replacement stone tesserae: white	80 g Samuel H. French dental plaster 0.4 g fawn ochre (Kremer #40241) 4.3 g pencil clay (Kremer #40960)	mix dry ingredients and sprinkle into about 70 ml water
replacement border	1 part Hydrocal FGR: 3 parts Hydrocal white by volume	formula developed for chip resistance and strength

servation team is committed to preserving the integrity of the original, the object also needs to meet the high aesthetic standards of the fine arts museum where it is to be presented to the public. Therefore, in this case, the mosaic requires a different level of aesthetic compensation from one that remains in an archaeological site or that is presented in the context of an archaeological museum. It was felt that the large lacunae would distract the museum viewer, bringing the focus to accidents of time rather than to the work of art itself. For this reason, the MFA has chosen to restore the lacunae to closely resemble the original. This approach is influenced by the model that guides the restoration of paintings and decorative arts in North America and parts of Europe, whereby inpainting is executed to imitate the original as closely as possible (Samet 1998).

Working within this framework, lacunae in the marine mosaic were filled with synthetic tesserae that visually matched the surrounding areas. Restoration materials are chemically distinguishable from the original and chemically stable and can be removed easily without damaging the original. In order that the restorations not be misinterpreted as original, diagrams mapping the areas of restoration will be presented beside the mosaic. Methods of treating mosaic lacunae that are more closely aligned with wall painting conservation methods, such as inpainting lacunae with *tratteggio* or pointillist techniques (see papers by Martin and Blanc, this volume; Mora, Mora, and Philippot 1984; Brandi 2005), as well as recessing reconstructed areas (Barov 2001) or painting molded lime mortar tesserae (Alberti and Muscolino 2005), were explored but were not considered suitable for this application.

Losses to the geometric areas, such as within the meander of the central panel or within the diamond pattern of the two side panels, were reconstructed according to the patterned geometry of the surrounding areas. Figures 7 and 8 illustrate before and after treatment of a damaged area associated with the cracked concrete of one of the side panels. Lacunae within the figural areas were approached somewhat differently. Due to the presence of many duplicate or "twin" figures in the

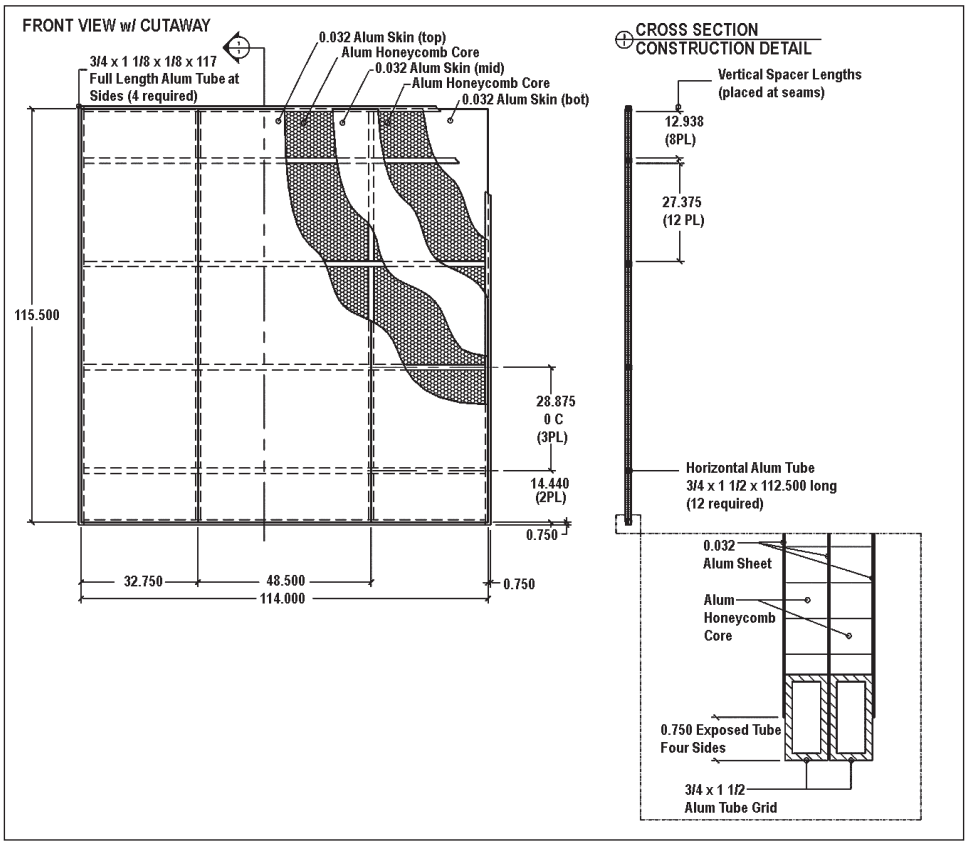


FIGURE 6 Fabrication diagram of the aluminum honeycomb support for the central panel. Courtesy of SmallCorp.

mosaic, models present in the well-preserved passages were used to accurately guide the restoration of losses in related fish, dolphins, and *erotes*.

Replacement stone tesserae were made by casting dental plaster into molds taken from the surface of the mosaic (see table 1 for formulation). The plaster was tinted with dry pigments in order to match the visual appearance of the stone. Once cast, the plaster was broken into individual pieces and strengthened by immersion in 10 percent (w/v) Paraloid® B-72 in ethanol:acetone (1:1, parts by volume) for about one hour. Replica glass tesserae were fabricated by casting a mixture of 40 percent (w/v) Paraloid® B-72 in ethanol:acetone (1:1, parts by volume) and dry pigments into molds of the surface.

The synthetic tesserae were then set into a bed of synthetic mortar made from Paraloid® B-72 mixed with cellulose powder and dry pigments (see table 1 for formulation). Final color adjustments were made with dry pigments mixed with Golden Porcelain Restoration Glaze Matte and Degussa Flattening Agent. For the last step in the restoration, a synthetic grout (see table 1 for formulation) resembling the color and consistency of the original lime mortar was made from a mixture of methylcellulose, cellulose powder, sand, and dry pigments. The grout was applied intermittently between the plaster tesserae, as well as to surface cracks resulting from the shattered concrete.

Gallery Installation

Once the treatment is complete, a significant step will be taken to unify the three panels into one pavement in order to re-create the original composition for installation. An illusion of unification can be achieved by re-creating the white and black border and white surround lost at the time of lifting (see fig. 2). These new parts of the lost mosaic will be made with interlocking sections of gypsum cement (see table 1 for formulation), molded and inpainted to visually match the original. To ensure that the mosaic is understood as a floor mosaic, the three panels, reunited with the re-created border, will be lowered close to floor level. Until recently, modern museums, due to lack of space and other concerns, typically chose to privilege the figural parts of the mosaics and as a result displayed them on their walls as paintings. This attitude was also prevalent in the past among archaeologists, as demonstrated by the Antioch excavators, who divided the floors into figural and geometric parts, leaving the



FIGURE 7 Damaged area resulting from cracked concrete backing before treatment. MFA 2002.128.2. Photo by C. Mei-An Tsu.



FIGURE 8 The same area after treatment. MFA 2002.128.2. Photo by C. Mei-An Tsu.

frames, surrounds, and other parts reburied in situ. In contrast, the architectural and archaeological context of the mosaic is of primary importance in our approach, with the mosaic to be presented on the floor and as the centerpiece of a new installation on Roman daily life in the eastern Mediterranean.

Conclusion

The conservation of the Antioch marine mosaic has required collaboration among specialists from diverse disciplines, all of whom played a critical role in the interpretation, safekeeping, and presentation of this ancient artifact. Curatorial and conservation decisions alike have been directed by the commitment to preserve and protect the integrity of the original and by the desire to respectfully reunite the artifact with its rich historical past within the parameters of its new setting.

Acknowledgments

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Notes

1 Mortar samples from the marine mosaic were studied by scanning electron microscopy/energy-dispersive X-ray spectrometry (SEM/EDS).

2 The iron rods in the Antioch marine mosaic were spaced about 30.5 cm apart and set in a grid running the length and width of the panels. The chicken wire was typically found in close proximity to the backs of the tesserae.

3 Facing and concrete reduction were supervised by Louise Freedman, architectural conservator in private practice in Boston, Mass. Rigging and rebacking were supervised by Jean-Louis Lachevre, conservation engineer, Museum of Fine Arts, Boston.

4 The concrete cutting system was designed by Mike Deblasio, Pamela Hatchfield, and Louise Freedman. Deblasio is the founder of M. DeBlasio, Inc., a masonry company based in Littleton, Mass.

5 TRAC Star 2000 with power-up and 10 in. diamond blades, manufactured by Intertool, 1607 Abram Court, San Leandro, Calif.

6 The composition of the Aegis cutting compound was analyzed and approved for conservation use by the Museum of Fine Arts, Boston, Objects Conservation Division. Aegis Concrete Concepts, M. Deblasio, Inc., Littleton, Mass.

7 Cuts were made 5.0–6.0 cm. deep, spaced 0.6–1.3 cm apart.

8 Craig Barnes, founder of CBI Consulting, Inc., has worked with MFA for over fifteen years designing support systems to protect objects during transportation and from natural forces when on display.

9 Araldite® AW8595/Hardener HW8595 was used to secure the panels to the epoxy leveling layer. It was applied with pneumatic guns in 9 cm diameter dollops, at 15 cm intervals. The same epoxy was used to assemble the aluminum honeycomb supports.

10 Aluminum honeycomb core, 0.75 in. thick; aluminum skins, 0.032 in. thick; aluminum rectangular tube, 0.75 by 1½ in., wall thickness, 0.125 in.

11 A laboratory testing program was undertaken to verify the stiffness of the system and the bonding of the various elements. A large-scale testing program, using full-size elements of the proposed construction, was used. Results of the testing program paralleled engineering calculations, which provided the confidence the team needed to proceed with construction.

12 The solvent-soaked fabric was typically applied twice—once to remove the burlap and again to remove the gauze.

13 A selection of the iron chelating agents tested: 2% nitrilotriacetic acid (NTA) buffered with TEA to pH 8, 2% ethylenediaminetetra-acetic acid (EDTA) buffered with TEA to pH 8, 2% oxalic acid buffered with ammonium hydroxide to pH 8. Poultices of the cleaning solutions were made with either cellulose powder or methylcellulose.

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Materials and Suppliers

Note: Please consult manufacturer's MSDS for toxicity, handling, and safety guidelines.

3M™ Scotchlite™ Glass Bubbles K20 (soda-lime borosilicate glass)
3M Corporate Headquarters
I-94 and McKnight Rd.
St. Paul, MN 55144-1000 USA

Aerosil® 200 (fumed silica-hydrophilic)
Degussa Corporation
379 Interpace Parkway
Parsippany, NJ 07054 USA

Aluminum honeycomb panels
SmallCorp
P.O. Box 948
Greenfield, MA 01302 USA

Araldite® AW8595/Hardener HW8595 (epoxy resin, 2 component adhesive)
Vantico Inc.
Adhesives & Tooling
4917 Dawn Avenue
East Lansing, MI 48823 USA

Araldite® AY103/Hardener HY998 (epoxy resin, 2 component adhesive)
Huntsman
Advanced Materials America, Inc.
5121 San Fernando Rd. West
Los Angeles, CA 90039 USA

Cellulose powder (99.7% cellulose)
American BioAnalytical
15 Erie Dr.
Natick, MA 01760 USA

Citric acid, diammonium salt
Sigma-Aldrich, Inc.
3050 Spruce St.
St. Louis, MO 63103 USA

Dental plaster (gypsum plaster)
Samuel H. French Company
4446–50 Cresson St.
Philadelphia, PA 19127 USA

Dry pigments
Kremer Pigments, Inc.
228 Elizabeth St.
New York, NY 10012 USA

Ethylenediaminetetraacetic acid (EDTA)
Sigma-Aldrich, Inc.
3050 Spruce St.
St. Louis, MO 63103 USA

Hydrocal™ white (gypsum cement) & Hydrocal™ FGR-95 (fiberglass reinforced gypsum cement)
United States Gypsum Company
125 S. Franklin
Chicago, IL 60606-4678 USA

Methylcellulose 4,000 cP
Sigma-Aldrich, Inc.
3050 Spruce St.
St. Louis, MO 63103 USA

Nitrilotriacetic acid (NTA)
Sigma-Aldrich, Inc.
3050 Spruce St.
St. Louis, MO 63103 USA

OK 412 Flattening Agent (silicon dioxide)
Degussa Corporation
379 Interpace Parkway
Parsippany, NJ 07054 USA

Oxalic acid
Sigma-Aldrich, Inc.
3050 Spruce St.
St. Louis, MO 63103 USA

Paraloid® B-72 (ethyl methacrylate and methyl acrylate copolymer)
Rohm and Haas Company
100 Independence Mall West
Philadelphia, PA 19106-2399 USA

Porcelain restoration glaze (acrylic emulsion)
Golden Artist Colors, Inc.
188 Bell Rd.
New Berlin, NY 13411-9527 USA

President putty soft (polyvinylsiloxane)
Coltène/Whaledent Inc.
235 Ascot Parkway
Cuyahoga Falls, OH 44223 USA

PVA-AYAF (polyvinyl acetate resin)
Dow Chemical Corporation
Midland, MI 48674 USA

Triethanolamine (TEA)
Sigma-Aldrich, Inc.
3050 Spruce St.
St. Louis, MO 63103 USA

Discussion—Session 2: Caring for Mosaics in Museums

Président/Chair: Federico Guidobaldi

Discussion following Maria de Fátima Abraços Presentation

ÉVELYNE CHANTRIAUX: Pour remplacer les parties manquantes, vous avez parlé des tesselles de résine magnétique ?

MARIA DE FÁTIMA ABRAÇOS: Non, non, une résine synthétique. Ce sont des résines qui ont un aimant magnétique pour coller au support.

Discussion following Carmen Dávila Buitrón Presentation

AÏCHA BEN ABED: Ai-je bien compris: Vous aviez un *emblema*, qui était sur un support d'ardoise et que vous aviez enlevé pour le remplacer par du métal?

CARMEN DÁVILA BUITRÓN: Je ne veux pas beaucoup parler sur ce thème. Ma collègue et moi commençons juste cette étude parce que, dans le musée, on comptait substituer tous les supports originaux par d'autres, en aluminium et résine de polyester.

SAMAR KARAM: Avez-vous de la documentation sur les anciennes restaurations ou vous ne savez rien ? C'est surtout pour les *emblemas*. Avez-vous des informations sur la raison pour laquelle ils ont séparé le tesson de céramique et le lit de pose du *tessellatum* dans les anciennes restaurations ? Parce qu'il semble qu'il y a quelques *emblemas* où il y a eu séparation.

CARMEN DÁVILA BUITRÓN: La documentation, non, il n'y en a pas. Dans les anciennes restaurations, je ne sais pas, peut-être qu'ils ont été séparés lors de la fouille, peut-être, mais je ne le sais pas encore.

FEDERICO GUIDOBALDI: Je peux ajouter que ce type de restauration de corniche avec le marbre jaune antique, c'est une chose qui a je crois, déjà été faite.

Discussion following Maja Frankovic Presentation

EWA PARANDOWSKA: As far as I understood, the restoration of this mosaic was executed in 1958, and I would like to know if you have many more mosaics that were restored that way, because in Alexandria, the mosaics transferred to the museum there were restored in a similar way, using iron bars with sealant as a support, which is very bad as far as we know now.

MAJA FRANKOVIC: The mosaic was restored in 1959. We also get our mosaics from the site of Stobi, which is now in the former republic of Macedonia. We have two pavements from that site, and, as far as I know, they were restored in the same way. The restoration was not later, I think, and they are in part better preserved.

UNIDENTIFIED WOMAN: Je voudrais reprendre un petit peu votre question sur les Balkans. Entre les années 1950 et 1970, ce type de restauration était fréquemment utilisé sur les sites en Bulgarie et parfois en Turquie, en Serbie beaucoup, et en Macédoine, donc effectivement, on rencontre aujourd'hui beaucoup de problèmes pour la conservation des mosaïques, parce que les gens n'ont pas les moyens. Il y a plusieurs mètres carrés de mosaïques dans cet état dans les Balkans.

MAJA FRANKOVIC: Yes, I would like to add just that in the 1950s plaster was much used in conservation in our country, not only for mosaics but for other objects as well, for metal objects, even for glass objects. So it was quite a universal solution used in the museums.

Discussion following Marie-Laure Courboulès Presentation

JANET GROSSMAN: You gave a very good idea of the collaboration between the Algerian and the French conservators, but I was wondering about the curatorial involvement in the work. Were curators involved in choosing the mosaics that were going to be part of these exhibitions in the first place? Or were they involved at all in establishing the criteria for what would make the mosaics suitable for exhibition? I'm wondering if you could speak about this.

MARIE-LAURE COURBOULÈS: Bien entendu ces choix sont faits en concertation avec, non seulement les conservateurs des musées, mais aussi les deux commissariats de l'exposition, et de notre point de vue aussi, la conservation même des objets bénéficie d'un projet de collaboration, d'expositions, pour sauvegarder des pièces qui étaient en danger.

EWA PARANDOWSKA: Je voudrais demander pourquoi est-il impossible de faire la restauration sur place, en Algérie, parce que le transport de cette pièce dans un état si fragile est également risqué ? Je pense qu'il est beaucoup plus coûteux de préparer cette pièce pour le transport pour faire tout ça en France.

UNIDENTIFIED MAN: Je vais répondre à la question. Les pans de mosaïque ont été transportés depuis l'Algérie en France sous des normes universelles de transport d'objets archéologiques, il n'y avait donc aucun risque de transport. De plus, le but, selon la convention entre le gouvernement algérien et le gouvernement français, était, en plus de la restauration de ces mosaïques, de former huit personnes.

UNIDENTIFIED MAN: Il y avait un petit choix à faire. Il fallait transporter le matériel de France vers l'Algérie parce qu'il n'en existe pas sur place ou bien, transporter les mosaïques d'Algérie en France.

AÏCHA BEN ABED: Mais ces mosaïques devaient faire l'objet d'une exposition en France. Je voulais savoir si vous avez une idée du coût de cette opération ?

PATRICK BLANC: Non, non, ce n'est absolument pas un secret, disons que déjà, le coût de cette opération, on est pas du tout dans une démarche commerciale. C'est une coopération entre deux pays, entre la France et l'Algérie qui ont une longue histoire commune, et il est très bien de pouvoir se retrouver aussi sur de tels évènements. Donc, ce qui coûte vraiment est bien sûr le matériel et les restaurateurs qui ont été mis à disposition pour ces collections. Cela a été pris en charge par les collectivités, entre autres la nôtre, le département des Bouches-du-Rhône. Les coûts financiers sont donc réduits au maximum puisque l'on ne pense pas du tout à faire un bénéfice dans un tel type d'opération. Il s'agit donc vraiment du coût du matériel prix coûtant et des salaires pour les gens qui y travaillent.

Discussion following Robert Vincent Presentation

JANET GROSSMAN: How long was the period of the decision-making process?

ROBERT VINCENT: The actual decision making was done in Cairo and Alexandria in a period of about a month, but then later, discussions to focus on specific mosaics took more time, as did the usual request for permission from the National Supreme Council of Antiquities Permanent Committee, and also the definition of the team to do the work. So it was a process that took place over several years before the project itself could start. From the beginning until the work started on the mosaics, it was about five years. I can't give you the specifics because we've been running a lot of projects at the same time. It was about five years, and it corresponded to changes within the organization's Supreme Council of Antiquities, with different secretaries-general in place and other changing situations.

Discussion following C. Mei-An Tsu Presentation

DENIS WEIDMANN: You showed us pictures of your mosaic before and after treatment. We really see the differences in the colors. In the last picture, after treatment, you have black tesserae, and before, a very grayish color. Have you replaced them?

C. MEI-AN TSU: No, part of that is my poor photography of the mosaic before treatment, and also you're looking through horrible layers of dirt before the treatment. Varnishing has renewed a lot of the blanched whiteness imparted in the dark stones as well, so really a lot of that has come from bad photography. Cleaning and then varnishing through very slow applications without bringing the surface to a glossy level has really changed the hue of the tesserae.

JANET GROSSMAN: Were there any problems convincing the director of the acquisition committee to acquire that object in such a state? That's rather unusual.

C. MEI-AN TSU: Yes, it was always sold more as a rescue operation. I certainly was not involved in that layer of decision making. The director was very keen on acquiring a monumental floor mosaic, and Christine Kondoleon was on the museum board; she was at the Worcester Art Museum during this acquisition period and had actually started to look for one [floor mosaic] on the market. But this project has been fully supported by the administration of the museum. It's one small mosaic, probably, in the context of Tunisia, but in Boston it's a significant project, and people are very excited to have something of this scale and beauty in the museum.

MONGI ENNAÏFER: Je poserai une question qui porte sur le fait que l'on achète encore des mosaïques alors que l'on cherche à restaurer et laisser les mosaïques *in situ*. C'est aussi un problème que les mosaïques partent de leur lieu d'origine, c'est quand même une perte de contexte.

FEDERICO GUIDOBALDI: This is not a recent acquisition. I know that the mosaics have been in Boston for a while.

C. MEI-AN TSU: This was a recent acquisition from one of the original sponsors of the Princeton Expedition, Dumbarton Oaks, which is a Harvard affiliate. Because of the scale of the mosaic, its size, they were unable to display it or care for it adequately. They're based in Washington, D.C. But, of course, any archaeological artifact now in a fine arts museum in America certainly represents an inherent conflict in Western acquisition policies. So that is something we try to be attentive to in deciding how we will present this piece accurately to the public. There has been a push from our curatorial [department], from Christine [Kondoleon], to try if possible to bring the context to the Fine Arts Museum, which is a new step for us. It was not always popular to really unite the three panels, and I think there were some in the museum who wanted to privilege the center panel. It was a real push just to take exhibition space to accommodate the scale of the mosaic.

DEMETRIOS MICHAELIDES: I think there is some misunderstanding in the discussion. It is a new acquisition as far as you're concerned, but it's an old discovery that has been around for many years. So we cannot discuss the ethics of buying mosaics because it doesn't enter into this particular case.

PART THREE

Documenting and Assessing Sites at Risk

The Mosaic Corpus of Turkey: A New International Research Project

Mustafa Şahin, Derya Şahin, David Parrish, and Werner Jobst

Abstract: *Turkey is one of the richest countries in terms of Roman mosaics. However, so far there has been no systematic presentation of these mosaics. Moreover, no collective strategy for the preservation of found mosaics has been developed. The aim of this study is to develop a corpus of Turkish mosaics and a collective working strategy.*

Résumé : *La Turquie est un des pays les plus riches en mosaïques romaines. Toutefois, jusqu'à présent ces mosaïques n'ont jamais fait l'objet d'une présentation systématique. En outre, aucune stratégie commune pour la préservation des mosaïques découvertes n'a été mise en place. Le but de cette étude est de développer un corpus de mosaïques de la Turquie et une stratégie de travail commune.*

In June 2004 a large group of mosaic specialists were assembled in Istanbul, under the authors' leadership, to begin a long-term project to document all the known mosaic pavements in Turkey, which date from the Greek to the Roman and Byzantine periods.[1] Turkey now joins the growing list of countries in the Mediterranean area and beyond that has established a national corpus of mosaics. The project team is working closely with the Association Internationale pour l'Étude de la Mosaïque Antique (AIEMA) and has a direct link to its headquarters in Paris.

In order to centralize and coordinate the inventory project, we decided to establish the Center for Mosaic Research in Turkey at Uludağ University, in the city of Bursa. The center includes a library and a computer database for mosaics;[2] a research assistant there serves as a correspondent. From its inception the Corpus project was planned to cover all of Turkey systematically. David Parrish, Werner Jobst, and Mustafa Şahin were its co-organizers, with participants coming from six countries besides Turkey: France, Italy, Austria, Germany, South Cyprus, and the United States. The first organizational colloquium was held in Istanbul in June 2004. The second colloquium took place in Izmir and Altinoluk in June 2005, with accompanying excursions to Old Smyrna and Pergamon and other mosaic sites in the region of Altinoluk. One sign of the project's success was the formation of a national chapter of AIEMA-Turkey, whose elected officers include mosaic specialists, university graduate students, museum administrators, field archaeologists, and mosaic conservators.

Organizing Principles of the Corpus Project

Various goals and criteria have guided our project from the outset, the first one being close cooperation with the director general for cultural heritage and museums and other officials in the Turkish Ministry of Culture and Tourism in Ankara, as well as in the Ministry of Foreign Affairs. The Corpus organizers have met with Orhan Düzgün, current director general of museums and archaeological sites, and other individuals, such as Mesut Özbek and Beyza Üntuna, who are concerned with cultural relations between Turkey and the European Union. All these individuals view the Corpus project in the larger context of documenting and preserving Turkey's national artistic heritage. At present a commission in Brussels is considering an application for European Union funding to support our research and conservation efforts. Other funding agencies are also being contacted for this purpose.

Two other principles have guided us in creating the Mosaic Corpus of Turkey. One is that this enterprise be bilingual. All the Corpus volumes will be published in Turkish

and English, and for this reason a Turkish translation of C. Balmelle, H. Prudhomme, and M.-P. Raynaud, *Le décor géométrique de la mosaïque romaine* (2002), is currently being prepared. All its descriptive terminology will be available to the Corpus authors by the end of 2007.

Implementation of the Corpus Project

For the purposes of this project, Turkey has been divided into twenty-one historical regions, with individual teams of scholars, composed of two to seven members, responsible for documenting the mosaics from the Greek, Roman, and Byzantine periods in those regions.[3] Only mosaic pavements are included, since the number of wall mosaics exceeds our research capacity. Previously published catalogues of mosaics from individual sites are to be integrated into the Corpus, such as the monograph on Antioch (Levi [1947] 1971) and the existing volumes on Ephesos (Jobst 1977). Other specialized studies of mosaics at individual locations, currently in preparation, will also become part of the larger Corpus.

The form for recording mosaics was developed collectively by the Corpus participants using the highest standards of our professions. This form is adapted to the requirements of individual archaeological sites, with special attention to the mosaics' architectural context. For example, if several mosaics decorated a certain building, a ground plan of the structure is provided (drawn in a similar scale and format in all cases) and all its rooms are numbered individually, with the associated mosaics clearly indicated. The building's social function and principal architectural features and the type of space each pavement ornamented are documented. In addition, the precise shape of the mosaic and its location and orientation in a given architectural space are recorded—for example, whether it serves as the main carpet facing the room entrance or as a panel inserted into a portico that faces a fountain in an adjacent court.

Otherwise, the inventory form gives all the necessary factual information about the pavement, beginning with its number in the Corpus volume (numbers are arranged consecutively for an entire archaeological site) and the technique of manufacture. This Corpus in fact encompasses all pavement techniques, ranging from pebble mosaics to *opus tessellatum* and *opus sectile* and other variant types of floors. For convenience, a title is assigned to the mosaic, and its provenance and present location are indicated. The Corpus includes not only pavements preserved at archaeological sites or kept in museums and private collections but also lost works of art known from archival sources.

Detailed information about the mosaic's physical features is also provided. This includes the pavement's dimensions, actual and reconstructed (if the work is fragmentary); the exact materials used to make it and the type of mosaic foundations; the density of tesserae in various parts of the floor; and the colors employed (for which a standardized chromatic chart, such as the Munsell system, is useful). Another significant aspect of the pavement's physical description is its current state of preservation. This includes evidence of ancient or modern restorations, the manner of protecting the mosaic, or the conditions in which it is stored in a museum. If a pavement is lost, it is essential to find an archival record of it, in the form of a photograph or watercolor drawing, as has been done so effectively, for example, for missing mosaics in H. Stern, *Recueil général des mosaïques de la Gaule. I: Province de Belgique* (1957–), and in the catalogue of mosaics from Trier and its surroundings by P. Hoffmann, H.-J. Hupe, K. Goethert, and L. Dahm, *Katalog der römischen Mosaike aus Trier und dem Umland* (1999).

The heart of the Turkish Corpus form is the description of the mosaic's design and imagery and the author's personal commentary. Proceeding from the pavement's outer margin, or *bande de raccord*, inward, all parts of the pavement are described in a precise, succinct fashion, using terminology from *Le décor géométrique de la mosaïque romaine*. If a mosaic contains several ornamental panels of differing design, all of these are numbered and indicated in a sketch. The accompanying commentary depends on comparisons with other, related works for questions of iconography and style. This also is the place to discuss the possible existence of a decorative program among the several mosaics ornamenting a particular building. The stylistic analysis, combined with any available archaeological evidence, also helps to give a date to the pavement, either confirming or altering previous chronological interpretations.

The final two elements in the documentation of a given mosaic are a bibliography of published references to the pavement and its illustration. The bibliography employs abbreviations found in the *Bulletin de l'AIEMA*, and the most important references are emphasized typographically. The illustrations include a plan of the building from which the mosaics come, photographs of the pavement, and, where necessary, a reconstruction drawing. The photographs will be published primarily in color.

Conservation of Turkish Mosaics

The final objective of the Corpus project is to promote not only scholarly research but also the active conservation of mosaic pavements in Turkey. We are equally committed to documenting these works of art and to doing whatever we can to help preserve them. It is the duty of the Corpus participants to indicate the exact physical condition of mosaics they are studying and,

wherever conservation is needed, to bring this to the attention of specialists and have them recommend appropriate treatments. Turkey has a few conservation laboratories, but they are in great need of professional materials, better equipment, and more personnel trained in this type of work. Therefore, funding is being sought to meet these needs and to foster a new generation of archaeologists and conservators specializing in the conservation of mosaics. For the moment, teams are needed to travel to individual archaeological sites to stabilize in situ mosaics at risk.

The purpose of the Corpus project committee is to alert the archaeological, conservation, and museological communities to the need for the conservation of mosaics wherever that need exists. The committee intends to do everything possible to help preserve Turkey's exceptional heritage in mosaic art, as well as to record it. Specific proposals for conservation have been made by the members of the committee:

- An inventory of mosaics must be created for each region of Turkey indicating the state of preservation of individual pavements. Forms with criteria for evaluating the mosaics' condition could be distributed to students and others gathering this information. The database at Bursa would collect all of the information from throughout the country.
- A three-part plan for the conservation of Turkish mosaics is proposed. It contains the following elements: (1) Create teams of specialists at various conservation laboratories in Turkey who can be contacted directly by field archaeologists and museum administrators and who can provide advice about mosaic conservation locally and also stabilize mosaics in situ at sites throughout Turkey. (2) Apply for funding to obtain materials necessary for mosaic conservation at various locations in Turkey over a three-year period. (3) Train selected Turkish students to become future, full-time specialists in the field of mosaic conservation in Turkey. Funding for this proposal will be sought outside Turkey. One possible source is the Getty Foundation in Los Angeles, California.

It was also suggested that individual Turkish students might seek additional training in mosaic conservation outside Turkey, for example, with internships at the laboratory at Saint-Romain-en-Gal in France. Another possibility is for students to apply to one of the professional conservation training programs in Europe sponsored by programs such as "Europa Nostra" and "Leonardo da Vinci" that aim to protect the cultural heritage of individual countries.

Finally, the Corpus will include previously published catalogues of mosaics at individual sites in Turkey alongside the new volumes. Each new volume will have color photographs exclusively, in addition to other, graphic illustrations.

The first volumes of the Turkish Corpus will document mosaics in Istanbul, Ephesos, Zeugma, and Xanthos. The purpose of this project is to make the vast treasure of mosaic art in Turkey easily accessible to the scholarly world and to give due recognition to these works of art.

Notes

1 The current project follows upon an earlier attempt to make a Turkish corpus, which was initiated in the 1970s by Elisabeth Alföldi-Rosenbaum (Alföldi-Rosenbaum 1971) but languished after the publication of a few volumes. The new Corpus is preceded by an initial synthesis of Turkish mosaics by Orhan Bingöl, *Malerei und Mosaik der Antike in der Türkei* (1997).

2 The Corpus library has already been the recipient of books generously donated by the headquarters of AIEMA in Paris.

3 The twenty-one historical regions are Thracia, Propontis, Bithynia, Mysia, Hellespontus, Lydia, Caria, Lycia, Pamphylia, Isauria, Lycaonia, Pisidie, Phrygia, Galatia, Paphlagonia, Cappadokia, Cilicia, Pontus, Mesopotamia, Gentes, and Erzurum, in eastern Turkey.

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La gestion des pavements de mosaïques découverts fortuitement : Déposer ou conserver *in situ* ?

Fathi Bejaoui

Résumé : *Les récentes découvertes archéologiques dans la région de Sbeïtla et de Thelepte dans les Hautes Steppes tunisiennes infirment l'idée selon laquelle ce territoire n'aurait pas connu durant l'Antiquité tardive l'essor artistique remarqué au Nord ou sur le littoral. Les découvertes datent principalement de l'époque byzantine (533–647). Le décor des pavements laisse penser qu'une activité artisanale régionale intense existait et les liens iconographiques et surtout la mention d'un atelier de mosaïste à Henchir Errich confirment l'existence d'une officine dans cette région. Il est également remarquable que certains thèmes représentés aient été en vogue plusieurs siècles auparavant (héros mythologiques) et qu'ils aient perdu leur vrai sens à l'époque byzantine en devenant de simples supports décoratifs.*

Abstract: *Recent archaeological discoveries in the region of Sbeitla and Thelepte in the Upper Steppes of Tunisia belie the assumption that during late antiquity this region did not experience the same artistic development as the North or the coast. Discoveries date mainly to the Byzantine period (533–647). The mosaic pavements' decoration suggests the existence of intense regional craft activity, and the iconographic connections and especially the mention of a mosaicist's workshop at Henchir Errich confirm the existence of production in the region. It is also remarkable that certain themes depicted (mythological heroes) were in fashion several centuries ago and in the Byzantine period had lost their true meaning by becoming simple decorative elements.*

La brève intervention que j'ai le plaisir de vous présenter concerne un problème de choix relatif à la conservation des dizaines de pavements de mosaïque mis au jour en Tunisie.

Ces découvertes sont évidemment associées à des monuments antiques pas toujours identifiés et résultent essentiellement de trois ou quatre sortes d'interventions ou causes fortuites.

Les fouilles organisées

Le premier type d'intervention concerne les fouilles organisées et encadrées par des archéologues et chercheurs, que ce soit au niveau national ou dans le cadre de conventions signées avec des partenaires et des institutions universitaires ou de recherches non tunisiennes (comme dans le cas des fouilles organisées à Pupput, Carthage, Zama, Uchi Maius, Jebel el Oust).

La conservation des mosaïques peut alors être assurée par un suivi régulier effectué par un personnel permanent et qualifié sur le site, capable de couvrir ou de remblayer éventuellement le pavement en cas d'importantes intempéries. Cette dernière solution pourtant a ses limites et elle est quasiment impossible à appliquer si les sites sont ouverts au public : il est difficile de justifier la couverture d'une mosaïque qui peut être souvent le but même de la visite. Il existe cependant des menaces réelles de détérioration – comme en témoignent un ensemble de mosaïques du site de Sbeïtla ou un pavement très connu des thermes publics de Makthar, à plus de 900 m d'altitude, qui subit régulièrement les effets du gel et de la neige (fig. 1). Ces pavements sont concernés par les récentes campagnes de formation pour la conservation et la préservation des mosaïques organisées sur différents sites du pays par l'Institut Getty de Conservation et l'INP (fig. 2).

Les découvertes fortuites suivies de fouilles de sauvetage

La seconde forme d'intervention concerne les découvertes fortuites suivies de fouilles de sauvetage. Ce sont celles qui



FIGURE 1 Makthar : Les mosaïques des thermes sous la neige.



FIGURE 2 Sbeïtla : Intervention des mosaistes sur une mosaïque *in situ*.

sont les plus nombreuses et le plus souvent en rapport avec des projets d'aménagement du territoire même dans les zones les plus reculées de la campagne tunisienne. Il s'agit de travaux d'électrification, de construction de barrages, d'autoroutes, et récemment d'aéroports et surtout des travaux de labours profonds utilisant des engins modernes.

Ici, le problème est plus délicat car il faut agir rapidement et trouver des solutions adéquates, le plus souvent en déposant la mosaïque pour la conserver hors de son contexte archéologique, parfois sans possibilité d'élargir la fouille. D'autre part, même s'il est possible de conserver la découverte sur place, d'autres problèmes de sécurité se posent. Cependant et dans des cas assez exceptionnels, le pavement peut être conservé et intégré dans son nouveau contexte. L'exemple le plus récent est celui que vient de négocier l'INP, à l'occasion d'un projet d'extension d'un complexe hôtelier à Pupput où des mosaïques ont été découvertes lors de travaux. Elles seront au moins partiellement conservées sur place et vont pouvoir être restaurées et mises en valeur pour présentation aux visiteurs.

Les découvertes dues à des facteurs naturels et aux fouilles clandestines

Deux autres types d'interventions nous échappent totalement. Ce sont celles qui causent le plus de dégâts : tout d'abord, les découvertes qui sont dues à des facteurs naturels – comme le ruissellement des eaux, érosion, oueds en crue, ainsi que la montée du niveau de la mer que subit le littoral tunisien. On peut également placer les découvertes dues aux fouilles clandestines dans cette catégorie.

Je commencerai par le problème de conservation des pavements apparus en raison de facteurs naturels. Les exemples sont nombreux ; je n'en citerai qu'un seul, celui de la fameuse mosaïque des îles et des villes découvertes à Haïdra (Bejaoui 1997) et dont l'apparition fait suite aux forts orages fréquents dans cette région de la Tunisie du centre-ouest. Le fait que l'édifice, dont les murs étaient à peine conservés, soit situé à la périphérie du site et au bord d'un grand oued dont les crues sont fréquentes et destructrices, ne nous a pas laissé d'autres choix que de déposer cette mosaïque de 30 m². Sa conservation sur place, dans ces conditions, l'aurait inévitablement fait disparaître à moyen terme. La repose de cette mosaïque a cependant bénéficié d'un traitement privilégié due à son importance puisqu'elle est actuellement sur nid d'abeilles grâce aux efforts conjoints de l'INP, de l'Agence nationale du patrimoine et surtout de l'apport capital en spécialistes et en moyens financiers de la mairie et du musée de Lattes (fig. 3). On comprendra aisément qu'en raison des coûts de ce genre de repose, notre institution, qui a l'énorme responsabilité juridique de la conservation du patrimoine national, ne peut supporter la généralisation de la repose sur nid d'abeilles. En effet, comme vous le savez – et contrairement à d'autres pays, notamment européens – il s'agit pour nous de dizaines, voire de centaines de pavements.

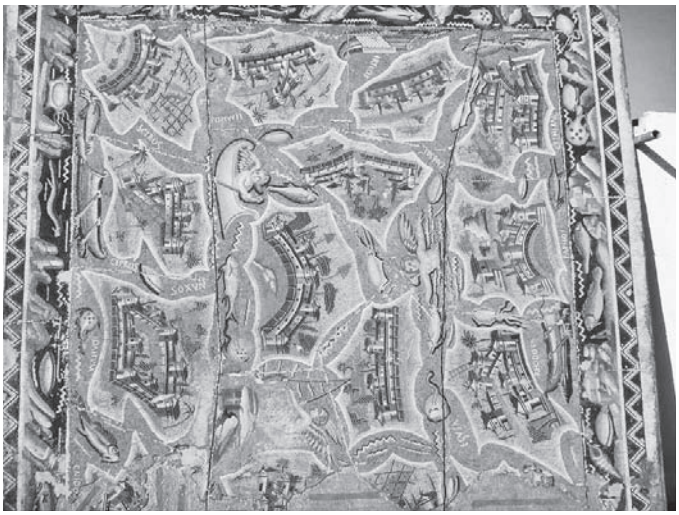


FIGURE 3 La mosaïque des îles et des villes deposée.



FIGURE 4 Henchir Errich : La mosaïque des héros mythologiques *in situ*.

J'en viens maintenant aux problèmes que pose l'apparition de pavements à la suite de fouilles clandestines. Dans ce cas, et malgré la création d'une brigade spécialisée dans la lutte contre ce fléau, le phénomène, qui n'est pas spécifique à la Tunisie mais qui est sensiblement maîtrisé, persiste encore et concerne le plus souvent les sites ruraux ou les petites fermes antiques. La fouille s'effectue souvent tard dans la journée, au lever du jour et parfois la nuit. Les dégâts sont parfois importants puisque après le repérage et bien entendu, la fouille clandestine proprement dite, le fouilleur tente de déposer le pavement avec les conséquences que l'on imagine.

En voici quelques exemples, choisis parmi les plus importants :

Le premier exemple est celui d'une mosaïque découverte dans la région de Sbeïtla. Elle décorait l'une des salles d'un petit complexe thermal et représente des figures mythologiques, des scènes de chasse ainsi qu'une scène de lutte (fig. 4). Dans ce cas précis, le pavement a été conservé sur place mais entièrement remblayé en attendant de pouvoir le déposer et le reposer sur un support autre que le traditionnel. Le site est cependant régulièrement inspecté par des agents de l'INP pour la simple raison que nous ne sommes pas très loin de Sbeïtla où il existe une structure d'inspection (Bejaoui 2001).

Cela n'a pas été le cas de plusieurs pavements décorant le sol d'une église rurale fouillée clandestinement sur un site totalement isolé, entre Sbeïtla et Gafsa, au lieu-dit Henchir El Ouara (Bejaoui 2001). Les mosaïques ont été déposées (fig. 5).

Ailleurs, dans le nord-ouest du pays et au lieu-dit Gobr El Ghoul, dans la région de Siliana, à plus de 30 km du célèbre site de Zama, une tentative de dépose clandestine a eu lieu sur

FIGURE 5 Henchir El Ouara : Mosaïque avec deux cerfs décorant le chœur d'une église rurale.





FIGURE 6 Gobr El Ghoul : Mosaïque des douze mois de l'année *in situ*.



(a)



(b)

FIGURE 7A, B Henchir El Goubeul : Vue générale du site (a) et la mosaïque deposée (b).

une mosaïque de la plus haute importance représentant les Douze mois de l'année (fig. 6) (Bejaoui 2002). Le pavement a été déposé.

Enfin, le dernier exemple est celui d'une mosaïque du lieu-dit Henchir El Goubeul dans la région de Thelepte. Là encore, le choix était limité et la dépose a été la seule solution en raison de l'isolement total du site et de son éloignement d'un site majeur gardé (fig. 7a, b)

Les baptistères

Pour conclure avec ces exemples, je voudrais seulement rappeler qu'il existe en Tunisie de nombreuses cuves baptismales mosaïquées et que l'on ne peut dissocier la conservation des bassins de celle de leur décor (Bejaoui 1992). Le problème est exactement le même que pour un pavement. Si, parfois, le démontage est la seule solution pour les sites isolés, c'est parfois le remblaiement qui s'impose à cause du risque de dégradation au cours de cette délicate opération. Parfois, la conservation sur place est possible comme c'est par exemple le cas de la cuve de Sidi Jdidi actuellement protégée par un abri discret en bois (fig. 8) (Ben Abed-Ben Khader, Fixot et Roucole 2004 : 339).

Conclusion

A la lumière de ce bref et rapide exposé, on se rend compte des problèmes que pose la conservation de la mosaïque dans certaines régions de Tunisie. On réalise aussi que certains choix



FIGURE 8 Baptistère de Sidi Jdidi *in situ* mais protegé.

sont douloureux pour les archéologues et institutions chargés de cette lourde tâche qui suit inévitablement la joie de la découverte.

Et c'est à ceux qui sont sans doute confrontés à ce type de situations qu'on s'adresse pour réfléchir à des solutions à de nombreux problèmes. Faut-il déposer la mosaïque découverte sur des sites totalement isolés ? Sur quel type de support faut la reposer ? A-t-on les moyens de systématiser les supports légers ? Peut-on également conserver la mosaïque en place avec tous les risques de dégradations et de vol que cela comporte ? Autant de questions à résoudre.

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Mosaic Floors Unearthed at Rescue Excavations in Turkey: A Philosophical and Ethical Evaluation of the Decision-Making Process

Hande Kökten

Abstract: *As rescue excavations in Turkey expose many floor mosaics in need of preservation, the decision-making process becomes a philosophical, ethical, and legal issue. Reasons affecting the approach of decision makers, who are always archaeologists, vary according to postexcavation concerns. This paper analyzes in detail the proceedings of the Annual Museum Rescue Excavations Symposium in Turkey, published between 1990 and 2004, which consist of excavation and restoration reports. The following topics are covered: purpose of the excavation, condition of the mosaic floor, preservation measures, decision-making process, and postexcavation approaches. This analysis is followed by the proposal of a new approach based on interdisciplinary cooperation between the archaeologist and the conservator.*

Résumé : *En Turquie, les fouilles de sauvetage dégagent de nombreux pavements en mosaïques nécessitant une préservation et la prise de décision pose des problèmes philosophiques, éthiques et juridiques. La motivation des décideurs, toujours des archéologues, dépend des enjeux post-fouilles. Cette communication propose une analyse des actes du "Symposium annuel des fouilles de sauvetage en Turquie" publiés entre 1990 et 2004, abordée selon les thèmes suivants : objectif des fouilles ; état du pavement en mosaïques, mesures de conservation, processus de prise de décision et approches post-fouilles. Finalement, une proposition est présentée pour une nouvelle approche basée sur une collaboration interdisciplinaire entre l'archéologue et le conservateur.*

Rescue archaeology is described as "the swift excavation and collection of artifacts at sites in immediate danger of destruction, usually by major land modification or construction projects. Archaeologists record and recover as much of the site as they can in the brief period before it is destroyed."[1] As at many sites around the world, mosaics are routinely unearthed during rescue excavations in Turkey, and archaeologists not only recover and record them but also make decisions regarding their preservation. Before discussing the preservation methods and the circumstances surrounding them, it is necessary to distinguish two major types of rescue excavations in terms of their scope, process, and management:

- Long-term rescue excavations, which aim to unearth archaeological remains discovered during the construction of major projects such as dams (e.g., Zeugma, Allianoi)
- Short-term rescue excavations, which must be carried out because of the discovery of archaeological remains at construction sites (i.e., excavations for sewer systems, plumbing, underground constructions) or illegal excavations by smugglers (i.e., of tombs, tumuli) detected by security forces or other authorities

These two types can be differentiated not only on the basis of the duration and size of the excavations but also by their preferred preservation practices. Long-term rescue excavations, led by a team of museum and university staff, including conservators, often ensure adequate and correct preservation treatment of the mosaic floors unearthed. The generous excavation budgets provided by the institutions involved in the construction project make a noticeable difference. On the other hand, due to the destructive effect of water at dam construction sites, mosaic floors are considered "movable cultural property" and therefore are almost always lifted and transferred to muse-

ums. Rescue excavations inevitably cause delays in the planned schedule of development projects. Pressures from local authorities and those citizens who expect to benefit from the project, along with the lure of increased tourism to be gained by a new exhibition, make the lifting of mosaics almost unavoidable.

The differences between preservation approaches used for mosaics unearthed in short-term rescue excavations and long-term systematic ones are based mainly on the following causes:

- Short-term excavations operate against time, and therefore the archaeologist needs to be swift both during the decision-making process and during implementation of the conservation method.
- There is a lack of conservation professionals in the rescue excavation team.
- Inadequate security is provided once the rescue excavation is completed, which increases the risk of illegal digs and smuggling.
- Rescue excavation taking place on public land incurs delays in the development project, and owners or local officials (i.e., municipalities, building contractors) exert pressure to hasten the excavation process.
- Owners face financial difficulties when rescue excavations occur on private holdings.

A careful study of the proceedings of the Annual Museum Rescue Excavations Symposium in Turkey for the period 1990–2004 indicates that decisions regarding the preservation of mosaic floors were often both hasty and perfunctory (see Kültür Bakanlığı 1990–2004). The preservation measures applied and the reasons for them are summarized below.

- Lifting of the mosaic floor and removal to a museum:
  - Lack of security and the threat of illegal excavations, which typically results in the destruction or smuggling of the mosaic floor.
  - Difficulties exhibiting and protecting the mosaic floor due to the vast distance between the ancient building or ruins and the modern settlement.
  - The mosaic floor hinders the development project.
  - The mosaic floor qualifies as a unique example to be exhibited in museums.
- Temporary reburial of the mosaic floor:
  - Incomplete rescue excavations that require extending to another campaign.
  - Insufficient budget to remove the mosaic floor.
  - The need to expand archaeological research after expropriating the private holdings where the rescue excavation takes place.
- Preservation of the mosaic floor in situ:
  - The mosaic floor and the ancient building are in good condition, which enables the museum to exhibit them in situ.
  - The need to expand the excavation area and expropriate the private lands for extensive systematic excavations.

Archaeologists' decisions to lift and remove mosaics at rescue excavations are founded on a basis different from those made during systematic excavations. According to the statistics available in the volumes of the Kültür Bakanlığı (1990–2004), 50 percent of the mosaics unearthed during rescue excavations were removed to museums, whereas 25 percent were reburied or preserved in situ. There are no available data for the remaining 25 percent.

Given these circumstances, the following practices must be understood:

- The aim of the excavation takes primary importance when evaluating how best to conserve mosaics, and therefore their state of preservation becomes a secondary concern.
- Even when there is the possibility of expropriating the land in order to start extensive systematic excavations, mosaic floors are lifted and removed to museums during rescue excavations.
- Locals aware of the discovery are considered a threat, and therefore mosaic floors that might be preserved in situ are lifted for security reasons.
- Archaeologists who are also museum researchers tend to evaluate floor mosaics as movable cultural property, especially the "unique examples" unearthed during rescue excavations, since they enrich a museum's collection.
- Archaeologists who make all the decisions in the absence of a mosaic conservator also take charge of the lifting process and the transfer of the mosaic onto a new support.

It is remarkable that when archaeologists discover mosaic floors during a rescue excavation they seem to prefer lifting and removal as a preventive measure, whereas the condition of the mosaic and supporting mortar layers directs the conservator

toward determining the preservation method during systematic excavations. Among the rescue excavations studied here, there is only one example in which a different preservation method was chosen based on the condition of the mosaics and their unity with the building. At Çiftlik Köyü–Sinop heavily damaged mosaics in danger of sliding into the sea were lifted and removed to the local museum, whereas the undamaged mosaic floors were preserved in situ in the church (Tatlıcan 1997).

The rescue excavation reports reveal that even in those cases in which conditions did not compel excavators to lift the mosaic, re-covering was not considered a suitable and secure preservation alternative. Hence it was resorted to only as a temporary measure when lifting treatment could not be performed. Furthermore, the decision-making process was not based on well-defined principles and criteria that enabled the excavator to be objective during the rescue excavation. This means that the excavator was obliged to come up with his own solutions, which of course were based on his experience and knowledge of preservation.

The Orpheus mosaic from the Polatlı-Kayabaşı Mound is the most striking illustration of this situation. During rescue excavations in 1989 archaeologists had to expand their research and start a systematic excavation at the Kayabaşı Mound. In accordance with this proposal and because the mosaic was partly covered by a modern house soon to be expropriated, the Orpheus mosaic was reburied and preserved in situ (Kopar 1991). It was protected by the villagers for eleven years, until a new museum was built at Polatlı to store and exhibit the various Phrygian artifacts recovered from the Gordion excavations. In 2000 this new museum was nominated for the European Museum of the Year award, and because of its uniqueness (it is one of eight Orpheus mosaics in Turkey), the Opheus mosaic was lifted and displayed in the museum's garden (Temizsoy and Kaya 2001).

The most common reason for lifting mosaics, however, continues to be insufficient security measures and illegal excavations that result in destruction and smuggling. This serious problem is related to the lack of public education. This is especially true of those sites or individual archaeological remains that are far from museums or modern settlements, in which case lifting and removal of the mosaics becomes the only option if they are to be saved.

Another drawback of the current situation is the fact that archaeologists who tend to lift mosaics at rescue excavations lack the knowledge, skill, and judgment to perform such a complicated operation. There are many steps involved before one can begin the lifting process, such as documentation, cleaning, temporary filling of the lacunae, and cutting the mosaic into sections. Further, unexpected complications that arise during the lifting work require the skills of an experienced mosaic conservator. However, as the proceedings of the Annual Museum Rescue Excavations Symposium in Turkey reveal, this complicated operation is carried out by archaeologists who typically use the standard "recipe" of glue, fabric, and chisels. This is the result of insufficient professional support that state museums suffer from in the field of conservation, as well as the delay in establishing standards for archaeological conservation practice in Turkey. A workshop that was organized in the early 1990s has generated a group of museum researchers who see themselves as experts in the conservation of mosaics and therefore the goodwill of the institutions involved in this training program has inadvertently resulted in the destruction of numerous mosaics.

Although the Central Laboratory for Restoration and Conservation was founded in Istanbul to provide a research unit dedicated to dealing with the conservation problems of collections in state museums, this institution gradually turned into a laboratory where conservators treat hundreds of objects in poor condition from almost any museum in the country. As a result of the extensive amount of work, limited budget, and lack of qualified personnel, the Central Laboratory is unable to provide consultancy services and practical assistance during rescue excavations (Kökten 2006).

On the other hand, active conservation treatments to transfer the mosaics to a new movable or fixed support are performed by archaeologists, and both the methods and materials used are irreversible and destructive (Yaman 1991; Ermişler 1992; Mertek 1994; Yener 1994). In addition, the inadequate storage and poor display of mosaics increase the risk of their being damaged by uncontrolled environmental conditions and lack of maintenance. Furthermore, the content and application of the re-covering material for those mosaics that are temporarily preserved in situ are not up to standard, as layers of plastic sheeting, sand, and soil are applied to the surface of the mosaic floor for an indefinite period (Tatlıcan 1997).

In light of these observations, the steps needed to ensure the success of preventive and active conservation approaches can be grouped under three major headings:

- Defining the principles and criteria to be used during the decision-making process
- Training of archaeologists in preventive conservation of mosaics
- Professional help by conservators

To answer the questions of where, how, why, and by whom mosaic floors found at rescue excavations are to be preserved, it is necessary to assemble a consultative commission composed of the Ministry of Culture and Tourism, the General Directorate of Cultural Property and Museums, the Central Laboratory, and the conservation departments at Turkish universities. Archaeologists and experienced conservators who are to be involved in this commission should discuss and solve the following issues.

1. Define the principles and criteria to be used in the decision-making process: when and why (or why not) to lift the mosaic floor.
2. Define the archaeologist's responsibilities during a rescue excavation and limit his or her involvement in preventive conservation. Archaeologists should not become the acting conservators at rescue excavations.
3. Prepare a handbook for archaeologists elucidating the preventive conservation methods to be used for mosaic floors. Excavators should know and understand the importance and necessity of preventive measures that facilitate further active conservation treatments. The handbook should cover the following topics:
   - Preventive conservation measures to be used during and after excavation.
   - Content and application method of re-covering materials to be used for those mosaics that are to be preserved in situ.
   - Storage methods and maintenance of mosaics to be displayed in museums.
4. Create an extenstive list of conservators who specialize in mosaics and prepare a reference directory so that museums can contact experts easily.

In the meantime, the mosaic conservation unit at the Central Laboratory in Istanbul should be reorganized and reactivated so that it can provide proper and swift professional support to archaeologists during rescue excavations. This will contribute to improving the condition of lifted and/or remounted mosaics at museums since a lack of maintenance leads to their slow deterioration.

With the archaeologist and the conservator working together during the excavation, especially in cases in which complicated lifting techniques are necessary to ensure a safe rescue operation, the excavator will be prevented from unwittingly damaging the mosaics. It should be noted, however, that it is crucial to train archaeologists in preventive conservation methods since they are always the first to discover the mosaics.

To assist with professional help for museum researchers, Ankara University, Başkent Vocational School (Conservation Program), has developed a distance education program titled "Preventive Conservation for Museums" that includes a section on rescue excavations and preventive conservation. A handbook covering the first aid measures and preventive conservation techniques and materials for newly excavated movable and immovable archaeological property is already under way.

With the setting of standards for decision makers and the provision of training programs and support by conservation professionals, the preservation of mosaics unearthed at rescue excavations will soon meet international standards, thus becoming another accomplishment in the field of conservation for Turkey.

Notes

1 AIA—Education—Introduction to Archaeology—Glossary. www.archaeological.org/webinfo.php?page=10299.

2 In 1995 a course and a seminar were organized by the Central Laboratory for Restoration and Conservation titled "The Conservation of Mosaics in Situ without Lifting at Archaeological Sites," with the contribution of the UNESCO Participation Program and the collaboration of ICCROM. During this seminar, held in Istanbul, examples of conservation/restoration work carried out on various mosaic sites were presented by specialists, and problems as well as treatment methods were discussed in detail. The practical work was carried out on the floor mosaics at the archaeological site of Side in Antalya.

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PART FOUR

Managing Sites with Mosaics

Conservation and Preservation of Mosaics in Syria: The Case for a Multidisciplinary Approach—or New Strategies for Old Problems

Amr Nawar Al Muayyad Al-Azm

Abstract: *Syria is a repository for a phenomenal catalogue of cultural heritage that includes a unique and rich corpus of mosaics. Yet today this corpus presents daunting challenges—an entrenched policy of mosaic removal rather than in situ preservation, poor storage conditions, out-of-date conservation techniques, and limited record keeping—for which traditional methods are not always viable. Several new projects have been initiated that include local awareness-raising to encourage in situ preservation and the use of databases for the recording of both new mosaic finds and those on display and in storage. This approach will provide a better understanding of the underlying problems and more effective means to deal with them.*

Résumé : *La Syrie renferme un patrimoine culturel phénoménal comprenant un riche corpus de mosaïques qui aujourd'hui se trouve confronté à des défis considérables – une politique préconisant la dépose des mosaïques plutôt que leur préservation* in situ*, des mauvaises conditions de stockage, des techniques de conservation dépassées, peu d'enregistrement de données – contre lesquels les méthodes traditionnelles ne sont pas toujours appropriées. Plusieurs projets ont été lancés notamment pour encourager la préservation* in situ *et l'utilisation de bases de données pour enregistrer les nouvelles découvertes ainsi que les mosaïques exposées et en réserve. Cette approche permettra une meilleure connaissance des problèmes et des moyens plus efficaces pour les résoudre.*

Syria is a repository for a phenomenal catalogue of cultural heritage, which is the product of a long history of interaction with its neighbors and the region as a whole. An important part of this heritage is a unique and rich corpus of mosaics. There are literally thousands of square meters of Classical- and Byzantine-period mosaic pavements in Syria, which come from public buildings, churches, and private houses. Although some can still be seen in situ, many more have been lifted and even more still lie safely buried and undisturbed in the ground. Of those that have been lifted, only a few are on public view in museums; most are in storerooms awaiting conservation. This corpus presents a daunting challenge in terms of conservation and preservation, in a country where traditional, tried and tested methods are not always viable.

Therefore, it is of vital importance that the management of mosaics and archaeological sites rich with mosaic floors become part of a common strategy of cooperation between the institutional partners and local stakeholders. One of the hoped-for outcomes of the programs outlined in this paper is to present the General Department of Antiquities and Museums (DGAM) with a new strategic approach aimed at improving the integrated management of the mosaic corpus in Syria as well as the sites where they are discovered.

In a paper presented at the conference on mosaics conservation held in 2003 at Piazza Armerina in Sicily, I outlined some of the problems related to the management and preservation of mosaics in Syria (Al-Azm 2004). One of these is that the treatment of choice for the majority of new mosaic discoveries is removal. The main reason for this is the lack of available resources to provide physical protection in the form of a structure to protect mosaics from the elements or a guard to prevent theft or vandalism. Furthermore, as a result of this policy, over a period of forty to fifty years Syria has acquired a backlog of untreated mosaics amounting to a recently revised figure in excess of 6000 square meters and growing, as new discoveries are made every year. Until very recently the most common method of mosaics management in Syria was still

removal rather than preservation in situ, and the majority of these mosaics continue to be stored in very poor conditions similar to those described in 2003 (fig. 1).

Since mosaics represent one of the main assets of Roman and Byzantine archaeological sites in Syria, particularly due to their intrinsic historical and artistic value, it is crucial to tackle immediately and effectively the problems of continuing removal, poor storage conditions, and inappropriate conservation methods. The approach being proposed here is a multidisciplinary one based on a strategy that concentrates on the concept of integrated heritage management. It is only through such an integrated management system that these problems may begin to be resolved in a sustainable manner that will eventually permit on-site preservation. Sustainability is critical to the success of any proposed programs and can only be achieved through the tapping of the sites and their local communities for their full potential in terms of socioeconomic development.

For this reason, the approach aims to involve local stakeholders and professionals at all levels. It is hoped that, in addition to providing a better understanding of the causes of these underlying problems and more effective means of dealing with them, a national strategy may be put in place and implemented. Ultimately, for any such national strategy to succeed it will need to incorporate most, if not all, of the following points: (1) the encouragement and marketing of local, typical products related to the history and culture of the area or region as a means of sustainable development; (2) raising awareness about the positive effects of business and employment opportunities related to cultural heritage; (3) training and capacity building in both the public and private sectors regarding the preservation, management, marketing, and promotion of cultural heritage, both objects and sites; and (4) increasing cooperation both among the various institutional partners and with the local stakeholders.

To achieve these aims, the following projects are being implemented in Syria today:

- Recruitment and training of local mosaic conservators.
- Participation in national and regional training workshops.
- Improvement of storage conditions.
- Banning the use of reinforced cement.
- Purchasing and using new and more appropriate materials.
- Encouraging in situ preservation.
- Encouraging local stakeholder participation and education.
- Encouraging and supporting local business initiatives relating to the cultural heritage of the area or region.
- Creating a working Corpus of Syrian Mosaics.



(a) (b)

FIGURE 1 Examples of poor storage conditions: (a) stacking of faced fragments with no supports; and (b) loose tesserae and fragments of damaged relaid panel. Courtesy of Department of Antiquities and Museums (DGAM), Syria.

Several intensive training programs in mosaic restoration and preservation have been instituted in order to build a dedicated core of conservators to carry out the required work and to act as a nucleus for training additional people as the need arises. These programs were organized at the local level within the Science and Conservation Laboratories of the DGAM as well as at the regional and international levels, for example, the Bilad Al-Sham mosaic restoration training programs (Hamdan and Benelli 2005). The Bilad Al-Sham program, which included intensive courses on ancient mosaic restoration and awareness-raising activities on the importance of preserving cultural heritage, involved the antiquities departments of Syria, Lebanon, and Jordan and was supported by the European Union. Furthermore, with the use of cement banned, lighter composite durable frames are now employed using materials such as Aerolam® (an aluminum and fiberglass sandwich panel). The most recent efforts are devoted to encouraging and promoting in situ preservation. These include an element aimed at increasing the awareness of local communities as to the value of having the mosaics preserved and displayed locally. This is being achieved through education projects and stakeholder participation highlighting the benefits of in situ preservation.

A pilot project for stakeholder participation is being carried out at Maarrat Al-Numan in northern Syria. Maarrat Al-Numan lies in a mosaic-rich area and has a long history of being associated with the production of mosaics. It was the location of an important workshop for the local production of mosaics in the Roman and Byzantine periods. Today there are a number of workshops in and around Maarrat that still produce mosaics that are sold and exported all over the world, in addition to the less than reputable pastime of illegal removal of mosaics. The reason for the latter activity is linked to a large extent to the practice of removal by the DGAM. Local people realize that any discovered mosaic is likely to be removed, and therefore they will gain no benefit from it. Furthermore, since most of these mosaics are located in their fields, near their homes and backyards, local people feel entitled to some benefit from them, which justifies their illicit removal of mosaics. Thus a vicious cycle of removal for protection by the authorities and removal for gain by the inhabitants is perpetuated. A new initiative aimed at local education and stakeholder participation is being tried at Maarrat to break this cycle.

The value of in situ preservation has not been lost on the local people. They are coming to recognize that it is to their advantage if visitors are able to see the mosaics in their original setting on-site and then visit the local workshops, where they may be able to purchase copies. Thus, by involving local stakeholders, we are encouraging sustainable means of income generation based on the concept of in situ preservation, thereby preventing the killing of the goose that lays the golden egg.

Another example of this new approach is an ongoing joint project of the Centre for Archaeological Research at the University of Damascus and the European Centre for Byzantine and Post Byzantine Monuments (EKBBM). The project has two main aims:

- To establish a working database with which to fully document mosaic pavements on-site and in storage in museums in Syria using modern methods.
- To conduct a training course for Syrians to carry out this process.

The end product should be the publication of a usable corpus of mosaics of Syria for future analysis and study.

The project began with eight students being chosen from the University of Damascus for training. Their program included formal lectures and practical sessions in archaeology, art history, conservation, documentation, and management. Once the initial phase of their training was completed, the students were required to begin gathering and recording information about the mosaics (fig. 2). (See also Politis, Al-Azm, and Bakirtzis, this volume.)



FIGURE 2 Training of University of Damascus students. Photo courtesy of Department of Antiquities and Museums (DGAM), Syria.



FIGURE 3 Copying surface patterns. Courtesy of Department of Antiquities and Museums (DGAM), Syria.



FIGURE 4 Measuring dimensions. Courtesy of Department of Antiquities and Museums (DGAM), Syria.

The recording process aims to gather all available information on mosaic pavements in Syria, both treated and untreated, including those that have been conserved and are on display in situ or in museums and those that are in storage, as well as those that have had no intervention beyond being removed and stored (figs. 3, 4). The main sources of information are mosaic pavements on display or in storage. In addition, records kept by the DGAM are used when available. These records include original site plans and photographs of the mosaics in situ prior to their removal (fig. 5). However, this documentation procedure is not intended to include comprehensive analyses, such as art historical analysis, but rather act as an aid for that purpose.

For optimal data storage and management, a relational database was created using Microsoft Access and designed to allow data to be recorded, retrieved, searched, compared, and cross-referenced quickly and accurately. The information can then be made widely available by permitting access to the database through the Internet. The database includes information on the following: the building from which the mosaic was

FIGURE 5A, B Examples of original in situ mosaic photographs. Courtesy of Department of Antiquities and Museums (DGAM), Syria.



(a)



(b)

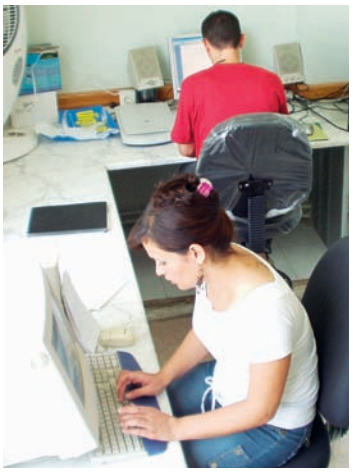


FIGURE 6A Data entry in the database. Courtesy of Department of Antiquities and Museums (DGAM), Syria.

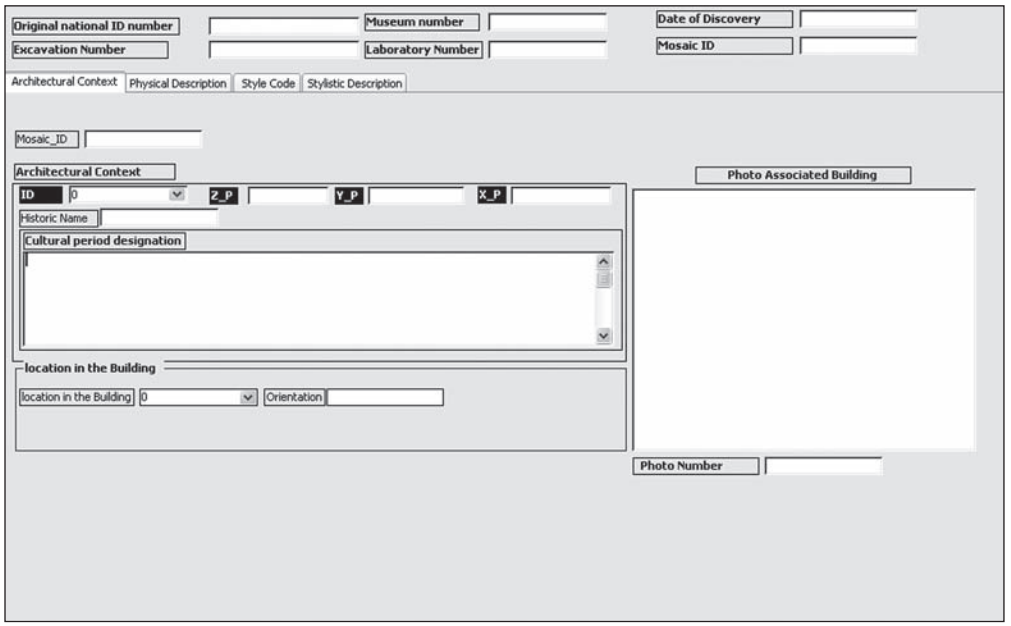


FIGURE 6B Database data entry form. Courtesy of Department of Antiquities and Museums (DGAM), Syria.

recovered (architectural context); the condition of the mosaic; a physical description; a stylistic description; and other information such as dates and publications (figs. 6a, 6b).

The training and recording phases of this project are ongoing. The data are being entered into the database, which is still in its testing stages, by the trainees. It is hoped that one of the outcomes of this project will be a risk map of existing mosaics both in storage and in situ that can be used as a basis for the establishment of an intensive restoration and preservation program to eliminate the massive backlog of stored mosaics, both restored and unrestored, as well as promote new management policies aimed at encouraging and supporting in situ conservation.

In conclusion, it is hoped that through outlining existing problems and the application of a multidisciplinary approach that includes projects such as those outlined above and stakeholder participation as an integral part of its methodology, we may finally begin to see a change in how cultural heritage management in general and mosaic preservation in particular are being dealt with in Syria.

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Um Er-Rasas (Um Al-Rasas): Preservation of the Mosaics at a New World Heritage Site in Jordan

Mervat Ma'moun Ha'obsh

Abstract: *In 2004 the site of Um Er-Rasas was added to the World Heritage List because it represents a masterpiece of the human creative genius, given the artistic and technical qualities of the mosaic floor of the Church of St. Stephen. The existing shelter that covers the church does not provide suitable protection for the mosaics. Therefore, the Ministry of Tourism, with the help of the European Commission, made the decision to construct a new shelter. Numerous studies were first undertaken to identify the critical issues and parameters that should be considered prior to the shelter's design and construction. These include a topographical survey, a geophysical survey using various methods (gravity, magnetic and resistivity, and ground penetrating radar [GPR]), and collection of data regarding climatic conditions, wind loads, the enclosed shelter environment, earthquakes, and water drainage.*

Résumé : *En 2004, le site d'Um Er-Rasas a été inscrit sur la Liste du patrimoine mondial à titre de chef-d'œuvre du génie créateur humain pour les qualités artistiques et techniques du pavement en mosaïques de l'église de St Stéphane. L'abri qui recouvre actuellement l'église ne protège pas correctement les mosaïques et le Ministère du Tourisme, soutenu par la Commission européenne, a donc décidé la construction d'un nouvel abri. De nombreuses études ont d'abord été entreprises pour identifier les questions et paramètres essentiels à prendre en compte avant la conception et la construction de l'abri – notamment étude topographique, examen géophysique utilisant diverses méthodes (gravité, magnétisme et résistivité, et radar géologique [GPR]), avec collecte des données relatives aux conditions climatiques, charges de vent, environnement sous abri fermé, tremblements de terre et drainage des eaux.*

Um Er-Rasas (Kastron Meffa) is a village in southeastern Jordan known for its archaeological remains from the Roman, Byzantine, and early Islamic periods (end of third to ninth century C.E.). It is situated about 30 kilometers southeast of Madaba and north of Wadi Mujib-Arnon, about 12 kilometers west of the modern Desert Highway (Amman-Aqaba Highway). The site was located along the Roman commercial "New Trajan" road, which joined Bosra Al-Sham in the north with Ayla (Aqaba) in the south, passing through Philadelphia (Amman).

The first explorer of Jordan, U. Seetzen, recorded the site in 1807. In February 1872 H. B. Tristram camped at Um Al-Rasas and accurately described the ruins. It was not until 1896, however, that S. Vailhe realized that the large city could be a Roman camp. Based on this notion, J. Germer-Durand identified the ruins as the biblical Mefa'at which, according to Eusebius, was a Roman military station.

In 1986 archaeological work began at the site, which provided epigraphic evidence for the identification of the site as Kastron (Fort) Mefea, a toponym known from Roman and Arabic sources and from the Bible (Piccirillo 1993: 232). The remains that were discovered are primarily from the Iron Age (seventh–sixth centuries B.C.E.) and the Nabataean (third century B.C.E.–106 C.E.), late Roman (third–fourth centuries), late Byzantine (sixth century), and Abbasid (750–1258) periods.

The name "Um Al-Rasas" is related to the arabic root *rass*, meaning the action of putting something on top of something else in perfect alignment, in this case, a strong wall that was built of stones laid over each other. The visible remains of a well-fortified camp of about 10 hectares corresponds to the fortress of Mefa'at. Adjacent to the walled area, to the north, is

an open quarter, called the Northern settlement, roughly the same size as the fortress. Eleven of the site's fourteen churches have been excavated. Several contained extraordinary mosaic pavements that have made the site famous. In addition, the stylite tower—named for the monastic movement symbolized by St. Simeon the Stylite—an exceptional monument more than 13 meters high, is well preserved. The tower is the only intact monument from this monastic movement. It is affiliated with a small church and a series of other buildings. Old agricultural fields between this group of buildings and the castrum are exceptionally well preserved.

In 2004 Um Al-Rasas was inscribed on the World Heritage List based on the following criteria: (i) it "represents a masterpiece of the human creative genius, given the artistic and technical qualities of the mosaic floor of St. Stephen's church"; (iv) it "presents a unique and complete example of stylite towers"; and (vi) it "is strongly associated with monasticism and the spread of monotheism, including Islam, in the whole region" (World Heritage Center 2004).

The Existing Shelter

The St. Stephen complex within the site consists of four churches: the Church of St. Stephen, the Church of Bishop Sergius, the Church of the Aedicula, and the Church of the Courtyard (fig. 1). The floors of the Churches of St. Stephen and Bishop Sergius are paved with exceptional ancient Byzantine mosaics (fig. 2). All of the Church of St. Stephen and the choir of the Church of Bishop Sergius have been protected by a closed, covered superstructure. So far this has helped not only to protect and conserve the mosaics but also to provide public access to them. Constant and regular visitation has given a

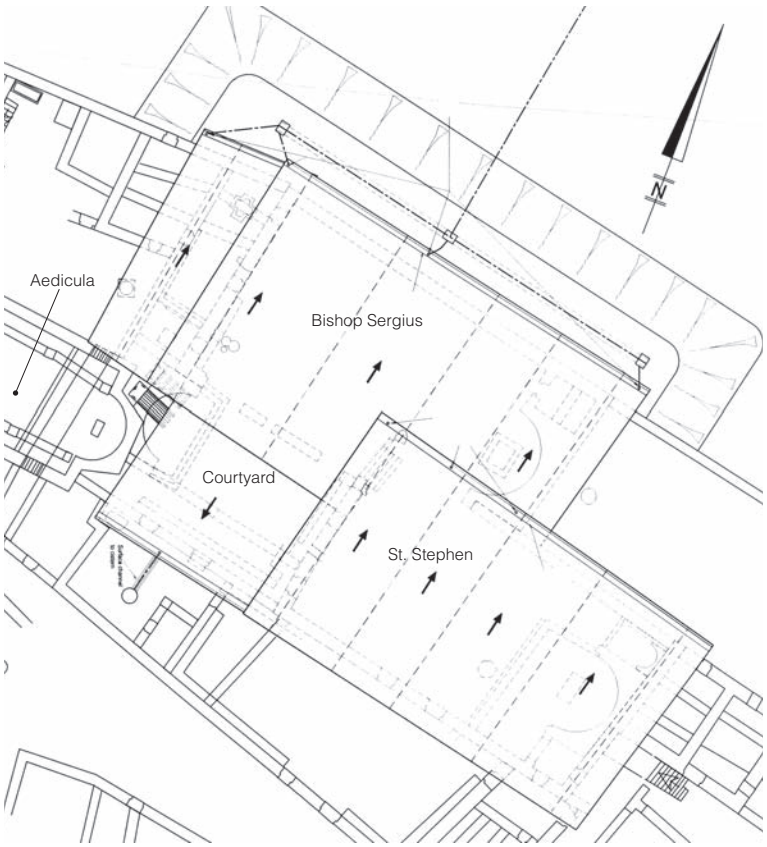


FIGURE 1 The St. Stephen's complex and proposed drainage system. Courtesy of Halcrow Group, Ltd.



FIGURE 2 The mosaics of the Church of St. Stephen. Photo by Mervat Ma'moun Ha'obsh.



FIGURE 3 The existing shelter structure. Photo by Mervat Ma'moun Ha'obsh.

certain celebrity status to the site, its religious buildings, and their beautiful mosaics. The continuing increase in the number of visitors from around the world demonstrates the wide interest shown by the international community (SECA 2001).

The shelter's structure is made of a steel frame with a pitched roof supported by columns and lattice trusses approximately 4 meters apart. The roofing is a saddle roof made of thin steel plates. The supporting columns are founded outside the original walls, within unexcavated zones. The shelter elevations are pierced with large glass openings. Only one access point allows visitors to enter, on footbridges raised about 1.20 meters above the floor. The building is 7.50 meters high, and all the side panels are light yellow-green (figs. 3, 4).

Although the shelter protects the mosaics from bad weather, it does not mitigate other problems, such as water and air infiltration and poor air circulation, lighting, and water drainage. In addition, the visual impact of this huge shelter on the site and the architectural quality of the interior volume need to be adequately addressed. The beams are a conventional lattice truss with iron corners. Parts of the beams were welded on-site. Some of the shelter parts are noticeably old and require replacement in the near future. Finally, the indoor walkways are built too high above the mosaics and constitute another negative characteristic of the shelter.

The shelter has been in position for about eighteen years, and it has kept the mosaics in good condition. There is some significant accumulation of salts on the mosaic along the south side, indicating that this area might have suffered from evaporation and the drawing up of salts through the ground.

FIGURE 4 The interior of the existing shelter. Photo by Mervat Ma'moun Ha'obsh.



The existing system of ventilation (taking into account the broken glazing) is adequate in that it keeps the shelter reasonably cool for much of the year, with the exception of the north wall. The mosaics and the church walls appear to be dry and in a good, sustainable condition, and there are no rust stains on the mosaics from leaks in the roof or from condensation.

Risks to the Mosaics

The greatest risks to the mosaics are excavation by robbers, mechanical damage caused by cleaning or by tourists walking on them, standing water, salt encrustation, mold and algae, temperature variations, bird droppings, and water from condensation or a leaking roof.

Salt crystallization cycles eat into the surface of the tesserae, resulting in serious damage. It is caused by water evaporating from the surface of the mosaic that has been drawn through the soil and contains dissolved salts. The level of risk depends on the water content of the soil as well as the concentration of salts. The material beneath the mosaic floor needs to be dry at all times to prevent salt crystallization cycles. Salt crystallization was observed in the north side of the Church of Bishop Sergius, where the external ground is about 0.9 meter above the mosaic, and water penetrates through the wall. A proper drainage system will solve this problem. Maintaining a balanced temperature inside the shelter enclosure and dry soil under the mosaic floor will also prevent salt crystallization.

Concerning the conservation and protection of the mosaics, the Ministry of Tourism and Antiquities (MoTA) has appointed a committee to review all the issues concerning the design of the shelter. The committee consists of a MoTA technical team, a Department of Antiquities (DoA) archaeologist and conservation engineer, and the UNESCO representative in Jordan. Relevant studies were conducted before developing the shelter design.

Preliminary Studies

Topographical Survey

A full topographical survey was conducted on the site, especially in the St. Stephen complex and the surrounding area, to find ways to resolve the water drainage problems. Detailed elevations (inside and outside the complex) and plans for the complex were carried out. The topographical survey will help to solve the water drainage problems.

Geophysical Surveys

In February 2005 the Geophysics Division of the Natural Resources Authority of Jordan conducted geophysical surveys at Um Al-Rasas. The objective of the study was to map buried structures, locate buried artifacts, identify target zones quickly (thereby reducing the required amount of costly excavation), and evaluate the applicability of geophysics as an archaeological aid for studying historic sites in Jordan (Natural Resource Authority 2005).

Total magnetic field, gravity, resistivity, and ground penetrating radar (GPR) measurements were collected. However, magnetic and gravity methods were complicated by the presence of the shelter over the Church of St. Stephen. It is therefore recommended that the shelter be removed in order to run detailed gravity and magnetic measurements over the site area. The resistivity survey showed an area of low resistivity to the north of the complex, indicating that there is higher moisture content in this area. A curved structure was identified below the Church of St. Stephen.

Issues in the Design of the New Shelter

Critical issues were considered in the design of the new shelter, aimed at preserving the mosaic floors of the entire complex. Some of the following problems have already been identified: climatic conditions, seasonal storms that deposit dust on the mosaics, safety and security of the shelter enclosure both for the mosaics and for visitors, water drainage, light, ventilation, cavities under the mosaic from some sort of structure (perhaps a cistern or tunnel), and additional loads on the existing ancient walls. Solutions to these problems were sought, taking into consideration ICOMOS charters and regulations regarding interventions on archaeological sites (ICOMOS 1966, 1990, 1999).

Climatic Conditions

The site is in an arid area. It is hot and dry in summer, which usually lasts for about six months. There is no rain for four months, which means low relative humidity and a high evaporation index. There is regular rain in winter and high relative humidity and a lower evaporating index.

Wind Loads

Analysis of the available data at the nearest location, Queen Alia Airport, from 1991 to 2000 shows an average wind speed of 20 kilometers per hour (10.5 knots). The data do not provide peak wind speed values; therefore, wind load has been

calculated in accordance with the Jordanian wind code, which specifies a maximum wind speed of 126 kilometers per hour. The fact that the site is exposed, with few wind breaks, was taken into account when considering the shelter design and the wind speed parameter. Strong winds come from the south and southwest. All these loads were taken into consideration when designing the columns.

Enclosed Shelter Environment

The main reason for building a shelter is to protect the mosaics from direct solar radiation and rain at all times. The roof of the shelter will be extended to the south side to prevent direct solar radiation, and it will be ventilated naturally, using the cross flow of wind to provide air movement. The internal temperature and humidity will reflect external conditions. The cross flow of wind from the south and west will change the air inside the shelter about six times per hour, thus dissipating the increased humidity and temperature resulting from the presence of visitors.

Based on modeling of the internal environment, it is expected that with a well-ventilated lightweight shelter the internal temperature will approximate the external air temperature. The combination of the internal heat from visitors and solar gains from the roof will account for a maximum temperature rise of 2°C above the ambient external air. The model predicts that the average internal temperature will be 25°C, exceeding 36°C only 7 percent of the year.

The internal relative humidity will follow approximately ambient conditions and is expected to be between 5 and 10 percent lower than in the external environment due to the slightly higher internal air temperature.

Earthquakes

Information regarding earthquakes was taken into consideration, since the area was destroyed by one in the past, as evidenced by collapsed arches at the site.

Water Drainage

When archaeological excavations were conducted on-site, soil was deposited north of St. Stephen's complex. The existing ground level next to the Church of Bishop Sergius is about 0.9 meter above the mosaic level, which was the main reason for the change in the natural drainage of rainwater. During the winter, standing water was observed on the pavement in the Church of Bishop Sergius, and dampness has been observed on the north side of the Church of St. Stephen, causing damage to the mosaics.

The Shelter Design

The concept behind the shelter enclosure is that it behave substantially like an open shelter, with adequate ventilation provided by two rows of windows. The shelter will be built using a lightweight material placed directly onto the ancient walls that were restored five years ago. The designer and the archaeologists decided that building on the ancient walls will give the true dimension of the complex while not endangering the unexcavated archaeological area around the complex. Since the walls need consolidation, lime grout will be used to fill the voids.

Structure

The shelter is designed as a gravity structure to be supported by the existing church walls. The steel frame has wall plates at the bottom to distribute vertical loads into the walls. The frame is braced to transfer horizontal loads along the axes of the walls, with minimum loads distributed across the width of the wall (fig. 5). Horizontal loads in the north/south direction are transferred to the gable walls through roof bracing. The gable walls are braced, and they transfer the loads into the walls. The columns and beams act as moment-resisting frames with no bracing. The roof is extended at the sides to prevent direct light and rainwater exposure (Halcrow Group 2005).

Glass Walls

Most of the north and south walls will be made of glass. The glass adds to the feeling of a lightweight structure and has the following advantages: transparency to reduce visual impact of the structure and natural light for viewing the mosaics. It will also allow visitors to connect the view outside the complex with the interior. Bands of windows along the top and bottom of the walls that can be opened will provide air circulation and ventilation. Existing doorways will be glazed, offering views into the interior. The wall between the courtyard and the Church of Bishop Sergius will also be glazed.

Supporting Walls

The new walls will be built directly onto the ancient walls. They will be thinner than the existing walls so that the form of the standing archaeology can be read from inside and outside the building. The texture and color of the render will be simple and smooth in order to provide a strong contrast with the rough stone texture of the ancient walls.

The majority of stone walls on the site were built without mortar: dry stones were placed one on top of one another

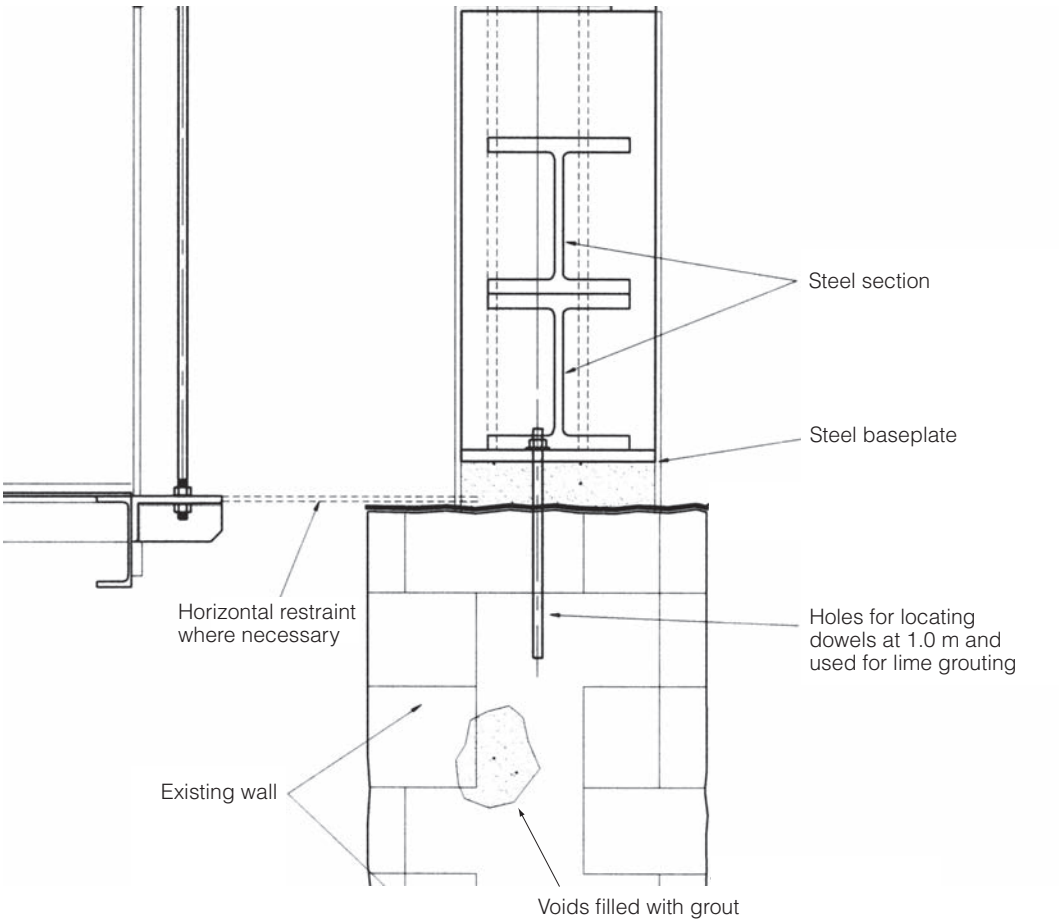


FIGURE 5 The proposed wall structure of the new shelter. Courtesy of Halcrow Group, Ltd.

and then wedged together with small stones. The core of the wall is filled with soil and stone chips. The consolidation of walls using a mortar of cement and reddish sand has already taken place, and although it is not the proper technique, any attempt to remove the mortar would damage the ancient stones. Consolidation will be carried out on those walls around the churches that are to support the new structure. Cavities in the walls will be filled with injections of lime-based slurry (see fig. 5). Holes will be drilled in the top of the walls at approximately 1-meter centers horizontally and at 0.5–1.0-meter lifts vertically. Wet clay can be used temporarily to retain the grouting material within the wall. Where walls are subject to weathering, joints should be pointed up with a lime–sand–stone dust mortar (1 part lime putty, 1 part local sharp sand, ¼ part local fine sands, ¾ part limestone dust), taking care to keep mortar off the face of the stonework. This will increase the stability of the wall by transferring the load from stone to stone evenly and by retaining the core material (Halcrow Group 2005: 25–26).

The new concrete applied on top of the existing walls will be beneficial to the structure, and the continuous load will stabilize the top of the walls by providing a mechanical key. (Note that a separating layer will prevent chemical bonding between the new and the ancient material. Removable stainless steel dowels will provide the necessary sheer connection. This construction system is reversible.)

Water Drainage

A proper drainage system for surface water will prevent the collection of water under the mosaic, and leveling the ground around the complex will help do this naturally. Rainwater will be collected from the roof and discharged through rainwater downpipes to ground level and into a gulley with a U-shaped silt trap and then into a piped system belowground. The pipe will collect any groundwater above the pipe level and discharge it away from the complex. Since the roof over the Church of the Courtyard is lower than the others, rainwater in this case will be collected and discharged into the ancient

cistern near the church and will not be discharged to the gulley (see fig. 1).

Interiors
The height of the structure reflects the hierarchy of the original basilica spaces. Based on the semicircular arch and column spacing, the Church of Bishop Sergius was lower than St. Stephen's and apparently considered less important. A level ceiling will be provided under the trusses to add simplicity to the roof interior. Translucent hangings along the line of columns as well as the front of the apse will indicate the original form of the arcade and the apse.

Visitor Walkways
Visitors will view the mosaics from a raised walkway suspended from the roof.

Lighting and Security
The shelter will be provided with a lighting system under the visitors' walkways and also hung from the roof. ICCROM standards regarding lighting will be taken into consideration (Alcantara 2002). A security system with lighting and cameras will be used on the site.

Monitoring

Once the shelter is constructed, there will be full monitoring of the interior environment, including temperature variation, as the mosaics need to be kept at an even temperature in equilibrium with the ambient conditions. Monitoring will also include wetness from condensation or leaking from the roof, water evaporation, ventilation, and a full observation of salt efflorescences. These measures will prevent any negative impact on the mosaics from the shelter.

Site Management Context

Building the shelter is one of the issues that MoTA is addressing as part of the maintenance and conservation program. The management plan of the site that MoTA is developing will also include (1) protection of the site by designating it a protected area, which will entail new planning regulations for the surrounding areas; (2) development of a site management unit responsible for all aspects of the site; (3) visitor management; (4) marketing; (5) research and development; and (6) a participatory approach to the development of projects for the benefit of the local community. It is the hope of the Ministry of Tourism and Antiquities that the site will be preserved and developed in a sustainable way in partnership with the local community.

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Conservation and Restoration of the Nikopolis Mosaics: A Program for Integrated Management and Presentation of the Archaeological Site

Konstantinos L. Zachos

Abstract: *The excavations at Nikopolis, the "victory city" established by Octavian Augustus in northwestern Greece, have brought to light numerous Roman and early Christian monuments, many with mosaic floors. The mosaics are important not only for their artistic, symbolic, and technical values but also for the methodologies and conservation techniques applied since their discovery. Ten years ago the Greek Ministry of Culture initiated an integrated program for the management and presentation of the site, with the preservation of the mosaics being one of the key actions. This paper presents the methodology and specific processes for the conservation of the mosaics while attempting a comparison between old and recent approaches in this field.*

Résumé : *Les fouilles de Nikopolis, « ville de la Victoire », ont mis au jour de nombreux monuments romains et paléochrétiens comportant des pavements en mosaïques. Les mosaïques sont importantes pour leurs valeurs artistiques, symboliques et techniques, mais aussi pour les méthodologies et techniques de conservation appliquées depuis leur découverte. Le Ministère de la culture grec a mis en place un programme intégré pour la gestion et la mise en valeur du site dont la préservation des mosaïques constitue une des actions clés. Cette communication présente la méthodologie et les processus de conservation, et tente une comparaison entre les anciennes et les nouvelles approches dans ce domaine.*

The Site

Nikopolis received its name, "victory city," following the famous sea battle of Actium in 31 B.C.E. It is located in northwestern Greece, on a narrow strip of land between two seas, the Ionian to the west, which provides an open route to Italy, and the Ambracian Gulf to the east, which affords access to the hinterland of Epirus. To the south, beyond the peninsula of modern Preveza, lies the promontory of Actium, the place of an ancient sanctuary of Apollo. The geographic position of the new city, together with its status as *civitas libera,* granted by the founder Octavian, contributed to its development. Nikopolis soon became the social, political, and economic center of its provincial region and flourished for more than one thousand years (Chrysos 1987).

The extended archaeological site, which covers some 1300 hectares, is spread across a picturesque plain, framed in the north by a chain of low hills known today as the Michalitsi hills. Octavian had pitched his military camp on one of these hills during the days preceding the final collision of the two great navies. This location was later chosen as the site for the erection of the Trophy—or Victory Monument—of Actium, an extensive and monumental stone structure forming a kind of open-air sanctuary dedicated to Apollo, Mars, and Neptune (Murray and Petsas 1989; Zachos 2001a, 2001b, 2003).

The town plan was organized according to the regular division of *insulae*, separated by roads that intersect at right angles. The public buildings in the center of the city were surrounded by private houses, and a sophisticated system of water channels and cisterns distributed fresh water, entering the city at its western gate, through an impressive aqueduct covering a distance of about 50 kilometers (Doukelis, Dufaure, and Fouache 1995). Successive barbarian raids from the fourth to the sixth century C.E. forced the inhabitants to reduce the city to one-sixth of its original size and to relocate it to the northeastern section of the Roman city. Nikopolis not only survived but continued to flourish, as attested by the ruins of luxurious basilicas decorated with unique sculptures and mosaic floors

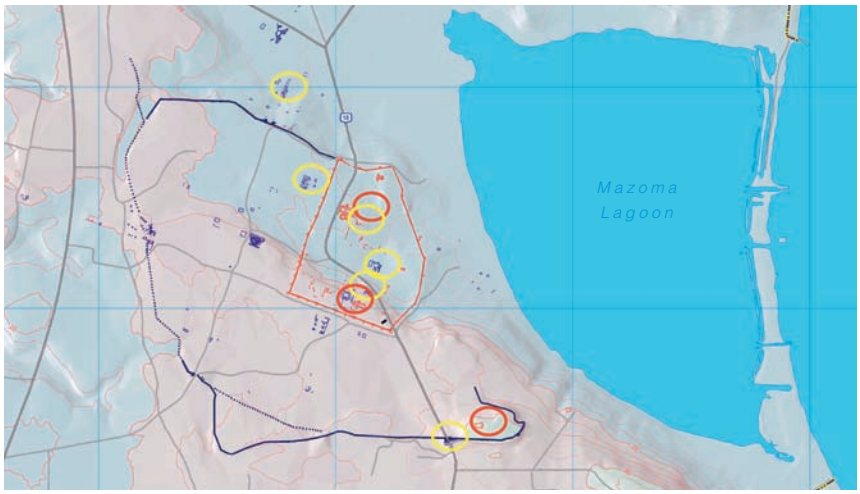


FIGURE 1 Map of Nikopolis. Circles indicate the major monuments where mosaics were found (yellow for Roman, red for early Christian). Projection: Transverse Mercator
Datum: GRS87
Map by Dimitrios Kalpakis, 2002.

(Pierrepont White 1986–87). What is known about Nikopolis from literary sources ends in about the eleventh century. The only references after that are the descriptions of travelers who passed through from time to time, because the ruins of the victory city continued to attract anyone interested in ancient history.

Excavations at Nikopolis began in 1913 and have continued intermittently until the present, albeit with long interruptions and uneven intervals of intensiveness, with the result that only a relatively small portion of the city has been unearthed. But even these limited excavations have brought to light a considerable number of Roman and early Christian monuments. Floor and wall mosaics—either complete or in a fragmentary condition—have been found in several buildings. The long period of time they cover makes their study important not only for their artistic, symbolic, and technical particularities but also for the methodologies and restoration techniques that have been applied to them since they were initially discovered. Indeed, Nikopolis preserves one of the most important groups of mosaics in the Balkan peninsula. In 1991 the Greek Ministry of Culture initiated an integrated program for the management and promotion of the archaeological site, with the preservation of the mosaics being one of the key actions within its framework.

Managing the Mosaics of Nikopolis

This paper presents the concept and methodology together with the specific processes employed in the conservation and restoration of the mosaics while at the same time attempting a comparison between old and recent approaches in the field. It concludes with the prospects for future approaches, in the context of overall management of the entire archaeological site.

The monuments where mosaics have been found include many from the Roman and early Christian periods. Figure 1 shows the mosaics representing the Roman period of the city (marked with yellow), which were found in private houses, public edifices, and grave monuments, and the mosaics from the Christian era (marked with red), which primarily adorned religious buildings and private houses.

The treatment of the Nikopolis mosaics may be summarized as consisting of two main categories: the treatment of those mosaics uncovered after 1990, when the extensive program for the investigation and promotion of the archaeological site was initiated; and the treatment of mosaics excavated up until the 1970s. For convenience, the treatment of mosaics is presented below according to the two main chronological groupings—Roman and Byzantine.

The Mosaics of the Roman Era

Immediately after mosaics are uncovered, one of the two following protocols is put into action:

- The mosaic undergoes the process of conservation-restoration using modern methods, or
- after partial exposure and surface cleaning (sufficient to gather details of stratigraphy, degree of preservation of the mosaic surface, identification of the theme depicted, etc.), the mosaics are stabilized, as necessary, and covered with geotextile and gravel and then protected beneath a temporary but durable covering

of sheet metal to avoid further exposure to natural or human impact.

In the latter case, the mosaics await an overall approach to their conservation-restoration when the monument to which they belong is included in a subprogram of excavation research, restoration, and public promotion.

Two examples of how mosaics in this latter category are being dealt with will suffice. At Basilica B, also known as the Basilica of the Bishop Alkison, excavation and research in the apse brought to light a mosaic floor from an earlier structure of the Roman period. The mosaic, first identified beneath the foundations of the basilica, depicts a hunt scene, with a small Eros holding a bow and arrows while a deer, wounded by the little hunter's bow, lies to the right. In trial trenches opened outside the apse, the poorly preserved continuation of the mosaic floor was encountered. It is clear that the mosaic must have belonged to an important building in the Roman city. The basilica and the Roman edifice beneath it were located in an area rich in springs and underground water, as several wells incorporated into the basilica complex indicate. A marble cylindrical altar dedicated to Asklepios, which was reused as a wellhead in the basilica complex and is still in situ, suggests the probable function of the Roman building. Its floor was decorated with geometric and floral motifs, similar to those found in other Roman buildings. Five partially preserved male figures are depicted in the central *emblema*. One is dressed in a short tunic and rests his right leg on a base while holding a double ax in his right hand. After initial conservation, the mosaic was covered with geotextile and gravel, and sheet metal was placed over it to provide protection pending future investigation that is to encompass the entire area surrounding the basilica.

The Central Baths, located in the heart of the Byzantine city, form a large complex probably dating to the second century C.E. Subject to numerous repairs, this building was in continuous use throughout the history of the city, and a large part of the complex is visible today. In the course of conservation work on the walls of the building, including extensive clearance of undergrowth, a trial trench was opened in the large, central Room A in order to gather information concerning the depth and condition of the floor. The trial trench revealed a partially preserved mosaic floor. Its decoration consists of zones with geometric and floral decorative motifs that create frames within which various scenes are represented. Part of a scene with dolphins may be discerned in the northwest corner, and a lotus blossom is in the southeast corner. For technical reasons and due to limited resources, it was not possible to fully uncover such an extensive mosaic in this large room, which has a total area of 372 square meters. Following what may be termed "conservation first aid," the mosaic was covered, just like the one in Basilica B, until such time as it can be incorporated into a more comprehensive program of excavation, restoration, and presentation of the Central Baths, with all the necessary prerequisites to support a major conservation project for the mosaics.

As for the immediate treatment of those mosaics revealed by recent excavation, a typical example is that from the House of Manius Antoninus, which presents at least two building phases (fig. 2). The first phase has been assigned to the second century C.E., based primarily on the dating of the mosaics; the second, building-reconstruction phase has been dated to the middle of the third or the beginning of the fourth century C.E. Preliminary investigation of this house began in 1972 when a mosaic floor was accidentally discovered by a local farmer cultivating a plot of land. The excavations brought to light the south section of the house, an area of 360 square meters (Vokotopoulou 1973). There are several reception rooms with mosaic pavements, smaller service rooms, and part of a rectangular interior courtyard, or atrium, with an *impluvium*. The mosaic pavements of the reception areas, decorated with polychrome geometric and floral motifs, are preserved in a fragmentary condition. The floor pavement of the large reception area (Room 11) stands out with its design of eight-rayed stars. Of the central *emblema*, only the southeast corner is preserved in good condition; it depicts the head of a clean-shaven youth, possibly the god Dionysos. Next to the reception areas is an antechamber (Room 14) that leads to a triclinium (Room 15). The antechamber is decorated with a circular mosaic composition bearing an inscription with the name of the owner and renovator of the house, along with the name of his wife (fig. 3). The inscription dates it to the end of the third or the beginning of the fourth century. The text of the inscription reads as follows:

Man(ios or -ilios) [son of] Aristoklias
May the fortune of the house be prosperous, and
prosperous too the restorer of the house,
Man(ios) Antoninos with his [wife] Theosegos

The mosaic floors of the house were showing alarming deterioration due to the decomposition of their substratum. In 1979 the local Ephorate of Antiquities requested the assistance of the then Directorate for the Conservation of Antiquities at the Ministry of Culture, and a specialized team of conservators



FIGURE 2 Plan and reconstructed view of the House of Manius Antoninus.



FIGURE 3 House of Manius Antoninus. Mosaic pavement with inscription in Room 14.

was sent from Athens. However, in accordance with the practice of that time, the team did not leave any detailed documentation of their work. In Room 11, for example, the mosaic floor was cut out in sections, framed on aluminum squares, and placed on a cement mortar. Following this, the unstable ancient substratum mortar was removed, and finally the square pieces were placed back on cement mortar and the missing parts were also filled with cement. The mosaics were then covered with plastic nets and metal sheets. In the long term such methods of restoration have proven unsuccessful, or, to put it more bluntly, disastrous. Today these mosaics are in poor condition; in many places the tesserae have come unstuck, and all the surfaces are covered with thin layers of cement. Painstaking mechanical cleaning may solve some of the problems. A mechanical test cleaning on the head of Dionysos gave promising results.

When excavation was renewed in August 1997, the various structures of the house were consolidated and the mosaic pavements, depending on their condition, were either conserved or restored, and then some units were covered in order to be protected. The area excavated so far is roughly 3500 square meters, across which the architectural complex (59 by 57.36 m) stretches, covering—it would seem—an entire *insula* of the urban grid of Nikopolis. Today the monument is open to the public. Visitors enter the house from its east side, step above the threshold of an ancillary door (the main entrance of the house is positioned on the south side), and pass four

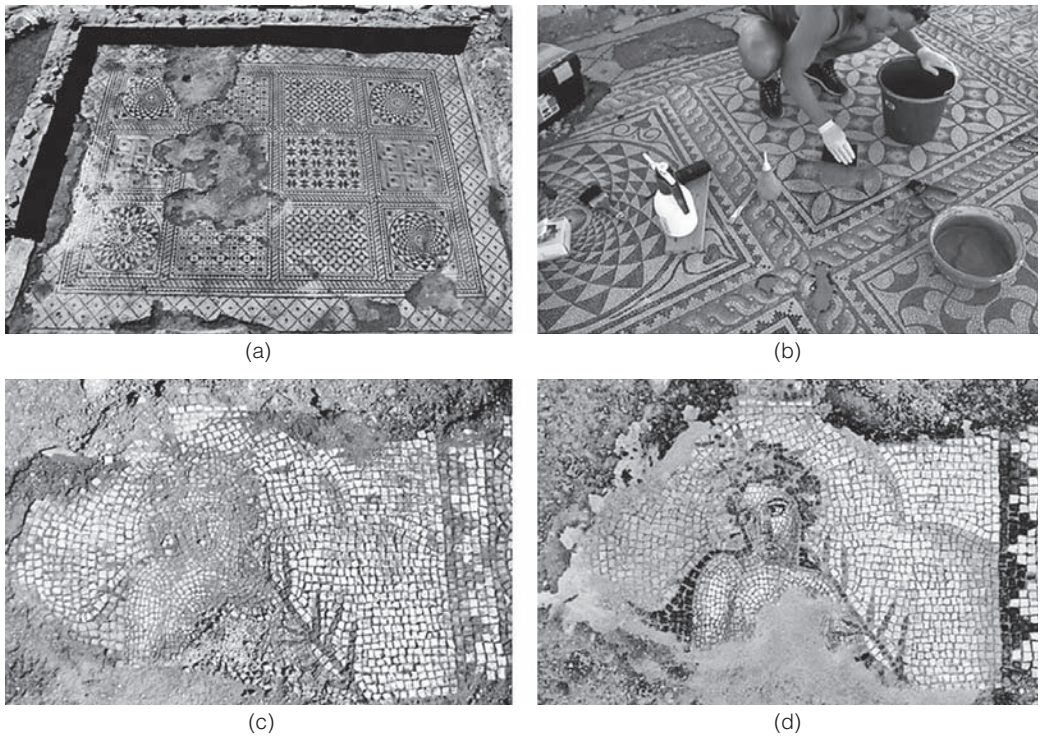


FIGURE 4A–D House of Manius Antoninus. Mosaic in Room 6 (a) before conservation; (b) during cleaning and conservation; (c, d) before and after cleaning.

rooms facing onto the peristyle courtyard. Three of the rooms (1–3) probably related to the daily routine of the family and are paved with mosaic floors bearing geometric and vegetal motifs. The fourth room, a triclinium, is decorated with an elaborate composition and is in good condition. The central *emblema* of the pavement is dedicated to a scene from the life of Dionysos. To the left of the peristyle scant structural remains belong most probably to the garden of the house surrounded by a second peristyle. To the north, and near the ancillary door, are the remains of a small private bath complex (*balneum*), of which the hypocaust is in good condition.

Continuing toward the west, visitors pass another atrium with a square pool at its center. The atrium is surrounded by more functional rooms, including bedrooms, kitchen, lavatories, and service rooms. Room 6 is interpreted as a triclinium and is distinguished by its rich mosaic floor, which has an *emblema* depicting a scene (largely destroyed) from the life of Dionysos. Some remnants of the wall paintings with vegetal motifs are still in situ.

The mosaic floors of the house were composed primarily of limestone or terracotta tesserae. In the case of the central scenes, many different types of glass paste tesserae were also used. The colors vary and cover a wide spectrum (e.g., white, black, blue, ocher, gray, green, red), depending on the composition. Construction technique does not, however, follow the standard methods used by artisans of the Roman period. Usually there are small, sometimes rather large divergences in the substructure mortar used to support the pavements. It is only in Room 6 that the standard method has been followed. Otherwise, the lower layers are fused into one, while in quite a few instances these layers are forgone completely. In these cases the underlayer of mortar (*nucleus*) is laid directly on the ground, and a thin layer of lime is spread on top of the nucleus as the *supra nucleus* on which the tesserae are set.

A characteristic example of in situ conservation is that of the mosaic in Room 6 (fig. 4). The floor composition consists of eleven rectangular units with geometric motifs, such as triangular shields, back-to-back *peltas*, perspective meanders, lozenge-shaped stars with eight rhomboid petals, lotus blossoms, and ivy leaves. The central composition of the room is largely destroyed, and only the laurel-wreathed head of Dionysos, a part of his upper body, and parts of an unidentified figure are preserved.

The pathology of the mosaic is as follows:

a) fractures and breaks in the mosaic surface, frequently extending laterally to the substratum of the floor;

b) anomalies in the level of the floor and at some points subsidence or bulging, caused mainly by surface anomalies and geological changes;
c) disintegration of the materials of the substratum;
d) biological activity;
e) erosion of the surface of the tesserae, especially those made of limestone; and
f) lacunae in the surface of the mosaic.

In brief, conservation entailed the following activities:

a) uncovering the mosaic surface;
b) collecting scattered tesserae;
c) initial surface cleaning in order to document the pathology of the pavement;
d) documentation drawing (scale 1:1) to map losses from the surface of the mosaic, along with sketches of the motifs and other illustrations;
e) more detailed surface cleaning accompanied by wide-scale stabilization, including the replacement of eroded and loose tesserae in their original position;
f) stabilizing and consolidating the edges of the mosaic, either through edging repair (i.e., the edges of those sections with damaged perimeters are consolidated with lime mortar plaster placed a few millimeters below the level of the preserved mosaic surface) or by similar methods that aim at temporarily consolidating the surface until it can be permanently stabilized;
g) aesthetic restoration-presentation, done by filling both large and small gaps with new plaster and by replacing and setting all the tesserae that had been removed from their original positions; and
h) documentation, photography and drawings, through all stages of the work.

After conservation is completed and when it is determined that a respectable number of mosaics should be visible and accessible to the public (within the framework of the overall restoration of a building), a shelter is placed over the mosaics, as in the case of Room 6, which was covered over by a metal framed shelter that can be extended if needed in the future (fig. 5).

In cases in which the mosaic is in a fragmentary state, removal is chosen, so that conservation can take place in the laboratory. This was the method chosen for Room 3, on the east side of the villa, where a total of six mosaic sections, covering an area of some 17 square meters, were preserved from



(a)



(b)

FIGURE 5A, B Mosaic protective shelters: (a) House of Manius Antoninus, completed 2000; (b) Basilica A, completed 2005.

the border area of the composition, while the central scene had been entirely destroyed. The preserved mosaic surface of these sections displays three characteristic colors: white, blue, and rose. Apart from the loss of a large portion of the decoration, the tesserae themselves were frequently found broken or had their surfaces stripped off. In this case, the mosaic, with its total surface area of 10.06 square meters, was removed and transferred to the laboratory in fourteen pieces (fig. 6).

The decision-making process in such interventions is as follows:

- First, the conservators propose and fully document the need to remove the mosaic, describing in detail all the stages of conservation that will ensue.
- Then, following approval by the Nikopolis Scientific Committee, the proposal is submitted to the Central



(a)



(b)



(c)

FIGURE 6A–C House of Manius Antoninus. Room 3 mosaic showing (a) stabilization, (b) drawing, and (c) lifting in process.

Archaeological Council, which ultimately issues a recommendation concerning the advisability or otherwise of removing the mosaic.

- Upon completion of the work, the conservation team submits a report to the Nikopolis Scientific Committee. The report is placed in the relevant archive, together with drawings and photographic material.

In the neighboring Room 4, where the central *emblema* represents a scene from Dionysos's youth, a different procedure was chosen. In accordance with the judgment proffered by the Central Archaeological Council, it was decided to conserve all the mosaic decoration in situ, except for the central *emblema*, which, by virtue of the rarity of its theme, was to be removed for conservation in the laboratory (fig. 7). The original is to be exhibited in the new Archaeological Museum of Nikopolis, with an exact replica placed in situ. A study concerning the procedure for removal of the mosaic has been prepared, just as a technical report will have to be prepared for submission following completion of the removal and conservation.

Finally, it should be noted that the villa's mosaics, like those of a number of other buildings at Nikopolis, were found at a shallow depth. This resulted in their sustaining a great deal of damage from agricultural activities, especially plowing, carried out on the site during earlier years. To avoid this type of destruction, the plot of land on which the remains of the villa are located was expropriated. But the greater portion of the archaeological site, although protected by relevant legislation, is owned by private individuals.



FIGURE 7 House of Manius Antoninus. Mosaic pavement in Room 4 depicting a scene from the life of Dionysos in the central *emblema*.

The Mosaics of the Early Christian Era

Mosaics from Basilicas A (known as the Basilica of the Bishop Dometios), B, and D are from early Christian Nikopolis. The oldest early Christian mosaic at Nikopolis, however, dates to the beginning of the fifth century and covers the floor of a secular building known as the Villa at Ftelia, located outside the walls of the city. These mosaics were excavated in the past, when some were conserved according to the methods of the time and others were covered with plastic sheeting and gravel, resulting in the complete destruction of some.

The entire collection of early Christian mosaics from the basilicas establishes Nikopolis as the most important mosaic production site in Old Epirus. In particular, the lavish decoration of the transept wings of Basilica A, interpreted as representing an allusion to earth and the terrestrial paradise (a Christian *mappa mundi*), has been considered a reference point in research on mosaic pavements of the late antique and early Byzantine periods (fig. 8). The "school" of Nikopolis was active for about two generations, from the late fifth century to the mid-sixth century. It is characterized by a high level of artistic quality and range of iconographic themes. The geographic expanse of the artisans associated with the Nikopolis workshop has not been ascertained. Echoes of their influence are seen in neighboring regions as far away as eastern Illyria (Kitzinger 1951; Sodini 1970; Chalkia 1997; Bowden 2003: 110–14).

Conservation projects in the past, as noted in reports from the 1960s, removed the mosaic floor in sections and then, after careful cleaning, reset them in cement mortar so as to fully restore their cohesion and horizontality. Gaps in the compositions were also filled with cement mortar. The large amount of cement, in relation to the aggregates, had serious consequences for the stability of the mosaics. Today the cement mortar is severely cracked and crumbling. In the areas of the transept wings of Basilica A, as well as the room north of the narthex and the chapel south of the narthex (*diakonikon*), sheet metal roofs were installed in the past, on raised modern walls built atop the ancient walls. In 1984, after various repairs, the entire construction was taken down because the metal sheets had rusted and because the shelters had an inappropriate aesthetic appearance. After a thorough cleaning, the mosaics were covered with plastic sheeting and gravel. Fortunately they did not remain covered by the plastic sheeting for long. After about twenty years of discussion and debate, new roofs were installed over these areas, and thus today the mosaics can be visited by the public (see fig. 5). According to the decision made by the Central Archaeological Council, the walls of the various architectural units to be roofed were built



FIGURE 8 Basilica A. The mosaic panel of the north wing of the transept with the dedicatory inscription mentioning Bishop Dometios.

to a certain height using stones, bricks, and lime mortar like the ancient walls, together with lead sheets to distinguish the new construction from the original walls. They were topped with a wooden roof covered with bituminous shingles bearing a ceramic granule coating.

The method of sheltering was a topic of several meetings. In accordance with the governing legislation, several committees are involved in making such decisions, which is not always conducive to achieving a consistent approach. Because the site is extensive and ranges chronologically from Roman to early Christian, uniformity in sheltering could be confusing for the average visitor. In the case of the House of Manius Antoninus (see fig. 5a), it was decided to build a metal shelter that could be expanded should the entire villa one day be excavated. The method of sheltering the Basilica (fig. 5b) arose from the desire to re-create the volumes of the original structures for purposes of interpretation to visitors.

In the central aisle of Basilica A, where large cracks appeared in the previous interventions and the cement had come loose, a more drastic form of intervention was undertaken. The difficult and delicate work of cement removal was accomplished by mechanical means, and the cement mortar was replaced with traditional lime mortar.

The best-preserved mosaic from the older excavations in Basilica A is the wall mosaic on the base of the pulpit (*ambon*), originally the base for a statue from the age of Augustus. It bears a relief Amazonomachy that had been scraped off in order to lay the mosaic. This mosaic, which is indicative of the quality of the mosaics that probably covered the interior decor of some of Nikopolis's churches, was saved because the whole was transferred to the museum years ago, when the tesserae showed alarming signs of decomposition (Guidobaldi 1987).

Conclusion

This brief paper describes the issues that are of concern regarding Nikopolis as well as the procedures followed in the treatment of the mosaics, within the framework of a larger program to further explore and manage this extensive archaeological site. The most basic problem is the absence of specialist personnel (technicians-conservators) to undertake this large-scale and demanding project. A second problem is the conservation of those mosaics excavated in previous years that have already undergone conservation. A third problem is that of the construction, and types, of roofing that should be installed so as to satisfy all the parameters involving protection of the mosaics on the one hand and ensuring a consistent and aesthetic appearance of the site on the other. Finally, the storage of mosaics that have been removed will soon be a major problem, as the museum that has been built on the site does not have a great deal of storage space. For the first time we are attempting to address these problems within a comprehensive and holistic plan.

It would seem that most of the problems encountered at Nikopolis are common to the majority of sites throughout the Mediterranean. Therefore, I want to stress the necessity of disseminating knowledge concerning current views and perspectives, together with the technical know-how of mosaics preservation and restoration.

Acknowledgments

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Les mosaïques de Volubilis (Maroc) : Planification de la conservation et de la gestion

Hassan Limane et Gaetano Palumbo

Résumé : *Le site du patrimoine mondial de Volubilis comporte de nombreuses mosaïques* in situ. *Cette communication évoque l'élaboration d'un plan de gestion pour le site avec une importante composante conservation. L'état de conservation des mosaïques est documenté et un système de suivi comportant des visites répétées au site est mis en place. Les mosaïques sont nettoyées des effets de la prolifération de lichens et leur entretien assuré par le balayage de l'eau stagnante après les pluies ainsi que par un nettoyage régulier. Cela permet de maîtriser les lichens ainsi que d'autres formes de végétation. Si pour l'instant il a été décidé de ne pas recouvrir ni abriter les mosaïques, seulement un suivi permanent permettra de décider d'un recours éventuel à des interventions plus importantes afin d'assurer la conservation de ces chef-d'œuvres de l'art romain.*

Abstract: *The World Heritage site of Volubilis has a large number of mosaics in situ. This paper presents the development of a site management plan with a strong conservation component. The mosaics were documented for their state of conservation, and a monitoring system consisting in repeated visits to the site was established. The mosaics were thoroughly cleaned from the effects of lichen growth, and their maintenance ensured by sweeping the water that stagnates after major rain episodes and by regular cleaning. This controls the growth of lichen and other vegetation. Although the decision for the time being was not to backfill or shelter the mosaics, only constant monitoring will tell whether more substantial intervention will be needed to ensure the proper conservation of these masterpieces of Roman art.*

Introduction générale

La mosaïque est l'un des plus importants témoignages artistiques et elle reflète toute la finesse du savoir-faire des anciens. Sa conservation et sa présentation doivent être programmées dans le cadre d'un plan de gestion intégrée.

Le cas du site de Volubilis est un exemple qui mérite réflexion. L'ensemble des mosaïques visibles *in situ* est exposé toute l'année aux intempéries comme aux actes de vandalisme. L'entretien est limité à des actions simples comme le désherbage dans les fissures et autour du pavement, l'évacuation des eaux après des pluies abondantes et un balayage occasionnel. En fait, la conservation des mosaïques ne devrait pas se limiter à des interventions saisonnières ; elle exige au contraire une action continue portant sur l'ensemble des éléments d'un site archéologique comme Volubilis.

Un projet de conservation de la mosaïque donnant lieu à l'établissement d'une documentation riche et variée est une composante essentielle d'un plan de gestion bien structuré. Cela devient alors l'outil de travail, de suivi et d'observation qui assurera à la mosaïque un bon entretien et une surveillance adéquate.

1. L'importance de la mosaïque à Volubilis

Le site de Volubilis n'est pas simplement connu pour sa belle collection de statues en bronze et la richesse de son répertoire architectural privé, mais aussi pour la variété des pavements de mosaïque qui ornent les maisons et les thermes.

La plupart de ces pavements ont été mis au jour dans les années 1940 et 1950 (Thouvenot 1936 ; Chevalier 1960). Les mosaïques ont subi par la suite des interventions de conser-



FIGURE 1 Mosaïque d'Orphée. Reproduit avec la permission du Program INSAP-UCL Volubilis.



FIGURE 2 Mosaïque du Bain de Diane dans la Maison de Vénus. Reproduit avec la permission du Program INSAP-UCL Volubilis.

vation sans lesquelles elles n'auraient pu être sauvegardées. Pourtant, certaines de ces interventions sont à l'origine des problèmes que nous observons aujourd'hui.

Parmi les mosaïques majeures de Volubilis, citons celles de la maison d'Orphée (Thouvenot 1941), où le dieu est représenté charmant les animaux (fig. 1), la mosaïque des Néréides et celle de la maison de l'Éphèbe (Thouvenot 1945 ; Qninba 1998) qui, malheureusement, a perdu son éclat originel du fait de l'accumulation des lichens et de l'instabilité du terrain.

D'autres méritent aussi d'être signalées : la mosaïque des travaux d'Hercule (Thouvenot 1948), de Dionysos et des Quatre Saisons (Étienne 1951) et des Fauves (Étienne 1962). Celles qui ornent la maison du Cortège de Vénus sont sans conteste les plus belles de Volubilis, du point de vue esthétique comme par la variété des thèmes évoqués (Thouvenot 1958). Cette maison comporte plus de dix pavements entourés de cadres géométriques richement décorés ; les plus célèbres sont le Bain de Diane (fig. 2), l'enlèvement d'Hylas, le Cirque et l'Amour aux oiseaux.

On ne peut cependant préserver ce trésor pour le transmettre aux générations futures que par des mesures bien définies, dans le cadre d'une conservation et d'une mise en valeur de l'ensemble du site. Dans ce contexte, la formation d'un personnel qualifié chargé de toutes les opérations prévues aura une importance essentielle.

2. La place de la mosaïque dans le plan de gestion

L'élaboration d'un programme de gestion du site de Volubilis se fonde sur son étude et sa compréhension.

Depuis dix ans, il devient de plus en plus nécessaire de doter Volubilis d'un plan de gestion, et cela pour de multiples raisons, notamment l'afflux touristique grandissant. Le site attire en effet de nombreux visiteurs (plus de 150 000 par an), auxquels il faut ajouter les spectateurs du festival de Volubilis, inauguré en 2000, qui accueille jusqu'à 4 000 personnes lors des soirées d'affluence. Une situation budgétaire difficile, un manque de personnel spécialisé et une détérioration insidieuse et permanente des vestiges archéologiques qu'un simple entretien ne peut empêcher posent de nombreux problèmes de gestion. Qui plus est, le Ministère de la Culture et les communautés locales s'efforcent, non sans difficultés, de rendre le site encore plus attractif pour le tourisme culturel, en vue de développer la région de Meknès.

S'agissant de la conservation des structures, la situation est grave, voire catastrophique. De nombreux murs s'effondrent chaque année. Des mesures de sauvegarde et de nettoyage des mosaïques sont pourtant en place : les eaux de pluie, les mauvaises herbes, le sable et la terre sont régulièrement éliminés et les lichens, qui défigurent parfois totalement certaines mosaïques, sont systématiquement grattés. L'équipe de Volubilis a reconstruit plusieurs murs emportés

par les pluies torrentielles de ces deux dernières années, mais beaucoup sont toujours en très mauvais état. De plus, de nombreux sondages anciens ont été laissés ouverts, surtout dans les zones peu fréquentées par les touristes. À ces endroits, les structures mises au jour sont souvent très dégradées et peuvent présenter de réels risques pour les visiteurs.

Présenter le site au public reste un problème majeur : les panneaux explicatifs sont tout à fait insuffisants et les guides sont incapables de fournir une explication satisfaisante du site et de son rôle dans l'histoire du Maroc.

Le projet de plan de gestion, mené par une équipe conjointe UCL-INSAP[1], vise donc à définir les valeurs du site pour les différents groupes d'intérêt présents à Volubilis et à vérifier les conditions administratives, de gestion et de conservation. L'objectif est d'établir un plan de conservation, de présentation et de développement du site afin de lui redonner l'importance qu'il mérite, en tant que bien du patrimoine mondial, et de favoriser un processus de développement culturel et économique au niveau local.

Ce plan accorde un rôle essentiel à la mosaïque. Le travail accompli va être renforcé par la mise au point d'un outil de travail structuré qui facilitera sans aucun doute les interventions et les opérations de conservation en dégageant les priorités de préservation, de conservation et de mise en valeur.

3. La stratégie de travail

L'analyse se fonde sur l'évaluation des mosaïques, la vérification de leur état, la documentation des interventions précédentes, la numérotation de base et la documentation écrite et photographique. Par ailleurs, il a été décidé d'effectuer un suivi de l'état de deux des cinq mosaïques précédemment réensevelies. C'est ainsi que des images digitales de plusieurs mosaïques font clairement apparaître le problème de la rétention d'eau.

Toutes les mosaïques ont été photographiées depuis un point de vue élevé (un escabeau de 4 mètres). Dans plusieurs cas, il a fallu prendre 4 à 6 photos pour couvrir toute la surface d'une mosaïque et pouvoir effectuer la rectification.

Des cibles ont été placées sur la mosaïque en utilisant un module de 1 × 1 m ou 2 × 2 m, pour faciliter le processus de transformation. Le logiciel de rectification d'images utilisé est Asrix, développé au Canada par Steve Nickerson et Stewart Wilson. Il donne une image rectifiée en noir et blanc qui peut être importée sur AutoCAD et mise à l'échelle 1:1. C'est ce qui a été utilisé pour la description des dommages et interventions pendant les activités de suivi et d'entretien.

L'équipe a mis au point une fiche permettant d'établir des conventions graphiques, pour représenter les conditions

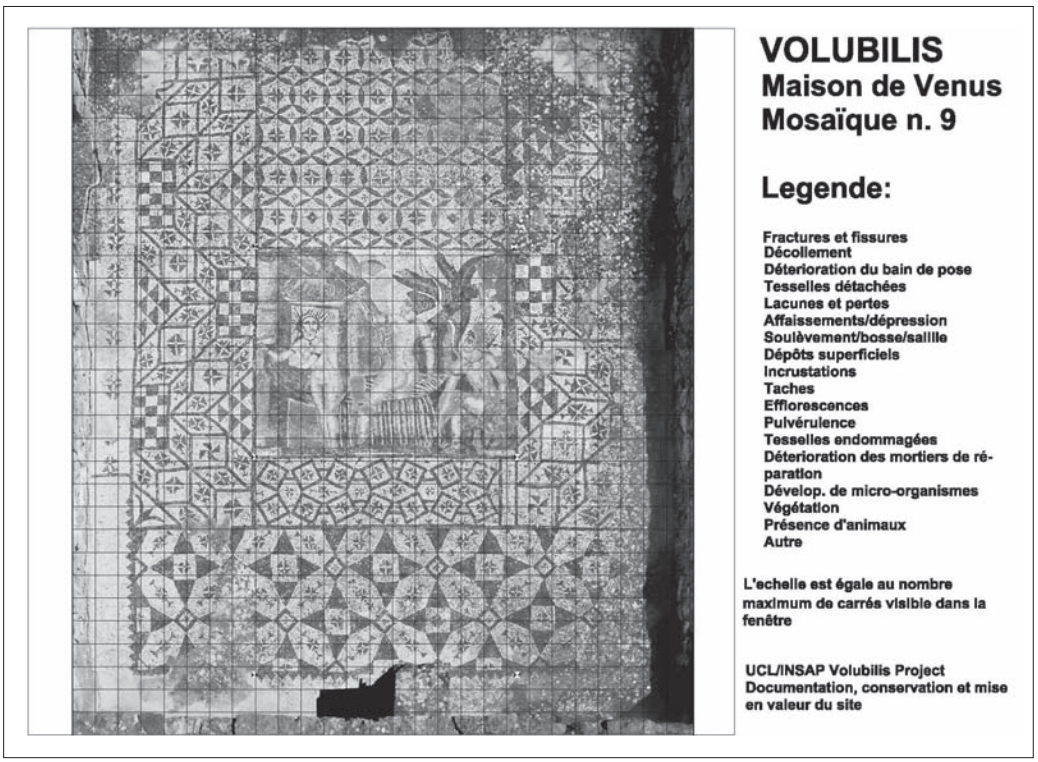


FIGURE 3 Une grille de 20 × 20 cm est utilisée pour marquer la condition des mosaïques sur des feuilles transparentes, avec des symboles agréés. Reproduit avec la permission du Program INSAP-UCL Volubilis.



FIGURE 4 Cette image du SIG montre les mosaïques du quartier nord-est (en violet), les huileries (en vert) et les parcours actuels des touristes (en bleu clair). Reproduit avec la permission du Program INSAP-UCL Volubilis.

observées sur des fiches transparentes (fig. 3), avant transfert dans des fichiers électroniques au format AutoCAD. La fiche a également été utilisée pour créer une échelle numérique représentant le degré de dégâts structurels, de surface et d'attaques biologiques (forme la plus connue de dommages observés sur le site). Cette échelle a fourni la base de la description des mosaïques à l'aide d'un système d'information géographique (SIG), développé pour l'ensemble du site (fig. 4). Le SIG, avec ses divers niveaux d'information, permet une observation intégrée et servira d'élément d'analyse et de gestion, surtout en matière de programmation des interventions d'entretien ordinaire et d'urgence.

Par ailleurs, l'analyse des tesselles et des mortiers faite en laboratoire a permis de reconnaître divers types de pierres, aux caractéristiques différentes, utilisées dans les mosaïques, ce qui a permis de mieux comprendre certains phénomènes de détérioration[2]. L'historique des interventions sur les mosaïques de Volubilis est très compliqué et l'on a essayé de le reconstituer à partir d'entretiens avec les conservateurs du site et de recherches dans les archives. Les premières étapes ont tout de suite montré que l'enregistrement des mosaïques comportait des lacunes. En parcourant les archives, on a retrouvé quelques dessins des mosaïques, mais aucune photographie aérienne, bien qu'il en ait existé de nombreuses dans le passé. Cette étude a permis d'établir que l'on a, jusqu'à maintenant, découvert à Volubilis soixante et onze pièces dotées d'un pavement en mosaïque.

Les conservateurs qui se sont succédé sur le site ont fourni des informations sur les projets de conservation et de restauration réalisés ces quinze dernières années. Nous les avons décrits et rapportés sur une carte, ce qui constitue un répertoire historique des différentes interventions menées sur chaque structure depuis les premières fouilles. Cette phase du projet exige naturellement une mise à jour régulière.

Tout en effectuant ces analyses, on a continué le suivi permanent des mosaïques et les mesures simples mais efficaces comme l'élimination des eaux de la surface des pavements après de fortes pluies. Les structures qui supportent les mosaïques sont aussi actuellement sous observation (fig. 5), ce qui nous a permis de repérer des phénomènes de glissement de terrain dans la zone du quartier nord-est.

Cette analyse intégrée de l'état des mosaïques de Volubilis, toujours en cours, permet de mieux comprendre l'évolution de certains facteurs liés à l'exposition et de trouver des réponses aux problèmes posés. Il est donc prioritaire d'équiper le site d'un outil de travail permettant de prendre toutes les composantes en considération.

4. Prévoir la conservation des mosaïques de Volubilis

Les observations effectuées à ce jour sur la totalité des mosaïques du site n'ont pas révélé de véritable urgence en matière de conservation. Les dégâts observés se classent dans la normalité des phénomènes de détérioration des pierres et des mortiers à ciel ouvert avec une seule exception, celle des mosaïques du quartier nord-ouest où l'on observe un glissement de terrain, notamment dans la maison de Vénus. Toutefois, ce phénomène n'évolue pas de manière constante et il est difficile de prévoir si le glissement va s'accélérer ou se ralentir.

La décision actuelle est de ne pas recouvrir les mosaïques d'abris ou de couches de sable (exception faite pour les cinq mosaïques déjà recouvertes).

Le suivi va continuer à intervalles réguliers (au moins deux fois par an) et l'entretien sera poursuivi avec des actions ponctuelles de nettoyage, trois ou quatre fois par an. Un drainage léger sera effectué après chaque pluie pour éliminer l'eau de surface. L'équipe du site se chargera également des petites réparations, comme le renforcement des bords et des lacunes, en utilisant des mortiers de chaux.

Pour ce qui est des mosaïques qui présentent, ou présenteront, des dégâts plus importants – comme des décollements

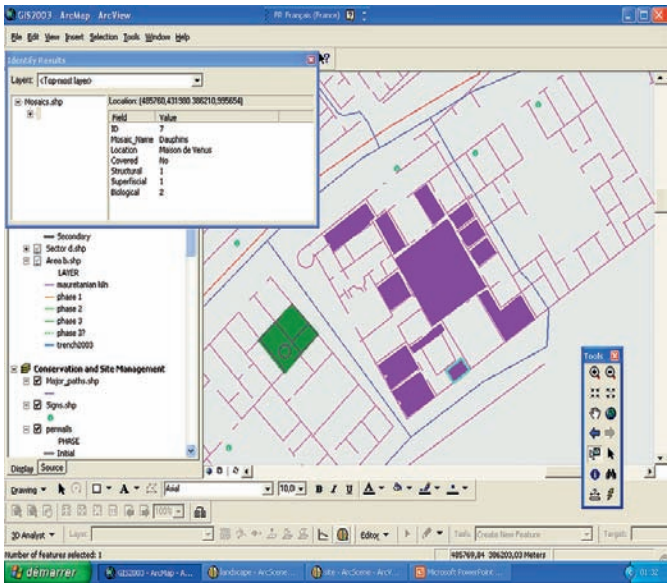


FIGURE 5 Cette image montre un détail du SIG, centré sur la Maison de Vénus et les attributs d'une des ses mosaïques (Dauphins), avec les conditions structurelles, d'attaques biologiques et les conditions de sa surface. Reproduit avec la permission du Program INSAP-UCL Volubilis.

ou des effondrements – un plan de conservation spécifique sera établi et soumis à la Division du Patrimoine pour approbation et financement.

Concernant la présentation des mosaïques, nous étudions actuellement des parcours pédagogiques. Objectif : faire comprendre aux visiteurs l'aspect technique de la mosaïque ancienne ou son évolution dans l'histoire du site et sa fonction à l'intérieur des grandes demeures et des espaces publics de Volubilis. Comme la plupart des visiteurs connaissent très peu la mythologie classique, il faudra prévoir dans ces parcours une présentation de ces mythes, en se référant peut-être aussi à d'autres représentations figurées sur des mosaïques du Maroc et d'Afrique du Nord. Les parcours pédagogiques pourront être suivis avec les guides, qui vont être formés pour transmettre ce savoir, et à travers des expositions qui seront organisées dans le Centre d'accueil des visiteurs, actuellement en construction. On va également étudier la possibilité de réaliser des brochures ou des audio-guides pour les touristes qui souhaitent visiter Volubilis à leur gré, sans guide local.

Grâce à ces mesures, nous espérons sensibiliser les visiteurs aux risques qui pèsent sur ces œuvres d'art, souvent par manque de compréhension de leur importance.

Notes

1 Ce projet s'inscrit dans le cadre de la coopération archéologique qui a débuté en 2000 entre l'UCL (University College London) et l'Institut National des Sciences, de l'Archéologie et du Patrimoine.

2 Voir le poster d'A. Dekayir et al. dans la présente publication.

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The Legacy of Nora, Sardinia: A Project for the Conservation, Restoration, and Maintenance of Mosaics

Chiara Zizola

Abstract: *This paper describes the project for conservation and maintenance of the floor mosaics of the site of Nora, Sardinia, that was designed in 2002 by the Centro di Conservazione Archeologica–Rome (CCA) for the Soprintendenza Archeologica di Cagliari. Because of the large number of visitors and the site's marine environment, extensive restorations and reburials were undertaken during the 1960s. The 2002 project was based on an analysis of the state of conservation of the mosaics and the performance of previous restorations and reburials. It produced a detailed technical program for treatment of the mosaics and a general plan for regular maintenance of the mosaics and the site. Today this project is the basis for the management plan of the Soprintendenza for Nora.*

Résumé : *Cette communication décrit le projet de conservation et entretien des pavements en mosaïques du site de Nora, Sardaigne, conçu en 2002 par le Centro di conservazione archeologica de Rome pour la Soprintendenza archeologica di Cagliari. Du fait de la fréquentation importante et de son environnement marin, des restaurations importantes et des réenfouissements ont été effectués dans les années 60. Le projet 2002 s'est basé sur l'analyse de l'état de conservation des mosaïques et des résultats des restaurations et réenfouissements précédents. Cela a débouché sur un programme technique détaillé pour le traitement des mosaïques et un plan pour leur entretien et celui du site. Ce projet constitue la base du plan de gestion de la Soprintendenza de Nora.*

In the current panorama of mosaic conservation at archaeological sites, a new problem has emerged that calls for active responses. This is the enormous number of mosaics exposed to the outdoors that were subjected to radical restoration treatments in the 1960s and 1970s, following a wave of enthusiasm for technical approaches. Mosaics were detached and reapplied on cement, as conservators were convinced that this would settle things once and for all. This was based on their faith in the modern materials developed for the building trade and adopted in the conservation of ancient monuments and the techniques used for removing surface features.

In Italy, which became a major center of study because of these treatments, it soon became apparent that they not only had limitations but also caused damage to the artifacts and their context. The situation is quite different in other places, where these treatment techniques were introduced some twenty years later and are still often practiced.

By the early 1980s protests were arising from various professional groups about the inadequacy of these treatments. Archaeologists, art historians, restorers, and scientists joined forces to point out the erroneous theoretical and ethical basis for such treatments, especially the serious and obviously damaging impact on the ancient materials and the sites in general, as well as the high cost of implementing and managing them afterward. They maintained that other solutions, apart from the purely technical ones, could be used to conserve the mosaic heritage. The critical review obtained in the large "laboratory" of all the archaeological sites with detached mosaics presented a strong case for a radical cultural change in the field of archaeological conservation. This led to a theoretical and methodological reversal in policy, whereby conservation in situ has now become the guiding principle for safeguarding archaeological areas with mosaics.

As a result of this new approach the practice of in situ conservation during the past ten years has led to the



FIGURE 1 The archaeological site of Nora. Courtesy Centro di Conservazione Archeologica–Rome (CCA).

formation of not only its own objectives but also, notably, the tools needed to achieve them. Among these—and quite apart from developing specific techniques for the direct and preventive conservation of surfaces—there is now a major emphasis on planning treatments as part of a global project of site management that includes not only the material conservation of the artifacts but also the relationships that exist among research, scholarship, presentation, and the dissemination of information.[1]

This paper discusses the project for the conservation and restoration of floor mosaics at the archaeological site of Nora, located in the province of Cagliari, Sardinia, Italy. In 2002 the Soprintendenza Archeologica di Cagliari (Archaeological Superintendency of Cagliari) commissioned the Centro di Conservazione Archeologica (CCA) to head a project to respond to the serious conservation problems posed by the mosaics. It was possible to analyze thirty-one pavements in detail, totaling 720 square meters of mosaics. About half had been detached and relaid on reinforced concrete in the 1970s, thus permitting a comparative study of their state of conservation under different display conditions in the same environmental and archaeological context. It also provided an opportunity to study the effect of contact coverings placed over some pavements in the early 1980s and to evaluate the benefits some twenty-five years after they had been placed on surfaces that had been first restored and laid on cement and on surfaces that were still in situ on original layers.

The Archaeological Site of Nora

Founded by the Phoenicians, Nora was colonized by the Carthaginians and conquered by the Romans in 238 B.C.E., becoming the capital of the Roman province under their dominion. It is located by the sea on the promontory of the Cape of Pula, which dominates the Gulf of Cagliari in the southeast of Sardinia (fig. 1). The gradual penetration of the sea and the arrival of the Vandals in the fifth century C.E. led to its slow decline and eventual abandonment in the eighth century (Tronchetti 1986). In the stratigraphic phases now open to the public, the city is characterized by a series of important mosaics, notable for the quality of their decorative compositions and extent. The site spreads over more than 3 hectares and is composed of fourteen monumental groups (720 square meters of mosaics), all belonging to the Roman phase of its life. It has public and private buildings, including a theater, a basilica, baths, temples and houses, streets and squares. With white beaches and crystal-clear sea nearby, the site draws tourists from all parts of the world, especially in spring and summer, and is a focus of regional development.

The conservation history of the mosaics and their display begins in the second half of the twentieth century with the first systematic excavations of the site. Although the city was known from the sixteenth century for its ruins emerging from the water, it was only extensively excavated in the period between 1952 and 1960 by Gennaro Pesce, then superintendent of antiquities of Sardinia. He brought to light most of the surface that

is now on display. Further archaeological investigations were conducted in the late 1970s and early 1980s by Carlo Tronchetti of the Cagliari Superintendency, who uncovered the entire area of the baths near the sea. Research activities continue today under the direction of the Cagliari Superintendency, in collaboration with various Italian universities.

After the excavations in the 1960s an initial major restoration campaign was started in order to prepare the site for public display. Following the popular approach of the time, most of the pavements were detached, mounted on reinforced concrete panels, and relaid in situ, again on cement. By the end of the 1970s, some twenty years after treatment, the restored surfaces presented such serious deterioration that the Superintendency, in the person of Tronchetti, sought various solutions to protect the mosaics. The practice of detachment was abandoned, and newly excavated mosaics were left in situ. The treatments varied according to the seriousness of the condition of the surfaces, as did the decision as to whether or not to leave them on view. Eight pavements still on their original bedding layers and one restored pavement on reinforced concrete were given protective contact covering as follows: a layer of about 5 centimeters of river sand (or quarry sand, without salts), a layer of polyethylene, and a layer of lime-cement mortar of an average thickness of 5 centimeters. This completely isolated the surfaces from exposure to the environment (fig. 2). Treatment of the remaining, unrestored pavements was limited to reinforcing the edges and filling the lacunae with lime-cement mortar.

From 1988 to 1990, given a dangerous worsening in the condition of the still-exposed mosaics relaid on reinforced concrete, further treatments were performed to restore the restorations. Either the entire surface was detached again and the iron armature removed, or the tesserae were lifted and then replaced after the bars were removed. These treatments affected only those pavements restored in the 1960s; the pavements still on reinforced concrete are currently in desperate condition.

The Project for Conservation of the Mosaics

The objective of the project requested by the Cagliari Superintendency in 2002 was for the CCA of Rome to devise a global strategy for conserving the mosaics for both the short and the long term. The idea was to categorize and prioritize problems and to develop a plan for project implementation and the management and supervisory activities of the Superintendency. To formulate the project, the following phases were undertaken:

1. collecting information to determine the characteristics and conditions on the site;



FIGURE 2 The protective contact covering of lime-cement mortar completely isolates the surfaces from contact with the environment. Courtesy Centro di Conservazione Archeologica–Rome (CCA).

2. analyzing data, defining the site, and identifying problems and their types (condition, regional context, threats, human resources, users, managers, development of research and knowledge);
3. listing treatment priorities; and
4. defining a strategy for the site's conservation and management based on priorities and drafting a comprehensive action plan including operations and materials as well as necessary professional and financial resources.

1. Collecting Information

The first phase was dedicated to examining every component of the site. This included collecting all available information along with a technical analysis of the current situation in order to discover the physical characteristics of the mosaic surfaces; to quantify their exact extent; to reconstruct the conservation history from the time of excavation to the present; and to clarify the relationship between the current state of affairs, the environmental parameters, and the normal habits of life, use, and management of the site. The procedure was as follows:

- collecting archival photographs of the mosaics and all available written information, either published or in the form of internal reports;
- studying existing archaeological publications about the site;
- directing activity in the field to analyze and document all the pavements;
- producing base maps to record and describe the current condition (documentation); and
- visiting existing infrastructure (routes, visitor services, site museum) and interviewing personnel responsible for certain tasks, with particular attention to tour guides.

At the end of the study, it was possible to

- estimate the exact extent of the exposed surfaces;
- define and document their current condition;
- clearly identify the risk, deterioration factors, and deterioration processes under way;
- trace a picture of the relationship among the exposed mosaics, visitor routes, and current use.

The results of this first phase led to the drafting of a detailed report covering each mosaic analyzed: dimensions, compositional character, visible appearance of deterioration, conservation history (including the period of exposure and presence of preceding restoration treatments and their typology), the onset of deterioration and mechanisms at work, an evaluation of the gravity of the material condition found, and the degree of risk. A further element, studied individually for each monumental group, was presentation to the public in its current state. The evaluation process included the importance of the monument and its mosaic surfaces for understanding the site, the efficacy of any possible use, and the direct effect on its condition.

Three categories were identified among all the mosaics (fig. 3):

1. pavements laid on original bedding layers and never detached;
2. pavements detached and relaid on reinforced concrete and still on reinforced concrete;
3. pavements detached and relaid on reinforced concrete, with subsequent removal of the metal parts (1988–90).

This initial division corresponds to a substantial difference in the condition of the pavements. In fact, it became apparent that the greatest risk is to the pavements still on reinforced

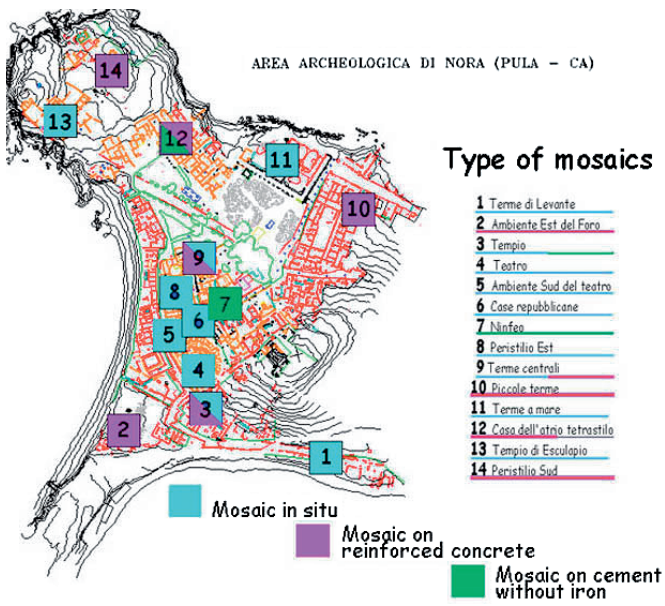


FIGURE 3 Three categories of the Nora mosaics. Courtesy Centro di Conservazione Archeologica–Rome (CCA).



FIGURE 4 Central baths, *frigidarium*. The pavement is on reinforced concrete with metal rods and suffers from such serious deterioration that the survival of the original material is at great risk. Courtesy Centro di Conservazione Archeologica–Rome (CCA).

concrete with metal rods (fig. 4). For some years now mosaic specialists have known the reasons for this situation: oxidation and consequent expansion of the iron, the excessive hardness and low porosity of cement, and solubilization and crystallization of soluble salts—all these factors take their toll on the ancient materials.

The mosaic pavements of Nora can be divided into three broad categories based on their condition:

(1) *Pavements on original setting beds:* Generally, the original preparatory mortars of these pavements have partially or totally disintegrated, with resultant detachment of the *tessellatum*, which is therefore often resting on the ground, as well as formation of lacunae. Where the mortars are still partially cohesive, there is cleavage between the original layers and infiltration of dirt and other organic material between the tesserae and the layers beneath, leading to the growth of weeds. The surface of the tesserae is covered with biological incrustations, lichen in particular.

In this category only two cases are serious. One is the pavement of the Temple of Aesculapius, which has been left exposed since excavation in an area that is especially unfavorable because it is close to the sea and far from the usual visitor routes. The other is the *apodyterium* of the central baths, which had been protected since excavation by a tile roof (perhaps because of its condition) and was then protected again in the 1980s with a contact covering. Almost all the other pavements that are still in their original position exhibit, to a similar degree, the same forms of deterioration. Seven of these can be defined as stable, thanks to the contact coverings that keep their microclimate in equilibrium and do not expose them to mechanical damage. In the four cases that have good general surface condition, this is due to their protected location and to the composition of the original layers. This is the case with the *opus signinum* and the *spicatum* of the Republican houses. Because they are situated lower than the adjacent spaces and because of the presence of *cocciopesto* (lime mortar with crushed brick) in the composition, their materials possess general compactness and resistance.

(2) *Pavements detached and reapplied on reinforced concrete in the 1960s:* The majority of these pavements suffer from such serious deterioration that the survival of the original materials is greatly at risk. Because of the total instability of the restoration materials on which the mosaics are bedded, entire portions of *tessellatum* are literally disappearing. On this type of pavement one generally finds explosions beneath the tesserae, with resulting detachment and raising of the *tessellatum*, cracks, subsidence, and progressive and exponential increase in lacunae, along with growth of roots under the tesserae.

Of the eleven pavements bedded on reinforced concrete, only one—Room L of the House of the Tetrastyle Atrium—can

be defined as stable. This is due to the presence of the contact covering that sealed the pavement, impeding its interaction with the environment for more than twenty years. The two principal factors responsible for the current poor condition of the surfaces are exposure to the marine environment since excavation and the damaging restoration materials used in the 1960s.

(3) *Pavements detached from reinforced concrete support and relaid on cement alone:* These pavements are generally in good condition thanks to their restoration in the late 1980s, when iron elements in the bedding layers were removed. While this treatment eliminated the major element of instability, it was not without consequences, given the ample presence of patching along the cuts that were made while removing the sections of the mosaic. This patching indicates a high percentage of loss of original surface.

Although these pavements were exposed for twenty years after this treatment, they did not suffer rapid or dramatic deterioration. The three pavements that were re-restored are generally solid, except for occasional detachment of the *tessellatum* from the cement layer beneath and a slight loss of tesserae. Forms of decay are found principally on the tesserae surfaces and the interstitial spaces, with extensive accumulations of dirt and microflora.

2. Analyzing Data and Defining Treatment Priorities

Comparative analysis of the data led to defining and characterizing categories of problems, which in turn allowed for the planning of specific types of treatment to meet the various conservation needs of the pavements and the creation of a list of priorities. The chemical-physical processes acting on the artifact from the marine environment (i.e., rain, wind, strong and prolonged exposure to sun, frequent thermal fluctuations, and a significant presence of chlorides in the environment) were found to be the main factors responsible for the decline in the condition of the mosaics. These mosaics were already strongly compromised by the natural deterioration of their constituent materials, especially from the numerous imbalances introduced by past restorations. Moreover, some mosaics are directly exposed to erosion from the sea nearby.

The impact of poorly controlled tourism was also found to be among the principal causes of damage. The surfaces were subject to light and heavy damage from improper visitor behavior, such as walking on the mosaics or removing tesserae. This results from the lack of maintenance of paths, the illegibility of information panels, and insufficient control of the entire visitor access area, which receives peak numbers in summer without a corresponding increase in guards or additional ordinary maintenance.

In brief, the general picture regarding the state of the mosaics shows large surfaces where the mosaic fabric is detached from the support, the tesserae no longer adhere to each other, the original mortars are mostly crumbled or completely lost, and the materials used in previous restorations have activated the dangerous phenomenon of detachment of the *tessellatum*.

An encouraging fact that emerged from the comparative study was the efficacy of stabilization and protection of the surfaces through contact covering, which was carried out in the 1980s on nine pavements. In the case of those mosaics still on original layers and in the sole case of a mosaic on reinforced concrete, these coverings kept the mosaics' condition unaltered over the course of twenty years. The mosaics on original layers and those applied on cement without reinforcement are in serious but not alarming condition. In contrast, all those on reinforced concrete are in an advanced state of decay and urgently need treatment.

Starting from these objective considerations, the pavements were divided according to a hierarchy of treatment priority and a two-phase program devised (fig. 5):

- phase 1, treatment of pavements needing urgent and immediate attention;

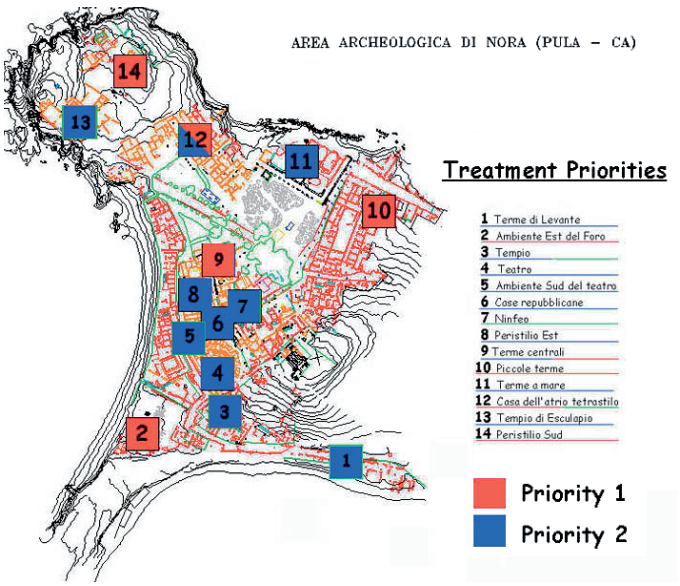


FIGURE 5 Treatment priorities determined for the mosaics. Courtesy Centro di Conservazione Archeologica–Rome (CCA).

- phase 2, pavements that can be treated later on—thanks to a medium to low level of deterioration or to contact protection that maintains the status quo.

3. Defining a Strategy and Drafting an Operational Plan

The main objective of the strategy was to create a long-term, sustainable conservation approach for Nora's mosaic heritage and to keep down the future management costs without diminishing the historical and archaeological interest of the monuments and the site as a whole. In other words, a compromise was sought between pure conservation needs and developing the site's tourism potential. It was felt that the greater the public appreciation and awareness of archaeological heritage and the benefits of economic and social development of the region, the greater the benefit to safeguarding the heritage itself—in a case in which presentation to the public is managed as part of a defined cultural program with all the structural and auxiliary support required.

Therefore, two treatment approaches were contemplated. One was a treatment aimed at conserving the surfaces, with a study of various specific treatments for each category of mosaic noted, including preventive conservation measures and maintenance plans. The other was the management and strengthening of the current visitor facilities for the site (which already has an archaeological museum in the nearby town of Pula), visitor routes, information panels, and other services such as a café, bookshop, guides who give free tours for the Superintendency, and shaded parking areas.

Restoration and conservation treatments

The following methodologies were given precedence when formulating the project:

- in situ maintenance and consolidation of the pavements not already detached;
- detachment, restoration, stabilization, and reapplication in situ of the pavements that are now on reinforced concrete;
- use of lime-based materials compatible with the original materials and structures;
- full documentation of the current state of affairs and of the operations to be performed.

Three types of treatment were identified for the various conservation needs of the pavements at Nora. The choice of one type or another was dictated by the condition of the original materials, by the presence of previous restorations carried out with unsuitable materials, by the condition of such restorations, and by the presence or absence of suitable environmental conditions for keeping the pavements in situ.

(1) *Conservation in situ through consolidation:* This treatment can be performed on pavements that have their original preparatory layers and on pavements that—although previously detached and relaid in situ—are basically in a solid and stable condition.

(2) *Detachment, restoration in the workshop, and replacement in situ:* This treatment is needed for all those pavements detached and relaid in situ on reinforced concrete during previous treatments that now show considerable deterioration due to the materials used in the restoration but also have environmental conditions that permit their replacement in the original position.

(3) *Detachment, restoration in the workshop, application on honeycomb panels, and display in the museum:* This treatment is needed for all those pavements detached and reapplied in situ on reinforced concrete during previous treatments that have major deterioration and almost total loss of the original *tessellatum* and do not have the environmental conditions necessary for being kept in situ for the long term.

The various typologies entail thorough documentation, including thematic base maps and photographs to register the current condition of the surfaces and all the treatments to be performed, such as cleaning of surfaces, consolidation of tesserae, repairing the interstitial mortar, and treatment of lacunae. An integral part of the treatment involves plans using indirect measures to prevent damage, managed presentation of the mosaics with periodic covering/exposure along the visitor routes, and implementing schedules for regular maintenance and long-term conservation. Each type of treatment has its related cost estimate, which clearly shows the high expense of treatment for those mosaics that are now on reinforced concrete.

Preventive conservation and maintenance

Long-term conservation of the mosaic heritage of Nora calls for the implementation of combined action plans to minimize the environmental impact on the surfaces, control deterioration factors, and maintain the positive benefits of the conservation work performed. Given that the mosaics are in an outdoor setting with unfavorable environmental factors (growth of weeds and lichen, proximity to the sea, wind, pronounced temperature changes) and are also subjected to heavy tourism during spring and summer, a plan was devised to respond in a balanced way to the needs of conservation and those of public enjoyment of the site. The plan involves a program of covering and exposure

of the mosaics along the visitor route, combined with regular maintenance of the exposed mosaic surfaces.

The covering/exposure program will reduce the total surface area of mosaics exposed to the risks of environmental deterioration (and hence management costs) and will also limit the exposure time to periods of minor climatic risk. The regular maintenance program—through direct action performed on a consistent and continuous basis—will eliminate or limit the resurgence of alteration phenomena on the surfaces due to environmental decay factors that cannot be prevented. The combined action of these activities will ensure the enhancement of the site and its conserved monuments, increase visitor enjoyment, and drastically reduce the impact of decay factors on the original materials.

Program for covering or exposing the mosaics

The program for periodic or permanent covering of the mosaics was devised with the following factors in mind: condition, exposure to environmental risks, risk due to wear and small acts of vandalism by visitors, typology, geographic location along the visitor itinerary, and enhancing understanding of the monument and the site.

The pavements were classified on the basis of these factors and grouped according to different methods of display:

- always visible: a maintenance plan was foreseen for the mosaics on permanent view.
- seasonal visibility: implementing a schedule for seasonal covering with a temporary contact cover of geotextile bags filled with expanded clay granules, which will protect the surfaces from chemical, physical, and biological decay during the period of greatest climatic risk (winter) and lowest tourist presence.
- always covered: permanent contact covering was proposed for pavements far from the main visitor routes and/or those exposed to environmental and human risk factors such that they might not survive even with regular maintenance. Given the proven efficacy of the covering previously used, the mosaics will be protected using the same system.

Maintenance program

Maintenance must be performed on the mosaics that are always visible and those covered seasonally while also considering the paths and information panels. The maintenance program will involve cleaning the surfaces, manual and chemical weed removal, biocide treatments, inspection of materials, updating of information panels and replacement of damaged or illegible ones, and inspection of paths and routes with eventual modifications if they are not effective. These operations must be continuous and performed at regular intervals (table 1).

Conclusion

Fifty years after excavation Nora is one of the many archaeological sites with mosaics where conservation solutions were tested and became part of the history of archaeological restoration, from detachment and reapplication on reinforced concrete to temporary coverings to contact coverings and re-restoration. While strolling through the site, one can thus read the attempts made over half a century to reconcile the needs of conservation with those of heritage appreciation and knowledge. One can read the errors made and see the devastating impact of massive technical-type treatments and the sad outcome of the effects of natural forces and of human action or the lack thereof.

What clearly emerges is that so far the approach has been to adopt specific solutions one case at a time, without a broader perspective that sees the problems and the context as a whole. In other words, there is no global overview, not only of the risk factors, but also of the objectives set forth for future use of the archaeological area, including the complex relationship among conservation, management, and cultural use and the cost of operation. A critical examination of this situation allowed us to evaluate the material conservation of the works in real terms and to quantify the financial ramifications of the treatments that until recently were emblematic of our archaeological sites. We were also able to see more clearly the validity of the technical and methodological solutions offered by conservation in situ.

At Nora we have inherited mosaics that—precisely because they were restored—are now seriously damaged. Some have been irremediably transformed and will require substantial funds for conservation. We also inherit the certainty of a proven technical tool such as contact covering, which merits increasing consideration for the prevention of damage and for long-term conservation, together with regular maintenance. Moreover, we inherit the important signs of a cultural change in process. The Nora project is a key example of policy planning on the part of a local administration that intends to perform its duty of heritage protection, following a program that has examined the various current priorities and cultural objectives and attempts to acquire the tools that will permit the best autonomous, long-term management of the treatments and resources available.

Table 1 Program for the presentation of the mosaics and scheduled time for maintenance

Locale	Mosaic Surface (m^2)	Presentation and Maintenance	Annual Frequency	Workdays per Year
Baths of Levante, room A	91	Seasonally covered, with ordinary maintenance	7	11
Forum	12	Displayed in the museum of Nora with ordinary maintenance	12	2
Temple	21	Exposed, with ordinary maintenance	12	9
Theater	14	Seasonally covered, with ordinary maintenance	8	4
Republican houses	25	Permanently covered; no maintenance required	0	0
Spaces south of theater	9.5	Permanently covered; no maintenance required	0	0
East peristyle portico	33	Exposed, with ordinary maintenance	12	4
East peristyle porticos	23.5	Permanently covered; no maintenance required	0	0
Nymphaeum	83	Exposed, with ordinary maintenance	12	12
Central baths, *apodyterium*	39	Seasonally covered, with ordinary maintenance	7	11
Central baths, *frigidarium*	101.5	Exposed, with ordinary maintenance	12	12
Small baths, corridor	25	Permanently covered; no maintenance required	0	0
Small baths, *frigidarium*	9	Exposed, with ordinary maintenance	12	4
Small baths, *apodyterium*	18	Seasonally covered, with ordinary maintenance	7	11
Baths on the sea	63	Exposed, with ordinary maintenance	12	9
House with Tetrastyle Atrium	78.5	Exposed, with ordinary maintenance	12	12
Temple of Aesculapius	70	Exposed, with ordinary maintenance	12	12
South peristyle	4	Displayed in the museum of Nora with ordinary maintenance	12	2
Total workdays per year				**115**

Acknowledgments

The author wishes to thank Cynthia Rockwell for her translation of this paper from Italian.

Notes

1 For an analysis of the theme of conservation in situ, the issues connected to its implementation, and the objectives involved, see Melucco Vaccaro 2003: 17–22.

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Discussion—Session 4: Managing Sites with Mosaics

Présidente/Chair: Martha Demas

Discussion following Amr Nawar Al Muayyad Al-Azm Presentation

KONSTANTINOS POLITIS: First, I want to make a quick comment related to the earlier paper given by our Turkish colleagues about documenting mosaics in the paper Dr. Kökten gave on a project funded by the European Center for Byzantine and Post-Byzantine Monuments. This is an ideal kind of situation where we can have regional cooperation, not just within Syria but also with this new entity. I hope to see the possibility for cooperation between more than one country in the region, in terms of documenting mosaics. Now for my question to Dr. Amr. The impression I got is that even though there are things being done in Syria to enhance the protection and documentation of mosaics, perhaps the administration might be the problem. You understand what the problems are; a number of people in Syria understand the problems, which are obvious from your lecture, but might the administration be inhibiting the protection of mosaics?

AMR NAWAR AL MUAYYAD AL-AZM: When you say "administration," we should be more exact in dealing with this particular point. It's not that the administration does not want to cooperate. I don't think that's the case; it's more a case that the administration, in many ways, is ignorant of what it needs to do. And quite often, while perhaps the conservators might be aware of what needs to be done, the curators who are responsible ultimately for looking after the mosaics once they have been conserved are not always aware of what needs to be done. And there are gaps in information. The administration as a whole is aware of what needs to be done, and it is supportive, as and when it can be. When you come up with a good project, the administration supports it and has been supportive of our work. So I think it's more a matter of a lower level, curators, conservators, archaeologists, working together, rather than the "administration."

JACQUES NEGUER: First of all, felicitations for your planning. Everybody here is dreaming of such a system with physical condition information online. But did you have some legal frame and time frame to implement this?

AMR NAWAR AL MUAYYAD AL-AZM: Well, as with all best-laid plans, we establish time frames, but whether we are able to stick to them or not is another matter. In a way, yes; I mean, our actual self-imposed time frame to come out with the first *tranche,* if you will, of information is about two years. And we are already, I'd say, three quarters through our first year. We have documented, at least in preliminary form, the mosaics from two major museums, which is no small undertaking when you consider that there are only eight students, myself, and a few of our colleagues working with us. The data have been input in the database, which is a major undertaking in its own right. But then presenting the data once they're in the database in a format that is readable by everybody is going to take a bit of work as well. So we hope that at least we can have something available by the end of 2006.

HOUDA MOUSSA: Ma question, docteur, n'est pas une question, c'est une remarque. Je le félicite pour avoir mis l'accent sur les mauvaises conditions de conservation dans les réserves et aussi pour le rôle constructif qu'il a tenu durant des années en qualité de chef du département de conservation et restauration au sein de la direction. Félicitation pour ses travaux dont on voit maintenant le fruit.

AMR NAWAR AL MUAYYAD AL-AZM: Thank you very much for your kind words, but I believe that we are really only at the beginning of a long road. And by the way, I'm no longer at the

department. I resigned, and I am now at the university. But the team that was put in place is still there, and they are carrying on the work that we started, so the future credit goes to them rather than to me.

EWA PARANDOWSKA: A couple of years ago I had the chance to visit the basement of the Damascus museum, and I was really impressed by seeing hundreds of mosaics resting on their facings and, let's say, neglected. I'm curious if, according to your present knowledge, they were stored like that because they belong to category B, which is a simple geometric design, and will never be treated and displayed because of lack of space, money, and so on, or maybe you can tell us that you're planning to do something with all these mosaics. I would say that our museum, the National Museum in Warsaw, would be very happy to have at least one of the category B mosaics in our exhibition.

AMR NAWAR AL MUAYYAD AL-AZM: Very briefly, the mosaics that you are referring to are not just simple geometric designs. There are mosaics that appear to be more interesting and more important, but they're all part of this same corpus, and they're all important. But some of them are very important. And, unfortunately, in some cases we don't have a lot of documentation on them, and we have not yet been able to open the boxes; we just moved them and organized them in a safer place, but I hate to think what will happen when their turn comes and we start to work with them. All I can say is, we can hope for the best. But if you wish to come and take on one of those mosaics, please, I am sure the Department of Antiquities would be more than happy to accommodate you. And you know the team members there, so you can talk to them.

Discussion following Mervat Ma'moun Ha'obsh Presentation

ÉVELYNE CHANTRIAUX: My question is about the choice of glass for the walls of the shelter; you said it was because of transparency. Is it to see the mosaics from outside to inside or to see the archaeological context of the landscape from inside? Do you think that you have a system to reduce the effects of the sun? Because in Jordan, of course, during some months there is a lot of sun, and it can be very difficult to control the heat in the shelter. Did you plan for some flexible curtains or panels, something to provide protection? Because glass is a problem.

MERVAT MA'MOUN HA'OBSH: I would like to assure you that we have taken into consideration all the issues in environmental modeling, and we have measured everything. The environment inside the shelter will be just two degrees different from that outside the shelter, taking into consideration all the issues relating to visitors. Transparency here does not mean that it's all open, no, just for ventilation at the top and at the bottom so that you will have natural ventilation. Of course, we have taken into consideration the sheltering or covers on the windows and the glass. What we intend is that you can look through the glass from one side to another. The opening of the glass will be on the north and south, not on the east and west. It's a place in the desert, and we have to take into consideration all the issues regarding this.

THOMAS ROBY: I'm interested to know, considering the title of the conference, "Lessons Learned," whether while you were designing the shelters for Um Er-Rasas, you considered, or studied, other examples of preexisting shelters on mosaics. In particular, I'm aware of a shelter at the Petra church nearby.

MERVAT MA'MOUN HA'OBSH: Yes, we took into consideration other shelters. The design of the shelter is being studied by a consultant, a British company. And, of course, we asked the consultant to do a survey of different types of shelters. At the beginning, we were considering putting a tent over the shelter because we wanted it to be in a form that existed in the desert, but studies showed that there is a lot of wind in the area, more than 35 kilometers per second, and this is an issue that we have to take into consideration. So, yes, we looked at many examples.

JACQUES NEGUER: I'm interested in the decision-making process. Did you study the impact of the shelter on the environment, on the archaeological site, and the impact of the shelter on the mosaics, physically and visually? The shelter will change the landscape and the context of the churches. How is this shelter included in the site image, in the landscape?

MERVAT MA'MOUN HA'OBSH: If I understand the question correctly, yes, we studied all the issues—financial issues, physical and environmental issues—all around the site and inside the site. We looked into how this shelter would work with the whole environment, the outside, its shape, and how it looks. So we studied the elevations, and we also studied the height of this shelter, and we have diagrams that show all the different issues regarding the shelter itself.

FEDERICO GUIDOBALDI: Only a very short question: You don't think that ventilation can be dangerous for the efflorescence of salts in the mosaic? It all has to be very well calibrated, because I think there is a real danger with ventilation.

MERVAT MA'MOUN HA'OBSH: You're right about this issue, but from what we found from the existing shelter, its natural

ventilation was working well. The main problem was the water drainage under the mosaic.

AÏCHA BEN ABED: I'm going to ask a very naive question, I think. It seems that your project is very fancy and particularly expensive and using glass and all this material that needs a lot of maintenance. My question, my naive question, is why didn't you consider just rebuilding the walls according to the ancient techniques? It would be much simpler, less expensive, and easier to maintain.

MERVAT MA'MOUN HA'OBSH: We have considered this issue. We don't know exactly what type or what the architectural form of these churches is. So we were thinking that if we build a wall, we might give the wrong impression. We decided—of course, there is a committee that is responsible for advising the project—that a new structure would be better than re-creating the walls. First of all, it would differentiate between the old and new, and at the same time it would be sustainable for a long time. Yes, it cost a lot, but we considered the cost. We were trying to do all the mechanical work or the technical work in Jordan, so that local people can do the maintenance and it will be easier for us. And the main reason is that we don't know the exact shape of the churches, and we don't want to give an unrealistic form to them.

Discussion following Konstantinos L. Zachos Presentation

PAULA ARTAL-ISBRAND: When you talked about the Dionysos mosaic, you said that it was decided to remove the *emblema,* to place it in the Nikopolis museum, and, basically, a replica was made. I'm just curious about what you used to make the replica. What materials did you use?

KONSTANTINOS L. ZACHOS: We're going to use modern materials to make a replica to put back in situ where the original existed. Stone, glass, it depends. But we're going to follow what had existed before. We're using limestone, local stones for the pink, and also glass.

FEDERICO GUIDOBALDI: I remember there was a meeting perhaps fifteen years ago, and I presented a paper on the *opus sectile* of Nikopolis, which was in a terrible situation. I was surprised that you didn't speak about *opus sectile* floors too.

KONSTANTINOS L. ZACHOS: No, I did not speak about *sectile.* It was preserved in the late 1970s. It's covered, and we're planning to restore and reopen it again, and the church too.

JACQUES NEGUER: I'm impressed by the way you obtain approval for the removal of mosaics. Is this only for the Nikopolis area or for all of Greece?

KONSTANTINOS L. ZACHOS: No, this is only for Nikopolis, and there is a special committee for Nikopolis so it's easier to organize and decide than for the entire country of Greece. There is a scientific committee, of which I have the honor to be president, and the work is supported by the European Union. The scientific committee made the master plan for different issues, including mosaic preservation, and our decisions have to be approved by the central council, even after we start the actual work.

Discussion following Hassan Limane Presentation

ÉVELYNE CHANTRIAUX: Quand vous parlez de rendre à la nature, pour les deux cas les plus gravissimes, je n'ai pas très bien compris si cela voulait dire les réenfouir sous une couche de sable ou de terre ou les abandonner.

HASSAN LIMANE: Non, c'était les recouvrir, parce que vous ne pouvez pas les laisser comme ça. Oui, les rendre à la nature, c'est parce que normalement dans la vraie nature, ils étaient ensevelis, donc je crois que la meilleure manière de les protéger dans cet état-là, c'est de les recouvrir et les rendre à la nature. Car en tout cas une fois qu'ils sont en sous-sol, ils sont moins sujets à des dégradations. On a essayé, c'était aussi une expérience, on les avait recouverts avec du sable sec, c'était l'été, un plastique troué pour l'aération, bien sûr, et de la terre, et on les a recouverts pendant l'étude que nous avons opérée avec nos collègues anglais et ils étaient intacts, impeccables.

ÉVELYNE CHANTRIAUX: Sur quelle durée de temps le plastique a-t-il été utilisé ? Le plastique est plutôt déconseillé, c'est mieux d'utiliser du géotextile ou un Bidim.

HASSAN LIMANE: Sur deux ans. En tout cas, il n'y a eu aucune réaction. Vous savez, on travaille avec les moyens du bord.

ÉVELYNE CHANTRIAUX: Ce n'est pas très cher le géotextile, c'est utilisé pour faire les voiries publiques, ce n'est pas un matériau très cher.

HASSAN LIMANE: Mais en tout cas selon les analyses que nous avons effectuées, il n'y a eu aucune dégradation, ni au niveau des tesselles, ni au niveau du *tessellatum*, rien du tout. Il faut que j'ajoute qu'il y a aussi eu une étude de laboratoire, des analyses, pour les altérations. On a aussi établi une carte de risques, pas simplement une carte de risques pour les mosaïques, mais il y a aussi une carte de risques pour les structu-

res et il y a une concordance. Ce que nous avons observé au niveau de l'ensemble du site, c'est qu'il y a un glissement de terrain qui agit sur les structures, que cela soient les structures verticales ou les structures horizontales.

ABDELILAH DEKAYIR: Je pense que ce n'est pas une bonne chose de recouvrir les mosaïques parce que si on les recouvre, de toutes les manières, toutes les couches de la mosaïque restent en contact avec l'eau, et c'est l'eau qui est l'agent dégradant des mosaïques. Je pense que si on ose recouvrir des mosaïques, il ne faut pas les recouvrir avec du sable parce qu'on sait que le sable, il est très poreux, il faut les couvrir avec des matériaux qui ne laissent pas passer l'eau, par exemple des argiles ou quelque chose comme ça. Je rappelle aussi qu'à Volubilis, on a entamé des recherches sur la minéralogie et la chimie des pavements et des tesselles. Ça aide beaucoup à comprendre comment fonctionne ce système, parce que je pense que les mosaïques, ce sont des systèmes qui sont très complexes, et on ne peut pas conserver des mosaïques sans connaître de quoi ces systèmes sont formés. Les mosaïques, pour nous en tant que géologues ou gens des sciences de la terre, c'est des systèmes qui sont avec plein de roches et donc c'est des systèmes qui sont très complexes. Et il faut aussi voir les mortiers, parce que le mortier fin, il est pratiquement de la même composition que les mortiers grossiers, mais c'est les caractéristiques qui sont différentes. Je pense que lorsqu'on veut parler de la conservation, je suis vraiment désolé de ne pas comprendre d'abord qu'est-ce que c'est qu'un système de mosaïque. Donc, j'aimerais, par exemple lors de la prochaine conférence, qu'il y ait des sessions sur l'art, des sessions sur la gestion et une session pour les scientifiques, pour parler des phénomènes de la dissolution, des attaques, de tout. Et donc, je pense que la place des scientifiques, elle est en plein là-dedans.

HASSAN LIMANE: Je répondrai seulement au niveau du recouvrement, sur le côté scientifique je te donne raison puisqu'on travaille toujours dans le même axe ensemble, mais au niveau du recouvrement de la mosaïque, je ne suis pas d'accord parce que c'est là où réside le problème. C'est une décision, qu'elle soit positive ou négative, mais en tout cas il faut la prendre. Doit-on laisser la mosaïque à l'air libre et qu'elle continue à se dégrader ou doit-on trouver une solution adéquate, même la plus simple des décisions, et arrêter, au moins momentanément, la dégradation ? Je crois, que soit du point de vue archéologique ou du point de vue de la conservation, la meilleure solution, c'est de recouvrir, parce qu'au moins on donne une longue vie à la mosaïque en attendant d'avoir les moyens et l'équipe nécessaire pour intervenir.

ABDELILAH DEKAYIR: La dégradation des mosaïques, comme on l'a vu, c'est des attaques qui se passent dans le bain de pose, et donc, si on couvre des mosaïques, c'est vrai qu'on ne va pas attaquer la surface des tesselles, mais il faut voir qu'il y a des drainages qui sont latéraux et qui attaquent le liant fin. Donc, j'imagine que ce n'est pas une solution.

HASSAN LIMANE: Non, je réponds encore et je maintiens mon idée. C'est là où réside notre problème de conservation. C'est la décision. Quelle décision doit-on prendre ? Lorsque tu es conservateur d'un gros site comme ça et tu vois un patrimoine qui est en voie de dégradation, mets-toi à ma place. Le système de drainage, oui, je suis d'accord pour l'installer, mais avant d'installer le système de drainage, il faut déposer. Avant de déposer, il faut avoir les moyens, et dans des cas comme ça, on n'a pas les moyens. A l'origine, la mosaïque, elle était enterrée, donc c'est l'exposition qui l'a rendue comme ça. Donc je crois que la meilleure solution, même si tu n'es pas d'accord, c'est de recouvrir.

CHIARA ZIZOLA: To respond to your critique, you have to remember that we found mosaics under the earth after two thousand years, so the degradation that you see is not related to the burial situation but the opposite, to the open air, to the drying of the mosaics, and to the interaction with the environment. The degradation of the mosaics after reburial is very slow, so slow that it's not a real problem.

Discussion following Chiara Zizola Presentation

JEAN-PIERRE DARMON: Je voudrais simplement dire que cet exposé concernant les mosaïqes de Nora était particulièrement remarquable et qu'il apporte une illustration parfaite à l'invitation qu'Évelyne Chantriaux nous faisait hier d'adapter les solutions à chaque cas et que chaque problème est un cas d'espèce. Vous avez très bien donné une illustration concrète de l'application de ce principe à un site à la fois très riche et qui fait l'objet d'une réflexion excellente. Le problème maintenant, c'est de passer à la pratique.

CHIARA ZIZOLA: Thank you. It's true that any archaeological site has its problems. We have to adopt specific solutions for each problem. So we are not against the lifting of mosaics, always and forever, but when it's necessary for conservation needs, we have to take into account these methodologies, always thinking that it's better to conserve in situ if conditions allow.

ZE'EV MARGALIT: Do you have any conclusion about the removal of the concrete backing and the return of the mosaic

in situ? I was very interested in the seasonal reburying, but what is the impact of opening and covering every year? Can you say a few words about this?

CHIARA ZIZOLA: Seasonal covering will happen once a year, for the winter season. We feel that it is practical because we use filled bags of geotextile that you simply put on the floors with a sheet of geotextile underneath. So it's not a complicated method.

PART FIVE

Sheltering Mosaics

Rapid Assessment of Shelters over Mosaics: Methodology and Initial Results from England

John Stewart

Abstract: *The effectiveness of protective cover buildings, or shelters, over mosaics presented in situ is rarely assessed. In 2004 English Heritage, the Israel Antiquities Authority, and the Getty Conservation Institute agreed to collaborate on the development of a common methodology for rapid assessment of shelters in England and Israel. This was designed to collect data on a large number of shelters in order to determine if there is a relationship between mosaic condition and shelter design. Preliminary results from the survey in England are reported in this paper.*

Résumé : *L'efficacité des structures de protection, ou abris, couvrant les mosaïques exposées* in situ *est rarement évaluée. En 2004, English Heritage, l'Autorité Israélienne des Antiquités et l'Institut Getty de Conservation ont entamé une collaboration visant à élaborer une méthodologie commune pour effectuer une évaluation rapide des abris en Angleterre et en Israël. Il s'agissait de recueillir des données sur un grand nombre d'abris afin de déterminer s'il existe une relation entre l'état des mosaïques et la conception de l'abri. Les résultats préliminaires de cette étude en Angleterre font l'objet de cette communication.*

Protective cover buildings, or shelters, are one means to protect and present vulnerable archaeological features, such as mosaics, in situ. However, the effectiveness of the protection they confer in the long term is rarely assessed. It is clear that some shelters actually contribute to deterioration of the pavements they are meant to preserve.

English Heritage—the statutory agency for the protection of the historic environment in England—the Getty Conservation Institute (GCI), and the Israel Antiquities Authority all have research initiatives related to shelters over mosaics. Recognizing this shared interest, they agreed in 2004 to collaborate on a shelters evaluation project. This entailed developing a common methodology for rapid assessment, which was then applied to all sheltered mosaics in England (24 shelters over 70 mosaics) and in Israel (36 shelters over 105 mosaics).[1] In its evaluation of the Orpheus mosaic project in Cyprus, the GCI also assessed this sheltered mosaic using the same methodology.[2]

The objective of the evaluation was to better understand the relationship between the condition of a mosaic pavement and the environment created by the shelter covering it. Evaluation of the results of these surveys is expected to identify sites of further research interest for more intensive investigations and monitoring programs. Ultimately the aim is to define improved design and environmental criteria for shelters over mosaics in different climates.

In these assessments the term *shelter* has been applied very generally, to describe all forms of protective structures, whether fully enclosed or open on all sides. Subterranean sites were excluded from this project because of the very different constraints on the design of protective environments for mosaics below modern ground level.

Research Questions

The methodology developed for this rapid survey attempts to quantify

- the condition of the sheltered mosaic: is it relatively stable or actively deteriorating? (what data are needed to confirm active mosaic condition and its causes?)

- the influence of shelter design on the condition of the mosaic (what data are needed to prove a correlation between mosaic condition and the shelter design?)
- the best methods to efficiently describe all of these factors, in quantitative and qualitative terms.

Phenomena indicative of active deterioration of mosaics are listed in table 1, suggesting the possible role of shelter design in these deterioration processes.

Aspects of mosaic condition that are unrelated to environmental causes of deterioration have been excluded from this evaluation project, such as the impact of visitor walkways or damage due to visitors walking on the mosaic. These problems are understood and can clearly be addressed in a precise architectural brief for a new shelter and in a good management plan for any existing or new shelter.

Mosaics are composite structures made of a variety of porous inorganic materials—stone, ceramic, lime mortar, and sometimes glass—with varying susceptibility to deterioration processes. These processes are largely related to porosity and porosimetry of the material. Based on our current understanding, the most common direct causes of deterioration of mosaics

Table 1 Principal mosaic deterioration phenomena and the possible contributory role of a shelter design, open or enclosed

Mosaic Conditions Indicating Active Deterioration	Possible Relationship to Shelter Design
Salt florescence (on or below surface)	Shelter prevents rain from falling on the mosaic (no washing of salts) but allows or promotes water infiltration or seepage: • from lack of proper drainage (from and around shelter), leading to subsurface moisture (may be combined with topography that drains toward mosaic and/or footings that allow runoff toward mosaic) • from inadequate site drainage of high water table • from leaks in roof (design faults) • from condensation, cooling at night from lack of insulation • from inadequate lateral protection against rain or coastal aerosols • from limited shelter coverage (roof area) or excessive roof height, allowing rainwater to fall beyond the shelter to easily migrate below shelter and promotes wetting and drying cycles: • from direct sunlight • from heat buildup in shelter, lack of insulation • from passive ventilation (via open sides or fenestration pattern) or active mechanical ventilation with unstable internal climatic conditions.
Microbiological growth	Shelter allows • water infiltration (see salt florescence above) • condensation • insufficient ventilation/stagnant air • too little/too much light (dependent on species of microorganism)
Disaggregation, flaking, or fracturing of tesserae	Shelter promotes wetting/drying cycles (with presence of salts). Shelter does not protect mosaic from freezing (no or poor insulation).
Subsidence of mosaic	Drying out of subsoil below mosaic (contraction of subsurface with expansive clay), as a result of the construction of the shelter (may cause initial bulging).
Detachment or bulging of *tessellatum*	Swelling of subsoil below mosaic (expansion of subsurface with expansive clay), possibly as a result of removal of trees for shelter construction and access (increase in groundwater level). Shelter promotes wetting/drying cycles from subsurface moisture (with presence of salts), leading to detachment between layers. Shelter does not protect mosaic from freezing (no or poor insulation).
Bulging associated with loose tesserae or collapse of *tessellatum*	An indication of ongoing problem (continued expansion/contraction). Shelter allows concentrated direct thermal gain.
Rusting of iron reinforcement (relaid mosaic)	Shelter allows water infiltration (see salt florescence above).
Collapse of hypocaust supports	Shelter promotes salt florescence and/or microbiological growth (as above), which can result in decohesion of mortar joints.

Source: Martha Demas, adapted by John Stewart.

in sheltered environments are specific soluble salts, some types of microbiological growth, and thermal expansion-contraction and freeze-thaw events, causing, among other things, decohesion of mortar. Most of these processes are cyclical, and their severity is also associated with the concentration and relative strength of deteriogens as well as the frequency of cyclical events, which in turn is related to environmental conditions. All processes are progressively degenerative and are directly or indirectly dependent on the presence of moisture in its various forms.

Assessment Methodology

The methodology used for the site assessments distills the components of a conventional condition survey into a concise standardized template. This can be applied consistently to any mosaic or group of mosaics and associated shelter.

There are two components in the assessment process: preliminary research and site survey with evaluation. Preliminary research entails the compilation of existing written and graphic records relating to the discovery of the site, the history of the condition of and interventions to the mosaic, the construction and history of modifications to the shelter, and the site's environmental attributes. The site survey entails a very broad preliminary assessment of each site, undertaken over the course of one day, using the standardized template. In a hierarchy of description, it records, as visible:

characterization of the mosaic

- materials and structure of the mosaic
- deterioration phenomena within tesserae, the *tessellatum*, and its support, utilizing defined terminology[3]
- grading of each of these phenomena on a numerical scale by its physical extent (percentage of surface area) and an estimation of the degree of its severity (table 2)
- assessment of the loss of the *tessellatum* over time

Table 2 Sample pro-forma survey sheet for the rapid assessment project (Getty Conservation Institute, English Heritage, and Israel Antiquities Authority)

Mosaic: Observed Phenomena **Rate the extent and severity by circling the appropriate number. If the phenomenon is not present, circle 0.** **Add further comments if necessary.**		
Extent refers to the percentage of surface area affected by the phenomena: **0** None, **1** (<10%), **2** (10–30%), **3** (30–60%), **4** (>60%)		Severity refers to the degree to which the phenomenon impacts the physical or aesthetic integrity of the mosaic. **1** low, **2** low–moderate, **3** moderate, **4** high
Surface Conditions		
(Salt) efflorescence or subflorescence	Extent 0 1 2 3 4 Severity 1 2 3 4	Briefly describe appearance, e.g., fluffy, needle shaped, thin veil, thick veil, and distribution.
Biological Growth		
Higher plants/vegetation or roots	Extent 0 1 2 3 4 Severity 1 2 3 4	Briefly describe appearance with type if known, and distribution.
Microbiological growth	Extent 0 1 2 3 4 Severity 1 2 3 4	Briefly describe appearance and distribution.
Deteriorated Tesserae		
Disaggregation	Extent 0 1 2 3 4 Severity 1 2 3 4	Tesserae displaying loss of surface cohesion, which have disintegrated into powder or small grains. Comments (including distribution):
Exfoliation/flaking	Extent 0 1 2 3 4 Severity 1 2 3 4	Tesserae displaying detachment or loss of layers, parallel or perpendicular to the mosaic surface. Comments (including distribution):
Fracturing	Extent 0 1 2 3 4 Severity 1 2 3 4	Tesserae displaying linear breaks or network of breaks through their matrix. Comments (including distribution):
Erosion	Extent 0 1 2 3 4 Severity 1 2 3 4	Tesserae displaying a worn or abraded surface. Comments:

- cumulative rating based on the numerical grading of each mosaic's condition
- summary classification of mosaic condition, described as "active deterioration," "nonactive/stable," or "cannot determine"

characterization of the shelter and environment

- construction materials, structure and its condition
- estimation of the shelter's efficiency in excluding or reducing all potential sources of moisture
- designed site drainage and its efficacy
- the site's ambient climate, hydrology, topography, and land use
- summary evaluation of the shelter's performance in protecting the mosaic(s) and mitigating environmental risks

Limitations of Assessment

There are clear limitations in any preliminary rapid survey, most obviously the time available to carry out detailed archival research. The extent of previous investigations, such as the amount of climatic and hydrological data available, will also vary greatly from site to site. However, rapid preliminary surveys are still the most logical means to characterize sites very generally and to identify those of greater potential for future research.

Good archival records are critical for understanding mosaic condition and particularly the rate of change over time. During this preliminary survey of sites in England, it proved difficult to locate archival records for many mosaics; photographic records are surprisingly poor or inadequate. However, it was possible to gather a reasonable number of illustrations of mosaics excavated in the nineteenth century, and most of these seem relatively accurate (figs. 1, 2). They provide at least some means of assessing the survival of the decorated *tessellatum*.

Importantly, where a mosaic has been lifted and relaid, the justification for this decision is almost always lacking. Lifting can have been prompted by one or a combination of the following factors:

- active degradation of the mosaic (e.g., bulging or collapse of the *tessellatum*, detaching tesserae, collapse of hypocaust structure)
- a subjective and incorrect assessment of the severity of a mosaic's condition and rate of change, influenced by the strength or lack of confidence in certain types of intervention (lifting and re-laying vs. consolidation in situ)
- the contemporary approach to treatment: conservation preferences, materials, and technology evolve over time; for example, re-laying was common in England during the 1960s and 1970s but is rare today

The relatively poor archives for the English sites excavated a century or more ago make their assessment much more difficult than for the sites in Israel, where the vast majority were excavated at the end of the twentieth century and sheltered in the 1990s. However, the numerous mosaics in England sheltered over a greater period of time are certainly of interest in this research.

Mosaic Sites in England

In England there are currently some fourteen sites with twenty-four shelters, which protect and present seventy Roman mosaics in situ.[4] Half of these sites were discovered in

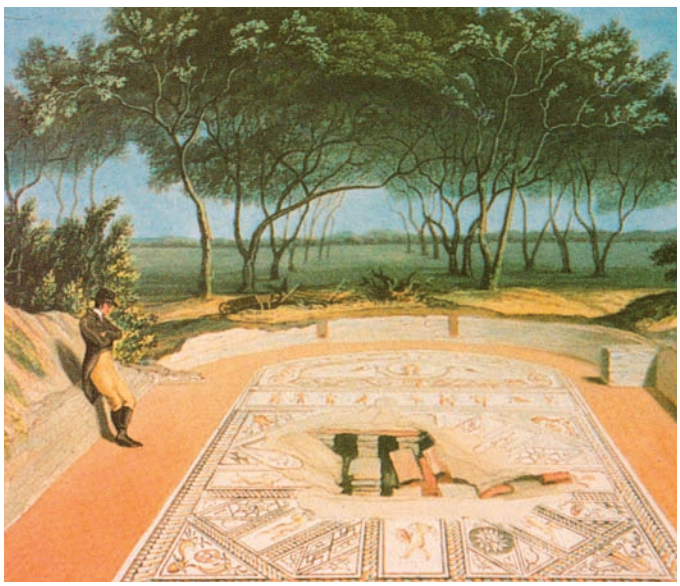


FIGURE 1 Bignor Roman Villa. The Venus Room after its discovery in 1811 (Richard Smirke) and before construction of its shelter. Subsequent loss of the *tessellatum* in the center of the mosaic may have been a result of collapse of the hypocaust. The pavement was relaid in 1926. Reproduced with the kind permission of the Tupper family. Bignor Roman Villa, West Sussex, U.K.

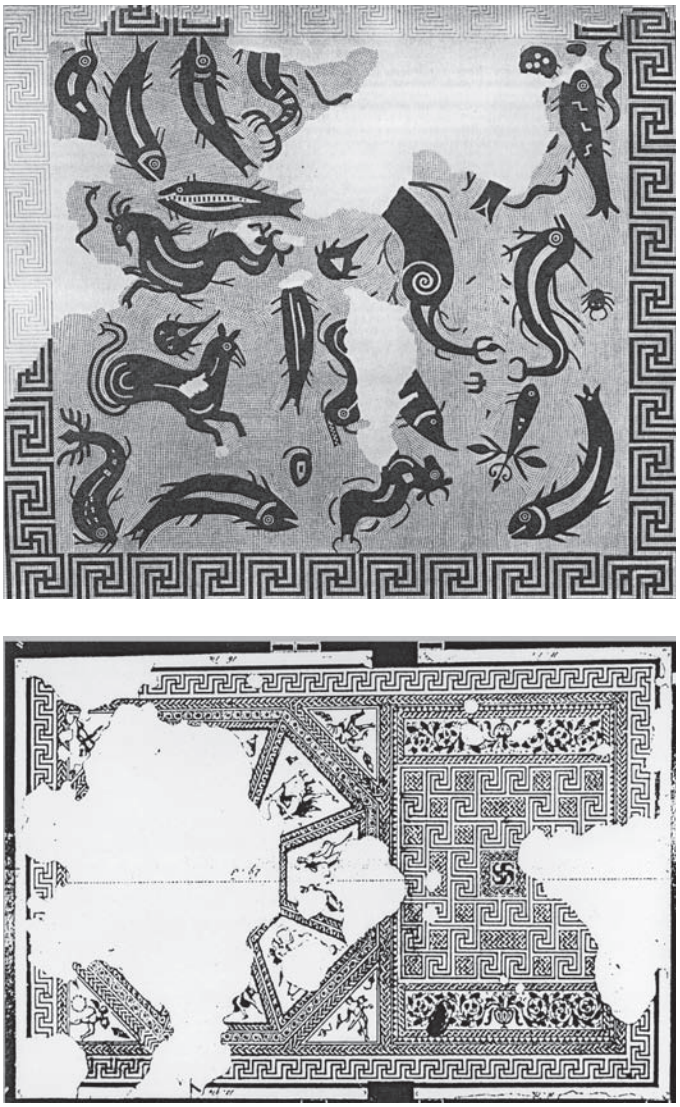


FIGURE 2 Examples of nineteenth-century illustrations of mosaics. Top: Great Witcombe Roman Villa, the pavement in Room 6 (ca. 1819, after Samuel Lysons); bottom: Chedworth Roman Villa, the triclinium mosaic (ca. 1869, George Fox). The latter drawing, executed shortly after the discovery and protection of the mosaic, shows that the *tessellatum* has changed very little when compared with its extent today. Courtesy Society of Antiquities of London.

the nineteenth century, and all but one are located in the south of England, which has a damp and temperate climate but is subject to winter frosts (table 3). Less than ten mosaics are on hypocausts, and just under half of all mosaics have been lifted and relaid. The shelters were erected between 1812 and 2004.[5] Several sites have had a sequence of structures, beginning with simple sheds and moving on to permanent buildings. The majority are vernacular buildings of masonry or timber-and-masonry walls supporting a timber roof covered with stone slates, thatch, or other materials (table 4). In the 1960s modern structures with large spans became common. A few shelters have mechanical heating to prevent freezing temperatures and mechanical ventilation to inhibit microbiological growth or reduce internal temperatures. A small number of sites benefit from real-time monitoring of environmental conditions, the only means to properly understand the dynamic role of environmental parameters.

Several additional issues make it difficult to compare the English sites with one another:

- the great range of dates of excavation and presentation (from 1812 to 1998)
- the great variety of shelter designs (affecting ventilation, solar gain, insulation)
- the evolution of shelter design, with two or three successive shelters over mosaics on some sites
- variations in seasonal opening times (affecting internal conditions)

Therefore, in England it is difficult to establish specific trends based on comparative analysis of shelter typologies.

Preliminary Assessment Results in England

The range of conservation issues encountered is best illustrated by a summary review of five English sites with different shelter designs. They can all be classified as relatively damp sites. As moisture is usually associated with the deterioration of mosaics, these sites are of greater interest than the few English sites that are apparently "drier," where mosaics appear sound.

Fishbourne Roman Palace (West Sussex)

Fishbourne Roman Palace was discovered in 1960, just a few kilometers from the English Channel. It has the largest collection of in situ mosaics in the country; some twenty-five pavements of the palace are presented under the modern shelter, which opened in 1968. The entire south elevation of this structure was glazed, resulting in high solar gain and, in sunny conditions, intense sunlight falling directly on some mosaics (fig. 3). The roof had no insulation. In summer months internal conditions were very warm, so windows were kept open and electrical fans installed to assist ventilation for visitor comfort. The site has a high water table with aggressive soluble salts.

Table 3 Sites with shelters over mosaics in England

Date of Discovery of Site	Site	Shelter over Specific Mosaics	Date of Shelter Construction*	Number of Exposed Mosaics in Shelter	Number of Mosaics Relaid (date)	Condition of Mosaics on Original Supports*
1811–17	Bignor *Note:* museum and corridor mosaics were reburied, then reexcavated in the twentieth century.	Venus mosaic Ganymede and Geometric mosaic Winter, Dolphin, Four Seasons mosaics Medusa mosaic Museum mosaic Corridor mosaic	1812–13 1812–13 1815–16 1818 1959–60 c. 1974	1 2 3 1 1 1	1 (1926) 0 3 (1973) 1 (1973) 1 (1973?) 1 (1976)	A (salts and bulging)
1813–15	North Leigh	Room 1	c. 1823	1	1 (1929)	
1818–19	Great Witcombe	Rooms 5, 6 Room 10	c. 1820 c. 1820	2 1	2 (1906) 0	NA/S
1832 1848	Aldborough	Lion mosaic Star mosaic	c. 1830s c. 1840s	1 1	1 (1920?) 1 (1920?)	
1863	Wadfield		1895	1	1 (?)	
1864–67	Chedworth	Triclinium mosaic West Bath Suite Laconicum	c. 1867 c. 1867 1960s	1 4 1	¼ (1993) 1 (1978) 1 (1978)	NA/S
1880–82	Brading	Rooms 3–12	[c. 1882, 1907] 2003–4	5	1 (1982)	NA/S
1926	Newport	Rooms 1–9	1960s?	5	2?	NA/S
1933 ff.	St. Albans	Insula IV, Building 8	[1930s, 1950s] 2003–4	1	0	NA/S
1937–38	Dorchester Colliton Park *Note:* mosaics were reburied in 1938. Room 8 was reexcavated in 1957; others in 1998.	Room 8 Rooms 8–18	[1957] 1996–99	1 6	0 0	NA/S and A (algae and moss)
1948	Bristol Kings Weston *Note*: Room 6 mosaic is from another site	Rooms 3–7	1950s	3	2	NA/S
1949	Lullingstone	Rooms 12, 13	1961 1986–88	2	0	NA/S
1960	Fishbourne	Rooms 1–29	1968	25	14 (1960s) (1979–80) (1982) (1991)	A (salts and bulging)
1976	Littlecote *Note:* excavated 1727; subsequently lost until 1970s	Orpheus	1999	1	1 (1979)	

Note: Relaid mosaics, excluding those at Fishbourne, appear stable. Mosaics that remain reburied on some sites are not included on this list. Dates are as accurate as possible, within the time limitations of the survey. [ ] denotes shelters that have been demolished and replaced.

*Observed mosaic condition: A = active deterioration; NA/S = nonactive/stable.

Table 4 Structural typologies of shelters over mosaics on sites in England (with dates of construction*)

Vernacular Construction (traditional small windows or no windows)				**Modern Materials / Construction**					
Masonry enclosure(s)		Timber and masonry enclosure(s)		Corrugated iron and structural frame enclosure		Timber, glass, and masonry enclosure		Metal frame, open structure	
1812–18	Bignor	ca. 1823	North Leigh	[1907–2003]	Brading	1960s	Chedworth (Laconicum)	1996-99	Dorchester
ca. 1820	Gt Witcombe	ca. 1867	Chedworth	1986–88	Lullingstone	1968	Fishbourne	1999	Littlecote
ca. 1830s ca. 1840s	Aldborough	1950s	Bristol			ca. 1974	Bignor (corridor)		
1895	Wadfield	2003–4	Brading**						
1927 or ca. 1960	Newport								
[1950s–2003]	St Albans***								
1959–60	Bignor (museum)								

* Dates are as accurate as possible, within the time limitations of the survey.
** The new shelter at Brading contributes other new characteristics to this traditional design.
*** The new shelter at St Albans (2003–4) does not conform to any of these typologies (steel frame, precast concrete panels, and glass enclosure)
[ ] Denotes shelters that have been rebuilt.

Upon excavation nine mosaics were found to be in poor condition, so they were lifted and relaid in cement mortar. Another four mosaics on their original supports deteriorated in the new shelter, and these were relaid between 1978 and 1991, this time in lime mortar. The ten mosaics that have never been lifted currently exhibit active bulging of the *tessellatum* and disaggregation of tesserae, with clear presence of soluble salts. Two of the relaid mosaics, both located next to the south glazed elevation, now also show some limited bulging (Rudkin 2003). This appears to be due to thermal dilation from direct solar gain. The condition of these mosaics is the most serious encountered on any of the English sites. High internal temperatures, with mechanical ventilation and fluctuating relative humidity, have probably encouraged evaporation of groundwater and the mobilization of salts.



FIGURE 3 Fishbourne Roman Palace. Extensive glazing in the shelter's original design contributed to major solar gain on adjacent mosaics and high internal temperatures. Photo: John Stewart.

The structure is now being modified to create more stable environmental conditions, with the installation of roof insulation, double glazing with solar reflective glass, reduction of window area by approximately 50 percent, and improved ventilation.

Bignor Roman Villa (West Sussex)

The main interest of this site is the seven mosaics within four shelters erected between 1812 and 1818 (figs. 1, 4, 5). There are another two twentieth-century shelters built to protect two reexcavated mosaics. The earlier shelters are of stone or brick with thatch or slate roofs and small windows. Thatched roofs have no rainwater gutters or downpipes, so historically rainwater has been deposited around the perimeter of the buildings.

Of the mosaics in the earlier shelters, one was relaid in 1926 and four in 1973. This was possibly due to active



FIGURE 4 Bignor Roman Villa. The earliest surviving site shelters in England (1812–16), built of stone and timber and thatched roofs. Another shelter of brick (1818) is out of view. Photo: John Stewart.

deterioration and/or poorly controlled visitor access, as four of these pavements appear to have lost from 20 percent to 60 percent of their *tessellatum* between their initial excavation and re-laying. The two mosaics excavated in 1811–13 that have not been relaid show excellent survival of their *tessellatum*. However, the Geometric mosaic in Room 6 (fig. 5) began to deteriorate rapidly in the 1990s, with bulging of the *tessellatum* and the appearance of soluble salts. This decay has been related to an observed rise in the groundwater table. Drainage has since been improved, and the pavement is now being monitored.

Chedworth Roman Villa (Gloucestershire)

Chedworth Roman Villa was discovered in 1864. Within a few years two shelters had been constructed to present five mosaics (fig. 6). The shelters are of timber on low stone walls and have slate roofs. One of these has late-twentieth-century insulation, and both have winter heating. Four mosaics are on their original bedding, and compared with early records (see fig. 2), their *tessellatum* appear very well preserved. Their general condition is largely good with only small areas of instability. Algae and salt efflorescence are common, but the *tessellatum* of each mosaic has not been seriously affected.

Another mosaic shelter dates to the 1960s and has glazing on all four elevations. Consequently, it has very high levels of damaging microbiology, especially in the damp hypocaust. The small area of mosaic was relaid in 1978.

The environment of all shelters and the site has been monitored for the past eight years.[6]

Dorchester Roman Town House (Dorset)

Dorchester Roman Town House (Colliton Park) was excavated in 1937–38 and subsequently reburied. The mosaic of Room 8 was revealed again and presented under a wooden shed in 1957. Four decades later the rest of the house was fully reexcavated and a shelter constructed over it. The steel-framed structure has open gables above and fragmented glass panels below, creating a high degree of ventilation (fig. 7). The shelter offers negligible thermal insulation and allows direct sunlight to fall on at least one pavement. The roof of stone slate attempts to replicate the Roman design and therefore does not have gutters. Consequently, the roof feeds a large quantity of rainwater directly to the outer perimeter of the building. Site drainage was already poor, as a result of the depression created by the original excavation.

All six mosaics within the shelter are on their original bedding. They show variable degrees of dampness, algal growth,



FIGURE 5 Bignor Roman Villa. The *tessellatum* of the Geometric mosaic in 1815 (Samuel Lysons), which survives intact to this day. However, serious deterioration began in the 1990s with a rise in groundwater level. Reproduced with the kind permission of the Tupper family, Bignor Roman Villa, West Sussex, U.K.



FIGURE 6 Chedworth Roman Villa (ca. 1867). The Western Bath Suite, sheltering five mosaics. Photo: John Stewart.



FIGURE 7 Dorchester Roman Town House (1996–99). Steel structural frame with open gables and glass sheets below. Photo: John Stewart.

and salt efflorescence. The one mosaic that is most shaded has also been colonized by moss, which is tenacious and difficult to remove. The other mosaics currently appear relatively stable. Yet only seven years after their reexposure and conservation there is real concern about their long-term stability in such an open structure and unstable environment, particularly given the appearance of moss and soluble salts. In an attempt to mitigate these problems the gables are to be enclosed, gutters are to be added to the roofs, site drainage is to be improved, and environmental parameters are to be monitored.



FIGURE 8 Newport Roman Villa (1960s?). Window apertures have been blocked in to help reduce algal growth in the shelter. Photo: John Stewart.

Newport Roman Villa (Isle of Wight)

Newport Roman Villa was discovered in 1926. The current shelter is of concrete blocks and may date to the 1960s, but this still needs to be confirmed (fig. 8). In 1982 windows were filled in to improve presentation with new internal lighting. The shelter protects five mosaics, most of which appear to be on their original supports.

The site is certainly damp, as evidenced by algal growth, especially within the hypocausts. However, it has been reported that the blocking of window apertures reduced this problem. Supplementary mechanical ventilation has also been installed to inhibit algal growth, and heaters are triggered when internal temperatures fall to 10°C. The mosaics currently show limited algal growth but are otherwise in excellent condition eighty years after their excavation. There is no evidence of active soluble salts affecting any of the ancient remains.

Discussion

Mosaics Relaid on New Supports

Most sites have a combination of relaid mosaics and mosaics on their original supports. As a result, on these sites in England there is no clear pattern between re-laying mosaics and the design of the shelter over them.

As stated earlier, the justification for lifting and re-laying is obscure. Of the mosaics discovered in the nineteenth

century, some were only relaid about 80 to 160 years later. Most re-laying can be dated to the 1960s and 1970s, when this treatment was common practice.[7] In one case, lifting of a mosaic at Bignor in 1926 may have been prompted by the collapse of the hypocaust beneath it (see fig. 1). However, the presence of a hypocaust under a mosaic does not seem to have consistently influenced lifting and re-laying, for of the nine mosaics over hypocausts on all sites, only four have been relaid.

Almost all the relaid mosaics appear to have been set in cement mortars. All but one of these (Littlecote) are inside full enclosures. These pavements are all now very solid and do not show any signs of deterioration, except at Fishbourne. Of course, cement is highly inappropriate for the conservation of mosaics as it is excessively strong and extremely difficult to remove safely, as well as aesthetically disfiguring. Fortunately, iron reinforcement does not appear common on relaid mosaics in England and is strictly only necessary as bridging on hypocaust structures. Its presence contributes to additional problems of iron corrosion with cracking of the cement matrix and mosaic. If iron is present on any of these pavements, the lack of cracking would infer that shelters are playing a protective role. Exceptionally, bulging and blistering have appeared on a few mosaics relaid at Fishbourne, both on new cement and on lime supports (of the 1960s and 1991, respectively).

Relaid mosaics are effectively of lesser interest in the survey in England. As almost all are currently stable and as the reason for re-laying has not been recorded, they contribute little to the understanding of the relationship between shelter design and environment. Even on damp sites relaid mosaics appear dry and sound and may be adjacent to mosaics on their original supports that are visibly damp and in variable condition (e.g., Bignor, Chedworth). This is undoubtedly due to the relatively impervious nature of cement to moisture from the ground and the possible inclusion of a damp-proof membrane under the relaid pavements. The problems with relaid mosaics at Fishbourne appear to be related specifically to the very unstable interior environment created in this modern structure.

Mosaics on Original Supports

On the sites surveyed there are eleven shelters with up to thirty-seven mosaics on their original supports (table 3). These shelters vary in design, all but one are enclosed, and most are traditional vernacular structures of masonry, or timber and masonry, with conventional small windows or no windows at all and with varied insulation properties (table 4). The sample number is small, but most of these shelters have provided reasonable protection in the English climate for their mosaics for at least fifty and as many as two hundred years.

In terms of recent observed deterioration phenomena, three sites are prominent.

At Bignor a traditional vernacular structure has not prevented damage from the recent change in site hydrology, with the presence of aggressive soluble salts. The role of the shelter is probably relatively benign, although the contribution of ventilation still needs to be quantified.

At Fishbourne substantial glazing and poor thermal insulation are suspected of accelerating the natural processes of deterioration from a high water table with aggressive soluble salts, causing blistering and detachment of the *tessellatum* of many mosaics. It was necessary to lift and re-lay four pavements within about fifteen to twenty-five years of excavation and presentation inside this shelter. Fortunately, it is a full enclosure, and its design is capable of being modified.

At Dorchester Roman Town House most of the mosaics have been exposed for only seven years. With poor site drainage, compounded by ineffective rainwater disposal from the building itself, aggressive microbiology has now colonized one mosaic, and salts are present throughout others. The environment in the shelter is very unstable, so the condition of the mosaics will have to be monitored very closely. With this shelter, stable internal environmental conditions could be created only at great expense, by extensive modifications to the rigid design concept.

All three of these sites have problems with inadequate shelter drainage and/or management of difficult site hydrology and unstable interior environments. Observed recent deterioration is all the more important given the poor archives for most sites. Other very specific events affecting site hydrology have also been recorded. A defective water main early in 2005 caused local damage to mosaics at Fishbourne. At Brading natural flooding inundated mosaics in 1990 and 1994, where there were inadequate flood defenses. The mosaics at Brading had previously been reasonably stable from their discovery in 1880.

Therefore, site drainage (from the building, from natural hydrology) and protection from acute water-related events are critical, particularly where aggressive soluble salts are also present. Problems of water management can certainly be exacerbated by shelter design, as for example by the high solar gain and unstable internal environment at Fishbourne, which has even affected robust relaid mosaics in addition to fragile ones on original supports.

Many of the more traditional vernacular shelters—of brick or stone with small external apertures—have the benefit of greater thermal mass (e.g., Great Witcombe, Bignor, Newport). However, thermal insulation does not necessarily seem to be the most important factor on sites with a mild winter climate. The shelter at Dorchester provides no thermal insulation, and some five years after its completion there is no clear evidence for frost damage, but this may still occur in time, with harsher winters. At Brading most mosaics survive on their original supports, although from 1907 until 2003 their shelter consisted of corrugated iron cladding on a structural frame, without any significant heating. However, the lack of thermal insulation in a shelter is more likely to affect mosaics in poor condition with high moisture content and where freezing temperatures are prevalent.

The role of ventilation or rates of air exchange may be significant, as it can mobilize soluble salts. However, this is extremely difficult to quantify and is certainly not possible to assess rapidly. All but two of the English shelters are fully enclosed, but most have conventional apertures that still allow for appreciable levels of ventilation.[8]

These issues of thermal insulation and ventilation illustrate that there is rarely one single contributing factor to the success or failure of a shelter; rather, several aspects of the design contribute in relation to the prevailing local environment—ambient as well as subsurface. These interact in a complex way with the structural condition of the protected mosaic.

Conclusion

The survey methodology developed for this project provided a useful and consistent tool for surveying a large number of mosaics and shelters in a relatively short time. The limitations of assessment of the complex English sites are evident in the significant gaps in knowledge of their postexcavation history, but meaningful case studies such as those presented above nevertheless have been identified.

In relation to specific risk factors, recurrent themes of concern in the designs of shelters have emerged from the survey in England:

- site drainage (from and around the shelter)
- area of glazing (direct and indirect solar gain and its influence on microbiology and mosaic dimensional change)
- thermal insulation (environmental stability)
- ventilation (influence on soluble salts and microbiology)

Of course, these general observations need to be corroborated by more thorough appraisal. From the inventory developed during this pilot study, a few sites with particular research potential can now be selected for additional study.

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Notes

1 See in this volume Jacques Neguer and Yael Alef, "Rapid Assessment of Shelters over Mosaics: Initial Results from Israel."

2 See in this volume Martha Demas, Thomas Roby, Neville Agnew, Giorgio Capriotti, Niki Savvides, and Demetrios Michaelides, "Evaluation of the Project to Conserve the Orpheus Mosaic at Paphos, Cyprus."

3 See the glossary developed by the Getty Conservation Institute and the Israel Antiquities Authority at www.getty.edu/conservation/publications/pdf_publications/mosaicglossary.pft.

4 There is also a long history of the protection of mosaics in England by means of reburial, recorded as early as the seventeenth century and still practiced today as a means of managing newly discovered mosaics that are not to be displayed.

5 Other mosaics excavated in the eighteenth and nineteenth centuries and protected under shelters have been lost through lack of effective maintenance and management (Stewart and Cosh 2005).

6 See in this volume Sibylla Tringham and John Stewart, "Protective Shelters over Archaeological Sites: A Review of Assessment Initiatives."

7 One company, Art Pavements, was active in lifting most, if not all, mosaics in this period.

8 Of interest in terms of ventilation is the Billingsgate Bath House beside the Thames in London. It is a subterranean site and

therefore was excluded from this survey. Partly excavated in 1848, it survived well in the cellar of the new Coal Exchange Building, with little or no ventilation. When this building was demolished in 1967, the replacement structure incorporated extensive mechanical ventilation, which resulted in major salt damage to the ancient walls and mosaics. All ventilation was subsequently terminated and more stable conditions were recorded (pers. comm., Brian Ridout, Ridout Associates).

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Rapid Assessment of Shelters over Mosaics: Initial Results from Israel

Jacques Neguer and Yael Alef

Abstract: *A risk assessment of 106 mosaics under 36 shelters undertaken by the Israel Antiquities Authority found that in half the cases the mosaics were deteriorating. These results made clear that shelters are not a simple solution for mitigating deterioration of mosaics; on the contrary, it seems that in some cases the shelters accelerated deterioration. This calls for rethinking shelters as a protective measure for mosaics and for systematic evaluation of their performance. Moreover, there are no clear criteria for their design, and very little information is available in Israel or elsewhere on the success of existing shelters either in mitigating deterioration or in the interpretation and presentation of the mosaics.*

Résumé : *Une rapide évaluation de 106 mosaïques sous 36 abris, entreprise par le Service des Antiquités d'Israël, a révélé une détérioration des mosaïques dans la moitié des cas. Ces résultats ont bien montré que les abris ne sont pas une solution simple permettant d'atténuer la détérioration des mosaïques ; au contraire, il semble que, dans certains cas, les abris aient accéléré la détérioration. Il convient donc de repenser les abris en tant que mesure de protection des mosaïques, et d'en évaluer systématiquement les performances. De plus, il n'existe pas de critères clairs pour leur conception et l'on ne trouve que peu d'informations, en Israël ou ailleurs, sur la manière dont les abris existants auraient pu atténuer la détérioration ou améliorer l'interprétation et la présentation des mosaïques.*

The Israel Antiquities Authority in collaboration with the Getty Conservation Institute (GCI) and English Heritage (EH) have been coordinating their individual efforts and developing a common methodology for assessing the protective function of shelters, which is being applied in Israel (and in England by EH).[1] The initial stage is a rapid assessment on a regional basis to discern broad patterns of preservation and deterioration. The assessment focuses on the microclimate a shelter creates and its effect on the condition of a mosaic, with the purpose of identifying evidence of active deterioration of the mosaic and linking this evidence with the design of the shelter. The outcome of this study will help to establish criteria and a methodology for evaluation of existing shelters that can then be used to improve design faults and maintenance of existing shelters and as a guide to the design of future shelters.

This paper presents the preliminary results of the mosaics and shelter surveys in Israel, starting with background information on shelters and the risk assessment of mosaics, which formed the basis for the rapid assessment of shelters over mosaics. It then describes the data collected and discusses preliminary observations that resulted from the survey, conclusions, and future directions for investigation.

Historical Overview of the Conservation of Mosaics in Israel

The continual discovery of archaeological sites with mosaics in Israel and the demand to open those sites for tourism pose serious problems regarding their conservation and presentation. In the past mosaics were commonly removed from their sites for display in museums. Today's historic sensibility requires that the authenticity of the ancient pavement be respected and the mosaic be interpreted in its archaeological context. This has led to favoring conservation and presentation of mosaics in situ. Until the early 1990s presentation of mosaics in situ entailed lifting them for treatment in the laboratory, where they were cast in cement bedding, and then re-laying

them in the site. Since then new techniques for conservation in situ have been introduced in Israel that allow mosaics to be conserved on the site with traditional materials such as lime-based mortar. A belief that shelters can be a good in situ measure for the protection of the mosaic and at the same time provide an opportunity to present the mosaic to the public has resulted in the construction of 36 shelters covering 106 mosaics in Israel.

The first shelter over a mosaic was built at the Mount of Olives, Jerusalem, in 1873 to protect the beautiful Artaban mosaic. During the 1930s, shelters were built over the synagogue in Beit Alpha and the Lady Mary monastery in Beit She'an. The majority of the shelters, however, were constructed in the 1990s, at a time when the development of archaeological sites for tourism became a national priority, resulting in large-scale projects that included the erection of shelters in Caesarea (fig. 1), Zippori, Tiberias, and Beit She'an.



FIGURE 1 In 2001 two large shelters were built over the Domus and Bathhouse in Caesarea. The shelters in the marine environment protect the mosaics from rain but allow aerosol and dust accumulation on the mosaics. Photo by N. Davidov (2005) © IAA.

Risk Assessment of Mosaics in Israel

The risk assessment of mosaics, undertaken by the IAA Conservation Department in Israel between 1998 and 2000, evaluated mosaic conditions in order to identify and prioritize their conservation needs; this was followed by a survey in 2002 that focused on the presentation aspects of shelters (Alef 2002). This was the first time information about the condition of Israel's mosaics was compiled and assessed; approximately one hundred sites were studied, among them sites with shelters. The risk assessment contributed to the development of the rapid assessment methodology by the IAA, EH, and GCI; it is therefore useful to describe briefly its methodology.

The aim of the risk assessment was to quantify the level of risk to a mosaic. Higher percentage of risk means a poorer condition of the mosaic; for example, a mosaic with 90 percent risk is endangered, whereas a mosaic with 20 percent risk is in good condition (table 1). The first step identified ten principal risk factors for mosaics under shelters:

- Active decay or ongoing deterioration, whose mechanisms or causes have not been halted.
- Insufficient security and protection from vandalism and animals (mainly birds).
- Inadequate roofing, primarily partial cover of the mosaic, which does not protect the entire mosaic from rain and sun.
- Inadequate site drainage, referring mainly to water runoff.
- Inadequate roof drainage.
- Vegetation and microbiological growth.
- Lack of preservation treatment or inappropriate intervention in the past, for example, treatment with cement or re-laying of only one part of the mosaic where other parts are treated in situ.
- Lack of mosaic maintenance.
- Lack of regular monitoring.
- Lack of shelter maintenance.

Following this basic identification of risk factors, the condition of the mosaic was rated by assigning 10 percent for each factor, which was then calculated as a numerical grade.

The scores of the assessment were roughly broken down into four categories, which provide a general idea of the vulnerability of the mosaic and the severity and extent of deterioration (see table 1). A similar concept for creating a numerical grading of mosaic condition was elaborated in the rapid assessment methodology.

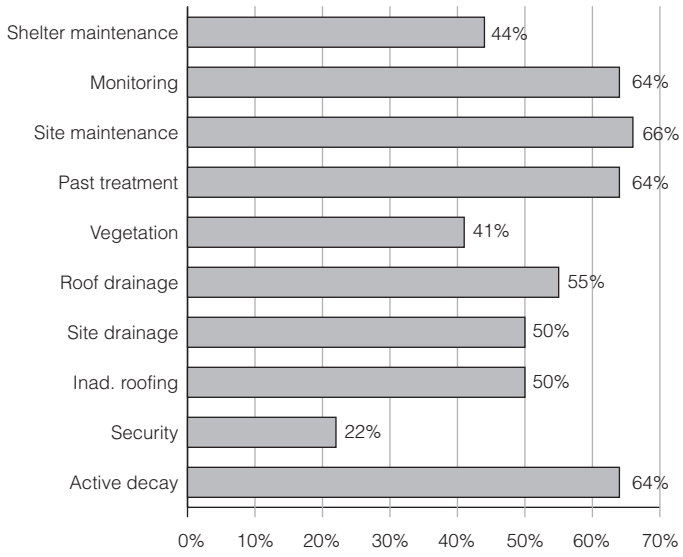
The results of the risk assessment show the condition distribution is as follows:

- 4 mosaics (10%) are in risk level "A," which means that they are endangered or have already been lost (at between 80% and 100% risk).
- 10 mosaics (28%) are in risk level "C," which indicates that they are in stable condition (at between 40% and 60% risk).

Table 1. Risk assessment, levels of risk categories

Levels of Risk	Description
A (80%–100%)	An endangered site, where total loss of the mosaic in the near future is imminent.
B (61%–79%)	The mosaic is in a state of active deterioration, which is likely to accelerate. In some cases partial loss may already be evident.
C (31%–60%)	The mosaic is in a stable condition. This may suggest that although no significant changes in its condition will be noticed, deterioration is still possible.
D (30% or less)	The mosaic is in good condition.

Table 2. Risk factor assessment



- 14 mosaics (40%) are in risk level "D," which indicates they they are in good condition (at less than 30% risk); these are usually cases in which the mosaics are protected and maintained and deterioration is under control.

When comparing the distribution of the condition of mosaics under shelters in each risk level and the distribution of mosaics exposed to the open air, we find that they are almost the same. Although deterioration of mosaics under shelters is a known phenomenon, its extent and similarity (in distribution) to that of mosaics exposed to the elements was not expected.

Along with the results of the risk assessment, an analysis of the risk factors was undertaken in order to begin to identify which of the ten risk factors (i.e., inadequate roof drainage, vegetation, etc.) are more prominent. The aim was to find out which are the principal factors that affect mosaics.

The risk factor analysis (table 2) gives an idea of the statistical weight of the studied factors that affect mosaics under shelters. It points out the following main causes for active decay:

- Lack of regular monitoring and maintenance of the mosaics and the shelter was found in 66 percent of the cases.
- Inadequate site drainage was found in 50 percent of the cases.
- Lack of conservation treatment of the mosaic or inappropriate intervention in the past was found in 64 percent of the cases.

The risk assessment proposes that the main factors affecting the condition of mosaics are monitoring and maintenance and conservation treatment. While the role of these factors in deterioration is quite well understood, the role of the environmental factors is less clear. These will be investigated further in the rapid assessment, to better identify the criteria for evaluation of the effect of shelters on the condition of the mosaic and to provide a better understanding of the weight of environmental factors in relation to other factors.

Initial Results of the Rapid Assessment

The evaluation of protective structures at archaeological sites consists of an analysis of the combination of the environmental and shelter characteristics and the mosaics' condition. To date we have collected existing information from previous surveys, including the risk assessment. At the same time we have surveyed most of the sites and collected information on the environment, shelter characteristics, and mosaic condition.

Table 3 provides basic information on the date of excavation of the mosaics and construction of the shelter and its typology. The typology is based on whether the shelter is enclosed or open and on its structural and material characteristics: lightweight metal structure, timber structure, reinforced concrete, tensile structure.[2]

The structural type of the shelter is defined by form, construction technology, and materials, which are characterized by strength and stability, durability, repairability, flexibility, ease of construction, and availability of materials and knowledge. The division between open shelters and enclosed shelters

Table 3. Rapid Assessment, sites and shelter data

#	Site	Location	History		Shelter Typology						No. and Area		Mosaic Treatment (support)					
													in situ (lime)		Relaid cement		Relaid epoxy	
			Excavation date	Shelter date of construction	Enclosed	Open shelter	Tensile	Metal frame	Timber frame	Concrete	Total no. of mosaics	Surface m²	No. of Mosaics	Surface m²	No. of Mosaics	Surface m²	No. of Mosaics	Surface m²
1	Beit Alpha National Park	Synagogue	1929	1931	X					X	1	80			1	80		
2	Beit Berl College	Mosaic from Tel Soho	1980s	1998		X					1	9					1	9
3	Beit She'an National Park	Sigma	1992–94	2000		X	X				8	148	8	148				
4	Beit She'an National Park	Lady Mary monastery	1930	1932	X			X		X	10	406	7[a]	335	3	71		
5	Caesarea National Park	Ibex mosaic	1990s	1997		X			X		1	110	1	110				
6	Caesarea National Park	Bathhouse	1990s	1995/ 2001[b]		X		X			10	410	10	410				
7	Caesarea National Park	Domus	1990s	1995/ 2001[b]		X		X			7	180	7	180				
8	Caesarea National Park	Experimental Shelter NN4	1990s	1998		X			X		1	10	1	10				
9	Ein Gedi National Park	Synagogue	1970–99[c]	1994–5		X	X				3	210	2	96	1	114		
10	Ramat Hanadive Park	Ein Tzur, Bathhouse	1991	1996		X		X			2	16	2	16				
11	Erez (Kibbutz)	The Hunter mosaic	1967	1967		X		X			1	4			1	4		
12	Hurvat Grarit	Church	1977	1980s		X		X			1	26	1	26				
13	Neot Kedumim Park	H. Hermeshit, Wine press	1988–97	1994		X			X		1	20	1	20				
14	Jerusalem, Ein Yael	Bathhouse	1986–7	1990		X		X			1	3	1	3				
15	Jerusalem, Ein Yael	Villa	1986–7	1990		X		X			2	25			2	25		
16	Jerusalem - Herodian Quarter	Residential quarter	1969–83	1990–1	X					X	10	90	4	44	6[d]	46		
17	Jerusalem, Mt. of Olives	Artaban mosaic	1872	1873	X					X[e]	2	45	2	45				
18	Jerusalem - Rockefeller Museum	Mosaic from Tel Hamam	1930s	1987		X		X			1	60			1	60		
19	Ma'ale Adumim - Martirius	Church and Monastery	1979–84	2002		X		X			2	440	2	440				
20	Maoz Haim	Synagogue	1974–7	1978	X			X			2	105	1	45	1	60		
21	Masada National Park	Bathhouse	1963–5	1965	X					X	1	2	1	2				
22	Masada National Park	Church	1963–5	1965		X			X		1	9	1	9				
23	Masada National Park	Western Palace	1963–5	1965		X		X			4	35	4	35				
24	Nahariya	Church	1972–6	1984	X				X		1	360	1	360				
25	Nir David Archaeology Museum	Tel Basul	1961–4	1970s		X		X			1	35			1	35		
26	Nirim - Ma'on Nirim	Synagogue	1957–8	1977		X				X	1	50			1	50		
27	Rishon Le Zion	Wine press	1991	1997–8		X			X		1	120	1	120				
28	Sussya	Synagogue	1970s	1980s		X			X		2	86	1	70	1	16		
29	Tel Aviv, Eretz Israel Museum	Mosaic from Ramla	1960	1995		X	X				1	18			1	18		
30	Tel Aviv, Eretz Israel Museum	Mosaic from Tiberias	1978-9	1995		X	X				1	6			1	6		
31	Tel Aviv, Eretz Israel Museum	Samaritan mosaic	1965	1995		X	X				1	13			1	13		
32	Tiberias (Archaeological Park)	Bathhouse	1954–6	1960		X		X			2	10	2	10				
33	Tiberias - Hamat National Park	Hamat Synagogue	1960s	1997		X			X		2	156	1	6	1	150		
34	Zippori National Park	Villa Dionysos	1987–8	1990–1	X					X	5	112	4	62			1	50[f]
35	Zippori National Park	Nile Festival Building	1991	1992/95–6[g]		X			X		13	270	12	265	1	5		
36	Zippori National Park	Synagogue	1993	1999–2002	X					X	1	60					1	60
				Total	9	27	5	14	9	8	106	3739	78	2867	25	753	3	119

a. Lady Mary: 7 mosaics are conserved in-situ with cement-based mortar

b. Caesarea Villa and Bath: 1995, temporary shelter erected; 1999, temporary shelter dismantled; 2001, permanent shelter erected

c. Ein Gedi: Several excavation campaigns

d. In the Herodian Quarter one of the mosaics is partly relaid on cement, and partly in situ

e. The enclosed shelter of the Mount of Olives is made of stone with repairs in cement

f. Zippori: Dionysos mosaic is partly relaid on epoxy, and partly in situ

g. Zippori Nile Festival shelter: 1991, temporary shelter erected; 1995–96, permanent shelter erected, combines metal and timber construction.

refers to the proportions between open and closed lateral surfaces of the structure, with no definitive distinctions. The types of shelters range from simple sheds, which provide only a horizontal roof, to open shelters with some lateral elements or completely enclosed structures, which allow additional facilities for protection and presentation. In some cases, lateral elements such as curtains or cladding are added or removed as needed (Alef 2002).

About 75 percent of the shelters in Israel are open. Open shelters provide a horizontal barrier to rain and direct sunlight, important considerations in the Mediterranean and desert climate of Israel, but they do not protect against wind-driven rain, dust and sand deposit, marine aerosol, temperature, and relative humidity, and they usually provide less security from animals and vandals.

Other data record number of sites and mosaics, surface area, and type of support. The survey found that 78 mosaics (74%) in an area of 2867 square meters are treated in situ; 25 mosaics (23%) in an area of 753 square meters are relaid on cement support; and 3 mosaics (3%) in an area of 119 square meters are relaid on epoxy and aluminum sandwich panels.

Discussion

The specific environmental factors pertinent to the protective function of a shelter are direct solar radiation (SRD), rain, wind-driven rain, relative humidity, moisture content, wind, pollution, marine aerosol, and deposits such as dust and sand. Other factors that are amenable to management solutions include drainage and protection from biological threats such as invasive flora and fauna and bird droppings.

Evaluation of the protective function of a shelter comes down to its effectiveness in mitigating the environmental and biological factors that cause physical deterioration of the mosaics. As can be seen in the following examples, a shelter can sometimes mitigate these factors, but it may also accelerate the deterioration process. Faults in shelter design are obviously among the main causes of deterioration, but identifying cause-and-effect is a difficult task. Mitigating mistakes that may be made in the future is one of the goals of this research, and the initial results advance the discussion on some of the phenomena that are found in shelters over mosaics, such as problems of accumulation of salts, condensation, and the effect of the type of shelter on the condition of the mosaics.

Shelters have been built in all regions of Israel and function under varied climatic conditions: Mediterranean climate in Zippori and Jerusalem; marine environment with high relative humidity in Nahariya, Caesarea, and Tel Aviv; semiarid climate in the area of Beit She'an; and desert climate with extreme temperature fluctuations in Ein Gedi and Massada. This distribution provides an interesting selection of case studies for examination.

Salts Accumulation in a Marine Environment

The in situ mosaics in Caesarea and the relaid mosaics in the courtyard of Eretz Israel museum, Tel Aviv, both situated on the Mediterranean coast, represent similar phenomena, where the exposed mosaics seem to have less dust deposit than the mosaics under the shelters in the same sites. In the survey, we noticed that this phenomenon is mainly found in sites in a marine environment.

The climate in Caesarea is humid subtropical (Mediterranean) with environmental conditions of 600 millimeters average annual rainfall. High relative humidity (average daily maximum ranges from 83 percent in January to 95 percent in June) makes it one of the most humid areas in Israel.[3] The Bathhouse and Domus were built in the fourth century C.E. and were in use during the Byzantine period. The interiors were decorated with marble fountains and paved with mosaics. The site was excavated during the early 1990s (Porat 1996). In 1995 a temporary wooden shelter was constructed, and in 2001, with the objective of preventing rain, two permanent shelters were constructed, one over the Domus and the other over the Bathhouse (see fig. 1).

The permanent shelters are large metal frame structures with hipped roofs—the bath shelter with an area of 646 square meters and 5.0 to 6.5 meters at the highest points and the Domus shelter with an area of 390 square meters and 3.0 to 5.0 meters at the highest points. Steel columns support an I-beam structural system. The roof cladding is made of metal sheets, and the ceiling is covered with aluminum sheathing. The roof is drained by gutters and pipes. The mosaics were conserved in situ with lime-based mortar. Their routine maintenance includes monthly dry and wet cleaning.

When comparing those mosaics to the exposed mosaics on the site, one finds greater amounts of dust and salt accumulation on the mosaics under the shelters. High relative humidity and moisture content together with the presence of aerosol and dust deposits in the marine environment can explain this phenomenon. The dust and its salt components, in the presence of water from relative humidity and aerosols, create an aggressive corrosion process. The open shelter provides horizontal protection from rain but does not prevent aerosols and

dust from accumulating on the mosaic (fig. 2). On exposed mosaics these deposits are washed in the rain, but under the shelter their removal is controlled and depends on maintenance. A comparative exposure test conducted by the GCI and the IAA in Caesarea between 1999 and 2002 showed that once mosaics under shelter are not maintained they deteriorate at a much higher rate than do exposed mosaics.

The decision to shelter the remains in Caesarea was made primarily because of their location in deep excavation pits that did not allow for appropriate drainage of rainwater. The shelters did protect against rain, but they created a new problem: the accumulation of dust and salts from aerosols. This does not suggest that the decision to construct shelters over the mosaics was wrong,[4] but it highlights the need for routine maintenance in order to control accumulation of deposits.

The case of Caesarea (fig. 3) and the similar case of the shelters in the courtyard of Eretz Israel museum, Tel Aviv, demonstrate the function of the shelter as an ecosystem in which each parameter is related to other parameters. All the environmental factors in this case—rain, wet and dry cycles, aerosols, salt and dust accumulation—are active players in this ecosystem. For example, reducing rain results in increasing the dust and aerosol. The assessment of the effect of a shelter on the environment of the mosaic, therefore, involves the development of an ecosystem-based model.

Relative Humidity and Condensation

Condensation is one of the first indicators of design faults that can be observed in shelters in humid subtropical (Mediterranean) climates with high relative humidity. This problem has to do with inadequate control of the causes of condensation or, once condensation occurs, with the removal of the condensed water from the interior surface of the roofs. This phenomenon affects the mosaics in various ways, as seen in the Nile Festival mosaic in Zippori (fig. 4), the Bath in Ein Yael, Jerusalem, and the experimental shelter (NN4) in Caesarea (see fig. 3).

The Nile Festival building in Zippori was constructed in the fifth century C.E. It measures approximately 50 by 35 meters and has more than twenty rooms and corridors planned around a basilica hall and a courtyard (Netzer and Weiss 1992). The entire building was originally paved with polychrome mosaics; twelve mosaic floors in an area of 242 square meters have been discovered in various states of preservation. The site was excavated in 1991 and in situ conservation was undertaken during 1994–95.[5] At the same time, a permanent open-sided



(a)



(b)

FIGURE 2A, B The experimental shelter (NN4) in Caesarea is a low-pitched roof, built in 1998 (a). The photo of the interior taken in summer shows dampness on the mosaic caused by severe condensation (b). The problem is the outcome of insufficient ventilation in the humid climate. This mosaic also suffers from water runoff and wind-driven rain in winter and from inadequate protection from direct sun, which accelerates wet and dry cycles. Photos by Y. Alef (2006) © IAA.



(a)



(b)

FIGURE 3A, B The test panel (a) shows severe disaggregation caused by the aggressive environmental conditions (high relative humidity, condensation, dust, aerosols) under the experimental shelter (NN4) in Caesarea. These phenomena are also evident on the mosaic (b). Test panel photo by N. Davidov (2003), mosaic photo by Y. Alef (2006) © IAA.



FIGURE 4 The Nile Festival shelter is a complex system of pitched roofs made of fiberboard and copper that rest on a metal-and-timber frame structure. A series of faults in the design and during its construction impaired its protective efficacy. Photo by Y. Alef (2002) © IAA.



FIGURE 5 During the summer the Centaur panel in the Nile shelter suffers from water accumulating on its surface (under the right front leg of the Centaur). A difference in thermal conductivity of the copper and the wood in addition to lack of insulation in the roof construction causes condensation on the fiberboard, which then drops onto the mosaic. Photo by Y. Alef (2006) © IAA.

shelter was erected measuring 670 square meters.[6] The shelter combines metal and timber framing. The posts are steel covered with wood, set in concrete footings. Fiberboard covered with copper sheets, with no insulation, rests on the beams. The roof is composed of a complex system of pitched roofs in three levels that overlap. The smaller modules at the bottom are 3.5 meters high, and three large modules, one above the Nile Festival mosaic and two above the basilica hall, are nearly 6 meters high at the top (see fig. 4).

During the rapid assessment survey, the Centaur panel was found to be wet from water dropping from the roof (fig. 5).[7] This phenomenon was already recorded in 2000 during a site inspection. An explanation for the accumulation of water on the mosaic has to do with the condensation of water on the

fiberboard that then falls directly on the mosaic. A difference in thermal conductivity of the copper and the wood, in addition to lack of insulation in the roof construction, is a cause of condensation on the fiberboard. It is not surprising, therefore, that the fiberboard all over the shelter shows signs of rot and needs to be replaced (fig. 6). However, most of the roof area has an angle sufficient to allow the water from condensation to leak along the slope. This is not the case above the Centaur panel, which rests at the end of a corridor, where a horizontal roof links two of the pitched roof modules (see fig. 6). The water that condenses on the fiberboard drops down on the mosaic. As a general note, soluble salts are not a major threat in Zippori, but the constant dry and wet cycles accelerated the damage to the mosaics, resulting in salt crystallization, bulging, and black-colored microorganisms on the mosaics.

Because the condensation problem of the Nile Festival shelter seems easy to manage, the question of how the design failed to address it arose. When we examined the planning and construction process of the shelter, we found that the original architectural details included roof insulation. During construction, however, unexpected expenses were incurred that originated from inadequate engineering planning. In order to stay within the budget, the decision was made to cut costs by leaving out the insulation (B. Shalev, pers. comm. 2002). The faults in the protective function, on the one hand, and the high costs of the shelter, on the other, raise questions regarding the choice of materials and design as well as on-site management decisions. It seems that architectural considerations were not balanced with other priorities of the site. This case illustrates a common problem in the decision-making process in Israel: not all the parameters of shelter design are integrated and balanced.

A similar phenomenon was also noticed in the Bathhouse of Ein Yael, Jerusalem, where the condensed water under the corrugated metal cladding ran along the metal construction and then dripped onto the mosaic. A stripe of rust stains on the mosaic traces the location of the metal beam above.

In a marine environment the consequence of condensation under open shelters is even more severe because of the corrosion of the materials such as stone and metal. The worst case of condensation was indeed observed in the experimental shelter of NN4 in Caesarea. This shelter was built in 1998 over a small mosaic as part of the comparative exposure testing project. The low-pitch roof rests on a wooden structure, with posts set in concrete footings. In the rapid assessment survey undertaken in summer 2006,[8] the mosaic was found wet. This was not surprising since it is a long-recorded phenomenon at this mosaic. During the comparative exposure testing, mosaic test



(a)



(b)

FIGURE 6A, B The fiberboard above the Centaur panel (a) shows signs of rot and needs to be replaced. Whereas in most of the roofed area there is sufficient slope, above the Centaur panel the roof is horizontal and water that condenses on the fiberboard drops onto the mosaic (b). Photo by Y. Alef (2006) © IAA.

panels under the shelter soon disintegrated into powder. The corrosion factors in these conditions are relative humidity, marine aerosols, surface deposits (very fine dust particles), and additional water from condensation, which activate and accelerate the deterioration processes that relate to multiple cycles of salt crystallization. This process in different variations, as shown so far, is a key to understanding corrosion under shelters.

Based on preliminary analysis, the key for reducing condensation in shelters lies in provision of proper ventilation, that is, sufficient height of the shelter and consideration of wind direction, sufficient angle of roof slope, proper selection of materials, including consideration of heat conductivity and insulation, and durability of materials that will ensure proper insulation. Finally, the importance of the cleaning of dust from mosaics under open shelters must be emphasized; this will eliminate one of the main corrosion factors, which is vital for their survival as well as for their aesthetic presentation.



FIGURE 7 The Artaban mosaic from the Mount of Olives was sheltered in 1873. The drawing on the left was made following the excavation (Clermont-Ganneau 1899). The photo on the right was taken in 2006 and shows the mosaic still in good condition. Photo by N. Davidov (2006) © IAA.

Condition of Mosaics in Enclosed versus Open Shelters

The survey results suggest that generally, as far as environmental factors are concerned, mosaics in enclosed shelters seem to be in better condition than mosaics in open-sided shelters. A preliminary observation for enclosed shelters, which will need further investigation as this research develops, is that deterioration seems to be associated mainly with management issues, namely, lack of site and shelter maintenance, rather than environmental factors.

Examples of mosaics in good condition can be found in enclosed shelters in Beit Alpha synagogue,[9] which was excavated 77 years ago, and the Mount of Olives mosaic in Jerusalem, which has remained in perfect condition for more than 135 years (fig. 7). The same could be said for the rather simple enclosed shelter over the mosaics of Lady Mary monastery, Beit She'an. The site was excavated in the 1930s, and two years later a metal frame structure with asbestos cladding and concrete walls was erected. This enclosed shelter performed well until the asbestos cladding reached its life span 15 to 20 years ago and broke. Since then, deterioration of the mosaics has accelerated, and today they are endangered. The enclosed shelter in Maoz Haim, not far from Beit She'an, was constructed in the late 1970s and provides sufficient protection for the relaid mosaics, but the in situ mosaic is disaggregating.

Each of the mosaics in these four examples was treated differently: the Mount of Olives mosaic was conserved in situ with lime-based mortar, the Beit Alpha mosaic was relaid on cement slabs, and the mosaics of Lady Mary were either conserved in situ with a cement-based mortar (the majority) or relaid on cement slabs. All but one of the Maoz Haim mosaics were relaid on cement slabs; the one exception was conserved in situ with cement-based mortar.

The examination of the condition of the different mosaics under enclosed shelters may indicate that these shelters provide sufficient protection for relaid mosaics. The condition of in situ mosaics in enclosed shelters depends also on drainage and groundwater insulation. In the case of Maoz Haim, for example, lack of drainage and groundwater insulation combined with the watering of fields adjacent to the shelter, high groundwater that originated from saltwater springs, and high soil salinity are the probable cause for the complete desegregation of the in situ mosaic.[10]

This observation is supported by a comparison of the mosaic under the open-sided shelter in Nir David and the mosaic in the enclosed shelter of Beit Alpha 3 kilometers to the west. The mosaic of Tel Bazul was lifted, set in cement bedding, and then relaid on a cement slab for display in the courtyard of the Museum for Regional and Mediterranean

Archaeology at Gan Ha-Shelosha (Nir David) during the 1960s.[11] The shelter is a simple shed constructed of metal posts set in concrete footings. The roof cladding is made of corrugated metal sheets. The mosaic rests in a concrete podium in the shape of a pool; no roof drainage was installed. Although the yearly average of rain is quite low (about 430 mm), wind-driven rain and wind-driven runoff from the roof accumulate in the pool-shaped foundation of the mosaic, which retains the humidity for long periods. This has resulted in disintegration of the cement support and may cause total loss of the mosaic. Both Nir David and Beit Alpha are relaid on cement slabs, but while the Beit Alpha mosaic is in stable condition, the Nir David mosaic is endangered.

Conclusion

The research presented in this paper is ongoing. To date, most sites have been surveyed, and a significant amount of information relating to the environmental data and the characteristics of the shelters and the condition of the mosaics has been collected but has yet to be fully analyzed. Nevertheless, some preliminary observations can be made. In all cases, the protective and preventive efficiency or the control of the process of deterioration is obtained only if a shelter is correctly planned, constructed, maintained, and used. If any of these elements is missing, the benefit of the shelter can be lost and its protective function transformed into an "accelerating aging machine" of the remains being sheltered (Accardo 2006: 21).

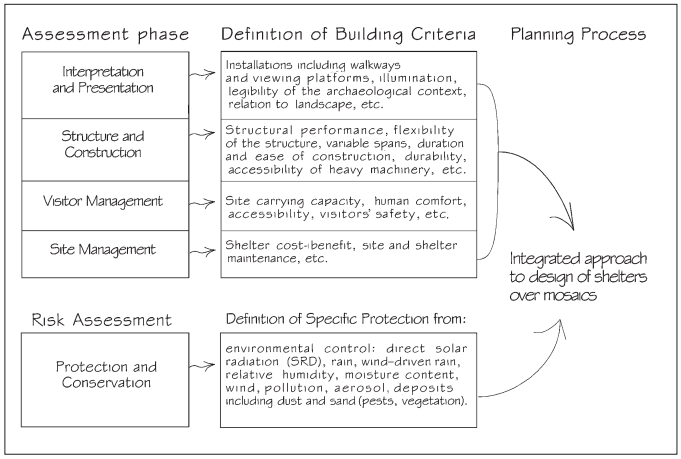
From the information collected so far, it appears that when shelters fail in their protective function it is because aesthetic design, visitor comfort, presentation, or other aspects were prioritized over the protective function, resulting in an unbalanced solution. The shelter over the Nile Festival at Zippori, for example, prevents rain, but the choice of materials and management generated a new problem, condensation. Integrated criteria, which form a common basis for communication among the participants in the process, are needed in order to prevent these mistakes.

Understanding the effect of shelters on the decay mechanism of mosaics (which is the focus of this research) is a first step in establishing common criteria for the evaluation of shelters. The protective criteria are only part of a broader context related to shelters and have to be considered in relationship to interpretation and presentation criteria, visitor and site management criteria, and structural and construction criteria (Alef 2002). With a common methodology for evaluation, an integrated planning process for the construction of new shelters, which responds to all the various concerns, can be developed.

Both the evaluation and the planning of shelters are based on understanding the shelter and mosaic as an ecosystem (table 4). An ecological evaluation or planning model for shelters as ecosystems needs to take into account not only the different criteria for each aspect independently (e.g., management, protection, presentation) but also the relations and interactions among those aspects. While the condensation problem in the Nile Festival mosaic is primarily a design fault due to the lack of an integrated approach, the shelters in Caesarea and Tel Aviv are good illustrations of the need for a balanced ecological system. Rain, wet and dry cycles, aerosols, and salts accumulation were factors that had to be addressed. Although the shelters prevented the entrance of rain, they created a new problem of salt accumulation from aerosols. Those problems created by the shelter require a maintenance routine different from that for the exposed mosaics in the same site. Understanding which environmental factor is most critical (e.g., rain, aerosols, condensation) guides the appropriate protection, treatment, and type of maintenance for the specific issues of each site.

At this stage it is too early to evaluate the validity of the methodology of the rapid assessment as a research tool and as a practical management tool for mosaic conservation. However, the development of a common methodology is already in itself an important outcome of the rapid assessment. A methodology for evaluation of the protective function of shelters based on defined criteria is a basis for common integrated criteria for evaluation of the overall shelter performance. In the case of evaluation of shelters, the answer to the question of whether a

Table 4. Integrated ecological approach to the design of shelters over mosaics



specific shelter fulfills its expectations depends on whom you ask. The architect may "like" it, while the site manager will criticize it for its expensive maintenance; the visitor may enjoy the shade, while the conservator may not be satisfied with how the shelter protects the mosaic from deterioration.

It is our hope that the results of the rapid assessment will assist in developing a planning model for shelters over mosaics with an integrated approach comprising all factors and based on ecological planning principles that considers the interaction of these factors.

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Notes

1 The methodology of the rapid assessment is described more fully in Stewart, this volume.

2 Intended duration, i.e., temporary or permanent, can also form a category. Temporary shelters are erected for an excavation in progress or at the end of an excavation until a decision is made regarding permanent protection. These are usually simple low-cost structures that in many cases do not provide sufficient protection for the mosaic. Today a temporary seasonal shelter made of nylon sheets over metal frame arches is built over the mosaic in Megiddo, which was excavated in 2005 and is awaiting a decision about its future.

3 The environmental data are based on those of the meteorological station in Geva Carmel (Bitan and Rubin 2000).

4 Water accumulation would have undoubtedly accelerated the deterioration of the mosaics, plaster, and ceramic elements of the site.

5 Excavations were led by Netzer and Weiss on behalf of the Hebrew University. The conservation work was conducted by the Centro di Conservazione Archeologica–Rome (Costanzi Cobau and Nardi 1996).

6 The cost of the shelter ($500,000) was high, due in part to the choice of expensive materials (B. Shalev, pers. comm. 2002).

7 The survey took place on October 14, 2006, at 15:00; the relative humidity under the shelter was 48%, and the air temperature was 28^{0}C.

8 The mosaic was surveyed on July 18, 2006, in the afternoon when the relative humidity under the shelter was 71.5% and the temperature was 29^{0}C.

9 The mosaic floor of the synagogue was discovered accidentally in 1929. Excavations were directed by E. L. Sukenik, assisted by N. Avigad, on behalf of the Hebrew University of Jerusalem. Shortly after excavation an enclosed shelter was built over the site and then was replaced in the 1960s(?) with the current shelter.

10 The area is ranked as "medium rate of salinity" (rank 4 out of 7), that is, 10 to 20 percent of the soils in the area are affected with salinity throughout the cross section (Rabikovitch 1970).

11 The mosaic was unearthed in archaeological excavations headed by Nehemya Zory on behalf of the Antiquity Department between 1961 and 1964.

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Protective Shelters over Archaeological Sites: A Review of Assessment Initiatives

Sibylla Tringham and John Stewart

Abstract: *The primary purpose of a protective structure, or shelter, on an archaeological site should be to provide a beneficial environment for the preservation of an archaeological asset, such as a mosaic pavement. However, in reality shelters perform variably. This paper provides a review of initiatives that have been carried out to evaluate shelters, describing the range of methodologies and technical methods that have been employed. The collective experience of these evaluations can help to develop better means of understanding the performance of existing shelters and potentially inform the design and evaluation of new ones.*

Résumé : *L'objectif principal des structures de protection, ou abris, sur un site archéologique devrait être d'assurer un environnement propice à la préservation d'un bien archéologique, tel qu'un pavement en mosaïques. En réalité, cependant, la performance des abris est variable. Cette communication passe en revue les initiatives menées pour évaluer les abris, décrivant une série de méthodologies et de méthodes techniques employées. L'expérience collective de ces évaluations peut contribuer à mieux apprécier les performances des abris existants et à renseigner la conception et l'évaluation des nouvelles structures.*

In recent years the growing recognition of the need for better conservation and management of archaeological sites has been reflected in a heightened interest in shelters.[1] Shelters are built to protect significant archaeological assets, such as mosaic pavements. They also play a valuable role in presentation and access and can enhance the display and interpretation of archaeological remains. Of course, sheltering is not appropriate for all features on all sites; other conservation options, such as reburial, may be chosen as part of the conservation strategy for a site.

Despite the recent proliferation in shelter construction, sheltering has a long history, extending back almost 250 years in the United Kingdom, which attests to the long-perceived benefit of covering remains. Approaches to shelter design vary broadly: from temporary tents to open-sided roofed structures; from simple enclosed vernacular structures to buildings assembled from innovative materials with sophisticated provisions for internal climate control and visitor access.

While the principal function of a shelter—and the focus of this discussion—should be to reduce the rate of degradation of the remains, the notion that a shelter of any design will afford adequate protection is misguided. Deterioration of the archaeological features may well continue after the erection of a shelter. Indeed, a shelter may actually contribute to the degradation of covered remains, for example, by inadequate rainwater dispersal. Therefore, understanding the complex relationships between the vulnerability of the archaeological features and the conditions created by the shelter is critical to the longevity of the resource. Put simply, assessment of shelter performance serves to determine the overall effectiveness of the structure in preserving the archaeological remains from the main risks over time (Teutonico 2001: 89). For existing shelters, assessment can help to identify the need for remedial alterations; for proposed new shelters, evaluation can predict the performance of the design, to detect and resolve potential flaws before construction.

In the conservation field, literature on shelters has traditionally been descriptive, emphasizing aesthetic character and interpretive function, and critical reviews and evaluations of shelter performance are rare (Demas 2001). More recently, however, some evaluations have been reported in the literature, and there are others that remain unpublished. This

review identifies and appraises these initiatives—their broad trends as well as their omissions—to develop better means of understanding existing structures and to potentially inform the design and evaluation of new ones.[2]

Shelter Performance Criteria

As it is at the interface of the buried and exposed environment, an excavated archaeological feature is susceptible to many types of deterioration, the causes and mechanisms of which are often complex and entangled. Mosaics, for example, are vulnerable to environmentally driven deterioration phenomena such as soluble salts and certain forms of biodeterioration that are activated by moisture in its different forms (as rainfall, dispersed or groundwater, or water vapor) (fig. 1). In general, a shelter needs to protect a mosaic or other cultural resource from climatic effects such as

- rainfall, through adequate roof cover, drainage, and water disposal
- insolation, through roof design and lateral wall cladding
- severe fluctuations in the internal climatic environment, preferably through passive means such as thermal insulation

The specific performance criteria of a shelter must of course be based on local climatic conditions and conservation requirements.

Shelters need to fulfill other utilitarian functions, including presentation and interpretation and security against unlawful entry (Stewart 2001). However, it is far easier to satisfy these requirements in a new design than it is to design a shelter that will create the best environment for the protection of archaeological resources.

Approaches to Assessing Shelters

Assessment of an existing or proposed shelter should be based on the understanding of the natural features of the site (including topography, hydrology, and soil structure/geology), the resources themselves (including their extent and condition), and the mechanisms of deterioration to which they are subject. A full understanding of these aspects of the site usually requires a number of investigations, including

- documentation of the archaeological feature and its postexcavation history

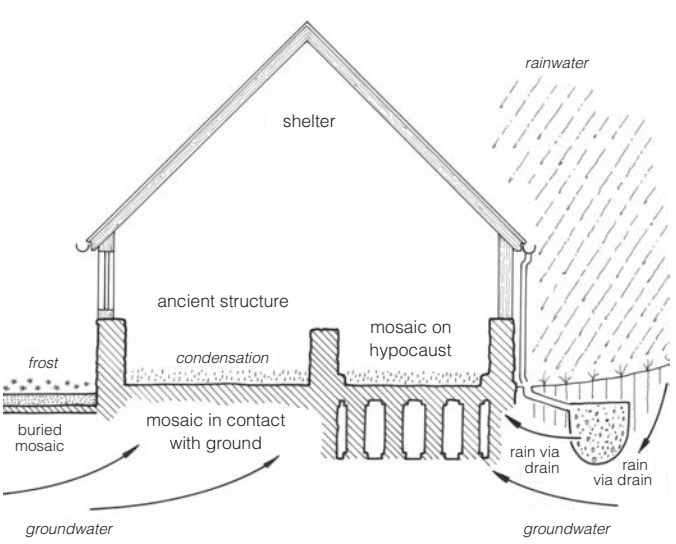


FIGURE 1 Schematic section through a shelter building with floor mosaics, showing typical sources of moisture activation mechanisms. Courtesy of Graham Reed.

- analytic investigations
- condition assessment
- subsurface investigations
- the collection of environmental data over time

Ranking the risks identified in these studies, in order of their severity and frequency, can help to define the specific performance criteria that the shelter needs to fulfill. These performance criteria should inform the design of a new shelter and function as a standard against which to test both its predicted performance during modeling and, ultimately, its actual performance as built.

The information gathered in these preliminary investigations can support monitoring strategies and data interpretation, in addition to providing a valuable baseline for further studies. More specific questions regarding the role of the shelter in the deterioration processes can then be addressed by assessing the main factors of deterioration and risk. Shelter evaluation needs to be a formal inquiry carried out with methodological rigor in which empirical observations are recorded systematically and corroborated with quantitative and qualitative data; as information is gathered it informs further investigations, feeding into a continual process of questioning and reinterpretation.

Source Material

For the purposes of this study, assessments of existing and proposed shelters were reviewed for a broad range of sites.[3] Over half the assessment initiatives have been undertaken at sites with mosaics; other sites have either stone or earthen architecture or wall paintings. This review aims to be as comprehensive as possible and includes both published and unpublished projects around the world. However, inevitable obstacles and omissions result from a range of issues, among them projects still in progress, material in preparation for publication, language limitations, and insufficient description in the published literature. Where possible, information was supported with personal communication. The data were collated in tabular form with sites, site typology, and assessment methods, which revealed trends in approaches to assessment (table 1).[4] With six project sites, Italy has the highest number of assessment initiatives. Other recent or ongoing projects are located in Cyprus (1), Czech Republic (1), El Salvador (1), England (3), Greece (1), Israel (1), Mexico (1), Norway (2), Switzerland (2), Thailand (1), Turkey (2), and the United States (3).

Methods of Assessing Shelters

Condition Survey and Monitoring

Condition survey or assessment, defined as a study that relates condition and deterioration phenomena, is a valuable and widely used tool in conservation. It has enhanced value for assessment when combined with monitoring change over time, in relation to an existing shelter or a proposed new one. The essential basis for the survey is a preliminary study of the physical history of the remains through previous documentation (written, graphic, and photographic). Photography plays an important part in both the initial survey and subsequent monitoring, as long as it is consistent, repeatable, and of sufficient resolution to capture a meaningful level of detail. Graphic representation of deterioration phenomena can be especially valuable because it emphasizes the distribution of the phenomena. However, the value of graphic documentation as a monitoring and evaluation tool is critically dependent on its objectives and design.[5] Furthermore, the terminology, relative accuracy, and consistency, as well as accessibility for future use, will affect its value. In most projects reviewed, a condition survey was undertaken in the initial investigations but rarely functioned as a comparative tool for longer-term monitoring. Few studies reported on the condition of the shelter during shelter evaluations, with the exception of the rapid assessments carried out by English Heritage, the Israel Antiquities Authority, and the Getty Conservation Institute.[6]

Investigations such as impulse radar and photogrammetric survey, which provide structural information on mosaics, have demonstrated value for mosaic condition assessment and diagnosis and potential for longer-term monitoring. However, these methods were reported only at the sites of Brading and Chedworth in England.

Analytic Investigations

Analytic investigations that provide information on original materials and deterioration phenomena are essential for developing conservation strategies. Most studies undertook materials characterization of the ancient fabric, although few carried out physical and chemical analysis to investigate the identified risks. For mosaics, salt analysis (quantity, composition, distribution, and hygroscopicity) was the most common investigation, providing a broad indication of the predicted risk from salts' presence.

More in-depth analytic investigations can serve to define risk parameters and aid specification of appropriate internal shelter conditions. This is amply demonstrated at the Roman site of Orbe-Boscéaz in Switzerland, where salts and blistering affected the *tessellatum* of one mosaic. Experiments characterized the critical range of relative humidity for the salt mixtures found underneath the mosaic as well as the role of thermal and hygric fluctuations in the formation of blisters. The actual behavior of materials in situ may vary significantly from that of materials in the laboratory environment and the internal conditions proposed. Therefore, the experiments were subsequently performed on-site, along with environmental and condition monitoring. These types of investigations have proven extremely valuable but unfortunately are unique among the shelter assessments reviewed.

Survey of Liquid Moisture Sources

Identification and characterization of all liquid water sources affecting the archaeological remains and the shelter may provide insight into their potential for activating or accelerating mechanisms of deterioration. Investigations into water movement through the site by hydrogeological, drainage, and/or geophysical surveys were a priority at Novy Kuks, Orbe-Boscéaz, Vallon, Brading, and Chedworth and resulted in the installation of appropriate drainage systems to manage the water sources. The availability of appropriate sampling locations that are not disruptive to surrounding undisturbed

Table 1. Shelter assessment initiative

Resource type		Mosaics/tiles										Stone			Earth						Misc.			Total
Site		**Chedworth (UK)**	**Brading (UK)**	**Vallon (Switz-erland)**	**Orbe-Boscéaz (Switzerland)**	**Cleeve Abbey (UK)**	**Domus dei Coeidii (Italy)**	**Domus at Corfinio, Varignano, Arianna, Piazza Armerina (Italy)**	**Paphos (Cyprus)**	**Caesarea (Israel)**	**Ephesus (Turkey)**	**Novy Kuks (Czech Republic)**	**Apollo Epicurios (Greece)**	**Hamar Cathedral (Norway)**	**Casa Grande (USA)**	**Catalhöyük (Turkey)**	**Joya de Cerén (El Salvador)**	**Tell Mozan (Syria)**	**Cacaxtla (Mexico)**	**Fort Selden (USA)**	**Wat Sri Chum (Thailand)**	**Blackwater Draw (USA)**	**Trondheim (Norway)**	
Analytical investigations/ survey/ research	Analytical investigations			X	X	X		X	X			X	X		X	X	X		X				X	12
	Physical/ chemical properties				X			X				X	X		X	X	X						X	8
	Salt	X	X		X	X		X	X			X			X								X	9
	Hydrogeological	X	X	X	X				X			X											X	7
	Geophysical	X	X		X							X												4
	Drainage	X										X												2
	Condition survey of existing shelter		X													X		X				X		4
	Condition survey of resource	X	X		X				X	X		X			X	X	X		X			X	X	12
	Literary/ historical survey				X							X		X	X									4
	Comparison of current condition with historic photographs		X									X			X			X						4
Monitoring	Condition	X			X	X	X	X	X	X		X				X	X	X		X		X		13
	Internal environment	X	X		X	X	X	X	X		X	X	X	X		X	X		X	X	X	X		17
	External environment	X	X		X	X	X	X	X	X	X	X	X			X	X	X		X	X	X		17
	Pollution							X		X														2
	In situ soil moisture content/ temperature	X			X	X											X							4
	In situ masonry/ mosaic moisture content/temperature	X	X		X								X	X			X			X			X	8
	Mosaic/masonry dimensional change				X									X										2
	Indicator materials/ test samples/replica						X	X		X							X	X		X	X			7
Other	Protective indices							X									X			X				3
	Thermal simulation		X					X			X													3
Total		10	10	2	13	6	4	10	7	5	3	12	5	4	6	7	10	5	3	6	3	5	6	
References		Stewart et al. 2003 Stewart et al. 2004	Edwards et al. 2003 Gifford 2003 Knight 1994	Guex 2003	Fischbacher et al. 2003 Flatt et al. 1997 Weidmann 1987 Weidmann et al. 2003 Weidmann and Girardet 2005	Pers. Comm. Bill Martin	Laurenti 2001	Laurenti 2001	Stanley-Price 1991	Pers. Comm. Jacques Neguer	Krinzinger 2000	Kotlik and Heidigsfeld 2002	Theoulakis 1993	Ibenholt 2003 Statsbygg n.d.	Matero 1999	Catalhöyük archive reports	Maekawa 2006	Buc-cellati and Bonetti 2003	Pers. Comm. Diana Moletore	Agnew et al. 1996	Nishiura et al. 2002	Jerome et al. 2001	Peacock and Turner-Walker 1998	

archaeology may limit the information generated from subsurface surveys.

Moisture Monitoring

Further investigations into the movement of moisture at a site by means of real-time monitoring of moisture variations in porous materials (e.g., mosaic, wall, or soil) can reflect potentially hazardous moisture fluctuations, including wetting and drying cycles. There are a number of techniques available commercially to monitor moisture content, including resistivity and capacitance probes, but they currently have drawbacks in accuracy, coverage, applicability, expense, and compatibility with datalogger technology (Dill 2000). Soluble salts and variations in soil composition may also affect results. Such technical challenges in moisture measurement may have resulted in its omission in many of the assessment projects. Where such monitoring of moisture in porous materials was carried out in the projects reviewed, it relied on custom-made equipment or adapted instruments intended for other purposes, with varying success.

Environmental Monitoring

Environmental monitoring serves to measure the prevailing microclimate within the shelter and how it functions as an envelope with respect to the external macroclimate; it may also be used to assess empirical observations. In the studies reviewed, environmental monitoring was the most frequently employed method to assess shelter performance—typically with simultaneous monitoring of the conditions (at least temperature and relative humidity) both outside and inside the shelter. Monitoring several variables at the same time in an integrated strategy, such as surface temperature or moisture content of the archaeological features alongside climatic data, can help to characterize relationships among environmental factors, associated risks, and the condition of the remains.

Such combined strategies are less frequently undertaken, although at Chedworth, where mosaics are affected by salts and microorganisms, an integrated monitoring program over the past eight years has characterized the environments within several different types of shelters on the site. In addition to the more common parameters, surface temperature, masonry, and soil moisture content were also recorded to provide real-time data on the movement of moisture in relation to external events (fig. 2).

Collecting environmental data on an archaeological site presents inherent difficulties, and integrated monitoring strategies are limited by the availability of appropriate technology, sound strategies, and expertise; therefore, the dissemination of innovative solutions is especially valuable. Other interesting approaches to integrated monitoring are illustrated at Orbe-Boscéaz, Fort Selden (a nineteenth-century military outpost in the United States), and Joya de Cerén (a Classic period Mesoamerican site in El Salvador).

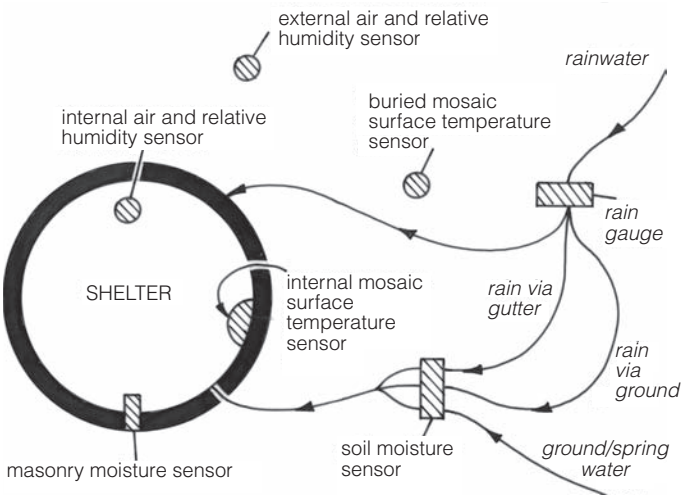


FIGURE 2 Schematic design of the integrated monitoring program at Chedworth Roman Villa. Courtesy of Graham Reed.

When monitoring data (such as climatic data) is examined alongside condition monitoring data, significant correlations may be revealed, shedding light on deterioration mechanisms and the performance of the shelter (e.g., at Fort Selden and Orbe-Boscéaz).

Protective Indices

A tool for interpolating meaning from environmental data has been developed by the Getty Conservation Institute in the form of "protective indices." The protective index is a mathematical expression defined as the reduction in the variability of an environmental attribute brought about by sheltering (Agnew et al. 1996) and is intended to quantify the effectiveness of a shelter. For example, at Fort Selden the protective index demonstrated that the hexashelter significantly buffered various climatic effects. Provided that a control is present, as described below, protective indices can define the effect of the shelter on any environmental parameter and are of particular value when comparing several shelters at the same site.

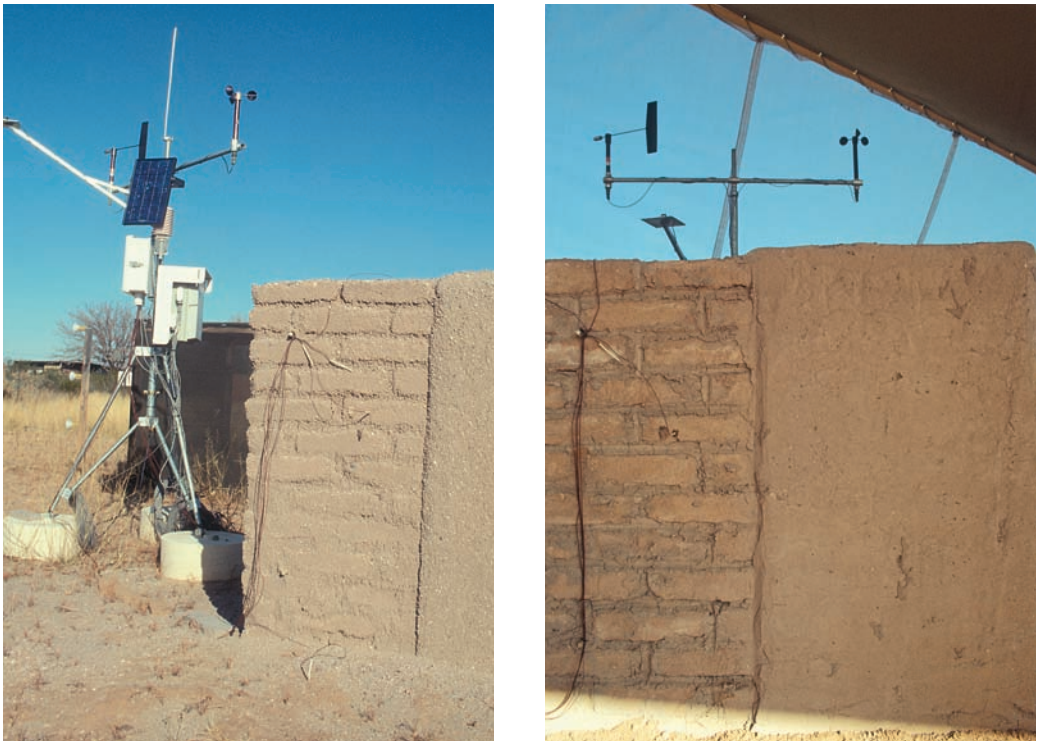
Controls, Replicas, and Test Materials

A potentially effective way to demonstrate the effectiveness of a shelter is to assess the effects of the shelter on controls or replicas placed within it. This is employed by an increasing number of initiatives; for example, at Fort Selden an exposed earthen test wall exhibited significant deterioration after nine months compared with the sheltered test wall (fig. 3). Monitoring the condition of replicas or other test materials eliminates risk to the original asset during testing; however, efficacy depends on a good understanding of the original and contaminant materials and the similarity of the analogue replica to those. Moreover, interpretation of results needs to take account of the likely differences in original and replica materials.

Computer Modeling and Test Structures for New Shelters

For predicting the performance of proposed shelters, computer modeling is demonstrating potential value as a design aid by characterizing the thermal response of the proposed building envelope to different conditions such as climate and anticipated usage. At Brading Roman Villa in England the new passive-design shelter is designed to provide conditions that mitigate environmentally driven deterioration. Thermal modeling demonstrated that a relatively stable internal climate could be achieved year-round without active mechanical climate control (fig. 4).[7]

However, the thermal model does not predict the influence of water vapor, a critical factor in deterioration. For example, moisture may enter the shelter envelope from the ground (especially during periods of heavy rain, increased temperature, or rising water table) or be contributed by the construction materials themselves, which can act as moisture reservoirs and desorb moisture into the shelter under certain conditions. These limitations emphasize the need for continued evaluation after shelter construction to identify long-term conditions that may be damaging. This is being carried out at Ephesus in Turkey and is part of the strategy for the new shelters proposed at megalithic temple sites in Malta.[8] Ideally, new designs for shelters should incorporate flexibility for modification in response to postconstruction review.



(a) (b)

FIGURE 3A, B Fort Selden, New Mexico. Adobe test walls outside the hexashelter (a) and beneath the hexashelter (b) after nine months of exposure. Photos: Neville Agnew. © J. Paul Getty Trust 1991.

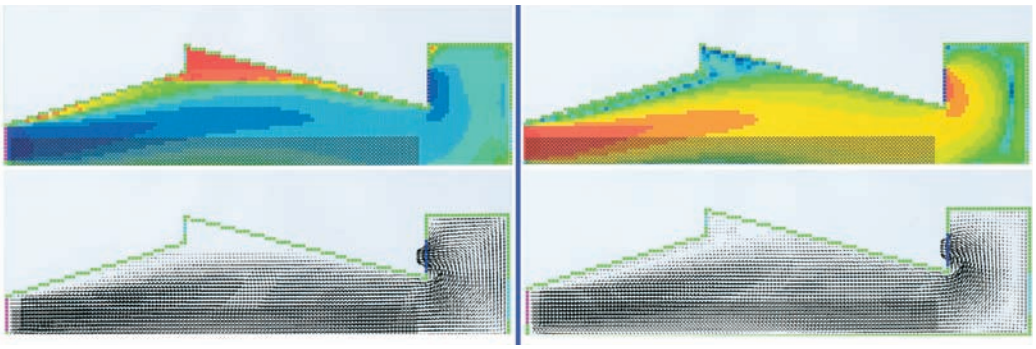


FIGURE 4 Brading Roman Villa. Winter (left) and summer (right) predictions of temperature (above) and airflow distribution (below) by means of computational fluid dynamics analysis. Courtesy of Gifford.

An alternative to computer modeling is the use of test structures to determine the optimal design properties for a permanent shelter. An adjustable tent structure has been erected at Cleeve Abbey in England, where the medieval tile pavement is vulnerable to thermal stresses.[9] The performance of this test shelter in varying configurations will be evaluated over a five-year period with some of the methods discussed above. This provides the opportunity to examine the benefits of a relatively simple cover in order to confirm that sheltering is an appropriate long-term conservation option. However, the inherent limitations of the simple cover mean that the environment created by a more complex design cannot be simulated.

Exemplary Assessment Projects

Several cases have emerged as models in shelter assessment. In these examples, the investigations and monitoring program were part of a larger conservation strategy and were based on coherent methodologies developed expressly to better understand the role of the shelter in the preservation of the archaeological resource.

The research at the Roman mosaic site of Orbe-Boscéaz stands out as a comprehensive and effective investigative program.[10] Laboratory experiments characterizing material behavior were supported by environmental monitoring (of both ambient climate and subterranean conditions) and condition monitoring. The results identified specific environmental parameters for the preservation of the mosaics, which prompted subsequent modifications of the shelter and a strategy for control of the shelter microclimate and subsurface conditions.

The program at Chedworth is notable for its integrated monitoring strategy and for the considerable research into multiple components of the site. Monitoring of various parameters using innovative as well as traditional quantitative and qualitative methods provided insight into the relationship between the shelters and condition of the mosaics (fig. 5). Also in England, Brading exemplifies a well-structured sheltering project with preliminary investigations into deterioration and definition of performance criteria before design, design testing with computer simulation, and the means of assessment after construction by environmental monitoring.

At Fort Selden an integrated monitoring program with replica earthen panels was employed to evaluate the performance of the modular hexashelter. The study also correlated condition with the prevailing environment, and protective indices quantified the degree to which the shelter reduced environmental variations. A similar approach was carried out at Joya de Cerén, where large earthen structures are protected by varying shelter types.

Although these cases employed a number of different methods in various combinations, they share some underlying approaches, which make them of interest:

- Clear articulation of the mechanisms of deterioration and of the real and potential risks to the features, by means of well-planned investigations undertaken by professionals.
- Consideration of the shelter as an intervention within the whole environment. Integrated monitoring strategies were developed relative to the identified risks while taking account of the variables of the resource, microclimate, and subsurface environment.
- Acknowledgment that research needs to be of a multidisciplinary nature and that only relevant specialists working in collaboration with conservators are able to choose the approaches and methods most appropriate to the specific needs of any one site.



(a)



(b)

FIGURE 5A, B Orbe-Boscéaz. The nineteenth-century shelter (a) and Roman mosaic (b). Courtesy of Archéologie Cantonale–Canton de Vaud–Switzerland.

Future Perspectives

Over the past decade the importance of evaluating shelter performance has been increasingly acknowledged. Other significant results are anticipated from assessment projects in progress, such as Piazza Armerina in Italy (Meli 2004), Brading in England, and Ephesus in Turkey, as well as of the proposed shelters at Dolmen de Dombate in Spain (*Dolmen de Dombate* 2005) and at Hagar Qim and Mnajdra in Malta (Lino Bianco and Associates 2004).

Most of the studies use familiar diagnostic methods of varying complexity; more novel methods were also occasionally encountered, such as tools for monitoring dimensional change. However, there are clearly technological gaps, for example, in masonry and soil moisture monitoring, that need to be addressed. Other conservation fields with parallel areas of investigation may provide some solutions. Many of the contributions to the two PARIS (Preservation of Archaeological Remains in Situ) conferences examine ways of monitoring the burial environment, and these could shed light on appropriate methodologies and instrumentation (Corfield et al. 1996; Nixon 2004). Further evaluations of indicator materials specifically for mosaics would be useful. There is also scope for investigating additional parameters, such as ventilation/air exchange or dust deposition, not encountered in any of the project descriptions. As instrumentation is always adapted from other industries, dissemination of methods, results, and evaluations is critical to advance the field.

Omissions in the approaches to shelter assessment are noticeable. Condition monitoring is rarely correlated with environmental data, and more in-depth investigations into the causes and processes of deterioration are often lacking. Integrated approaches using a variety of techniques are clearly beneficial, although they require careful planning and investment of time and money. Ultimately, there is a need to define a model methodology to guide the assessment of existing shelters, based on the experiences reported above. Shelters are an important investment for the future longevity of the resource as well as the presentation of the site to the public. They are also a major financial investment, including both the initial capital costs and permanent maintenance. Therefore, shelter assessment needs to be an integral component both in any new shelter design and in the long-term conservation plan for the site.

Notes

1 The term *shelter* is used to describe all protective structures that include a roof, from those that are fully enclosed to those that are open on all sides.

2 This review was commissioned by English Heritage. The research continued during Sibylla Tringham's internship at the Getty Conservation Institute (2004–5).

3 Subterranean environments and buildings attached to vertical faces (such as cliff structures) were omitted for the sake of simplicity in the review as these are in different environmental contexts, although they may yield valuable information in the future.

4 Please refer to table 1 for literature references to each site.

5 See in this volume M. Demas, T. Roby, N. Agnew, G. Capriotti, N. Savvides, and D. Michaelides, "Learning from Past Interventions: Evaluation of the Project to Conserve the Orpheus Mosaic at Paphos, Cyprus."

6 See in this volume J. Stewart, "Rapid Assessment of Shelters over Mosaics: Methodology and Initial Results from England"; and J. Neguer and Y. Alef, "Rapid Assessment of Shelters over Mosaics: Initial Results from Israel."

7 Computer simulation has also been used in the design of a shelter for Lot's Basilica, Jordan (more detailed information on the method is provided in Aslan 2001, 2003) and at Ephesus (see Krinzinger 2000).

8 Ephesus: pers. comm., Frederick Krinzinger; Hagar Qim and Mnajdra temples: Lino Bianco and Associates 2004.

9 Pers. comm., Bill Martin, English Heritage.

10 See in this volume D. Weidmann, "Orbe-Boscéaz (Canton de Vaud, Suisse) 1975–2005: 30 ans de réflexions sur la conservation d'anciennes et nouvelles mosaïques."

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Lessons Not Learned: The Shelters at Kourion, Cyprus

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Abstract: *This paper is a critical discussion of the protection of the in situ mosaics with shelters and the overall management plan and landscaping at the site of Kourion. An examination of previous interventions, shelters, and walkways at both Kourion and Paphos reveals the consequences of lessons not learned, as evidenced in the current situation at Kourion. Some of the main problems resulting from the lack of proper planning in conservation and site management are pointed out, in an attempt to use the present unsatisfactory situation as a lesson to be learned for future interventions at other sites on Cyprus.*

Résumé : *Cette communication ouvre un débat critique sur la protection des mosaïques* in situ *par des abris, ainsi que le plan global de gestion/aménagement du site de Kourion. En examinant les interventions du passé, les abris et les passerelles à Kourion, les auteurs évoquent les conséquences des leçons non retenues, telles qu'elles apparaissent sur le site de Kourion. Certains des principaux problèmes découlant du manque de planification adéquate en matière de conservation et gestion de site sont rappelés pour que l'on puisse tirer des enseignements de la situation insatisfaisante actuelle pour des interventions futures sur d'autres sites à Chypre.*

The city of Kourion, which traces its founding to a hero of the Trojan War, is one of the most important and spectacular archaeological sites on Cyprus. The surviving monuments of the area date from the thirteenth century B.C.E. to the seventh century C.E., while most of those located on the so-called Acropolis date to the Roman and early Christian periods. The monuments have been investigated since the 1930s, first by a team from the University of Pennsylvania and later by other excavators, both foreign and local (Swiny 1982; *Kourion* 1987; Soren and James 1988).

The site is famous primarily for the mosaics that decorate a number of buildings, such as the House of the Gladiators, the House of Achilles, the Episcopal Basilica, and, above all, the Annex of Eustolios, whose mosaics have acquired international significance. The Annex was excavated between 1935 and 1948, and its mosaics are dated, by coins found in the bedding layers, to the early fifth century C.E. The mosaics exhibit high technical and artistic quality, but their fame derives from the fact that they are among the rare artistic examples worldwide of the passage from paganism to Christianity. An inscription from the East Portico of the building mentions Apollo as the old patron of the city; another, preserved near the south end of the East Portico, mentions the "symbols of Christ" as the power that holds the building upright (Michaelides 1992: 85).

Because of its monuments and dramatic location, the site has always been one of the main tourist attractions of the island. Despite this, however, its monuments and, in particular, its mosaics have not been properly treated or protected over the years—something that has resulted in the loss of a considerable portion of them.

Previous Shelters at Kourion

Only one mosaic panel in the southeast corner of the portico of the Annex of Eustolios was treated differently. This panel is decorated with birds and fish and is accompanied by the previously mentioned inscription referring to the symbols of Christ, the importance of which was recognized on excavation. Thus, soon after its discovery in 1935, it was covered with a primitive shelter made of stone columns supporting a tiled roof. The other important mosaics of the Annex were lifted onto slabs of concrete reinforced with iron rods and relaid in

their original location but left exposed, without the protection of a shelter (Daniel and McFadden 1938).

The shelter over the inscription panel provided protection for a few years until it was seen as ineffective and then removed. In 1966 two wooden bridges were constructed over the two most important floors in the Annex of Eustolios "so that visitors may move about without stepping on the mosaic floors" (*ARDAC* 1966: 7). These were the mosaic with the Christian inscription and the mosaic depicting the personification of Ktisis located in the *frigidarium* of the bath wing (Michaelides 1992: 86–87). Additional wooden bridges were constructed in 1967 (*ARDAC* 1967: 10), but they deteriorated so much that they had to be replaced in 1974 (*ARDAC* 1974: 16). In 1971 and 1974 some of the previously relaid floors were lifted again because of the corrosive effect of the iron bars (*ARDAC* 1971: 10; 1974: 16). The annual report states that these floors "were set on a new base of lime concrete" (*ARDAC* 1974: 16) (it provides no further information on the composition of the backing material used) and returned to their original position. But again they were not provided with a shelter. No further intervention in terms of protection at the Annex of Eustolios is documented until 1980, when "wooden bridges were constructed to facilitate the viewing of the mosaics and the baths" (*ARDAC* 1980: 15). The bridges were repaired in 1984 (*ARDAC* 1984: 19).

A shelter was added to the Annex to protect the mosaics in 1985, specifically over the mosaic of Ktisis (*ARDAC* 1985: 20) (fig. 1). This shelter was much larger than the one from the 1930s, as it covered most of the remains of the Annex of Eustolios. It consisted of a metal frame covered with translucent corrugated fiberglass sheets. This provided partial protection to the mosaics, most of which had been lifted and relaid on iron-reinforced "lime concrete" panels (*ARDAC* 1974: 16). An attempt was made to create a windshield by adding a skirting at the top, but this proved insufficient, as it failed to solve the major problem the site is facing: complete exposure to the strong, salty winds that come from the sea. Within a few years the shelter had become unsightly and unsafe, destroyed by the relentless sun and wind, a condition exacerbated by the lack of proper maintenance. New wooden walkways were provided for the Annex, but it is unspecified whether these were additions or replacements of the existing ones (*ARDAC* 1986: 20). Work began in 1987 on the construction of a shelter over the mosaics of the "Exedra" (southeast corner of the Annex) and was completed in 1988 (*ARDAC* 1987: 22; 1988: 23).

This shelter was replaced by a new one in 1990–91. It followed similar principles of design and construction as the previous one, but this time the metal structure was larger and roofed with corrugated iron sheets. A larger skirting was added at the top, but given the weather conditions and the lack of maintenance, this shelter deteriorated even faster than its predecessor. The metal parts oxidized severely, and drainage problems also occurred. Moreover, despite the skirting, dust and rain (carried by the wind), as well as sunlight, came into direct contact with the mosaics.



FIGURE 1 The shelter constructed over the Annex of Eustolios in 1985. Courtesy of Department of Antiquities, Nicosia, Cyprus.

In recent years the Department of Antiquities (Ministry of Communications and Works) decided that given the pressures from the tourism industry and the inadequacy and rapid deterioration of the shelter, the time was ripe for a new shelter—the fifth—over the Annex of Eustolios. The department also decided to landscape the entire site and to "protect" all its major monuments with additional shelters—a project that at the time of writing is well under way but not yet complete.

This brings us to the issue of lessons *not* learned. Apart from the lessons that should have been learned from the previous unsuccessful attempts to protect the mosaics of the Annex of Eustolios, there is also the sad story at the World Heritage Site of Nea Paphos, which provides important lessons that should have been taken into account. Looking at the history of sheltering and landscaping interventions at Paphos, one can see both positive and negative aspects. If these lessons had been taken into consideration when the master plan of Kourion was developed, major errors could have been avoided.

The Site of Paphos

One of the most important aspects of the Paphos master plan was the protection of the mosaic floors with shelters of a uniform design, some of which were going to replace the temporary shelters already on the site (Hadjisavvas 2003: 356). For this reason, some of the old "unsightly" shelters were removed, leaving the exposed mosaics to await new shelters. However, almost twenty years after the plan was drafted the new shelters have not yet been installed. The mosaics remain either exposed to the elements or protected by a series of old shelters, sometimes "temporary" ones, of different designs and variable efficiency.

What has also become evident in the case of the Paphos master plan, however, is its almost total lack of respect for the ancient structures and the way they functioned in antiquity. For example, the visitor is led to enter the Villa of Theseus, not through its original entrance on the east, which survives, but via a bridge over a ruined part of the facade and is taken directly to the spectacular mosaics that decorate the south wing—thus spoiling the logic of the architecture and the original, intended effect of a carefully planned "surprise," a constant element of Roman architecture and mentality.

This and other such issues, including the strain on the site that this landscaping has imposed, have been criticized by the uninitiated public, the local press, and, of course, many professionals, as evidenced in discussions at the 1996 ICCM meeting in Cyprus that followed the site visit and S. Hadjisavvas's presentation (2003: 357–61) and later in print (Stewart 1997).

Another failure of the Paphos project also not taken account of in the planning for the Kourion project was the fact that many of the problems of the newly landscaped archaeological park were the result of a near-total lack of maintenance. A project of such scale demands a relative increase in the number of employees to look after and maintain the new structures, as well as see to the safekeeping of the antiquities, an issue never seriously considered at Paphos.

One positive aspect of the Paphos plan was the location of the new parking lot away from the ticket office, where it had previously been located, thus removing the exhaust fumes, the noise of the air-conditioning systems, and the ice-cream vendors that had been a constant cause for complaints from people working at the site and from visitors.

Despite the lessons (both negative and positive) that should have been learned from the Paphos and the earlier Kourion experiences, nothing seems to have been taken into consideration when it came to designing the new shelters and the landscaping of the site of Kourion.

Current Shelters at Kourion

Beauty is in the eyes of the beholder, but to the eyes of the present writers, the beauty of some of the current shelters at Kourion is diminished or lost when one considers their visual impact on the site. Kourion was a beautiful site in the romantic sense of the word: well-preserved ruins in a beautiful landscape with the sea as a backdrop. Now, however, the site, both from within and from without, is marred by these shelters, which seem to have grown up like mushrooms. Those responsible seem to have been possessed by shelter mania; there are shelters everywhere, even where they were not needed, as in the case of the modern, stone-built ticket office (fig. 2).

How much thought has gone into the functionality of these structures, rather than their uniformity of appearance, is illustrated by the ticket office, the shelter of which was designed so that it covers only the back of the building. Thus the front, with its Perspex ticket windows, is left totally exposed to the strong sun during the first half of the day, making it an unbearable workplace, especially during the summer. Furthermore, this unnecessary shelter mars the wonderful view from the ancient theater across the site and down to the coast. A lack of similar functional considerations characterizes the shelter over the House of the Gladiators (fig. 3), which faces into the wind coming from the sea with what may be described as gaping jaws and draws wind, rain, and salty airborne water over the mosaics all the way to the back of the structure, from where the water has no easy escape.



FIGURE 2 The shelter over the ticket office. Photo by Demetrios Michaelides.



FIGURE 3 The shelter over the House of the Gladiators. Photo by Demetrios Michaelides.

Aside from the protective shelters, the site is now spoiled by what are described as visitor amenities. There is a proliferation of circular pavilions (fig. 4), professed to be resting and viewing points, scattered over the site, with a design alien to the character of the natural landscape. There are also several constructions that can only be described as gallows, set in sometimes very distant and isolated places, from where the adventurous visitor can admire the view over the bay of Kourion (fig. 5).

The Annex of Eustolios

The biggest part of the project is the protective shelter over the Annex of Eustolios (fig. 6). Its design is composed of a wooden arch-shaped frame consisting of heavy, curved beams topped by a membrane roof that covers an area of 30 to 35 square meters. The wooden beams are reinforced with metal bolts and connecting metal cables. The frame is secured to the ground with sixteen enormous cement blocks, whose foundations are 12 meters deep. Unfortunately, more details on the structure and its materials of construction are not yet available.



FIGURE 4 The circular pavilions. Photo by Demetrios Michaelides.



FIGURE 5 One of the site's resting points. Photo by Demetrios Michaelides.



FIGURE 6 The current shelter of the Annex of Eustolios. (Photo by X. Michael 2005)

Aesthetics

Although the shelter is not deprived of aesthetic qualities, it is very bulky and thus imposes on and dominates the landscape. From the outside, it is the sheer size and massiveness that disturbs, and on the inside it is the large and heavy wooden beams, in combination with the wooden walkways and the cement blocks of its foundations. Also, the shelter gives the impression of being too low for its size and seems to oppress the visitor—an impression accentuated during peak visiting hours and even more during the summer heat (fig. 7). There are also several unsightly incongruities, the most obvious of which is the difference in supports, which vary from the monumental for the shelter to the rudimentary for the walkways.

Conservation Effectiveness

It is too early to discuss the effectiveness of the shelter of the Annex of Eustolios in terms of the conservation of the mosaics, as it was only installed about two years ago, and no studies have been conducted to ascertain if the mosaics are faring better than before. Nevertheless, what can be stated is that this shelter, unlike its predecessors, covers the mosaic floors of the building more effectively, as it projects well beyond the edge of the mosaics. However, some pavements, for example, those near the southeast corner of the building, are partially outside the shelter, and others nearby are not well protected since that side of the shelter is open and allows wind and rain to enter.

Furthermore, this shelter is a prime example of the lack of coordination between archaeologists and architects. After one of the training courses organized by the Getty Conservation Institute, in collaboration with the Cyprus Department of Antiquities, in 1993, the latter decided to rebury a Hellenistic pebble mosaic belonging to an earlier building on this spot, which was suffering from erosion. This is one of the most important mosaics on the island, and the decision to rebury it in a scientific manner for protection—the first time ever in Cyprus—is certainly to be admired and commended. Unfortunately, it seems that it was reburied too well, as it was apparently "forgotten" by the archaeologists—and the architects. Hence, it is now left buried just outside the edge of the



FIGURE 7 The low ceilings inside the shelter seem to oppress visitors. Photo by Demetrios Michaelides.

Table 1 The main documented interventions at the Annex of Eustolios, 1935–2004

Date	History and Types of Interventions	Total Cost in CY £	Source
1935–38	A small shelter was constructed over the mosaic panel in the SE corner of the portico.	Not known	Archives of the Cyprus Department of Antiquities
1965	The mosaic pavements were repaired, but it is not known how.	Not known	*ARDAC* 1965
1966	Two wooden bridges were constructed over the Ktisis mosaic and the mosaic with the early Christian inscriptions.	527	*ARDAC* 1966
1967	Three wooden bridges were added at the Annex of Eustolios.	168	*ARDAC* 1967
1969	The mosaic floors of the baths of the Annex were repaired during November–December, and work began on the consolidation and restoration of all the floors of the area.	427	*ARDAC* 1969
1970	The floor of the baths was lifted and relaid on a new foundation and restored.	664	*ARDAC* 1970
1971	The pavement of the entrance hall was lifted and reset in its original position. Conservation began on the mosaic with inscriptions in the large room.	1,351	*ARDAC* 1971
1974	Parts of the wooden bridges were replaced due to advanced deterioration.	437	*ARDAC* 1974
	The mosaic pavement that was lifted before 1939 and reset on a concrete base was lifted again and reset on a new base of "lime concrete."	1,019	
1978	Repairs were carried out on the mosaics in the Annex, but it is not known how. The Hellenistic and Roman remains of the Acropolis were pointed and grouted; some mosaics were lifted and reset, but it is not known which ones.	3,027	*ARDAC* 1978
1979	Parts of the mosaics in the Annex were treated. Some mosaics were also treated in the Basilica and other buildings of the site.	2,966	*ARDAC* 1979
1980	Wooden bridges were constructed to facilitate the viewing of the mosaics and the baths. Mosaic sections were lifted and reset on a new foundation. Conservation work was carried out on the Basilica remains.	2,480	*ARDAC* 1980
1983	The mosaic pavement of the exedra was detached due to the corrosion of the iron bars inside the concrete. The mosaic was removed and cleaned and laid on a new bed of stones and two layers of "lime concrete." Repairs were carried out on the Basilica.	6,789	*ARDAC* 1983
1984	The wooden walkways were repaired.	2,053	*ARDAC* 1984
1985	A shed was constructed above the Ktisis mosaic in the baths, consisting of a metal frame with translucent corrugated fiberglass sheets.	5,901	*ARDAC* 1985
1986	New wooden walkways were constructed. Conservation began on the mosaics of the Nymphaeum.	1,424	*ARDAC* 1986
1987	Work was begun on a shed over the mosaics of the exedra at the Annex.	2,032	*ARDAC* 1987
1988	The shed, begun in December 1987, was finally finished.	8,600	*ARDAC* 1988
1991	A larger shelter was installed, made of a metal structure and roofed with corrugated iron sheets.	8,390	Archives of the Department of Antiquities
1995	Restoration was carried out on the mosaics of the whole site.	14,928	*ARDAC* 1995
2004	The current shelter was constructed.	Not known	

new shelter, on the edge of the precipice, condemned to lie hidden there, as uncovering it now would leave it completely exposed to the elements and lead to its rapid destruction.

Materials: Costs and Maintenance

The shelter and the pathways of the Annex of Eustolios indicate another lesson not learned in terms of conservation and maintenance: the use of materials compatible with the climatic conditions and with low-cost maintenance. The designers of the new shelter and pathways at Kourion have not taken into consideration the previous wooden pathways at the Annex of Eustolios, which deteriorated rapidly and required repeated and costly replacement (table 1). Inevitably, the new shelter and pathways at Kourion will have to withstand the same weather conditions as the previous ones and will eventually deteriorate due to humidity and climate fluctuations. Without frequent and regular maintenance, they will need to be replaced very soon once again.

Damage to the Archaeological Remains

Another disastrous effect of the shelter is the damage it has caused to the ancient remains. The deep foundations have been dug mechanically, with heavy machinery that should not have been allowed on the site, while ignoring the earlier archaeological levels lying under these late structures. When something similar happened in Paphos in the 1990s there was a public outcry, and when work began at Kourion in 2003 there were even stronger protests, to the point that some demonstrators blocked the machinery while others tied themselves to the railings of the Cyprus Museum (Department of Antiquities) in Nicosia. The authorities were not deterred, however. After a brief interruption, the excavation work continued. These foundations, while the deepest, are only the latest set dug for shelters or for the many walkways built over the years at Kourion.

Interpretation of Archaeological Remains

The arrangement of the visitor itineraries to and through the Annex of Eustolios marks two more lessons not learned from the Paphos experience: the need to present the ruins correctly within the spatial organization of the site; and the lack of understanding or the misinterpretation of how the building functioned when it was in use. Itineraries should enable the visitor to understand the role and function of the mosaics in their original context and to be able to relate the mosaics to the overall architectural structure of which they are a part. This, after all, is one of the main reasons for preserving mosaics in situ. The construction of the recent walkways ignores the original layout of the building in a number of ways, only the most serious of which are mentioned here.



FIGURE 8 The entrance for the disabled to the Annex of Eustolios. This is the entrance used by most visitors, thus turning the main entrance to the shelter—seen in the background to the right—into the exit from the Annex. Photo by Demetrios Michaelides.

One enters the site through the Information Center, which has a wooden floor and a glass southern side—materials that are not at all suitable to the dust and local climatic conditions. On exiting the Information Center, one comes across the northern side of the Annex of Eustolios and a secondary entrance to it for the disabled (fig. 8). The main entrance to the Annex is about 100 meters down the hill (seen in fig. 8 in the background behind the sign) and corresponds to the original entrance to the ancient building, but hardly any visitor (not even tourist guides) will walk this distance in the scorching sun. Thus most visitors enter the shelter through the entrance for the disabled, and the first thing they see is the mosaic of Ktisis, which should have been the highlight, reserved for later on in their visit, as was the case in antiquity. Unless they make a special detour, they cannot really appreciate the mosaic, since entering from this side means that they see the panel upside down.

The walkway near the panel of Ktisis is provided with a bench for resting and an exedra for getting a closer view of the mosaic. Both features are a good idea, but the bench is behind the exedra, and consequently those sitting on the bench see nothing but the backs of the visitors who crowd the balcony for a better view of the mosaics.

The pathways that guide visitors through the building do not pay due respect to its original organization, making it difficult to understand how the building functioned. For example, the square atrium with its rectangular pool, "the main architectural focus of the lower complex" (Rupp 1982: 133), cannot now be appreciated (or even easily recognized), since one of the main pathways cuts through it in the most incongruous way. Worst of all, the last thing visitors see when exiting the shelter is a room with the mosaic inscription "Welcome with good health to this house," which, of course, forms the original entrance to the Annex of Eustolios.

Landscaping and Relocation of the Parking Area

The positive lesson that could have been learned from the relocation of the parking area at the site of Paphos outside the archaeological area was unfortunately ignored at Kourion. Thus a new and large car park has been constructed right next to the Annex of Eustolios, which not only is incongruous but also prevents any further archaeological investigation of a large part of one of the most significant areas of the ancient city. Furthermore, the area in front of the Information Center, which is the main entrance to the site, is now designated as the parking space for coaches! The consequences of such an intervention in terms of noise, air pollution, and heat from the exhaust fumes and air-conditioning systems of the coaches seem to have been completely ignored. Instead, the convenience of the drivers and the coach-loads of visitors intent on a quick and "easy" visit seem to have been the primary concern in the landscaping of the site.

Conclusion

It is evident that all the mistakes pointed out could have been avoided if lessons had been learned from the past. Lack of money—a widely used, common excuse—cannot be blamed. Money was not lacking for either the Paphos or the Kourion project. The exact costs for Kourion have not yet been officially reported, but it appears that to date nearly 3.000.000 Cypriot pounds have been spent (at the time of writing, 1.6 Euros = 1 Cypriot pound).

Furthermore, such a huge project should have been the result of a multidisciplinary effort, involving people who have experience in what they are asked to produce. A good architect, for example, is not necessarily an architect who knows how to build shelters over archaeological remains.

Another issue that arises from this discussion is that of reversibility. Even a well-functioning shelter should not be built as a permanent construction. Just as the conservation treatments of artifacts and ruins should be retreatable, the same principle should basically hold true for the construction of a shelter.

Undoubtedly, such a large project should have been accompanied by an equally large increase in the number of staff, whose duty would be to conserve and maintain the antiquities and the shelters, as well as to guard the site. But so far there is no movement in that direction.

The involvement of the various stakeholders in the decision-making process of a site management plan is vital, but this did not happen at Kourion. Despite innumerable articles in the press and demonstrations as have never been seen before in Cyprus, the authorities decided they knew better. Clearly, the Department of Antiquities cannot bear all the blame. After all, many final decisions in large-scale, very costly projects are usually made by institutions other than those directly involved with antiquities.

One may well ask, why the criticism of the Kourion shelters after they have been built? The answer is simple. There have been protests all along, and many articles in the press, some by eminent professionals (e.g., Karageorghis 2005, 2006), criticizing the work that was being carried out on the site. But these were ignored, and the project has continued, albeit with some modifications. Even so, one remains optimistic that since the project is not yet complete some of the errors can be corrected before they become final.

In many ways, however, it is too late for Kourion. But perhaps Kourion can serve as a model to be avoided in the future. Even more important, we hope that with this criticism, some lessons will be learned and similar occurrences can be prevented at other sites, such as Amathous, another beautiful and unspoiled archaeological site, which is next in line for landscaping and roofing in the service of tourism once the Kourion project is completed.

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Une nouvelle approche pour la préservation *in situ* des mosaïques et vestiges archéologiques au Liban : La crypte de l'église Saint-Georges à Beyrouth

Isabelle Skaf et Yasmine Makaroun Bou Assaf

Résumé : *Entre 1994 et 2001, la restauration de la Cathédrale Saint Georges des Grecs orthodoxes de Beyrouth a permis des fouilles menées par le Musée de l'Université américaine de Beyrouth. Une surface de 250 m² sera ouverte au public sous un plancher en béton armé percé d'une paroi vitrée. Cette approche innovante pour le Liban a été le fruit d'une longue concertation. La crypte, accessible par l'extérieur, est un espace confiné sous contrôle climatique complet. Nous présentons les difficultés de conservation des mosaïques et des structures ainsi que les conditions de présentation des mosaïques. Un projet de mise en valeur des vestiges est en cours de réalisation.*

Abstract: *Between 1994 and 2001 the restoration of the Greek Orthodox Saint George's Cathedral provided the opportunity for excavations carried out by the American University of Beirut museum. A surface area of 250 square meters will be opened to the public under a reinforced concrete floor with a glass floor section. This innovative approach for Lebanon was the result of long consultations. The crypt, accessible from outside, is a confined space with permanent climate control. This paper discusses the difficulties with respect to the conservation of mosaics and structures as well as the presentation of mosaics. A presentation and interpretation project for the remains is in progress.*

Dans le cadre de la reconstruction du centre-ville de Beyrouth[1], l'évêché grec orthodoxe a entrepris en 1994 un long processus de restauration de la cathédrale Saint-Georges, située dans le quartier des églises[2], en bordure de la place des Étoiles.

Des recherches pluridisciplinaires

Dans une perspective globale de connaissance du monument et de son contexte, des recherches pluridisciplinaires ont été menées :

- à travers les sources historiques (Davie 1998) et les archives de l'évêché[3] car : « la cathédrale Saint-Georges est le dernier vestige d'un ensemble urbain complet, le centre épiscopal de la communauté grecque orthodoxe de Beyrouth, dont l'origine remonte à la période mamelouke, au moins ».
- à travers une lecture détaillée des phases chronologiques de l'évolution du monument conduite sur les structures du bâti[4] : cette approche a permis de dégager au moins quatre phases constructives du XVIII^e^ à la fin du XIX^e^ siècle.
- par le biais de fouilles archéologiques.

Les fouilles archéologiques[5]

Le projet a débuté par une étape incontournable de dégagements des déblais. Les fouilles en cours dans le secteur immédiat de la cathédrale auguraient des résultats prometteurs, confirmés par les premiers sondages intérieurs réalisés dans la nef centrale. Ces derniers ont livrés des indices qui témoignent de l'occupation ininterrompue du site et des origines anciennes de la cathédrale. Six niveaux d'occupation ont pu être identifiés (fig. 1). Les niveaux les plus anciens remontent à la période hellénistique (entre le III^e^ et le I^er^ siècle av. J.-C.) et se limitent dans un sondage étroit à quelques murs, des canalisations et du matériel (anses rhodiennes estampillées, lampes, anses figurées de braseros) ; la période romano-byzantine (entre le I^er^ et le VI^e^ siècle apr. J.-C.) est largement représentée, surtout par un tronçon du *cardo maximus*, des mosaïques variées, des bases de colonnes, un collecteur d'égout.

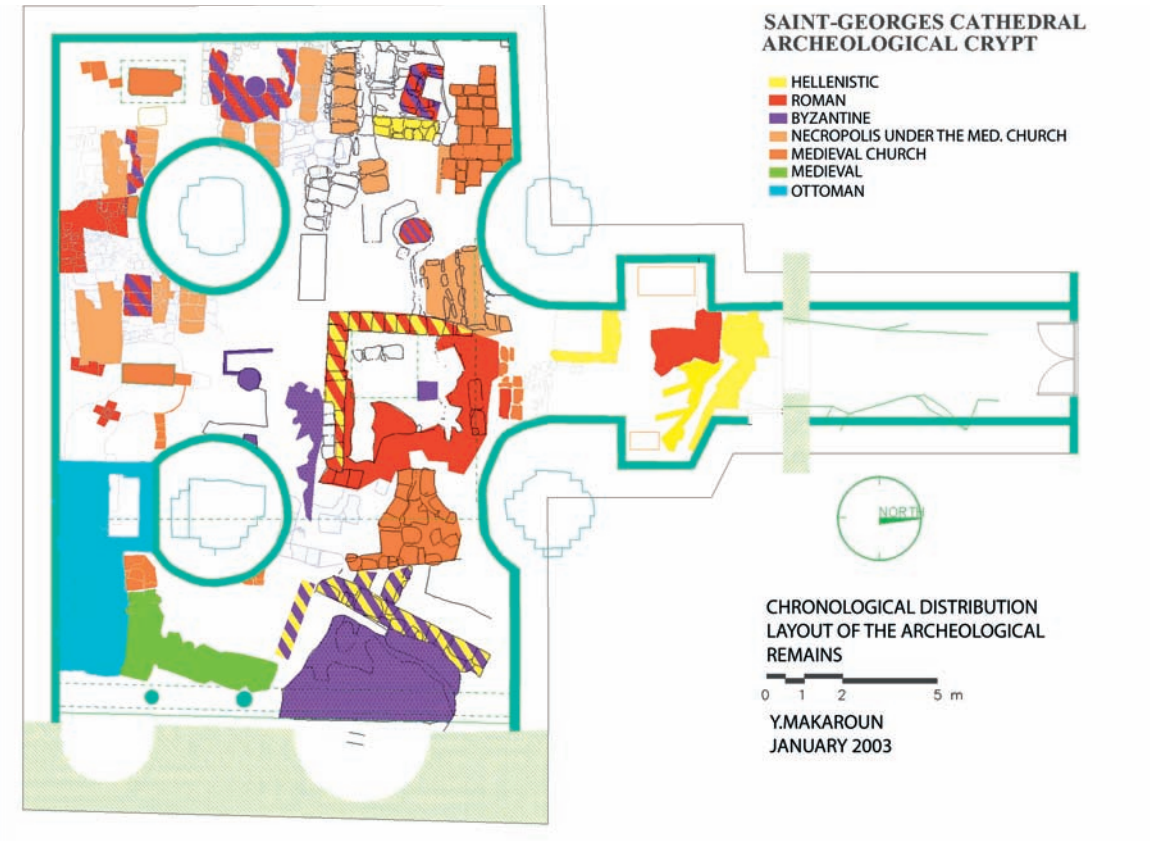


FIGURE 1 Plan des vestiges archéologiques. Reproduit avec la permission de Yasmine Macaroun Bou Assaf.

Les vestiges imposants d'une église marquent l'époque médiévale : piliers enduits peints, dallage en pierre, abside, couvrent une première nécropole. Cette dernière a livré plus de 20 tombes contenant un matériel de qualité (casque en bronze, flèches, croix).

A la période mamelouke, un cimetière se développe autour de l'église, avant sa destruction par un tremblement de terre, en 1759.

Des caveaux funéraires sont construits à la période ottomane contre les vestiges de l'église médiévale. En 1764, la communauté orthodoxe décide de démolir l'ancienne église pour en construire une plus grande, elle-même détruite et reconstruite après maintes transformations. Cette superposition continue d'églises devient le trait marquant du site.

Au regard de ces découvertes agrémentées par un matériel de qualité, le Comité de restauration de la cathédrale a été confronté à la question de la poursuite des fouilles face aux demandes pressantes de réhabilitation du monument au culte. Un délai de réflexion a été nécessaire avant que le Comité ne décide de la poursuite des travaux de fouilles.

Ces derniers étaient conditionnés par des mesures de confortations préliminaires des structures portantes. En effet, un agrandissement inconsidéré des sondages risquait de mettre en péril la stabilité de l'édifice. Des études géotechniques, étayées par des carottages, préconisaient la mise en place de micro-pieux[6].

Dans le cas similaire de réalisation de fouilles archéologiques sous la cathédrale Saint-Pierre de Genève, le prolongement des fondations par des micro-pieux a permis la confortation des structures instables et la possibilité de réaliser des fouilles extensives avant les travaux de restructuration du plancher. Malgré de nombreuses similitudes, le cas de la cathédrale Saint-Georges des Orthodoxes de Beyrouth, présentait des conditions différentes : des contraintes budgétaires et surtout de délais relatifs à la reprise des travaux de restauration ont conduit le Comité à renoncer à fouiller l'ensemble du monument et à se restreindre à la moitié de la surface.

Un projet d'extension des annexes de la cathédrale (salons, services, locaux techniques et autres) a conduit à la fouille du parvis nord, ce qui a permis de découvrir les vestiges d'un quartier hellénistique et d'imposants éléments de l'urbanisme romain, dont un tronçon du *cardo maximus*. Les éléments majeurs du stylobate et deux bases moulurées ont été réintégrés dans le plancher du salon de la paroisse (fig. 2).



FIGURE 2 Insertion des éléments du *cardo-maximus* dans le plancher du salon. Photo I. Skaf.

Le projet de crypte archéologique

Ce projet a vu le jour progressivement, à la lumière des résultats obtenus et de l'ancrage historique qu'ils fournissaient au monument. Cette opportunité unique de présenter ces vestiges *in situ* au public s'est cristallisée dans un concept de plancher-dalle isolant le sous-sol archéologique du lieu de culte. Des travaux préalables de consolidation et de protection des vestiges n'ont pas permis d'enrayer tous les risques de dégradations engendrés par les travaux des structures[7].

Ce nouvel espace confiné a pu être mis en relation visuelle et verticale ponctuelle avec le public à l'aide d'une plaque vitrée, aménagée dans l'axe de la nef centrale.

L'accès de la crypte est limité à une cage d'escalier indépendante et externe, accessible du parvis qui mène par un sas à une brèche percée dans les fondations du monument. Un parcours, prévu pour un public réduit, guidera le visiteur dans les 250 m² de la crypte, le long des vestiges et des vitrines, après une première introduction à l'histoire du monument.

Les problèmes de contrôle climatique

L'atmosphère est régulée par des moyens artificiels et des contrôles réguliers. La relative stabilité hygrothermique des lieux passe par une complète dépendance à un système d'air conditionné – une rupture de cet équilibre s'ajoutant à des paramètres extérieurs pouvant augmenter l'humidité ambiante.

Sans climatisation et sans apport d'air frais, l'humidité relative dans la crypte peut atteindre les 90 % en été, avec des températures atteignant 25 à 30°. À la suite de pannes d'électricité ou d'erreurs de manipulation du système de climatisation (commun avec la cathédrale) nous avons eu à traiter à plusieurs reprises la prolifération de micro-organismes, notamment de champignons (*aspergillus*) et de bactéries. De plus, les bouches d'aération étant mal réparties, certaines parties de la crypte sont plus ventilées que d'autres, d'où un développement plus important de micro-organismes dans les parties les moins aérées.

Le traitement a été effectué par une société spécialisée dans le traitement de plantations agricoles, à l'aide de deux produits Bayer – *Flint 50 WG* (2,5 g / 20 litres d'eau) et *Hygienist CD601* (1 % dans de l'eau) appliqués avec un atomiseur automatique et par aspersion directe à l'aide de pompes manuelles selon les recommandations de la société Bayer. Ces produits avaient été testés avant leur utilisation par application directe sur des fragments de pierre calcaire provenant du site.

Les mosaïques

Des pavements de mosaïques ont été découverts lors des fouilles du parvis nord et déposés dans le but d'une réintégration future dans les annexes de la cathédrale. D'autres pavements ont été mis au jour lors des fouilles à l'intérieur de l'église et ont pu être préservés *in situ* dans le périmètre actuel de la crypte.

Deux pavements à motifs géométriques (fig. 3) sont superposés et situés contre le mur Est de la crypte. La mosaïque supérieure d'une surface d'environ 5 m² se compose d'un motif d'écailles oblongues adjacentes monochromes avec apex chargé d'un bouton de rose (Balmelle et al. 2002 : 340). Le second niveau, qui n'est que très partiellement visible, présente un motif linéaire de méandres de svastikas.

Le pavement supérieur présente des problèmes de conservation principalement liés à l'humidité. Le parvis Est à l'extérieur de la crypte n'est pas dallé et un drainage insuffisant favorise les infiltrations d'eau de pluie. Le mur accolé à



FIGURE 3 Mosaïque à double niveau (Est). Photo I. Skaf.



FIGURE 4 Mosaïque centrale. Photo I. Skaf.

la mosaïque en sous-sol absorbe et emmagasine ainsi beaucoup d'humidité, ce qui favorise le développement de micro-organismes, surtout au point de contact entre le mur et les tesselles ainsi que dans les parties lacunaires du pavement. La bordure qui longe la berme archéologique est très fragile et sa consolidation devra se faire en fonction du traitement de la berme. Dans l'ensemble, la cohésion des tesselles est bonne et le mortier est en bon état.

La mosaïque centrale (fig. 4), d'une surface d'environ 3 m², présente une composition linéaire formée de bandes monochromes et gemmées, d'une tresse et d'un motif de rinceau de lierre. Elle est plus fragile que les pavements précédents car le mortier de base est endommagé et certaines tesselles sont disloquées.

La surface des deux mosaïques est recouverte d'une fine couche de concrétions calcaires. Le développement de micro-organismes et les traitements de désinfection ont été suivis d'opérations de nettoyage répétées avec scalpels, brosses, éponges et un aspirateur.

Les travaux de consolidation de certaines structures en maçonnerie et des bordures des pavements fragilisées par la fouille sont en cours à l'aide d'enduits de chaux. La suite des interventions consistera en une consolidation des substrats et des tesselles avec des mortiers de chaux hydraulique. Le traitement des lacunes ainsi que la poursuite du nettoyage de surface des pavements se poursuivront une fois que le climat de la crypte sera stabilisé.

Impact des mosaïques de la crypte

Il est intéressant de constater que les mosaïques découvertes lors de la fouille archéologique ont eu un certain impact sur la réhabilitation de la cathédrale puisque les motifs de rinceau de lierre et de bandes gemmées de la mosaïque centrale

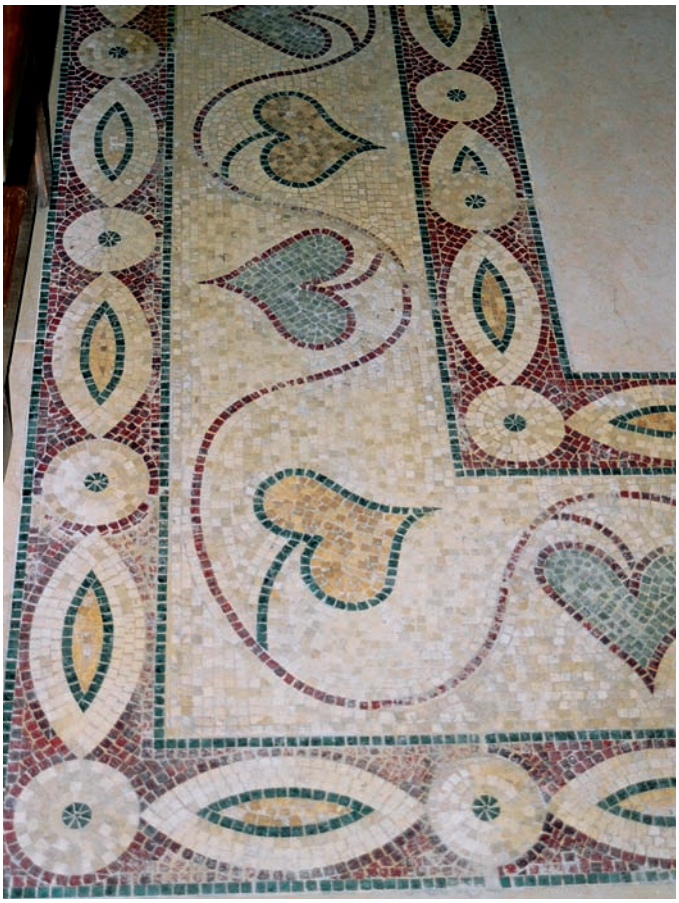


FIGURE 5 Exemple de reproduction du motif de la mosaïque centrale dans les revêtements de sol modernes. Photo I. Skaf.

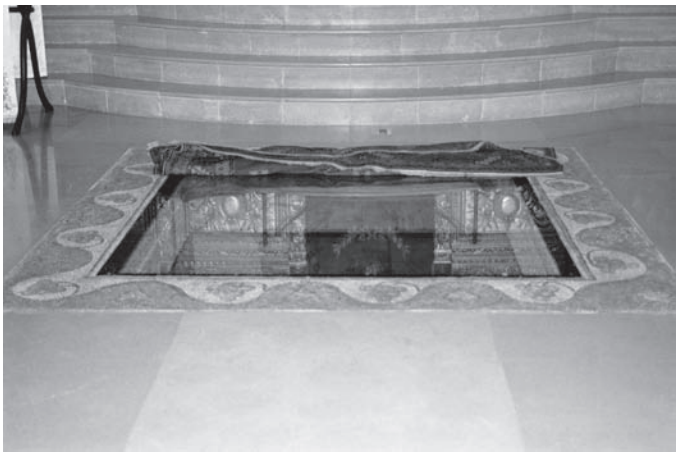


FIGURE 6 Relation verticale crypte/cathédrale. Photo I. Skaf.



FIGURE 7 Une des nouvelles mosaïques acquises sur le marché des antiquités, placée à l'entrée de l'église. Photo I. Skaf.

ont été reproduits dans les revêtements de sol modernes (fig. 5). Cette mosaïque est également visible à travers la plaque vitrée dans l'axe de la nef centrale (fig. 6) de la cathédrale et constitue (avec les vestiges archéologiques qui l'entourent) une attraction pour les visiteurs alors que la crypte est encore fermée au public.

De plus, cinq nouveaux pavements remontés sur dalle de ciment – acquis sur le marché des antiquités et offerts à la paroisse par un mécène – ont été intégrés dans le sol des allées principales de la cathédrale afin de décorer l'édifice et d'attirer un nombre plus important de visiteurs lors des tours archéologiques du centre-ville de Beyrouth (fig. 7).

Il est regrettable qu'aucune mesure ne soit prise pour protéger ces pavements piétinés chaque jour par de nombreux fidèles et visiteurs lors des offices religieux et des visites touristiques, alors qu'un budget important est déjà engagé pour

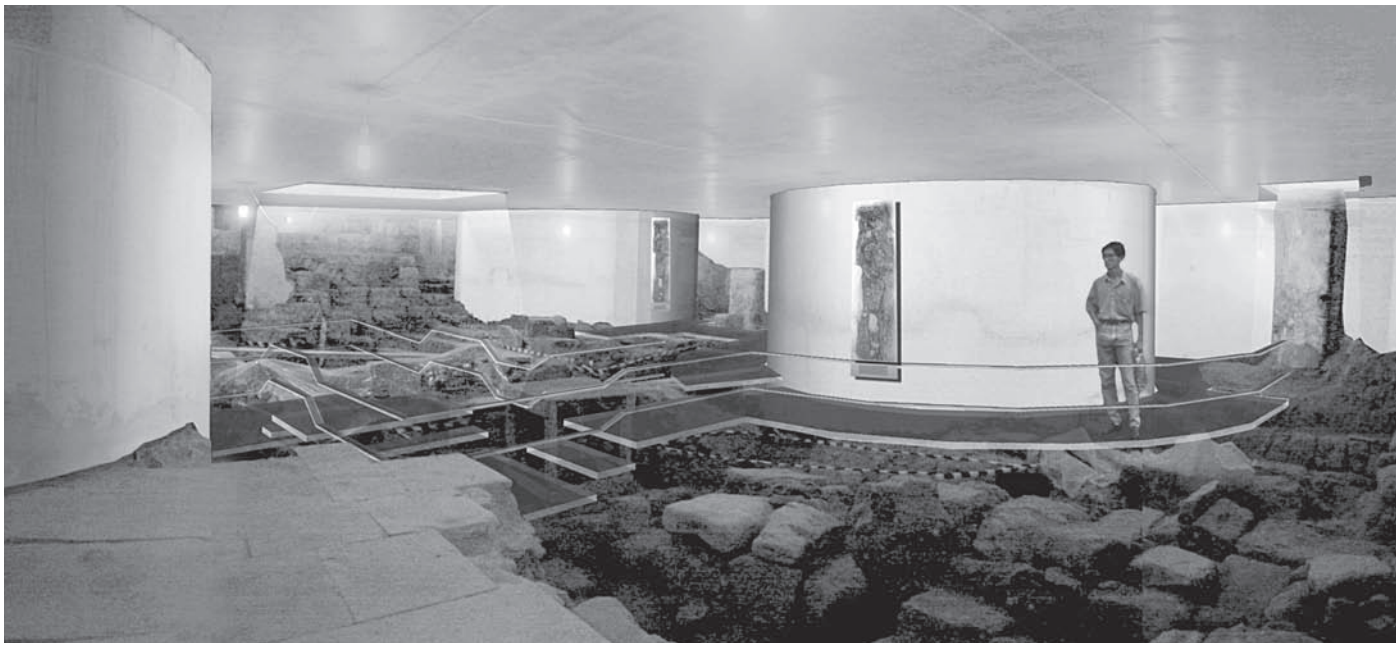


FIGURE 8 Perspective du projet de crypte. Reproduit avec la permission de Yasmine Macaroun Bou Assaf.

la conservation des mosaïques et autres vestiges archéologiques situés dans le sous-sol de cette même cathédrale.

Contrairement à d'autres projets de fouilles dans le centre-ville de Beyrouth qui ont vu des centaines de mètres carrés de pavements déposés et stockés sans lendemain, la volonté dans ce projet, unique au Liban, consiste clairement à préserver les vestiges de la crypte archéologique *in situ* et à les présenter au public (fig. 8).

Certains obstacles financiers et techniques persistent, notamment au niveau du contrôle climatique de la crypte. Il faudra résoudre ces problèmes avant de pouvoir passer à une mise en valeur et à l'ouverture de la crypte au public.

Notes

1 Après les longues années de guerre civile au Liban.

2 Trois églises parmi les plus anciennes de Beyrouth partagent ce secteur : Saint-Georges des Orthodoxes, Saint-Élie des Grecs catholiques et Saint-Georges des Maronites.

3 Slim Souad, Université de Balamand.

4 Dr Samir Rubeiz, Dr Yasmine Makaroun Bou-Assaf, Antoine Fishfish : études historiques du monument non publiées.

5 Dr Leila Badre, Université américaine de Beyrouth : « Rapport préliminaire ». Voir www.stgeorgebeirut.org

6 Certains micro-pieux ont atteint une profondeur de plus de 8 m.

7 Coulures de laitance de béton et déstabilisation de certaines structures.

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140 Years of Mosaic Conservation at Chedworth Roman Villa, United Kingdom

Philip Bethell

Abstract: *Chedworth Roman Villa is one of the most important Roman sites on public display in the United Kingdom. Many features survive, including fragments of at least thirteen mosaic pavements. The treatments that mosaics have undergone since their original excavation in 1864 represent the checkered history of mosaic conservation practice. The site presents the opportunity to examine the treatment of mosaics over a period of 140 years and should be useful for planning future conservation elsewhere. A comprehensive development plan is in progress that we hope will lead to new site shelters with greatly improved conservation performance, ensuring the safety of the mosaics for the next 140 years.*

Résumé : *La villa romaine de Chedworth est un des sites romains majeurs ouverts au public au Royaume-Uni. Plusieurs vestiges ont survécu, y compris des fragments d'au moins treize pavements en mosaïques. Fouillé pour la première fois en 1864, par le traitement de ses mosaïques depuis lors, il illustre l'histoire de la pratique de la conservation des mosaïques. Du fait que ce site permet d'étudier le traitement des mosaïques sur une période de 140 ans, il constitue une référence pour tout projet de conservation à l'avenir. L'élaboration d'un plan global de mise en valeur est en cours qui devrait aboutir à de nouveaux abris présentant des performances améliorées en matière de conservation, assurant ainsi la protection des mosaïques pour encore 140 ans.*

Chedworth Roman Villa is one of the most important Roman sites on public display in the United Kingdom (fig. 1). It has been open to the public for more than 140 years, and more than three million people have visited it. Current visitor levels are at 55,000 to 60,000 per year, surpassed by those of only one other Roman-period domestic site in the United Kingdom. Chedworth is the only Roman villa site open to the public that is owned by the National Trust. Although not to be compared with some of the astonishing treasures of the Mediterranean provinces of Rome, in the British context Chedworth is of the highest significance. Many features of the villa survive, including fragments of at least thirteen mosaic pavements in situ. Other elements, such as 2 kilometers of walls, two bathhouses, several hypocaust systems of varying types, at least one triclinium (dining room), and a water shrine with a running spring, provide evidence of a luxurious fourth-century house. With its long history of preservation and display, it presents an unusual opportunity to study a site where mosaic treatments have been carried out over many years. The conservation activities that began in the 1860s represent a checkered history of mosaic preservation and reflect changes in conservation philosophy and practice over time.

Discovery

The villa was originally excavated in 1864, but no primary records exist of that initial activity. Apart from one short published report (Farrer 1866), the excavators have left us nothing except the exposed ruins. Much later there is a newspaper interview (*Gloucestershire Echo* 1930) with Frederick Norman, who worked on the excavation when he was a boy. According to Norman, the triclinium mosaic was almost complete when first uncovered, but much of it disintegrated on being exposed. He described how thousands of visitors came to the site to marvel at the new discovery and had to be stopped from poking at the mosaics with their umbrellas and sticks. Crucially, none of the mosaics were lifted—the most common practice at the time. A number of other descriptions of the villa were pub-



FIGURE 1 Aerial view of the Chedworth Roman Villa site. The extent of the ruins, the nineteenth-century house, and the site shelters are clearly visible.

lished in the nineteenth century (Scarth 1869; Marshall 1887), but the exact extent of the original investigations remains unknown. One can conclude from modern excavation that the early diggers exposed the walls of the villa and cleared the interiors of the rooms and corridors. They stopped at the fourth century C.E. levels, whether or not there was a mosaic pavement present. Although it is possible to extrapolate the physical intervention carried out on-site, there is no written record of the conservation philosophy behind the initial decision to protect and preserve the site, a decision that was extremely significant for its modern history.

However, it is possible to say something about the social background that prompted the discovery and subsequent display of the villa. Interest in the Roman period at that time was a product of the educational system of the British aristocracy in the nineteenth century. The teaching of classics, including Latin and Greek texts, made Victorian gentlemen well versed in descriptions of life in the luxurious ancient villas of Italy. The discovery of something so "Roman" as a mosaic supported their belief that Roman gentlemen—in their eyes, the direct equivalent of the nineteenth-century British gentleman—had arrived with the invading army and built fine residences in order to rule wisely and civilize the barbarian inhabitants. The aristocracy saw many parallels between the British and Roman empires and between the role of the Roman elite and their own role as the cultural and political elite. Thus to some extent the Roman villa reflected and legitimized their position, as it was the direct forerunner of their own large country houses (Roach Smith 1865; Baddeley 1924)

Conservation History

The owner of the site, Lord Eldon, was determined to present his discovery to the world. Shelters were built over some of the surviving mosaics on-site (fig. 2); other fragments were reburied. The room interiors left unsheltered were covered in earth and allowed to grass over, and the surviving walls were leveled and capped using original stone from the building's collapse. A dedicated site museum was also built, and a house for a resident custodian was added soon after the initial excavation. It is clear that a plan to preserve and display the villa was made from the outset, but what can never be known is the thinking behind the selective reburial of the mosaics. Why were some left exposed and others not? The reasons could vary from the condition of the mosaics (only the least fragile were left uncovered?) to aesthetic considerations (only the most interesting/beautiful were not reburied?) to economic constraints (too costly to shelter and display the whole site?).



FIGURE 2 Late-nineteenth- or early-twentieth-century postcard showing the original site shelters and the wall capping using Roman roof tiles.



FIGURE 3 Early-twentieth-century postcard of the interior of the west bathhouse shelter. The wood-burning stove used for protection from winter frost can be seen to the right.

The site shelters, which still stand today, were essentially contemporary agricultural buildings, of timber frame and stone tile roof construction. The fourth-century masonry was consolidated and repointed with a hard lime mortar to provide a stable base for the shelter superstructure. This major intervention into the historic fabric that compromised the archaeological integrity of the surviving walls is perhaps not something that would be done today. It does, however, bring into focus the fact that one cannot construct shelter buildings without having some impact on the intact archaeology of a site. The decision to construct a shelter always involves some form of balance, with the aim currently being minimal disturbance of in situ archaeology. The nineteenth-century "conservators" did not worry about this too much but concentrated on creating a strong and durable structure to protect what they saw as the real archaeology: the mosaic pavements. It can be said that their work was very good in many ways, in particular, in terms of conservation, as it has preserved the remains that we can still see today, although much of the aboveground masonry has been altered since excavation (Cotswold Archaeology 2005). The three surviving shelters from the 1860s cover the triclinium, the bathhouse in the west range, and part of the north bathhouse (originally interpreted as a *fullonica*) (Fox 1905) (fig. 3).

Early conservation measures inside the newly constructed shelters included the use of wood-burning stoves to prevent frost. Lacunae in the mosaics were filled with a hard cement alone, without using tesserae to attempt to reconstruct patterns, despite their availability. The major changes to the site in the late nineteenth and early twentieth century were the landscaping and planting of the gardens around the villa. The consolidation work done during the 1860s was repaired and renewed, but little else changed. The site was in private ownership until 1924, and there was no consistent management plan. Early photographs show the site sometimes overgrown with trees and weeds, sometimes carefully trimmed and mown, and at various stages in between. There were very few visitors initially, and access to the sheltered mosaics was simply through the doors. Although there were windows in the shelter buildings, they were not opened regularly, so one can suppose that the shelters functioned reasonably well to protect the mosaics by ensuring relatively stable temperatures and humidity.

In 1924 the site came into the ownership of a conservation charity, the National Trust (Waterson 1995), and was marketed and brought to the attention of a wider public from that date. The National Trust had little in the way of resources, and certainly no expertise in the conservation of Roman mosaics at that time.

For the next forty to fifty years the routine maintenance of the mosaics on display consisted primarily of dry-brushing and mopping with spring water (Irvine 2001). A trial cleaning of the triclinium mosaic with diesel fuel sometime in the 1950s was not repeated, though it "gave the mosaic a lovely shine" (Irvine 2001). There was nothing that one would regard today as systematic conservation, but the constant attention paid by the very conscientious resident caretaker was most valuable. His conservation activities were both reactive and preventive. He ensured that the walls and roofs were repaired and that any problems were reported to specialist curators. The value of untrained but sensitive and intelligent caretakers in preserving many archaeological features should not be underestimated. However, this low-level preventive and reactive conservation work was not systematically recorded, so we do not know exactly what regimes were employed for cleaning and repair work until relatively modern times.

In the 1950s and 1960s new archaeological investigations showed the presence of several phases of building during the Roman period (Rutter 1957; Richmond 1959, 1965; Goodburn 1979). The north bathhouse was fully excavated and an additional shelter constructed over its western end, with some small fragments of mosaic preserved in situ. There was still, however, no systematic recording or analysis of the mosaics. As a result it is remarkable that the mosaics have not suffered more deterioration. Some pavements were vulnerable to visitor traffic, but

fortunately the visitor levels were relatively low until the 1960s and the diffusion of private automobiles. Since the mid-1960s visitors have averaged 63,000 per year (Bethell 2005).

The conservation methods employed for the first one hundred years of the villa's life as a public monument can be summarized as follows:

- an initial investment in durable, functional shelters;
- repair of lacunae and resetting of loose tesserae;
- irregular mechanical cleaning;
- selective reburial with no subsequent monitoring; and
- limited excavation and new shelter construction (in the 1960s).

The numerous developments in the theory and practice of conservation since the late 1960s has led to more varied treatments and interventions on the mosaics at Chedworth. It was during the late 1960s that the current overhead electric heating system, controlled thermostatically, replaced the wood-burning stoves (Irvine 2001). It was installed specifically to eliminate dewpoint events and freezing episodes on the mosaic surfaces. In the 1970s and 1980s an archaeologist was employed at the site who began some recording of the mosaics. This included nonrectified vertical photography to make a base record but was not accompanied by systematic monitoring, so its only value today is as a point-in-time reference. As the nineteenth-century shelters aged, some damage to the mosaic floors was noted both from faults in the buildings themselves and from erosion due to increasing visitation. Mitigation strategies were put in place to reduce the effects of visitor traffic on the pavements. Direct public access to the triclinium was stopped, and an external walkway was built. This required replacing the fixed windows in the side of the historic structure with windows that can be opened. The largest lacuna was excavated, revealing the fine, channeled hypocaust below (fig. 4). This also helped to ventilate the mosaic, as it allowed moisture to escape. It also revealed more of the floor's substructure, showing the silted-up hypocaust channels and providing better understanding of the whole structure. Some protective cloth scrim was glued with PVA along the face of the mosaic and mortar support laid along its collapsing edges. At some point water ingress to the shelter building and the action of frost began to damage the northern ends of the triclinium mosaic, and several sections were lifted, pending discussions on their re-laying (Irvine 2001).

A metal frame was erected in the west bathhouse to prevent visitors from stepping directly on the sensitive section of the *frigidarium* floor, and access was restricted to the *apodyterium* because the floor had begun to collapse. There has never been public access inside the new north bathhouse shelter, but it was built with clear glazing on all four sides to allow viewing from the outside (Irvine 2001).

Around 1980 the *apodyterium* mosaic of the west bathhouse was lifted and the hypocaust excavated and rebuilt. The floor was relaid on a hard cement base with a damp-proof plastic membrane. While this arrested the collapse of the pavement, it has had the effect of making the floor look very artificial. It is completely flat, and the colors of the tesserae are dull as there is no capillary moisture in them. The treatment does prevent salt efflorescence and algal growth, however, and therefore has both advantages and disadvantages. This mosaic happens to have the most complex history of ancient repair and re-laying of all those on the site, and it is feared that such archaeological subtleties can be lost as a result of such a drastic intervention (Irvine 2001; Chedworth Site Records n.d.).

In the 1980s limited investigation was initiated to establish the full extent of mosaics still buried on-site. Those in the west wing, between the triclinium and the bathhouse, were exposed and recorded photographically. However, recording was not done in a systematic way, so again it is useful now only as a snapshot in time. The photographs remain the most useful records from this investigation due to the lack of condition recording using modern systems (Chedworth Site Records n.d.).

Further work was carried out in the triclinium, with much discussion on the correct methodology to be used in the re-laying of the pavement fragments that had been lifted for safekeeping around 1980. The debate was a reflection of what was (and is still) going on in the wider world of mosaic conservation regarding the aesthetics of presentation, the need to preserve original bedding material, and so on. Before any re-laying was carried out, a French drain was dug across the back of the building to reduce the flow of water downslope



FIGURE 4 Excavation of the major lacuna in the triclinium mosaic, ca. 1980. The metal barriers were removed and visitor access to the triclinium halted from this date.

into the ground below the hypocaust and consequently into the mosaic through capillary rise (fig. 5). Different re-laying methods were tried, and one small area was treated, like the *apodyterium,* with an impermeable plastic membrane and cement base. Another area was relaid on lime mortar, resulting in a flat surface. Experiments were also carried out to try to reintroduce lime into the leached Roman mortar by dripping a lime solution into the in situ beds, but this has proven largely unsuccessful.

It was only in the early 1990s that the removed sections of the triclinium mosaic were relaid. In the end a decision was made to preserve as much of the surviving fourth-century mortar substrate as possible and to rebuild the mortar beds with materials matching the original. The surface contours were re-created as close as possible to those recorded at the time of lifting, the idea being to blend the appearance of the relaid area with the surviving in situ historic ruin.



FIGURE 5 Re-laying of part of the triclinium mosaic in the early 1990s. As much of the original mortar as possible was retained, and the new mortars were based on particle-size analysis of the Roman material. Photo by Philip Bethell.

Recent Conservation Activities

In the early 1990s a change in management resulted in the appointment of a single manager to control all aspects of the site's management, including conservation, finance, visitor services, and education (National Trust 1993). The desire to redevelop the site was also stated at that time, and long-term plans to create new shelter buildings and display more of the historic features of the villa began to take shape. This required a program of investigation and survey, which continues today.

An early survey undertaken as part of this program was a radar survey of the type used by structural engineers. This enabled the hypocaust tunnels to be mapped, and it also identified areas where adhesion to the mortar substrate was poor. In addition, cracks and other damage to the large flat hypocaust capping stones were recorded. This was very useful evidence for laying down a stricter access regime for the mosaic to carry out periodic cleaning of the surface. Now that the structural delicacy had been revealed by radar it was possible to map those areas of the mosaic that should not have any load placed on them and also to specify the use of foam pads and matching wooden boards to spread the load when cleaning or carrying out conservation of the mosaic (GB Geotechnics 1994).

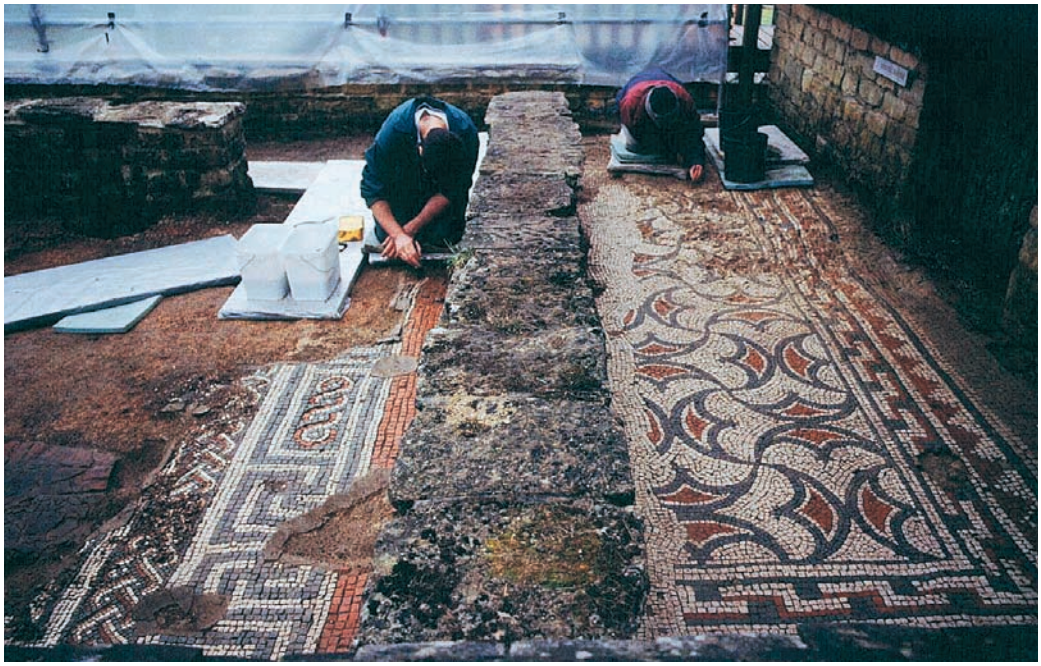


FIGURE 6 Uncovering of mosaics reburied after the 1864 excavation during a sitewide survey in 2000. These mosaics and others were recorded and reburied. Photo by Philip Bethell.



FIGURE 7 Mosaic in the west bathhouse, with subsurface moisture-temperature probe and ambient RH-temperature probes in place. These are part of the continuing environmental monitoring system, using remote radio signaling equipment to transmit data to a logger. Photo by Philip Bethell.

Other surveys have been conducted in recent years. The most exciting, perhaps, was the Buried Mosaic Survey in 2000 (Cotswold Archaeological Trust 2000). This involved test excavations all over the villa to ascertain the full extent of any surviving in situ mosaics (fig. 6). Although there were records of the 1980s intervention, these were not complete, and the intervention was not extensive. Therefore, it was necessary to uncover the three fragmentary floors in the west wing. What was surprising was the presence of an intact pavement with geometric designs under the portico of the west wing, just 5 centimeters below the feet of thousands of visitors. This mosaic was exposed in three small sample areas and found to be intact but in poor condition, as most of the interstitial mortar had disappeared and the bedding mortar was decayed (Stewart 1997).

Other small fragments of mosaic were found in the rooms and corridors of the villa, indicating that it had originally been far more opulent than was previously thought. What is important is that the location, as well as the current condition, of all the surviving mosaics is now known, and plans for their systematic monitoring and long-term conservation can be developed and implemented.

One major project that has been undertaken as part of improving the understanding of the optimum conditions needed for the mosaics and the conservation performance of the shelters is the wireless environmental monitoring program. This ongoing project (Stewart 2004) was instigated in 1997 and uses a number of probes to measure surface temperature, ambient temperature, relative humidity, and even the fabric moisture content inside the various shelter buildings. The readings are relayed via radio signal to a logger and compared with the ambient readings (fig 7). In this way the varying performances of the different shelters can be compared and the effects of introducing changes to the heating and insulation regimes monitored. For example, an analysis of the data from the triclinium led to the decision to switch the heating system to humidistatic control. This has resulted in a marked reduction in condensation on the mosaic surface, almost eliminating surface algal growth. However, this system has created a problem with increased salt efflorescence, as there is more evaporation of capillary moisture from the mosaic surface (Ahmon 2005). Clearly there needs to be a subtler control and heating system.

In addition to the above interventions, there has been a photogrammetric survey of all the exposed mosaics that provides an excellent base record for comparison in the future (Chedworth Site Records n.d.). A comprehensive investigation

of the biological growth associated with the Chedworth mosaics has also been undertaken (Wakefield 2001). In 2004 a base record of the entire exposed historic fabric was completed, enabling a fuller understanding of the context in which the mosaics are located (Cotswold Archaeology 2005). Study of the wider site environment has included a hydrological survey (Hunting Technical Services 1999).

The emphasis in recent years has been to develop a better understanding of the mosaics by surveying and recording their condition, their archaeological context, and their environment. It is clear that remarkably little active intervention has taken place, in the sense of lifting or repairs since the site was excavated, and this adds both to the value of the mosaics and to their conservation problems. In order to widen the involvement of partners in planning the future of the mosaics, a collaborative agreement with University College London's Institute of Archaeology currently enables archaeological conservation students to carry out thorough cleaning and condition recording of the mosaics during an annual fieldwork session. In addition, a new post is being created to provide a permanent conservation assistant on-site so that regular surface cleaning and condition monitoring can be carried out throughout the year. However, the dangers of spending too much time debating what to do while the ancient remains gradually decline are clear.

Conservation work currently under way and carried out in the past five years consists of the following:

- maintenance of historic shelters (including quinquennial structural survey, roof replacement, timber repairs, painting of exterior with wood preserver) (fig. 8);
- monitoring the internal environment of historic shelters and modifications to improve it;
- regular mechanical cleaning, with a defined protocol (including precleaning salt and algae survey, use of deionized water with separate buckets for salt-containing rinse water, use of foam padding to avoid pressure, supervision by a qualified conservator);
- monitoring of reburied mosaics via selective reexcavation and recording and surface temperature monitoring with buried sensors;
- excavation to understand the full extent of surviving archaeology and the hydrology of the site;
- base record production and regular monitoring of exposed historic fabric; and
- long-term conservation planning based on the best practice to date.



FIGURE 8 The triclinium shelter today. The original roof has been repaired and insulated and the timber cleaned and treated, but otherwise the structure is essentially as it was built in the nineteenth century. Photo by Philip Bethell.

Many of the findings from the recent investigations have been summarized in a Conservation Plan (Bethell 2005), which has helped to direct subsequent management of the site. A comprehensive development plan is being worked on. It is hoped that this plan will lead to new site shelters with greatly improved conservation performance, ensuring the preservation of the mosaics for the next 140 years. The much-improved knowledge of the entire site will ensure that the mosaics are not only better conserved but also displayed and understood in the context of the Roman house in which they still sit after nearly seventeen hundred years.

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Discussion—Session 5: Sheltering Mosaics

Présidente/Chair: Évelyne Chantriaux

Discussion following John Stewart, Jacques Neguer, and Sibylla Tringham Presentations

GAËL DE GUICHEN: C'est un commentaire général sur les trois communications. Je crois qu'on ne devrait pas faire une session sur l'évaluation des abris, ce que l'on devrait faire c'est l'évaluation des mosaïques qui sont sous abri. Parce que finalement on est en train de se dire, on a un bel abri, on n'a pas un bel abri, il s'intègre, il ne s'intègre pas, il protège ou il ne protège pas, mais on n'est pas en train de dire ce qui est en train de se passer en-dessous et ça, c'est beaucoup plus difficile. Les deux premières interventions ont parlé de la mosaïque, la troisième a plutôt évalué l'abri en lui-même. Je crois qu'il ne faudrait pas oublier l'objectif de l'abri, l'abri est fait pour protéger la mosaïque et à ce moment là on doit bien étudier comment la mosaïque se modifie ou ne se modifie pas, et pour ceci, je devrais dire que John Stewart a bien cherché à évaluer—justement, il a la chance d'avoir des abris en Angleterre qui datent quelques fois de deux cents ans—et John Stewart s'est bien occupé de la mosaïque. Et le résultat est très intéressant.

ZE'EV MARGALIT: I have a question for the three of you. Do you make a distinction between roof and shelter, which is a complete building? Because when you compare a roof with open walls to the roof of a house with a completely closed environment, the situation of the mosaic is completely different. So, in your assessment, have you, each one of you, differentiated between roofing and shelter?

JOHN STEWART: Well, as I said at the beginning of my presentation, we use the term *shelter* very generally to include all types, but of course, in our own assessments we define what the specific types of designs are. In the case of England, all but one of these structures are enclosures, for obvious reasons—because there is certainly a more severe winter climate. There's one mosaic that is within an open building; it's a mosaic that was lifted and relaid and very heavily restored on a cement bed in the 1970s and, in fact, is very sound, and it's given winter thermal protection. All the structures in England are enclosures, but, of course, in Israel this situation is very different.

JACQUES NEGUER: Yes, we looked at the relationship between shelters—open shelters and enclosures—and the relationship between the state of conservation and the shelter. I presented this. In general, enclosures are protecting the mosaics better, but this is related to the high cost of conservation and building, and at the same time, it's mainly affecting the site and the environment. Open shelters are very different in Israel. We have five identical shelters at two sites, but everything else is different, including the conditions. If we talk about mosaics conserved in situ, everything depends on the maintenance of the mosaics and the shelter together.

JAROSŁAW DOBROWOLSKI: I would like to ask John Stewart for just a bit of clarification. At the beginning, you talked about the shelter, an early-nineteenth-century shelter over a mosaic in Brading, and then you talked about a modern 2004 shelter, also in Brading. Does this mean that the early-nineteenth-century shelter was removed, or is it a different site?

JOHN STEWART: That's a different site. The first site was Bignor; the other site referred to was Brading.

MARTHA DEMAS: I would just like to address Gaël's comments, because I don't see how you can begin to understand what's happening with a mosaic and begin to put forth criteria for

building shelters that are going to protect mosaics without undertaking assessment of the environment of the shelter. I think it is extremely important, and the two are totally interconnected. So, maybe, Gaël, you meant something else, but I did not really understand the objection to the monitoring of shelters. I think it's a very important thing to do.

JACQUES NEGUER: In addition, the microclimate around the shelter itself is extremely important, and the change in the microclimate under the shelter is affecting the mosaics too.

HASSAN LIMANE: Je tiens d'abord à remercier les trois orateurs de leurs sujets, de leurs présentations, bien documentés sur un sujet qui est très délicat. Ce sujet des abris, effectivement, ça pose un gros problème de couvrir les mosaïques. Lorsqu'on est devant un site isolé, c'est simple, mais lorsqu'on a le cas d'un grand site, comme on en a vu des exemples, est-ce que ça ne pose pas un problème du côté paysagiste ? C'est à dire est-ce que ça ne déforme pas le paysage archéologique ? Bien sûr, on est tenté de couvrir l'ensemble des mosaïques, mais la multiplicité de ces abris, est-ce que ça ne déforme pas le paysage du site ? D'un autre côté, on a vu avec vos expériences que même avec les abris, ça réduit tout simplement la dégradation, c'est à dire que devant ce phénomène, devant la mosaïque, je crois qu'il n'y a pas de solution pour arrêter la dégradation, même avec l'abri.

JOHN STEWART: Well, first of all, I would just like to address the first half of your question. Any conservation solution that's chosen for a site obviously needs to be subject to a rigorous process, a methodical process, based on decision making, and that, of course, includes significance, condition of the resource, and the risks to which that resource is exposed. Now, shelters may be one solution or a solution for one site or part of a site but not necessarily the universal solution for an entire site, and of course, it's a combination of options, shelters, reburial, and so on. This morning Chiara Zizola showed us the site in Sardinia where three different types of options were used to present, or in the case of reburial, not to present, part of the site. The shelters are really only one part of the palette of choices that we have to present mosaics in situ, but, of course, there are other methods to protect mosaics in situ, such as reburial or seasonal reburial.

JACQUES NEGUER: Sometimes the shelters are built oversized, protecting not only mosaics but more vulnerable artifacts too, and the choice should be made from the beginning. Do you really need to build a shelter? Do you really want to spend a large amount of money, and not spend this money over time, maintaining the site? This is a big question, and it needs to be answered before the beginning of every construction project. A shelter is not a solution like every conservation operation. This all relates to management and maintenance over time. One solution for everything doesn't exist.

JEANNE MARIE TEUTONICO: This is just a quick comment regarding Martha's and Gaël's comments. I don't think you're really disagreeing with each other. I think what was being said is that it is important to understand the environment underneath the shelter, but it's also important to understand the effect that that environment has on the condition of the mosaics. I think that's what you're all trying to show. Maybe it was emphasized a little bit differently in each presentation, but I think that's the critical point. So, in fact, both are important. You can't understand the environment in the abstract; we have to understand how the environment affects the condition of the mosaic. What you were trying to do, Sibylla, was to show different ways of perhaps assessing that change over time in places where there weren't very good records on how the shelter was designed at the beginning and according to what criteria. So I don't really think there's an essential disagreement.

GAËL DE GUICHEN: L'abri est là pour nous protéger contre sept types d'agresseurs, ce sera le vandalisme, le vent, la poussière, la pluie, les changements de température, les changements d'humidité relative et les microorganismes. Je crois qu'on a fait le tour, là. Le vandalisme, on n'en a pas trop parlé. Le vent et la poussière, ce sera entièrement du si l'abri est ouvert ou fermé, et les trois autres éléments essentiels sont changement de température, changement d'humidité relative et microorganismes. On sait qu'un abri, il réduit les changements de température, ça on le sait, il n'y a pas besoin d'avoir des mosaïques en dessous et au-dessus, il réduit les changements d'humidité relative, on le sait, les microorganismes, on le sait pas. Alors, c'est important, c'est intéressant dans l'approche de John, parce que sont des approches différentes, c'est qu'il a d'abord cherché à voir s'il y avait une amélioration au niveau de la mosaïque du fait de la stabilisation de la température, du fait de la stabilisation de l'humidité. Je crois aussi que ce qu'il y a d'intéressant, c'est qu'il a pu faire des comparaisons, sous le même abri, entre des mosaïques qui avaient été détachées et des mosaïques qui n'avaient pas été détachées. Là, je crois que la méthodologie qu'il a appliquée est très intéressante et devrait être poursuivie.

DENIS WEIDMANN: Je pense que nous ne sommes qu'au début de ces analyses de situation, c'est un domaine très particulier.

On a là les premiers résultats des analyses et c'est très intéressant d'établir, comme le propose Sibylla Tringham, d'unifier un peu les critères, parce que c'est encore ça qui manque. Il faudra intensifier les échanges entre les personnes concernées et je pense qu'il faut multiplier les instruments. Pour répondre à Gaël, c'est les instruments qu'on dispose sous les abris qui vont donner des réponses, la mosaïque, elle répondra beaucoup plus tard aux effets. J'ajouterais un critère de plus peut-être, non pas aux calamités qui nous menacent mais, un phénomène qu'on voit se développer dans le domaine des abris, c'est celui de la prise de possession par les architectes. Certains abris deviennent des créations architecturales qui échappent, peut-être pas au créateur, mais aux archéologues et aux conservateurs. Souvent des projets deviennent des œuvres de pèlerinage d'architecture, on voit ça dans plusieurs musées qui protègent des sites, et là, il y a un autre facteur de difficulté auquel il faudrait prendre attention, peut-être l'illustrer dans certains cas d'analyse.

JACQUES NEGUER: Ce n'était pas une question je pense, mais disons qu'on sait pas toujours ce qu'on cherche. Nous sommes en train d'établir des facteurs à analyser pour comprendre ce qui se passe sous les toitures.

ÉVELYNE CHANTRIAUX: Les architectes sont quand même utiles.

JACQUES NEGUER: L'architecte n'est pas là.

KHALED KARAOUI: Mon intervention essaie de voir et de comprendre l'abri qu'on conçoit. Est-ce qu'il protège la mosaïque ou il protège autre chose ? Est-ce qu'il vise la protection de la mosaïque ou des structures qui sont autour de la mosaïque ? Si la protection est double, de quelle manière l'abri deviendra un élément didactique pour la compréhension peut-être même de l'architecture qui est autour ?

JACQUES NEGUER: Parfois, l'abri ne se protège pas lui-même, il est fait de matériaux qui ne résistent pas à l'environnement. Les matériaux de base de l'abri même se détruisent beaucoup plus vite que les mosaïques. Ensuite, avec la destruction, la corrosion des matériaux de la toiture, nous avons les problèmes sur les mosaïques. Alors, on doit seulement penser avant de construire.

ÉVELYNE CHANTRIAUX: Je pense que la réponse des architectes est déterminée par le cahier des charges qui est établi par les archéologues, les conservateurs, restaurateurs, les manageurs du site, et donc la réponse architecturale, elle sera d'autant meilleure qu'il y a une collaboration avec les différents acteurs qui interviennent sur un site et sur les mosaïques. Vous parliez de mise en valeur, si le cahier des charges met l'accent sur la protection, ça va être une réponse avant tout fonctionnelle, si le cahier des charges met l'accent sur la protection et la mise en valeur du contexte archéologique et avec une intention pédagogique, donc c'est des éléments qui vont influer sur la réponse formelle apportée par les architectes. Après la question de l'appropriation, c'est une question peut-être de rapport de force, c'est à dire si l'architecte est plus fort que les autres, c'est une question, je crois, d'équilibre à trouver entre les différents intervenants.

Discussion following Demetrios Michaelides Presentation

AÏCHA BEN ABED: Ma question est à propos des abris de Kourion. Je voudrais savoir si tu as une idée de ce que ça représentait dans l'esprit des planificateurs, de ceux qui ont fait ces projets d'abri. Est-ce que c'est vraiment un problème de mise en valeur ? Ou est-ce que c'est pour eux réellement, c'est un problème d'abri pour les mosaïques, de conservation pour les mosaïques ? Et qui prend la décision ? Est-ce que ce sont des archéologues, est-ce que ce sont des aménageurs, est-ce que c'est l'Institut du patrimoine ? Quels sont vraiment les décideurs pour ce genre de choix qui me semblent un peu, je sais pas, dépassés, et puis tuer le site que j'ai vu et que je trouve très, très changé depuis.

DEMETRIOS MICHAELIDES: Well, it is a difficult question to answer, in the sense that it's a very complicated process and a lot of it seems to be happening in isolation. The Department of Antiquities, for various reasons, decides that something needs to happen to the site. The proposal has to go to the Programming Office of the government. The Programming Office has to approve it; then they have to find the architect. The architect needs to be briefed. But frequently the architect is not briefed; also, the architect is not necessarily knowledgeable about ancient sites. So the architect is allowed to create, which is his right to do because nobody told him to do otherwise. When he arrives with a finished result, it goes to the Department of Antiquities. The Department of Antiquities says, "I don't like this, I don't like that." The architect says, "But it's going to cost much more." The plan goes back to the Programming Office, which says, "No more money," and then you start losing control over what happens, and either nothing happens, as in Paphos for twenty years, or something like this happens. And at the end, you can't blame anybody. It's the lack

of working together and programming everything well ahead. You can't find the mistakes of the shelter once it's built or once you sign an agreement that it's going to be built. You have to find them before. But if you don't ask for advice, you don't get it. The original thinking is that the shelters are to protect the mosaics, to make them accessible, and to guide the thousands of tourists that walk through the site in the summer in a manageable way. But they don't work like that, and we can't tell yet whether they are actually protecting the mosaics that are under them. We know the shelters don't protect the ones on the edge, because they're outside them.

FEDERICO GUIDOBALDI: This morning we heard about educating archaeologists in conservation. I think it's time to talk about educating architects in conservation because it's usually a great problem. I have lots of friends, splendid architects who understand conservation, but there's a large percentage of architects who think that it's very important to be creative, so they have to make something shocking that usually, like the things in Kourion, is not appropriate for us. Really, I think it's a great problem that we have to consider.

DEMETRIOS MICHAELIDES: Well, to a certain extent, yes, and there are architects who are educated in this way. The problem is higher up—the people who really make the decisions. Often, this is neither the architects nor the archaeologists, and this is a major problem in monuments that are controlled by the government. It is a governmental, political decision, and that affects antiquities, and that's where we need enlightenment and education. High up, not the archaeologists and the architects—that we can do among ourselves.

FEDERICO GUIDOBALDI: I was speaking for my country too. In my country the case is quite different: the architects decide; they have the final decision.

AGNIESZKA DOBROWOLSKA: I'm an architect, by the way. But I have a completely different and practical question. You mentioned that there are winds, salty winds, affecting the mosaics. Have you got any examples of any sheltering, or shielding from winds, that give positive results to the monuments, in terms of conservation?

DEMETRIOS MICHAELIDES: No, I cannot. But it is not my field. What I can see there is that all the shelters are open to where the wind comes from. And I think you only need to stand in the shelter to get the wind coming from the sea, so I know that doesn't work without being an architect. But I don't have a solution myself.

Discussion following Isabelle Skaf Presentation

PATRICK BLANC: Oui, ma question à Isabelle, c'est au sujet des gens qui ont repris les motifs et je crois qu'on en a tous rencontrés, des personnes qui font des copies pour la vente au grand public, pour les touristes, et qui sont parfois aussi appelées à faire de la restauration. Parce qu'il y a une contrainte, on est pour refaire à l'identique sur les sites entre autres on aime bien que les mosaïques brillent. C'est une question que je me pose qui n'a pas abordé lors de communications propres sur ce sujet. Je pense qu'il faut avoir une réaction vraiment ferme vis-à-vis de ces personnes qui font des copies et qui finissent par glisser vers la restauration, donc, qui ne sont pas vraiment contrôlées.

ISABELLE SKAF: Les mosaïques de la cathédrale ne sont pas des copies, ce sont des originaux. Ils ont été offerts à l'église, au comité, comme étant des originaux, sauf peut-être pour la petite bordure autour de la fenêtre que je pense être une reconstitution avec des tesselles anciennes. Pour les autres maintenant, je ne sais pas quelle partie de ces pavements est originale et combien est reconstitué, mais les mosaïques ont été offertes comme étant des originaux. Attention, il n'est pas question ici de refaire des nouvelles choses, eux sont convaincus qu'ils ont accepté une donation de cinq pavements anciens pour embellir l'église et augmenter le nombre de visiteurs. Mais ce ne sont pas des nouvelles mosaïques, enfin, ce sont peut-être des nouvelles mosaïques mais l'intention n'était pas celle-là.

PATRICK BLANC: Non, je parlais de celles qui étaient dans l'église, des motifs qui avaient été refaits, inspirés à partir de motifs antiques, le sol. Je voulais dire, c'est qu'il peut y avoir un glissement, donc, les personnes qui ont fait ça, les mosaïstes qui ont fait ce décor en tesselles, c'est une véritable mosaïque.

ISABELLE SKAF: Oui, mais ça, c'est un dallage normal, ce n'est pas des tesselles anciennes, c'est moderne, c'est des carreaux polis. Je ne pense pas qu'il y ait un quelconque désir de faire passer ça pour de l'ancien, non, c'est comme un carrelage normal, ils ont fait ça comme ça avec des petites mosaïques, avec des petits carreaux modernes. Donc, en reprenant le dessin parce qu'ils ont trouvé que c'était bien.

AÏCHA BEN ABED: Je voulais savoir, ces pavements qui seraient des originaux, est-ce qu'on sait d'où ça vient, quelle est leur provenance? Est-ce qu'ils viennent du Liban, d'un monument connu, comment ils sont arrivés là ?

ISABELLE SKAF: C'est un problème qui est très peu abordé au Liban parce qu'il y a quand même tout un aspect politique à ce trafic d'antiquités et les gens, en général, font très attention. Ce que je sais, ce qu'on me dit, c'est que les pavements viennent des pays avoisinants, ils ne viennent pas nécessairement du Liban, je pense qu'on peut le dire. À des personnes de Syrie, on dit que les pavements viennent de Syrie, à des personnes de Turquie, on dit que les pavements viennent de Turquie. Je le dis clairement, c'est ce que j'entends, c'est ce qu'on me dit. Il y a un trafic de pavements de mosaïques important au Liban. Maintenant, comment ça rentre, c'est quand même des grands pavements, je ne sais pas comment ça rentre. Je pense qu'il y a une partie qui est fausse, qui est reconstituée avec des tesselles anciennes, vendues comme étant des originaux. C'est très difficile, enfin, on connaît les marchands, mais il n'y a pas de volonté politique d'arrêter ce trafic actuellement.

AÏCHA BEN ABED: Mais là, c'est quand même une cathédrale, c'est quand même, je ne sais pas, ça me semble un peu …

ISABELLE SKAF: Oui, c'est assez étonnant, je dois dire, mais comme c'était une donation, ils n'ont pas voulu fâcher le mécène. Vous savez, c'est aussi des politesses, le mécène a dû donner de l'argent pour la cathédrale, il a dit « Voilà, j'ai cinq pavements que j'ai achetés sur le marché et je vous les offre, vous ne les voulez pas ? Comment ? » Donc ils les ont pris et ils les ont installés sans état d'âme. Je pensais que l'archéologue en charge de la crypte, qui est un membre éminent du comité, aurait quand même dit quelque chose—rien.

AÏCHA BEN ABED: Le Liban est un pays libre.

ISABELLE SKAF: Oui, enfin, plein de contradictions.

Discussion following Philip Bethell Presentation

JACQUES NEGUER: Did you try to prevent microbiological growth using UV light during non-working hours in the monument? The same question for Isabelle.

ISABELLE SKAF: UV light inside the crypt? No.

PHILIP BETHELL: We haven't tried that yet, but it's one of the plans we'd like to build into our new shelter design—that wonderful, perfect shelter we're going to build with all your advice.

JOHN STEWART: If I can answer your question, there was actually a proposal for Chedworth in 1999 or 2000 to modify the building by the elimination of fenestration on three elevations to introduce better ventilation and, during blackout periods, to introduce UV light and to test the results. But, as Philip said, it's still to be fully implemented.

PART SIX

Training of Conservation Practitioners

Questions d'actualité : La conservation des mosaïques dans le territoire de Gaza, formation de personnel et travaux d'intervention et de préservation des mosaïques *in situ*

Patrick Blanc et Hani Najar

Résumé : *Le programme de coopération associant l'Atelier de Conservation et de Restauration des Mosaïques du Musée de l'Arles et de la Provence Antiques, le Département des Antiquités du Territoire de Gaza et l'École biblique et archéologique française de Jérusalem, placé sous le patronage du Consulat Général de France à Jérusalem, a porté sur la sauvegarde* in situ *des pavements byzantins de Jabaliyah et de Nuseirat. Cette collaboration, engagée depuis dix ans, a permis à l'équipe de restaurateurs franco-palestinienne de poursuivre son travail de conservation des mosaïques du Territoire de Gaza, malgré les difficultés que connaît actuellement la région.*[1]

Abstract: *The program of cooperation among the mosaic conservation and restoration workshop of the Musée de l'Arles et de la Provence antiques, the Gaza Territory Department of Antiquities, and the French Biblical and Archaeological School of Jerusalem, under the auspices of the French General Consulate in Jerusalem, concerned the in situ preservation of the Byzantine pavements of Jabaliyah and Nuseirat. This ten-year collaboration enabled the team of French and Palestinian conservators to continue working on the conservation of mosaics in the Gaza Territory despite the region's present difficulties.*

Depuis 1995, l'Atelier de conservation et de restauration de mosaïques du Musée de l'Arles et de la Provence antiques (Conseil général des Bouches-du-Rhône) participe à des missions archéologiques en coopération avec le Département des Antiquités du Territoire de Gaza et l'École biblique et archéologique française à Jérusalem. Ces dernières années, deux sites byzantins ont été mis au jour, à Jabaliyeh (Blanc 2000) et Umm-el'Amr, livrant des mosaïques d'un riche intérêt iconographique et historique. Cette collaboration a conduit à la création d'une équipe de techniciens palestiniens à même de procéder à des interventions d'urgence pour la sauvegarde des mosaïques antiques.

Nos interventions ont été menées grâce à la logistique de la mission de coopération archéologique franco-palestinienne que codirigent M. Moain Sadek, Directeur du Département des Antiquités de Gaza, au nom de M. Hamdan Taha, Directeur général des Antiquités de Palestine, et Jean-Baptiste Humbert dans le cadre des recherches de l'École biblique. Le Consulat général de France à Jérusalem nous apporte son soutien et son aide pour l'organisation de ces missions. Que tous trouvent ici nos plus vifs remerciements.

Sur le site de Mukheitem à Jabaliyah a été mis au jour fortuitement, en décembre 1996, lors de travaux de construction sur la route reliant Erez à Gaza ville, un vaste complexe ecclésiastique remontant au milieu du V^e^ siècle, presque entièrement mosaïqué dont de nombreuses inscriptions qui permettent de suivre l'évolution du complexe du V^e^ au VIII^e^ siècle. Depuis l'exposition « Gaza méditerranéenne » (Humbert 2000) à l'Institut du monde arabe à Paris, en 2000, présentant pour la première fois cet ensemble, nous avons continué notre collaboration sur le terrain. Après nettoyage et consolidation, les mosaïques ont été réenfouies. Restauration de l'église et de ses annexes, projet de construction d'un abri protégeant le site … Nous examinerons la réalité d'un tel programme.

Au sud de Gaza, en bordure de mer, le monastère de saint Hilarion a été découvert par les archéologues palestiniens en 1997 (Humbert 2000) lors d'un diagnostic en vue d'un projet immobilier. Les fouilles du site se poursuivent depuis 2001 dans le cadre de la mission franco-palestinienne codirigée

par Ayman Hassoune et René Elter, en collaboration avec Jean-Baptiste Humbert. Elles ont permis la mise au jour d'une église et d'un monastère ornés de nombreuses mosaïques ; les bâtiments édifiés vers 360 connaissent des phases de réfection dont la plus importante se situe après le retour des restes d'Hilarion, ermite gaziote, mort à Chypre en 371 ; l'abandon du site paraît lié au tremblement de terre de 747. Tant pour préserver les pavements que pour aider à la poursuite des recherches archéologiques, plusieurs types d'intervention ont été menés par nous sur ce site : dépose, remise en place de mosaïque, consolidations … Ces travaux ont été l'occasion de perfectionnement pour l'équipe palestinienne que nous avions initiée à la conservation des mosaïques.

Jabaliyah

Le Territoire de Gaza est une région où la pierre est rare ; cela est particulièrement manifeste sur le site de Jabaliyah, situé à peine à 3 km du rivage, au pied de la seule colline dominant de 80 m la plaine côtière nord, et constamment balayé par le sable et les vents marins.

Les bâtiments du complexe ecclésiastique ont beaucoup souffert de déprédations diverses, tant durant l'Antiquité qu'à l'époque moderne. L'essentiel des murs a été démantelé ; quelques rares témoins encore en place montrent un appareil de modeste qualité, non calibré, en moellons de *kurkar*.

La compréhension du dispositif architectural est tout de même rendu aisé grâce à la conservation des pavements mosaïqués. Une grande église à trois nefs est bordée par une chapelle sur le côté nord, au-delà de laquelle s'étend un baptistère avec ses annexes.

Si la plupart des pavements subsistent malgré l'iconoclasme qui a touché les représentations d'êtres animés, certains sont plus fortement dégradés, emportés peut-être par des pillages anciens mais aussi par un nivellement récent. Dans l'église, la nef centrale a été particulièrement affectée par l'iconoclasme ; ce qui reste du pavement permet de restituer un tapis composé d'un rinceau de vigne constituant des médaillons dans lesquels devaient être figurés des animaux domestiques et sauvages ; l'ensemble est circonscrit par une guirlande en feuilles d'acanthe peuplée d'animaux et bordé par une chaînette de carrés ; parmi les inscriptions en mosaïque, l'une est datée de 732 de notre ère et serait la plus récente inscription en grec de Gaza.

Le bas-côté sud conserve deux pavements aux décors géométriques et une inscription de la fin du V^e^ siècle. Le bas-côté nord est complet : à l'ouest, un tapis en quadrillage de



FIGURE 1 Une équipe de techniciens a été initiée, dès les premières missions, aux différentes techniques de base pour la conservation *in situ* de mosaïques. Photo © ACRM / MAPA.

fleurs, les cases chargées alternativement de fleurettes et de représentations de vases ou d'aliments divers, fruits, légumes, viandes… : tapis « gastronomique » ou d'offrandes. À l'est, un tapis rectangulaire à huit cases ornées d'animaux – volatiles et quadrupèdes – donne accès à une pièce à abside dont le pavement renferme une inscription.

Plus au nord, entre l'église et le baptistère, une chapelle des offrandes, ou *diaconicon*, est séparée en deux parties à peu près égales par une barrière : à l'ouest, accessible par les fidèles depuis le bas côté-nord, le tapis le plus soigné du complexe figure, en cinq registres, une scène pastorale au milieu d'animaux sauvages. Dans la partie réservée aux diacres, à l'est, une scène agreste et une inscription datée du milieu du V^e^ siècle, mentionnant l'évêque de Gaza, Marcianos, signataire du concile de Chalcédoine en 451.

De vastes dimensions, le baptistère présente une cuve sous édicule. Une inscription donne les noms de Victor et Côme, originaires d'Ascalon, qui auraient orné ce baptistère en 548–549. Au sol, de part et d'autres, des animaux exotiques et des personnifications des fleuves du Paradis. Le péristyle et les salles annexes sont pavés de riches pavements polychromes géométriques.

Devant l'ampleur de la découverte et le bon état général de conservation des pavements, il a été décidé de maintenir les mosaïques en place, de ne pas poursuivre les recherches archéologiques sous les sols et de proposer une présentation au public de l'ensemble ecclésiastique.

Dès notre première intervention, a été mise en place une équipe de techniciens (fig. 1) qui ont ainsi été initiés, dès le départ, aux différentes techniques de base pour la conservation *in situ* de mosaïques :

- La documentation.
- Le nettoyage du *tessellatum*.
- Le nettoyage des structures antiques avant la pose de mortier.
- Le choix des différents matériaux utilisés pour la confection des mortiers, liants, charges et autres.
- La mise en œuvre et le travail des mortiers, l'aspect de surface, la protection lors de leur prise (contre vent et soleil).
- La consolidation du substrat.
- La remise en place de tesselles dans les petites lacunes, exclusivement dans le cas de motifs géométrique répétitifs.
- La maintenance de la cohésion du *tessellatum* par la consolidation du bain de pose.

À la suite de leur mise au jour, de nombreuses zones étant recouvertes de calcite empêchant de lire aisément les décors, les pavements ont été nettoyés. Les bordures du *tessellatum* ont été maintenues par la pose de solins et les lacunes ont été fermées par des mortiers de chaux. Ces interventions ont permis de stabiliser les pavements et de proposer leur maintien sur site.

Par ailleurs, en l'absence des murs – récupérés, seuls les négatifs en sont conservés –, la lecture du plan des édifices était peu compréhensible pour un public non spécialisé. Cette absence des murs fragilisait et déstabilisait également les bordures des pavements (fig. 2).

Afin de pallier ces différents problèmes, il a été décidé dans un premier temps de fouiller et d'atteindre les fondations des murs pillés. Les éléments encore en place et l'ensemble des négatifs de murs ont été recouverts d'une couche de gravier de rivière ; sur cette semelle ont été disposés des parpaings modernes scellés entre eux par un mortier de chaux ; puis ceux-ci ont été enduits par un mortier de chaux abrasé. Les zones lacunaires entre la mosaïque et les restitutions des bases des murs sont fermées par des mortiers de chaux, après dégagement du substrat d'origine. Celui-ci étant parfois absent, il a ensuite fallu reconstituer le radier de pierres.

En élévation, ces reconstitutions de murs restent très limitées, ne cherchant nullement à donner une quelconque idée de ce que pouvait être l'appareil antique. D'autre part, ne reposant directement sur aucune structure d'origine qui aurait été préservée, elles sont aisément réversibles.

L'emploi de matériaux modernes peut choquer – nous en sommes conscients –, mais cela résulte d'un choix volontaire de notre part. Afin de placer nos interventions sur un plan didactique, il était indispensable pour tous nos travaux d'employer du matériel et des matériaux aisément disponibles dans le Territoire de Gaza, d'un coût relativement bas et disponibles dans les commerces de matériaux de construction du pays. Les produits pour lesquels nous avons opté sont utilisés en grande quantité en Palestine lors des travaux d'urbanisation. Les techniciens formés à l'occasion de cette coopération sauront ainsi se procurer les matériaux que nous avons appris à mettre en œuvre. Parallèlement, toutes nos interventions devaient être aisément identifiables et réversibles. C'est le cas des mortiers en contact avec les structures antiques ; mais aussi de l'utilisation de parpaings qui ne peuvent évidemment pas se confondre avec des matériaux antiques (fig. 3).



FIGURE 2 La lecture du plan des édifices était peu compréhensible pour un public non spécialisé. L'absence des murs fragilisait et déstabilisait également les bordures des pavements. Photo © ACRM / MAPA.



FIGURE 3 Nos interventions devaient être aisément identifiables et réversibles. Photo © ACRM / MAPA.

Le site se trouvant dans une zone connaissant un fort développement urbain, il avait été nécessaire de protéger efficacement l'ensemble des découvertes. Une première couverture de protection temporaire avait été posée sur les mosaïques. Constituée d'une couche épaisse de sable, elle restait difficilement en place et n'était retenue par rien lors des pluies et des vents violents.

Grâce à l'aide du Programme des Nations Unies pour le Développement, l'ensemble du site a été enclos d'un mur et un bâtiment d'accueil construit (fig. 4). Utilisé par les personnes qui font l'entretien et la maintenance du site, le bâtiment pourra servir dans l'avenir à accueillir le public, voire abriter un musée de site.

Enfin, la couverture de l'ensemble de l'église et de ses dépendances par un abri est prévue par les autorités palestiniennes. Elle sera prochainement mise en construction. Ce dernier aménagement permettra de retirer les couches de sable recouvrant les mosaïques. Après des compléments d'interventions, les pavements pourront rester visibles en permanence. Le site de Jabaliyah deviendra alors un bel exemple d'un complexe byzantin sauvegardé sur site et visitable par le public, peut-être le premier d'une telle ampleur ainsi présenté.

Le monastère de saint Hilarion, à Umm-el'Amr

Depuis 2003, à Umm-el'Amr également, l'Atelier poursuit son travail d'encadrement et de formation d'une équipe locale, parallèlement à la poursuite de la fouille. Grâce à la compréhension du Département des Antiquités de Gaza, c'est la même équipe de techniciens qui a travaillé à Jabaliyah qui a pu continuer son apprentissage et compléter ses expériences sur ce nouveau site (fig. 5).

L'ensemble des découvertes comprend une église et un monastère pavés de nombreuses mosaïques géométriques essentiellement. Celles-ci présentent des états de conservation divers. Dès les premières découvertes, l'UNESCO a financé la mise en place de trois abris ; à terme, ceux-ci devront être reconsidérés.



FIGURE 4 L'ensemble du site a été enclos d'un mur et un bâtiment d'accueil construit. Utilisé par le personnel de maintenance, ce bâtiment servira aussi de musée de site et pour l'accueil du public. Photo © ACRM / MAPA.



FIGURE 5 Le monastère de saint Hilarion, à Umm-el'Amr, consolidation de la périphérie du pavement. Photo © ACRM / MAPA.



FIGURE 6 Préparation pour la consolidation de la mosaïque du chœur afin d'autoriser la fouille de la tombe. Photo © ACRM / MAPA.

Après examen attentif et documentation, nos travaux ont porté sur la consolidation de base de tous les pavements. Un travail particulier a été fait sur les pavements se trouvant dans l'église, et plus particulièrement dans le chœur. La mosaïque du chœur correspondant au deuxième état de l'édifice a été déposée afin de permettre le dégagement du sol mosaïqué de l'église primitive.

La fouille, autorisée grâce à cette dépose, a dégagé alors l'inscription identifiant Hilarion ainsi qu'un caveau se trouvant en partie sous la mosaïque de la nef centrale, en partie sous celle du chœur (fig. 6). Pour dégager la porte d'accès au tombeau présumé d'Hilarion afin d'y réaliser les relevés archéologiques nécessaires, nous avons appliqué, en accord avec les archéologues, un traitement de consolidation spécifique sur la mosaïque du premier état dont le support reposait sur un niveau de sable. Autorisant tout de même une fouille stratigraphique en sous-œuvre, sous le support de la mosaïque, cette opération a évité une seconde dépose. Le site ne présente actuellement aucune structure permettant la mise en réserve des panneaux déposés ; le premier pavement avait déjà dû être transféré à Gaza.

Par ailleurs, dans un bâtiment annexe du monastère, dans le secteur de la mosaïque dite des « Quatre Fleuves », une partie de mosaïque blanche sans décor a été déposée en 2003 pour permettre un sondage archéologique et évaluer la stratification puis les phases du bâti. La réinsertion des panneaux prélevés en 2005 a été l'occasion d'un chantier-école touchant à la repose de mosaïques sur support en recréant les strates d'origine du support antique avec des mortiers de chaux (fig. 7, 8). La remise en place même de ces modestes panneaux de mosaïque blanche participe au maintien de la cohérence de l'ensemble des vestiges.



FIGURE 7 Nettoyage des revers du *tessellatum* avant remise en place des panneaux de mosaïques. Photo © ACRM / MAPA.



FIGURE 8 Réintégration des saignées après repose de la mosaïque sur site. Photo © ACRM / MAPA.

Outre l'évidente sauvegarde des vestiges et des pavements, l'une de nos préoccupations principales est de favoriser l'appropriation des vestiges par les personnes qui travaillent sur les sites et qui en sont, bien souvent, de proches habitants. Pour ce faire, les sites doivent être accessibles, même lors de nos travaux. Nous avons fréquemment rencontré une demande forte de connaître, de comprendre l'histoire enfouie dont les vestiges, mosaïques ou autres, sont les témoins. Les visites nombreuses de groupes scolaires en attestent, mais aussi les rencontres plus ponctuelles de voisinage. Présenter le site, le rendre compréhensible fait partie de notre projet ; avec l'ICCM nous en avons bien souvent débattu.

Au cours de ces interventions, nous avons présenté et mis en pratique avec l'équipe de restaurateurs et de techniciens palestiniens, des méthodes de nettoyage, de consolidation, de dépose et de remise en place de mosaïques, de réenfouissement, de documentation, développant des techniques claires, simples à mettre en œuvre, peu onéreuses en matériel, autorisant à terme une présentation au public. Ces pratiques de conservation *in situ* pourront aisément être répétées en d'autres circonstances par les techniciens à la formation desquels nous avons ainsi collaboré.

Ces opérations ne sont pas achevées. La situation à Gaza n'est pas toujours simple et nous devons fréquemment ralentir, voire suspendre momentanément nos travaux. Depuis le début de nos interventions dans le Territoire de Gaza, l'équipe a été constituée des mêmes restaurateurs et techniciens tant du côté palestinien que français, assurant ainsi une continuité du travail et nous permettant aussi de mieux appréhender cette coopération, d'apprendre à échanger et à nous connaître, créant ainsi de solides liens d'amitié.

Notes

1 L'équipe réunie autour de nous comptait également MM. Salim Abdan, Mohamed Wael Hamudeh, Awny Khatab, Raed Khatab et Fadel el-Otol, du Département des Antiquités de Gaza, et Marie-Laure Courboulès, de l'Atelier de conservation et de restauration, MAPA.

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Experiences in Mosaic Conservation Training in the Middle East

Osama Hamdan, Tagrid Shaaban, and Carla Benelli

Abstract: *The conservation of cultural heritage in the Middle East has always been a complex matter, fraught with difficulties. One of the most serious problems has been the lack of skilled personnel at all levels. For some years, a team of conservators, working under the scientific supervision of Fr. Michele Piccirillo, has undertaken the conservation training of local personnel. This paper deals with the experiences of the Jericho Workshop for Mosaic Restoration, the conservation of the mosaics in 'Ain Duk–Na'aran Synagogue in Jericho, and the Bilad Al Sham training course in the conservation of ancient mosaics.*

Résumé : *La conservation du patrimoine culturel au Moyen-Orient a toujours été complexe et difficile. Un des problèmes majeurs est celui du manque de personnel qualifié à tous les niveaux. Depuis quelques années, une équipe de conservateurs, œuvrant sous la supervision du Père Michele Piccirillo, forme le personnel local en matière de conservation. Cette communication évoque les expériences de l'Atelier de Jéricho pour la Restauration de la Mosaïque, la conservation des mosaïques de la synagogue 'Ain Duk-Na'aran de Jéricho et le cours de formation en conservation des mosaïques anciennes de Bilad Al Sham.*

The State of Cultural Heritage in the Middle East Today

In the Middle East the urgency to meet basic needs means that cultural heritage is not considered a priority, despite its historic and artistic value. Thus only recently has conservation been introduced into the educational programs of local institutions. The variety and quality of local cultural heritage needs the attention and assistance of all those interested in its conservation and enhancement. It is especially important to train specialized local staff so they can intervene directly in order to safeguard their extraordinary heritage. It is also crucially important to support dedicated academic programs that can train at both technical and highly specialized levels.

Cultural Heritage, Sustainable Development, and the Local Economy

Cultural heritage has the potential to become an extraordinary resource for local development throughout the Middle East. Religious tourism has always characterized the region, and major monotheistic religions found here often share innumerable spiritual and material elements, reinforced over centuries of pilgrimage. Even the natural landscape is a reminder of the historical past. Thus investing in cultural heritage could promote progress for various productive sectors, including handicrafts and services related to tourism, which could lead to job creation (Valentino and Misiani 2004).

Limiting Conditions

Despite the opportunities that cultural heritage represents in the Middle East, there are many generic and specific problems that put it at risk, such as the lack of adequate laws and standards at the level of regional planning and, more specifically, governing cultural heritage preservation. There is a dangerous lack of awareness among national and local authorities, as well as among the general population, concerning the value of their heritage.

National policy does not always promote dialogue between the local population and central governments, and in

some cases there is direct or indirect occupation of vast areas of the territory by foreign military forces (Hamdan 2005). However, the major problems remain the lack of educational, scientific, and academic structures and laboratories specializing in research related to conservation and the enhancement of cultural heritage and training.

Our Experience

The goal of our involvement in the training sector of cultural heritage preservation is to support and improve local educational structures. We do this by providing them with scientific and management experiences that respect and benefit from the preservation of regional resources at the local level.

The following is a summary of our experiences in the field of ancient mosaic conservation.

a. Through the support of Fr. Michele Piccirillo, director of the Studium Biblicum Franciscanum in Jerusalem, and Italian cooperation through the nongovernmental organization Cooperazione Internazionale Sud Sud (CISS), we started our project in Palestine in 1999. We established the Jericho Workshop for Mosaic Restoration, building the infrastructure, which included a laboratory and a specialized library, to train a group of young Palestinians in the field of ancient mosaic conservation. The two-and-a-half-year training course, conducted forty hours per week, was held in cooperation with the Palestinian Department of Antiquities (within the Palestinian Ministry of Tourism and Antiquities). The course involved primarily on-the-job training under the supervision of the senior conservator, Franco Sciorilli, but also included theory and educational visits to Palestine, Jordan, and Italy. During the training course, the mosaics of the Byzantine church of Khirbet el Nitle (Jericho) were preserved, the mosaics in the Calvary Chapel in the Holy Sepulcher in Jerusalem were cleaned and consolidated, and the Umayyad-period mosaics of the Bath in Hisham's Palace in Jericho were monitored, documented, and preconsolidated (Hamdan and Benelli 2005a).
b. At the end of the first project, in Jericho, we studied, with the support and involvement of the same group of institutions, the possibility of conserving the floor mosaics and enhancing the site of the sixth-century synagogue of Na'aran in 'Ain Duk. An intervention project was prepared whose main purpose was a training course on conducting a condition survey and recording the site, according to its context.
c. In summer 2000 we started a joint program of intensive training courses with the Madaba Mosaic School of the Jordanian Department of Antiquities. Since then the summer courses, called the Bilad Al Sham project, have become an annual event. The courses are financed by the European Union, CISS, the Studium Biblicum Franciscanum of Jerusalem, the Jordanian and Syrian Departments of Antiquities, the Palestinian Mosaic Workshop, and the Committee for the Promotion of Tourism in the Jericho Governorate. They are attended by Jordanian, Syrian, Lebanese, and Palestinian trainees and take place in Jordan, Syria, and Palestine. The courses allow local staff not only to be trained but also to know and appreciate the experiences of their neighbors (Hamdan and Benelli 2004, 2005b).
d. At present, thanks to CISS, we are engaged in a project to support training in the field of cultural heritage at Al Quds University in Jerusalem. We are building a laboratory for ancient mosaic conservation at the main campus of the university and organizing specific training courses for undergraduate students.

Training Methodology

Our training course is based on the following constant elements: on-the-job training; maintenance training; training in research, analysis, and documentation; the relationship between conservation and presentation; theoretical studies; educational visits; and awareness activities.

On-the-Job Training

Most of the training is dedicated to the practical aspects of conservation. We try to work with the same people as much as possible, updating, year after year, and through varied conservation activities their knowledge and experience. Because every conservation activity has a specific character and specific problems that require different approaches, students are taught how to proceed in a variety of situations. We have been working, for example, on the following projects: (i) detached mosaics, as in the Byzantine mosaic pieces from the church of Khirbet el Nitle; (ii) mosaics stored in very bad conditions, such as those



FIGURE 1 Restoration of the mosaic floor of the Church of Saint George, Khirbet el Mukkhayyat, Jordan.

of the Aphamea tomb; (iii) detached mosaics that had undergone traumatic intervention, as in the mosaics of the Church of Saint George in Khirbet el Mukkhayyat (Madaba) (fig. 1); (iv) in situ mosaics that had suffered from intervention, such as in the ʿAin Duk synagogue and the Church of Saint Andrew (Jericho) (fig. 2); and (v) in situ mosaics in need of specific cleaning, which gave us the opportunity to train students in various cleaning tools and techniques, both mechanical and chemical (fig. 3), as in the Roman villa in Shahba (Syria) or in the Church of the Holy Sepulcher in Jerusalem.



FIGURE 2 Restoration of the mosaic floor of the Church of Saint Andrew, Jericho, Palestine.



FIGURE 3 Cleaning test using an ultrasonic system on the mosaic of the Four Seasons, in the Archaeological Museum, Suwaydah, Syria.



FIGURE 4 Ordinary maintenance of the Church of Saint Stephen, Umm Al Rasas, Jordan.

Maintenance Training

The importance of ordinary maintenance is stressed using a comprehensive conservation philosophy in order to avoid future radical interventions, as in the Church of Saint Stephen in Umm Al Rasas (Jordan) (fig. 4), the Crypt of Saint Elianus, and the Church of the Virgin and Hippolytus Hall in Madaba, as well as various pieces of mosaics exhibited in the Archaeological Museum at Suwaydah (Syria).

Training in Research, Analysis, and Documentation

Special attention is given to the importance of creating a detailed condition survey and record (fig. 5). Students are taught how to record the condition of the mosaics using simple tools and methods, such as digital photographs and photomosaics, thus achieving very accurate representations of the mosaic relief (fig. 6).

Relationship between Conservation and Presentation

The importance of the presentation of mosaics is stressed. Mosaics are conserved so that their historical, artistic, and technical values can be shown to the general public. Our conservation activity is always accompanied by studies on how to enhance the cultural heritage we are working on, how to facilitate access by visitors, and how to publish the results.

Theoretical Studies

Various specialists and experts in the conservation field present a series of lectures to give trainees basic information about the history and geography of the area, theories, techniques and technologies of conservation and documentation,



FIGURE 5 Recording the mosaic of the Church of Saint George on transparent film.

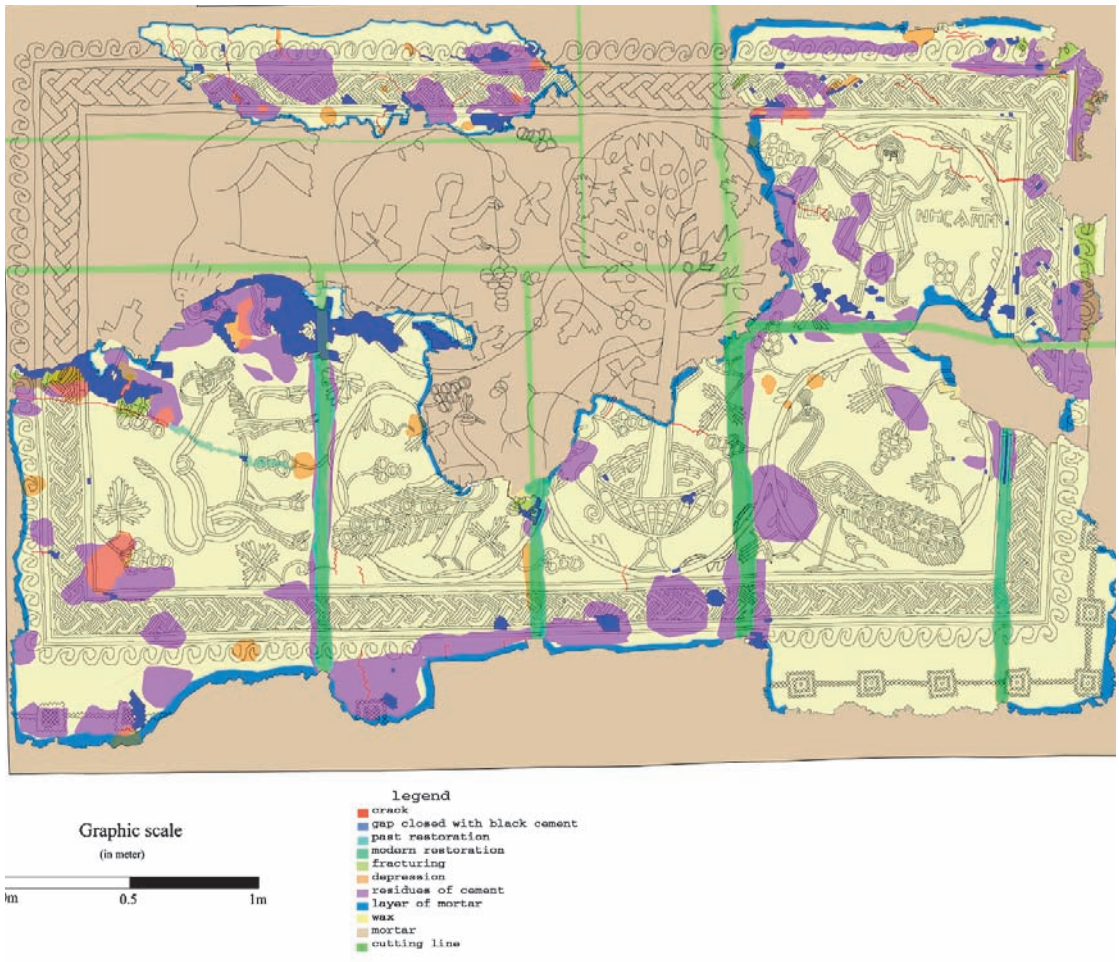


FIGURE 6 Condition survey of the mosaic of the Church of Saint George.

international and local laws related to cultural heritage, and other fundamental issues dealing with mosaics and cultural heritage conservation.

Educational Visits

During every training course, educational visits are made to archaeological and historical sites as well as to places where conservation activities are being carried out. Visits increase the trainees' knowledge about the area and its cultural resources and help them to better understand which problems are affecting the sites and what type of solution can be adopted to preserve and enhance them (fig. 7).

Awareness Activities

Our work sites are always open to the local population. We organize special visits for local people, including school and university students. We give special attention to raising awareness among the young and organizing training courses on the production of new mosaics that are geared for children, including lectures and slide presentations on the history of mosaics in the area and the ways in which one can respect one's cultural heritage (fig. 8).

Conclusion

After six years of working in the sector of training in mosaic restoration in various Middle Eastern countries, this paper has given us the opportunity to reflect on and evaluate our experience. We noticed that the results of our work vary from country to country, but we shall attempt to list some of them.

Institutions

In the beginning it was difficult to find specific institutions interested in the preservation of mosaics. Now something



FIGURE 7 Educational visit to the museum Marat al Numan, Syria.

is changing, as local experiences grow in quantity and quality. For example, the Madaba Mosaic School of the Jordanian Department of Antiquities is able to undertake ordinary maintenance and to participate directly, giving its support during archaeological excavations. Still, the results of our work depend largely on the personal engagement of individuals, and there is no clear and structured system of preservation management and control in the majority of the countries in the Middle East.

Students

Most of the students who took our training courses were members of the staff at national institutions and already involved in the preservation of cultural heritage, though they lacked the theoretical and practical instruments that would permit them to work in an adequate way. During our internal evaluations they told us that we have given them new impetus by increasing their skill and knowledge. The training courses have helped them to regain enthusiasm for their daily work. We were happy to note that many of them participated in the ICCM conference in Tunisia.

Mosaics

We saved many important mosaics from being abandoned and neglected. But the work that remains in this field is vast, and investing in the training of local staff is a key element to multiplying the impact of conservation projects and increasing the possibility of a better future for our cultural heritage.



FIGURE 8 Students from Al Quds University visiting the site of the sixth-century synagogue of Na'aran in 'Ain Duk during restoration, Jericho, Palestine.

Suggestions for the Future of Training in Ancient Mosaic Conservation

Middle Eastern countries should invest their energies and resources in the following:

- creating an ongoing training program;
- creating a management policy for mosaic conservation and presentation;
- recognizing the need to outline an integrated program for the conservation and enhancement of mosaics in relation to other functions of the region and local economy;
- supporting and establishing local institutions able to coordinate and enhance local resources;
- improving the ability and awareness of decision makers; and
- creating more opportunities for coordination and communication with neighboring countries in facing common problems in mosaic conservation.

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Training of Technicians for the Maintenance of in Situ Mosaics: An Assessment of the Tunisian Initiative after Three Years

Thomas Roby, Livia Alberti, Elsa Bourguignon, and Aïcha Ben Abed

Abstract: *After completion of the training of the first two groups of mosaic maintenance technicians, an assessment of their work has been carried out by those involved in this ongoing Getty Conservation Institute–Institut National du Patrimoine project. The training methodology, practice, and didactic materials provided to the trainees have also been critically assessed. As a result, revisions to the project have been made, including better defining the selection criteria for trainees, simplifying the written documentation required of them, and the introduction of digital photography. Despite the significant impact the technicians' work has had on several Tunisian sites, trained conservators and site managers with an understanding of conservation methods are still needed on-site to keep the level of the technicians' work high and sustainable in the long term.*

Résumé : *Après l'achèvement de la formation des deux premiers groupes de techniciens d'entretien des mosaïques, leur travail ainsi que la méthodologie de formation, la pratique, les supports didactiques fournis aux stagiaires ont été évalué par les responsables du projet conjoint Institut Getty de Conservation/Institut National du Patrimoine. Il en a résulté une meilleure définition des critères de sélection des stagiaires, une simplification de la documentation écrite exigée et l'introduction de la photographie numérique. Malgré l'impact considérable du travail des techniciens, la présence sur les sites de conservateurs et de gestionnaires de sites formés connaissant les méthodes de conservation est nécessaire pour maintenir le niveau du travail des techniciens et le pérenniser.*

At the first meeting of the International Committee for the Conservation of Mosaics (ICCM) in 1977, a paper titled "On the Need to Train Mosaic Restorers" was presented in which the author expressed the wish that the ICCM would propose the prompt establishment of schools for mosaic restorers. The paper began with a quote from an 1862 letter from Giovanni Battista Cavalcaselle to the Italian minister of education: "Beginning now, a school of restoration must be established to train skilled craftsmen to whom one can entrust mosaics without fear that they will be harmed" (quoted in Robotti 1977: 100). The author added that this statement was still valid in 1977 because nothing had changed (Robotti 1977). Has anything changed since 1977? The answer is yes—but not enough, despite repeated calls for training by conservation professionals. A school of mosaic restoration has existed in Ravenna, Italy, since the 1980s, and the Opificio delle Pietre Dure in Florence and the Istituto Centrale del Restauro in Rome, as well as similar professional training programs in other European countries and in the United States, have continued to train conservators, some of whom have specialized in mosaic conservation. These institutions and their graduates have been involved in training initiatives in other countries where specialized training does not exist. A prime example is the Madaba Mosaic School in Jordan, founded with support from Italian conservation programs through the Ministry of Foreign Affairs beginning in 1992 (Piccirillo and Cimino 2003).

More recently, at a roundtable seminar held in Tunis in 2001, a call was made for training at the level of technicians and maintenance personnel, conservators, and managers of sites, recognizing that successful mosaic conservation requires these three different categories of site personnel (Blanc 2001). Acknowledging that Tunisia lacks trained personnel at all three levels, the Getty Conservation Institute (GCI) and the Institut National du Patrimoine (INP) have been working together since 1998 to develop training for future maintenance

personnel, as well as site managers, and to provide advice and encouragement on the training of conservators overseas. This paper assesses the training of Tunisian maintenance technicians for in situ mosaics carried out since 2001 (Roby, Alberti, and Ben Abed 2005). Technician training initiatives have been undertaken recently by institutions in other countries in the Middle East and North Africa (Hamdan and Benelli 2005; Hamdan, Shaaban, and Benelli, this volume; Najar and Blanc this volume; ICR 2004). However, there is generally no coordination of these training activities, nor is there learning from previous training experiences, which considerably lessens the effective use of the scarce financial resources available.

Although this training initiative is not unique, there was no model that was followed when the course was developed in 2001. Since "mosaic maintenance technician" as a job category does not exist in Tunisia or in most other countries, the first step was to define this profile. For the instructors, a conservation technician is a skilled craftsman, as Cavalcaselle defined him, who performs basic manual operations to preserve works of art and monuments but relies on a conservator to establish the appropriate methodology and techniques for those interventions. Mosaic maintenance technicians, as defined in our profile, are capable of carrying out minimum interventions on a large scale to stabilize in situ mosaics while paying attention to the aesthetic impact of their work and respecting the integrity and authenticity of the mosaic. They are capable also of documenting their work and carrying out basic preventive conservation measures, such as reburial.

The aim of the Tunisian training program was to prepare people to carry out the maintenance of mosaics in situ on a daily basis in different sites in the region of the country where they are based. It did not attempt to train people in the maintenance of detached mosaics, whether relaid in situ, left in storage, or presented in a museum. Training in the maintenance of detached mosaics is also needed in Tunisia, but this was considered too different a subject from in situ mosaic conservation and therefore requires a separate training course.

So far, two groups of trainees have completed the course and a third group is currently following it. Each group is limited to eight to ten trainees to permit close supervision of their work by the two instructors and their assistant. At the beginning of each course the trainees are provided with a toolbox with equipment needed for mosaic stabilization work and a documentation kit so that they can be as autonomous in their future work as possible. The structure of the course has consisted of three to four training campaigns of four to six weeks in length separated by several months, during which time the trainees are expected to carry out independent work at their site as assigned by the instructors. The documentation and treatment work is then reviewed by the instructors during the next campaign. The training campaigns consist of supervised practical work, but there is also classroom instruction introducing a number of subjects that are reviewed again after the practical work on-site. The overall methodology of the technicians' work, which they are taught to follow, is provided by a series of survey forms to be filled out in order from 1 to 5 for each mosaic. Starting with the documentation of the mosaic (Form #1), its condition and the previous interventions carried out on it (Form #2 and #3), the process continues with the worksite organization and intervention planning (Form #4), then stabilization treatments as needed (Form #5).

The treatments the trainees carry out are limited to manual mechanical cleaning with and without water and stabilization operations using only lime-based mortars. These treatments should be followed at regular intervals in the future by condition inspections, then new interventions, where required.

During the final training campaign, the technicians also receive training in basic stabilization treatments for ancient wall remains that surround mosaics and in the reburial of mosaics. Carrying out and maintaining reburial interventions were considered a key part of the technicians' maintenance activities, because it is a preventive conservation measure that is within their capacities, as opposed to shelters (fig. 1).

When the course was developed, training materials for maintenance technicians, if previously developed for other training initiatives, were not known and therefore were created by the instructors for use in Tunisia. The instructors are practicing field conservators with considerable experience with in situ mosaic conservation and worksite training, but are not professional educators. Background and reference materials, along with the written documentation forms and instructions on different documentation methods, were created or developed and then provided to the trainees in French. All the training materials have now been translated into Arabic as well, for use by those trainees who have difficulty with French and for eventual use in other similar training projects in Arabic-speaking countries. An English version of the training materials will also be available in the near future. It is hoped that these materials will be of assistance to other instructors of technicians and that they will be adapted as needed for training technicians in other parts of the Mediterranean.

The materials developed for the training program were not intended as a manual, and therefore they do not provide step-by-step instructions for the actual stabilization work. In



FIGURE 1 Reburial of a mosaic during maintenance technician training, using sand and gravel and a separation membrane of geotextile between them. Photo by Elsa Bourguignon © J. Paul Getty Trust.

our opinion this type of document should be avoided, as it promotes the practice of copying procedures and recipes that will not be appropriate in many cases and contexts. The didactic materials do, however, provide manual-like instructions for the documentation to be carried out by the technicians, as well as basic reference material on the subjects covered in the classroom presentations, such as the deterioration of mosaics, the basic characteristics of the mortar components, and the different ways they are used to stabilize mosaics.

Lessons Learned

Training Methodology and Practice

One of the first lessons learned by the instructors was that the documentation work required of each technician trainee proved too demanding for the majority of the first group of trainees due to their overall low education level. As a result, the written documentation was simplified for the subsequent courses, and the average education level of the trainees has been raised with each successive group, so that more of them can carry out their own documentation work rather than relying on the more educated trainees for assistance or to do it for them.

Initially, the documentation training did not include the use of digital photography and computer-aided graphic documentation, which seemed appropriate given the average education level of the trainees and the general lack of availability of this technology within the INP. The intention was also to ensure that the documentation carried out by the technicians would be sustainable in the future, even with the most minimal resources, namely, a pencil, a measuring tape, and paper. However, as the education level of the trainees has increased with each group, so has their familiarity with digital and computer technologies, and therefore basic instruction in the use of digital photography for documentation has now been included (fig. 2), while training in traditional means of documentation continues, using analogue cameras and measured drawings. Our experience has shown us that photographic documentation carried out by the technicians is problematic for administrative reasons. Traditional film photography presents the need for the INP to pay for film development frequently, and digital photography presents the higher cost of maintaining and replacing the equipment and archiving the images. In the end, graphic documentation has proved the most sustainable method for the technicians, and a graphic base is almost always the best form of documentation for basic mosaic recording.

The didactic materials have been modified with each course so as to adapt them to the level of comprehension of the trainees and their needs. Illustrations have been added to facilitate understanding of the text (fig. 3). The text itself



FIGURE 2 Training of technicians in digital photography and its archiving. Photo by Thomas Roby © J. Paul Getty Trust.

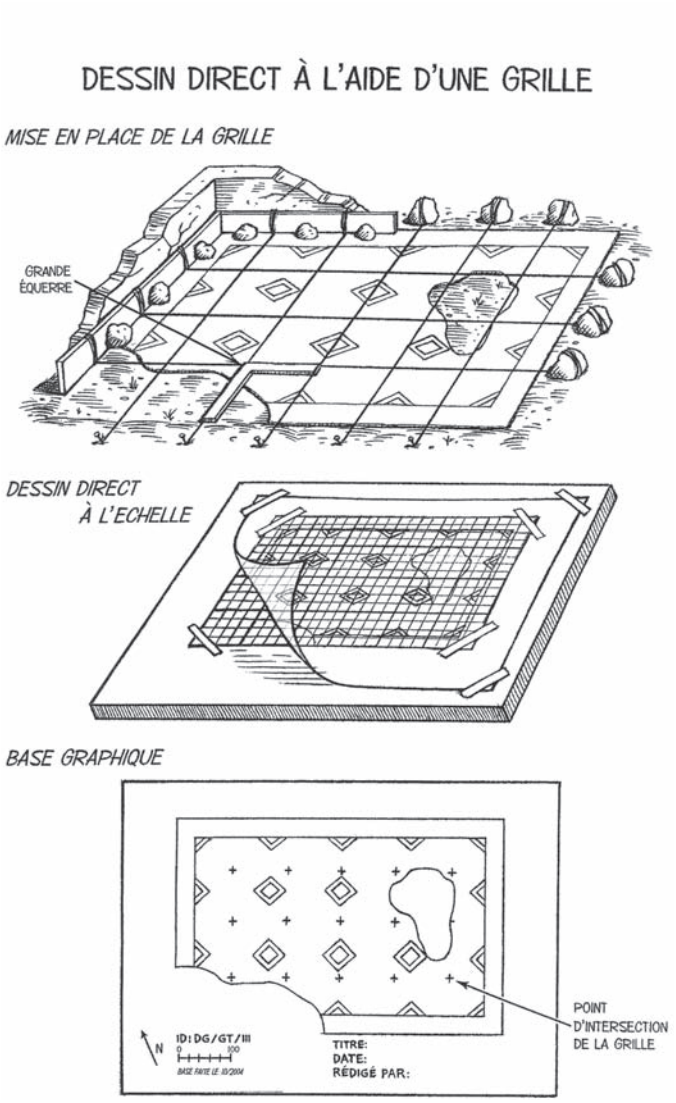


FIGURE 3 Illustration included in the didactic materials created by the GCI in collaboration with the INP as part of the training program for the conservation of mosaics in situ. Drawing by Dana Reemes © 2006 J. Paul Getty Trust.

has been improved by the extremely useful comments of colleagues, both inside and outside the project. However, we have found that despite the importance we have given to the text, and its utility for us as instructors, it has not generally been used greatly by the trainees, as they are not accustomed to consulting reference materials in their working life. In the future, we could do a better job of integrating the materials into the classroom instruction so that trainees become more familiar with and accustomed to consulting them.

The originally planned course length of fourteen weeks divided into three sessions, with independent work between sessions, may have been enough, but logistical challenges often prevented completion by the trainees of the prescribed in-between campaign work. Therefore, an additional training session has been organized for each group. The training course provided a solid base for the trainees to build on, but they require more time and experience to do their work properly. In addition, in the absence of Tunisian conservators, they still need to be followed by the instructors after the completion of the course.

The technicians also need to have a working relationship with the site directors or managers, who need to organize and support their work and provide them with materials and equipment. Input from the archaeologist responsible for the site is also required for filling out two of the written documentation forms and for gaining access to existing documentation of the site and establishing a work program, but that has not always been easy for the technicians to obtain. A site management workshop scheduled for 2007 and introduced to the future Tunisian participants in 2005 will attempt to raise awareness among future site directors of the need to be more involved in the trainees' work and the maintenance process.

Trainees

One of the most significant lessons learned from this training experience has been a better understanding of what types of backgrounds and profiles make for the more successful maintenance technicians. Level of education is a very important

parameter. Too little, and the documentation work is not done or not done satisfactorily, and the trainees do not possess enough problem-solving capacity or capacity to correctly choose the appropriate operations and mortars to be used. Too much education, and the trainees will not be interested in spending their days doing what is essentially a manual job outdoors.

We have seen that in a Tunisian context the ideal education level for a technician is high school, with or without the baccalaureate, the Tunisian high school diploma. In addition, those with previous schooling connected to building construction or other technical trades generally possessed the manual dexterity and practical skills required. While those with previous experience in making mosaics could make good maintenance technicians, they may also, due to their background and skills, be tempted to carry out operations that are not compatible with our approach, such as reintegrating lacunae with tesserae or resetting tesserae not in their original position, without regard to the authenticity of the mosaic.

Physical capacity is also an important prerequisite for a mosaic technician. Since most of their working hours will be spent doing very detailed work on the ground, mosaic technicians need a considerable degree of agility and flexibility, in addition to manual dexterity. The trainees should ideally be young, in their twenties, so that they have many years of work ahead of them, but also because they will be more willing to accept new work methods and will likely be more motivated, especially if there are opportunities for advancement within the institution.

Instructors

The importance of having as instructors conservators with considerable hands-on experience with in situ mosaic conservation has been confirmed by our experience. The trainees need to see the work done properly by others (figs. 4, 5) as much as they need to learn from their own mistakes. Not all experienced mosaic conservators are necessarily good trainers of technicians, and therefore some teaching experience is also needed. The presence of the same instructors throughout the training program was also an important factor in maintaining a consistent approach and standard of work.

The very different levels of education of the trainees posed some problems for both the instructors and the trainees, particularly regarding documentation. For the more educated, the documentation techniques were considered elementary, whereas for those with little schooling, the techniques were beyond their capacities. The trainees should ideally have the same education level in order for the training to be more efficient and productive for all.

The training program did not involve other specialists, for example, documentation experts or conservation scientists, and it did not need to because they would have provided more information than was needed and perhaps would have created confusion, considering the technician profile and the average trainee education level.

While fluency in Arabic would have been an advantage for the instructors, the fact that almost all the trainees spoke some French meant that this qualification was not necessary.



FIGURE 4 Demonstration during training of resetting loose tesserae. Photo by Elsa Bourguignon © J. Paul Getty Trust.



FIGURE 5 Demonstration during training of grouting areas of detachment. Photo by Elsa Bourguignon © J. Paul Getty Trust.



FIGURE 6 Maintenance technicians working in large groups to carry out initial stabilization treatment of a mosaic. Photo by Elsa Bourguignon © J. Paul Getty Trust.

Had the education level of the trainees been much lower, it would have been necessary; had the education level been higher, a higher level of proficiency in French would have been desirable for the instructors.

The better former trainees have been involved briefly in the training of the later groups, as a way of ensuring the sustainability of the project. While this experience proved positive for both the former trainees and the new ones, it is difficult to imagine at present most of the former trainees serving as more than training assistants for future courses. In the future, training of new groups of technicians will need to be done by Tunisian conservators, who do not yet exist.

Overall Project Evaluation

Many presentations at recent ICCM conferences have referred to the importance of maintenance as a key to successful in situ mosaic conservation (e.g., Neguer 2002; Zizola 2005). This training experience has taught the instructors that it is difficult to define the limits of a technician's work and to determine where maintenance work ends and conservation treatment begins. Maintenance presumes the existence of a situation in which the mosaic is already in an overall stable condition, that is, maintained through periodic inspections and small, limited interventions to repair damage to the mosaic or to previous repairs that will occur over time, especially if the mosaic is left exposed. However, the reality is that after decades of exposure there are very few mosaics in stable condition on Tunisian sites. The trainees therefore are faced with having to stabilize mosaics in very poor condition, which means they have to carry out a conservation treatment. As a result, they have had very little experience so far in conducting what one would define as a maintenance cycle program. Instead, they have to address situations that are often beyond their level of training. Because the stabilization of a pavement requires a much larger amount of work than does its maintenance and because stabilization requires a great deal of time to be done properly, the technicians need to work in large groups to have any hope of seeing the work progress (fig. 6). One or two technicians based at a site are often not a sufficient number to address the specific stabilization needs there, nor are the technicians able, given the limits of their training, to solve all the conservation problems that may exist. However, once the mosaics are stabilized, one or two technicians would be sufficient to address the site's maintenance needs and would also allow greater working autonomy, as was intended at the beginning of the training.

Finally, given the current number of trained INP maintenance technicians at some sites, site management strategies are needed to more effectively use their skills. A program is needed that involves both mosaic stabilization and protection

by reburial to be carried out by the technicians so that they can begin to devote their efforts to carrying out maintenance cycles rather than moving on to the next urgent conservation treatment project. The work of the technicians has already had a dramatic visual impact on several sites, but, despite the importance of their work, it is only one element in an effort to preserve Tunisia's in situ mosaic heritage.

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Une stratégie tunisienne pour conserver la mosaïque

Aïcha Ben Abed

Résumé : *Cette communication évoque les problèmes complexes liés à la conservation des mosaïques en Tunisie et présente une stratégie pour les résoudre. L'élaboration et la mise en place d'un programme rigoureux pour la gestion et l'entretien à la fois des mosaïques* in situ *et des mosaïques dans les musées et ailleurs est nécessaire. Un tel programme serait fondé sur la formation d'un personnel à différents niveaux. La stratégie comprend la formation d'équipes régionales de techniciens d'entretien des mosaïques* in situ. *Un conservateur est en formation en France et les universités tunisiennes ont récemment commencé à proposer des formations dans la préservation du patrimoine culturel. Cependant ces nouveaux diplômés rencontrent des difficultés sur le marché du travail et les moyens de mettre à profit leur formation doivent être trouvés. À un niveau supérieur, une formation pour les gestionnaires de site de l'INP dans la conservation et la gestion des sites archéologiques a débuté.*

Abstract: *This paper discusses the complex mosaic conservation problems faced in Tunisia and presents a strategy to resolve them. It is necessary to develop and put in place a rigorous program for management and maintenance of both in situ mosaics and mosaics in museums and elsewhere. Such a program would be based on training personnel at different activity levels. The strategy includes training of regional teams of maintenance technicians for in situ mosaics. One conservator is being trained overseas, in France, and in recent years Tunisian universities have begun to offer training in cultural heritage preservation. However, the new local cultural heritage graduates face challenges in the job market, and ways to utilize their general training need to be found. At the highest activity level, training for future INP site directors in the conservation and management of archaeological sites has also begun.*

L'expérience tunisienne en matière de formation de techniciens à l'entretien des mosaïques, a été conçue comme première réponse aux grands problèmes de la conservation des mosaïques *in situ* (Ben Abed 2003 ; Roby, Alberti et Ben Abed 2005). Ces dernières se comptent par centaines pour ne pas dire par milliers à travers les multiples sites antiques du pays et subissent un processus de dégradation de plus en plus rapide. À travers certaines interventions durant cette Conférence et surtout à partir de la visite que nous avons pu entreprendre à Thuburbo Maius et à Jbel Oust, vous avez pu prendre connaissance sur le terrain des composantes de cette action et sur les perspectives qu'elles ouvrent pour l'Institut National du Patrimoine dans le domaine de la conservation. Je ne vais pas revenir dans cette intervention sur l'analyse ni sur l'évaluation des capacités d'action des techniciens mosaïstes *in situ*. Je me contenterai de dire, dans ce sens, que cette expérience nous a fait prendre conscience, nous autres archéologues responsables de sites, des difficultés et de la lenteur du processus de stabilisation. Nous avons également réalisé la nécessité d'intervention constante des équipes d'entretien si l'on veut conserver notre patrimoine mosaïstique. Nous avons également pu constater les limites de cette expérience.

En effet, je voudrais parler de la complexité du problème de la conservation mosaïstique dans un pays comme le nôtre avec l'histoire et les moyens dont nous disposons. Parallèlement aux dizaines de sites sur lesquels se trouvent des mosaïques en place, des centaines de dalles de mosaïques déposées jonchent les réserves des musées et des sites. Ne pas porter une attention particulière à ce problème des mosaïques équivaut à la décision de les sacrifier.

Les besoins du patrimoine tunisien dans le domaine de la maîtrise de la technique de dépose et de la repose

sur nouveaux supports sont indéniables pour la survie des œuvres. La mise en place d'un système d'entretien et de contrôle continu aussi bien pour les mosaïques *in situ* que pour les pavements déjà déposés sont essentiels si l'on veut assurer la pérennité du patrimoine mosaïstique tunisien.

Ainsi le premier pas fait dans le domaine de la conservation des mosaïques *in situ* doit être absolument suivi et complété par une action de préservation des mosaïques déposées ou nécessitant une dépose. Partant de ces besoins, il est capital de mettre en place une formation pour des techniciens basée sur les pratiques de la dépose et la repose sur de nouveaux supports compatibles avec l'intégrité des œuvres en mosaïque. Ce n'est qu'à ce prix que le premier grand pas décisif sera effectué dans le sens d'une solution globale.

Reste cependant le problème crucial qui est celui de pourvoir les institutions patrimoniales de professionnels de la conservation, profil rarissime chez nous jusqu'à présent. J'entends par profil des conservateurs susceptibles d'entamer et d'encadrer le processus de conservation et de superviser régulièrement les travaux d'entretien. Si je me réfère aux prémices de notre expérience dans le domaine de la formation de conservateur, elles ne sont pas particulièrement encourageantes. Nous avons pu, grâce à l'aide et au soutien de professionnels, entamer le processus de former un candidat dans le domaine de la conservation dans les institutions françaises. L'étudiant a dû effectuer plusieurs années d'études avant d'être accepté par une université française pour quatre années d'études supplémentaires. Pour commencer à être opérationnel, il faudrait à notre candidat plusieurs années d'études et d'expérience.

Pourtant face et parallèlement aux techniciens formés a l'entretien des mosaïques avec le Getty Conservation Institute (GCI) (Roby et al., dans ce volume), et en attendant l'arrivée du ou des conservateurs affirmés, il est évident que l'institution a besoin de plus de personnel diversifié pour faire face aux multiples problèmes que pose la conservation de la mosaïque. Ce besoin concerne tout particulièrement ceux dont le niveau d'intervention se situe entre la conservation affirmée et la technique limitée. Leur pratique sera limitée à des interventions simples et ponctuelles sur les pavements.

En fait, l'université tunisienne produit depuis quelque cinq ans des profils nouveaux de ce qui est appelé « les métiers du patrimoine ». Les étudiants formés dans ce cadre sont initiés à l'histoire, l'archéologie et aux balbutiements de la conservation. Peut-être qu'une formation adéquate et adaptée à ces profils peut être une première réponse à la nécessité de diversifier les profils et hiérarchiser les niveaux d'intervention.

Or ces jeunes adultes qui seraient destinés à l'intervention sur la mosaïque ont un besoin urgent d'une formation adaptée et structurée basée sur la réalité de la situation des mosaïques dans le pays. Elle prendra également en considération les moyens et les produits disponibles dans le pays et accessibles au budget de l'institution qui préside aux destinées du patrimoine. Mais ces jeunes aspirent en faisant toutes ces études à un travail stable, or, il est de plus en plus difficile d'accéder à la fonction publique en Tunisie comme partout ailleurs. Dans ce sens, et en plus des efforts du Ministère de la Culture et de l'Institut du Patrimoine dans le domaine, il est du devoir des professionnels de suggérer, voire de trouver des solutions à l'avenir de ces jeunes qui désirent s'investir dans le domaine du patrimoine. L'idée de les inciter et les initier à former de petites entreprises privées formées à l'école du patrimoine mais indépendantes et travaillant en collaboration avec les institutions étatiques peuvent être une réponse à moyen et à long terme pour les problèmes de l'emploi dans le secteur du patrimoine.

Pour placer la formation des métiers du patrimoine et la formation des techniciens à l'entretien dans un contexte général de conservation et de gestion des sites, l'INP et le GCI ont organisé un premier séminaire sur la gestion des sites, déstiné aux responsables des sites.

Reste à savoir comment faire face, pendant la décennie à venir et en attendant les solutions radicales basées sur des formations solides, aux pavements dégagés et livrés à l'agression de la nature et des hommes sans intervention aucune.

La mise en place d'une stratégie demande du temps, de la réflexion et des moyens pour y parvenir et surtout une vision claire et honnête de ce que l'on veut faire. Il est évident que notre souci premier en tant que professionnels c'est la sauvegarde de ces œuvres pour les générations futures. C'est facile à dire mais plus difficile à faire.

Former et faire travailler les techniciens d'entretien des mosaïques est déjà un grand pas, mais il en faut des centaines pour travailler sur les milliers de pavements qui sont encore *in situ* et dans les musées ou dans des réserves dans un état de provisoire qui dure.

Alors la solution est-elle locale ou faut-il l'envisager à l'échelle de la région ? N'est-il pas possible d'envisager dans le cadre local de chaque pays des réponses qui partent d'un constat et d'une volonté générale ?

Ce n'est pas un atelier de plus que l'on suggère mais une réflexion collective sur la situation du patrimoine

mosaïstique dans les pays dont les réalités se rapprochent afin de mettre les forces ensemble pour vaincre les faiblesses et les atavismes. C'est tout de même dommage de voir les uns et les autres faire les mêmes expériences en s'ignorant et en faisant comme si c'était la première fois que de telles tentatives sont faites. Il est temps de mettre fin à ces expériences où l'on fait semblant de prendre une ou plusieurs personnes comme stagiaires dans un environnement qui est tellement différent d'un pays à l'autre et d'une région à une autre pour se donner bonne conscience. Avoir le courage de remettre en cause certaines pratiques, c'est aussi le but de ce genre de rencontre.

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Discussion—Session 6: Training of Conservation Practitioners

Présidente/Chair: Jeanne Marie Teutonico

Discussion following Patrick Blanc Presentation

JEAN-PIERRE DARMON: Je n'ai pas du tout suivi le dossier depuis la publication par Stern. Qu'est devenu le site de la synagogue de Gaza et où est la mosaïque ? Je suppose que la mosaïque de l'Orphée, du David en Orphée, doit être quelque part, mais où ? Et le reste de la synagogue, qu'en est-il ?

PATRICK BLANC: C'est un sujet, enfin, c'est difficile pour moi de répondre à cette question, mais cette mosaïque se trouve dans un musée actuellement, mais pas à Gaza. Sur le site de la synagogue, il reste quelques fragments de mosaïque noir et blanc géométrique dans le mortier mais il ne reste plus grand chose en place. Ce sont des travaux anciens déjà, donc, il reste vraiment peu de choses en place.

Discussion following Osama Hamdan Presentation

ISABELLE SKAF: I have a question for my two Palestinian colleagues. How will the training program develop in the future? Will you train new students? How is it going to be organized? What's the long-term strategy?

OSAMA HAMDAN: We are planning to continue our [training program], but I think, as I said in my presentation, that it is more meaningful to stop a bit and think. What did we get? Do we have results? Are they good? For example, our experience with the Lebanese is that they will participate in the training course for three or four years, but in the end we got no results. Each time the trainees were different, and they would find work other than conservation. This example is negative from our point of view. The experience with Palestine is more delicate, and it makes us think that maybe a training program must be part of an integrated program, a policy program. After three years, we can consider that our experience in Palestine failed completely. Maybe we can get small results but not sufficient results for the effort or the financial investment that we put into this project. We can say that we lost a lot. Of course, it makes us think that maybe this training should become national policy. I think in the Middle East it has happened very often that a lot of people come because they need training. Okay, but always this training, training, training, training without getting results—results in the field, results for the trainees, results for the country. And at the same time maybe it's bad for your country too.

AMR NAWAR AL MUAYYAD AL-AZM: I would like to reflect further on what you've said based on our own experiences in Syria. Obviously, we have participated in the Bilad Al Sham training program; we've also participated in other projects that aimed to develop training. I also noted that one of our other speakers, Tom [Roby], I think, said that training is an ongoing program and that it doesn't ever end. We're always learning. There's never any point when you say, "This is it. I've learned everything I need to know. I can now master everything." There's no such point; training is ongoing. Now, from our Syrian experience with this, we found that over the years we have been able to build a core group of people who are currently working in mosaic conservation. Obviously, they still require further training, but that's part of the nature of the beast that we're dealing with. However, we find now that our problems are not actually related to training programs but getting the materials that we need to do the training and convincing the people we're working with to apply these new techniques that we have learned, that we have acquired through experience, through participation, through what-

ever means. And sometimes we get even foreign or European excavation teams who don't wish to apply these new techniques. They won't even cooperate with us in applying what they would perhaps be forced to apply in their own countries if they were excavating a similar type of site. So it's not just a case of focusing on training, training, training. It's also a question of how we integrate that with the other problems and issues that prevail around this.

EWA PARANDOWSKA: I'd like to continue what my colleague from Syria said—that maybe it's very good that courses have started in all these countries. I also have some experience teaching monks in Egyptian monasteries, and it was not that successful. Right after we left, the testicles of a horse disappeared because the bishop didn't want to see them, or they put nails into the walls because they have to hang things up. So I think that we have to estimate how many conservators we need and give them permanent work, because as we can hear now, in many different countries mosaics are disappearing right after archaeologists leave the country, and it is done in a very professional way. So we have to pay them, and we have to teach them to be responsible for their artifacts. I think this is a question for all the speakers.

UNIDENTIFIED WOMAN: Related to the sustainability of the program, we started the Madaba Mosaic School in 1992–93, and we have now eighty-three graduates. The problem is that we find a lot of places with mosaics, but not all of the graduates are ready to go to these faraway places and do restorations. Not to mention that technicians in the Arab world in general are paid very little and that you don't find all the materials necessary. Yes, you need people, but you have to think of something to sustain a program of restoration. So not only do we need training, but we also need help in different places and also materials. It's not important how many graduates or trainers you have, but it is important that they reach the sites and do what they have been trained to do.

EWA PARANDOWSKA: Maybe we should think about how to stop the curiosity of archaeologists so that they do not discover so much.

Discussion following Thomas Roby and Aïcha Ben Abed Presentations

SABAH FERDI: C'est une question plutôt qui s'adresse à madame Aïcha Ben Abed. Je voudrais savoir, en Tunisie, quel est le statut des techniciens que vous avez formés, ou que vous êtes en train de former, du point de vue de la fonction publique ? Parce que le problème se pose dans notre pays pour les gens que nous formons. Il n'existe pas, dans le statut de la fonction publique, de poste de technicien-restaurateur ou de conservateur-restaurateur. Je voudrais savoir si en Tunisie vous avez déjà résolu ce problème.

AÏCHA BEN ABED: Tout le problème est là. Un problème de formation parce que, je m'excuse, ça fait quand même trois heures qu'on entend parler de formation et j'ai l'impression que nous sommes pas du tout sur la même longueur d'onde avec ce qui a été présenté pour Jéricho comme étant une formation de techniciens ou de conservateurs, enfin bon, tout ça reste à préciser. En Tunisie lorsque nous nous sommes rendu compte de ce problème d'absence de conservateurs et que l'on s'est dit qu'il fallait absolument y aller avec une expérience de formation de techniciens, on a essayé de voir ce qui était sur place. L'idée c'était de voir le personnel qu'on avait sur place et qui était déjà recruté dans le cadre de l'institution, ou sur le point de l'être, avec les matériaux, l'équipement disponible sur place et les possibilités budgétaires de l'institution. C'est à partir de ça que nous avons essayé de construire cette expérience de formation de techniciens qui sont sur les sites. Pour la plupart, je pense que pour 90 %, ce sont des gens qui existent déjà dans la grille de la fonction publique et de l'institution. Maintenant, qu'il faille enrichir, justement je parlais tout à l'heure de diversifier les profils, qu'il faille trouver des solutions, il est évident que ça n'est pas suffisant, mais c'est ça pour l'Institut National du Patrimoine, ce sont les gens qui travaillent sur les sites qui ont été désignés, qui ont été pris pour cette formation, et c'est en accord avec le Getty qu'on a voulu s'adresser à ce genre de personnel.

HASSAN LIMANE: La discussion restera toujours dans le Maghreb. Je remercie tous les intervenants de leurs exposés richement illustrés et qui ont débattu des sujets de fond de notre thème sur la mosaïque. J'ai une petite question pour nos deux collègues, Tom Roby et Aïcha Ben Abed, une réflexion et une proposition. La question, concernant effectivement cette expérience tunisienne qui est très, très intéressante, j'aimerais bien savoir quelle est maintenant la relation entre les techniciens et l'administration, et qui gère les interventions. Est-ce que ce sont les techniciens eux-mêmes qui gèrent leur intervention ? Ou est-ce qu'ils exécutent les décisions du conservateur ? Là, c'est une question très intéressante parce que s'ils sont des techniciens, ça veut dire qu'ils peuvent prendre la décision d'intervenir sur n'importe quelle mosaïque. S'ils ne sont pas des techniciens, ça veut dire qu'ils sont sous l'aile du conservateur qui doit les orienter vers l'intervention adéquate à faire. Ce qui me renvoie aussi à la réflexion de

savoir si cette question dépend effectivement du plan de gestion. Comme vous l'avez souligné, le plan de gestion est très intéressant, comme nous l'avons rappelé, je crois que ça reste un outil très intéressant dont nous devons d'ores et déjà doter nos sites afin de faire face aux problèmes de la conservation et de la restauration des mosaïques, mais aussi pour les autres composantes des sites. Et enfin la proposition, pour effectivement répondre aux attentes d'une formation, pourquoi ne pas reprendre au niveau du Maghreb l'exemple du Sham qui est un exemple très réussi ? Pourquoi ne pas échanger des expériences entre nous, entre le Maroc, l'Algérie, la Tunisie, au lieu que chacun forme ses techniciens ? Pourquoi ne pas former ensemble des techniciens qui répondent aux mêmes attentes, étant donné qu'on a le même problème qui se répète dans les trois pays et pourquoi ne pas l'ouvrir sur l'ensemble du bassin méditerranéen ?

AÏCHA BEN ABED: Je reprends un peu ce que j'ai dit tout à l'heure pour la première question. La Tunisie, comme vous le savez, est dotée d'un grand nombre d'archéologues qui travaillent sur les sites et qui dirigent les sites, en attendant la formation de conservateurs, donc de gestionnaires. Ce sont des gens qui doivent faire face à tous les problèmes sur les sites. Les techniciens sont des fonctionnaires de l'Institut National du Patrimoine à 90 %, donc c'est vraiment peut-être avec la naissance de ce noyau, de ce profil de techniciens de mosaïques, que le dialogue s'est établi avec les archéologues qui ont eu des techniciens formés dans le cadre de ce cours, comme Fathi Bejaoui, comme Monsieur Khanoussi, comme Mounir Fantar. Ce sont donc les directeurs de site, les archéologues qui dirigent, qui gèrent les sites, qui sont en contact avec les techniciens et qui, avec eux, essaient de diagnostiquer et de voir un peu quelles sont les interventions à faire dans le cadre de la sauvegarde, de la consolidation et de l'entretien des mosaïques. Donc, pour le moment, nous attendons ce profil de conservateur ou de conservateur adjoint que, j'espère un jour, on finira par créer en Tunisie ou dans le Maghreb. Évidemment, pour votre deuxième question, plus que oui. Je crois que c'est évident qu'il faut arrêter d'ignorer nos expériences mutuelles. Ce que nous avons fait ici, je vois que cela se fait aussi ailleurs. Ce genre de réunion, ce genre d'assemblée, sert aussi à ce genre de chose, à un rapport, à une collaboration entre les différents pays qui ont un passé semblable, un patrimoine semblable, un itinéraire semblable. Donc oui, c'est ce que je proposais en tous les cas, cela va tout à fait dans le sens des propositions de mon intervention.

JEANNE MARIE TEUTONICO: I can just say again, just to echo what Aïcha said, that certainly, from the Getty's point of view, and I think from the point of view of many people in this room, to try to coordinate activities better and to move toward more regional activities would be terrific, and it is really the right thing to do. Sometimes, I think, you need to begin an activity, perhaps on a national or on a more contained level, to develop it, and to develop a methodology, and then you have a kind of platform from which you can move to something a bit more complex. We may be at that kind of junction now, and we certainly would be open to discussing that kind of thing.

ROBERT (CHIP) VINCENT: There has been some wonderful discussion of the training going on regionally. I wonder if it is time to consider a training program for decision makers. I am not saying it is easy—if it was easy it would have been done already—but some of the institutions or organizations that have already been helping with training might, together with their colleagues in the countries in this region, try to design some ways of approaching those in middle to senior management in the government, to see if there is a way that the very fine training that has occurred at the technical level can be incorporated into the institution.

JEANNE MARIE TEUTONICO: I think Aïcha mentioned, and Tom did too, that a part of what we've been talking about in the Tunisia initiative is in fact to now develop a course for—we're saying site managers; I am not sure if we're talking about the same thing—but for those who in fact are managing sites as opposed to those who are at the technical level. I don't know, when you are talking about decision makers, are you talking about politicians? Yes, so again, that's not something that we have been talking about right now, within the initiative, but it certainly is an issue. I think one of the challenges is that often those people change, and so one has to deal with that kind of political reality, and sometimes there is not a lot of continuity in those whom you might reach. But it is not a reason not to try to approach the problem.

CARMEN DÁVILA BUITRÓN: It is not a technical question; it's a social one. I haven't seen any women in the photographs. Are these programs for men only?

HASSAN LIMANE: In our course, there is the participation of a lot of women. Yes, we have a lot of women in our courses, as trainees and trainers.

PART SEVEN

Case Studies

The Study of Hydraulic Lime Mortars for the Conservation of Mosaics

Michele Macchiarola and Gianluigi Fiorella

Abstract: *In order to prepare conservation mortars, based on natural inorganic binders, with an acceptable degree of reversibility, high compatibility with the original mosaic materials, negligible concentrations of soluble salts, and good durability in a humid environment, several hydraulic limes were analyzed. This study showed that only the so-called natural hydraulic limes (NHL, European standard EN 459-1), in spite of anomalous high concentrations of $CaCO_3$, are suitable for preparing conservation mortars. Subsequently the composition and mechanical properties of various NHL mortars were identified. The mortar with the best characteristics was successfully tested for re-laying a mosaic on a movable support.*

Résumé : *Afin de préparer des mortiers pour la conservation, à base de liants naturels inorganiques, comportant un degré acceptable de réversibilité, très compatibles avec les matériaux constitutifs de la mosaïque, avec des concentrations insignifiantes de sels solubles, une bonne durabilité dans un environnement humide, plusieurs chaux hydrauliques ont fait l'objet d'analyse. Cette étude indique que seules les chaux hydrauliques (NHL, norme européenne EN 459-1) malgré les concentrations anormalement élevées de $CaCO_3$ sont indiquées pour la préparation des mortiers employés dans la conservation. Le mortier présentant les meilleures caractéristiques a été testé avec succès lors de la repose d'une mosaïque sur un support mobile.*

In the past, one of the main causes of damage sustained by ancient mosaics was the use during restoration interventions of mortars incompatible with the original materials. The deterioration processes caused by cement or reinforced concrete, such as efflorescence and subefflorescence of salts, and the subsequent disintegration of the mosaic's surface and of its foundation layers have been known for many years (Jobst, Erdal, and Gurtner 1997; Menicou, Fiori, and Macchiarola 2003; Maioli, Racagni, and Perpignani 2005).

Fortunately, at present in Italy the use of Portland cement in mosaic conservation interventions is unusual. In recent years premixed mortars, hydraulic lime mortars, or strange biocompatible products have taken the place of cement mortars in architectural and archaeological conservation projects.[1] However, to this day the composition of the binders and the physicomechanical characteristics of conservation mortars are often ignored by conservators and conservation managers. Even the technical data sheets of these materials, supplied by the manufacturer, are incomplete. In addition, a specific European standard for conservation mortars does not yet exist. Currently, in Italy hydraulic lime mortars are most commonly used in mosaic conservation treatments.

Hydraulic Limes

Hydraulic limes are obtained by the calcination, at about 1100°C, of marly limestone, where clay concentration is between 8 and 20 percent. The burned product, suitably hydrated, is composed of calcium hydroxide ($Ca(OH)_2$) and different calcium silicates and calcium aluminum silicates; both of the latter compounds are responsible for the hydraulic properties of these binders. These silicates derive from the reaction between a fraction of the calcium oxide that comes from the decarbonation of the calcite and the amorphous residues of the argillaceous minerals destroyed during the calcination phase. Thus hydraulic limes have two setting mechanisms:

aerial, due to the carbonation of the calcium hydroxide; and hydraulic, due to the hydration of the calcium silicates and calcium aluminum silicates. The second reaction is much faster.

The hydraulic characteristics of these binders are closely linked to the concentrations of clay present in the calcinated raw materials. Their hydraulic properties can be expressed by the Hydraulic Index, which is the ratio between the sum of SiO_2, Al_2O_3, Fe_2O_3 (clay fraction) percentages and the sum of CaO, MgO (carbonate fraction) concentrations (Vicat 1997). Naturally, the greater the increase in the Hydraulic Index, the higher the concentrations of calcium silicates and calcium aluminum silicates in the binder.

The mechanical properties of the hydraulic lime mortars are slightly higher than those of the ancient mortars but far lower than the mechanical characteristics of cement mortars. In addition, hydraulic limes have small concentrations of soluble salts and high durability in wet conditions.

Laboratory Testing

Hydraulic Limes and Their Analyses

At present, the only European standard for building limes is the EN 459-1,[2] which classifies hydraulic limes according to a mechanical property: compressive strength. Unfortunately, the standard does not take into account the chemical composition. EN 459-1 allows the production and sale of three hydraulic limes:

- hydraulic lime (HL)
- natural hydraulic lime (NHL)
- natural hydraulic lime plus materials with hydraulic properties (NHL-Z)

Only NHL is obtained by the calcination of marly limestone. The other two limes can be made from a mixture of calcium hydroxide and cement.

In order to prepare mortars based on natural inorganic binders that are appropriate for the conservation of mosaics, several hydraulic limes currently available in Italy were analyzed:

- Lafarge NHL-Z 3.5
- Calix blanca Italcementi NHL 3.5
- TCS NHL 3.5 and 5
- Bio-E Tassullo
- Berti
- Brigliadori

Lime samples were investigated using a number of analytic methods. X-ray diffractometry (XRD) (Rigaku Dmax IIIC) was employed to identify the crystalline phases. The quantification of the portlandite (calcium hydroxide), calcite, and gypsum was obtained by differential and gravimetric thermal analyses (DTA-TGA) (Stanton STA 1500). Scanning electron microscopy was equipped with microanalysis (SEM-EDS) (Cambridge Stereoscan 360) for micro-texture observations as well as for chemical analyses. The elemental composition was obtained by EDS analyses, carried out several times on the binders after reducing them to dust. Finally, ionic chromatography (IC) (Metrohm IC NET 3.2) was used to determine the soluble salt concentrations.

Results and Discussion

The mineralogical phases detected by X-ray diffraction are shown in table 1. All the binders show unexpected high concentrations of calcite. It is understood, of course, that during the "setting" phase the calcite will act as an aggregate. Such high quantities of aggregate normally would not be found in a binder. The highest concentration of typical cement minerals (C_3S, C_2S, C_3A, C_4AF) were identified in the Lafarge product, an NHL-Z lime. The calcium hydroxide content in Bio-E Tassullo is zero, and high concentrations of dolomite and appreciable amounts of gypsum can be observed. Bio-E Tassullo is likely a premixed product composed of a small quantity of binder (gypsum and cement) and a considerable quantity of carbonate-siliceous sand. Brigliadori lime has small concentrations of $Ca(OH)_2$; in this binder the air fraction is much lower than in the hydraulic one. Finally, the traces of bassanite ($CaSO_4 \cdot 0.5\ H_2O$) detected in the Calix and the TCS NHL 3.5 are probably due to the anthracite that was used as fuel in the calcination process.[3]

Table 2 shows the calcite and portlandite ($Ca(OH)_2$) concentrations obtained by the DTA-TGA analyses. Thermal analyses confirm the high content of calcite in all the binders. The anomalous concentrations of $CaCO_3$ in the NHL binders range from 19 percent in TCS NHL 5 to 28 percent in TCS NHL 3.5. According to EN 459-1, Calix NHL 3.5 and TCS NHL 3.5 have the same hydraulic capacity but clearly show different concentrations of portlandite and calcite, respectively: 23 percent and 23 percent in Calix and 18 percent and 28 percent in TCS. Thus, the same values of compressive strength can be reached by limes having different mineralogical compositions. The concentrations of calcite (52%) and portlandite (traces) detected in Bio-E Tassullo underscore the high amounts of

Table 1 Crystalline phases identified by XRD analyses

Binder	Calcite	Portlandite $Ca(OH)_2$	Quartz	C_3S	C_2S	C_3A	C_4AF	Dolomite	Gypsum	Micas	Bassanite
Lafarge NHL-Z 3.5	XXXX	XXX	X	XX	X	trace	trace				
Calix NHL 3.5	XXXX	XXX	X	X	trace	trace	trace				trace
TCS NHL 3.5	XXXX	XX	X	X	trace	trace	trace				trace
TCS NHL 5	XXXX	XX	trace	XX	trace	trace	trace				
Bio-E Tassullo	XXXXX		XX	trace	trace	trace		XXX	X		
Berti	XXXXX	X	X X X					trace	trace	trace	
Brigliadori	XXXX	X	X	XX					trace		

Notes: The temperature inside the kiln is very variable during the firing. In some points the burning temperature can be 100 or 200°C higher than 1100°C (burning average temperature). In addition, the increase of the hydraulic degree (2 → 3.5 → 5) of the binders is obtained by means of an enrichment process of cement minerals (C_2S, C_3A . . .).

XXXXX = very abundant; XXXX = abundant; XXX = not very abundant; XX = discrete; X = scarce.

Table 2 Calcite and portlandite concentrations (%) obtained by DTA-TGA analyses

Binder	Calcite $CaCO_3$	Portlandite $Ca(OH)_2$
Lafarge NHL-Z 3.5	20	30
Calix NHL 3.5	23	23
TCS NHL 3.5	28	18
TCS NHL 5	19	17
Bio-E Tassullo	52	trace
Berti	37	7
Brigliadori	21	5

aggregate present in this sample. The DTA-TGA analyses also found about 3 percent gypsum (not reported in table 2) in the Bio-E Tassullo sample. Finally, the Lafarge sample has the highest value of air fraction (30% portlandite).

The high quantities of calcite detected by both XRD and DTA-TGA analyses in the NHL limes (obtained according to EN 459-1 by calcination of marly limestone and then hydration of CaO) could be due to low burning temperatures. In these thermal conditions, typical compounds of the cements develop with difficulty, and hydration of the CaO is facilitated. Otherwise, calcite powder could be added to the binder as a filler in order to obtain a precise value of compressive strength, which is the parameter taken into account by the European standard for classifying hydraulic limes.

In order to better understand the anomalous presence of calcite in the NHL binders, a sample of raw material (marly limestone) used for producing TCS natural hydraulic limes was analyzed using both optical polarizing microscopy (OM) and SEM. On the basis of the OM analysis the rock can be classified as a biomicritic marly limestone. In fact, a lot of bioclasts dispersed in a carbonate-clay matrix were observed (fig. 1). SEM observations of different TCS NHL 3.5 specimens identified whole and unaltered microfossils similar to those recognized by OM in the rock (fig. 2). The results of these optical and electron observations indicate that NHL limes (TCS at least) are obtained by calcination processes that do not take place at high temperatures (<1100°C). In fact, the calcite bioclasts located in the nucleus of the greatest calcinated pebbles can survive in these thermal conditions.

The mean concentrations of the main elements in some binders (Lafarge NHL-Z 3.5, Calix NHL 3.5, and TCS NHL 3.5) obtained by EDS microanalyses are shown in table 3. The values reported in this table are the mean of twenty analyses per sample. Table 3 also shows the Hydraulic Index (H.I.) values of the binders. It is possible to observe that limes classified in the same manner following the standard can show very different chemical compositions. Indeed, the concentrations of calcium and silicon in the two natural hydraulic limes (TCS and Calix) are remarkably different. In particular, Calix has a higher value

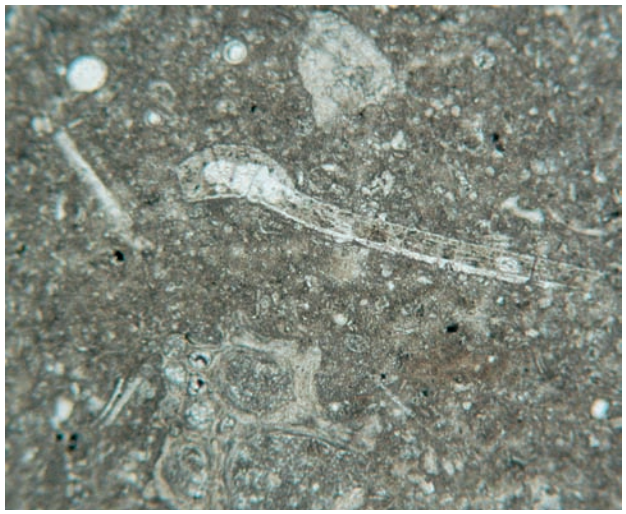


FIGURE 1 Optical microscopy observations by transmitted polarized light of the rock used for producing TCS NHL 3.5. Thin-section photomicrograph (parallel nicols) showing several bioclasts in a carbonate micro-crystalline matrix.

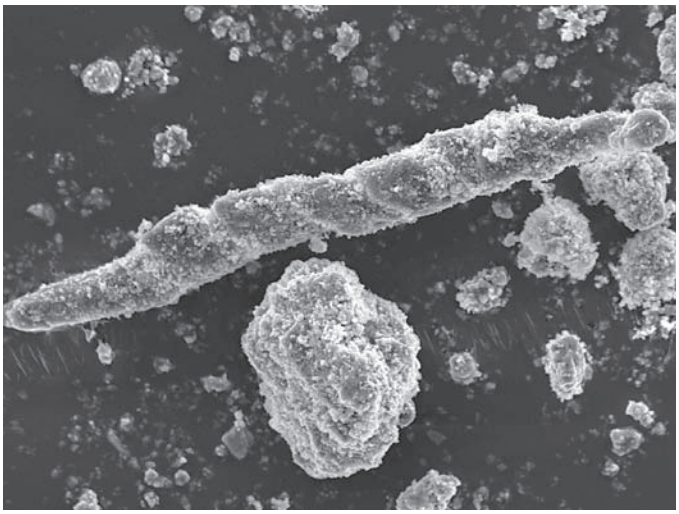


FIGURE 2 SEM observation of the TCS NHL 3.5. In the middle, a whole and unaltered microfossil similar to one present in the raw material (see fig. 1) can be recognized.

Table 3 Mean elemental concentrations (%) obtained by EDS microanalyses and Hydraulic Index (H.I.) values

Binder	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	H.I.
Lafarge NHL-Z 3.5	13.14	0.88	1.61	79.66	0.82	0.19
Calix NHL 3.5	8.15	1.44	0.22	82.91	2.35	0.12
TCS NHL 3.5	17.16	2.2	0.25	69.86	1.42	0.28

Notes: H.I. 0.10–0.16 = slightly hydraulic lime; H.I. 0.16–0.31 = medium hydraulic lime; H.I. 0.31–0.42 = hydraulic lime; H.I. 0.42–0.50 = eminently hydraulic lime; H.I.>0.50 = limit lime.

of calcium and a lower concentration of silicon than the quantities of both these elements found in the TCS lime. These chemical compositions indicate that Calix was obtained from a marly limestone with a higher concentration of calcium carbonate, while TCS, with its higher silicon and aluminum values, presents a more abundant hydraulic fraction.

Table 4 shows the concentrations in weight percentage of ionic species (anions and kations) determined by IC in our hydraulic limes.[4] In order to have significant comparisons, a Portland cement (type IV 32.5 R), and a white cement (type II 32.5 N) were also investigated.[5] The two cement samples show

Table 4 Ionic species concentrations (%) determined by IC analyses; traces, n.d. = not detected

Binder	F^-	Cl^-	NO_3^-	$PO_4^{\equiv}$	$SO_4^{=}$	Na^+	K^+	Ca^{++}	Mg^{++}
Portland cement type IV 32.5 R	0.03	0.03	–	–	2.46	0.07	0.39	8.00	–
White cement type II 32.5 N	0.08	0.04	0.12	1.52	1.27	0.21	0.08	7.50	–
Berti	trace	0.02	trace	–	0.17	0.22	0.07	6.64	–
Bio-E Tassullo	trace	trace	–	–	1.56	0.02	0.15	2.56	–
Brigliadori	0.02	trace	trace	trace	0.43	0.05	0.23	4.26	–
Lafarge NHL-Z 3.5	trace	trace	–	1.60	trace	–	0.05	>20	n.d.
Calix NHL 3.5	0.02	trace	0.01	1.60	0.06	trace	0.10	>20	n.d.
TCS NHL 3.5	0.01	trace	trace	–	0.28	trace	0.06	18.00	–
TCS NHL 5	0.01	trace	trace	0.19	0.06	0.01	0.07	14.86	–

appreciable amounts of sulfate ions, 2.46 percent in Portland cement and 1.27 percent in white cement. The similar concentration of SO_4^{2-} in Bio-E Tassullo (1.56%) is due to the presence of cement and gypsum. In spite of the presence of clinker, the quantities of sulfates in Lafarge NHL-Z 3.5 are negligible. In the other binders the SO_4^{2-} concentrations are very small or negligible. The high concentrations of Ca^{++} in Calix NHL 3.5 (>20%), Lafarge NHL-Z 3.5 (>20%), TCS NHL 3.5 (18.00%), and TCS NHL 5 (14.86%) are due to the abundant presence of $Ca(OH)_2$ in these samples. Finally, Cl^- is negligible in all the specimens. According to the IC analysis, the binders with the highest concentrations of soluble salts are the cements (Portland and white) and Bio-E Tassullo.

Mortar Sample Analyses

Four mortars with four different limes were prepared for the analytic study. The binders used were Berti, Brigliadori, TCS NHL 3.5, and Calix Italcementi NHL 3.5. Given the high concentration of calcite detected in the limes, the mortars were prepared in the following way: one part binder, two parts aggregate composed of limestone powder (maximum size = 1 mm, average size about 1/20 mm) and reagent water (10 MΩ) with a weight percentage about 20 percent of the other two components (binder + aggregate).

The mortars were examined two months later in order to identify their mineralogical composition (by XRD and DTA-TGA analyses) and to evaluate some mechanical properties, in particular, flexural strength and adhesive strength. Thermal analyses performed on specimens obtained by grinding mortar samples in the shape of small tiles (base of 10 by 10 cm and 5 cm high) highlighted the varying amounts of calcium hydroxide present in the mortars. The carbonation of the $Ca(OH)_2$ (due to its reaction with carbon dioxide present in the atmosphere) is a slow reaction that proceeds from the external surface to the internal part of the mortar. Table 5 shows the percentages of $Ca(OH)_2$ detected respectively in the binder and in the mortar.

Table 5 Portlandite concentrations (%) in binders and mortars obtained by DTA-TGA analyses

Binder	Portlandite $Ca(OH)_2$	Mortar	Portlandite $Ca(OH)_2$
Berti	7	Berti	2
Brigliadori	5	Brigliadori	trace
TCS NHL 3.5	18	TCS NHL 3.5	7
Calix NHL 3.5	23	Calix NHL 3.5	15



FIGURE 3 Adhesive strength tests. A specimen composed of a small mosaic placed in a Brigliadori-based mortar.

Small mosaic models were made in order to evaluate the adhesion properties of the mortars. The mosaics were made in square frames (20 by 20 cm) of wood (fig. 3). The tesserae in the mosaics were placed in the mortar setting bed down to two-thirds of their height.[6] Each mortar bedding was about 4 centimeters thick, while the mosaic dimensions were always 5 by 5 centimeters. Mechanically cut tesserae were used to ensure that all surfaces were completely level. Metal plates of the same dimensions as the mosaics were stuck on the mosaic surfaces with epoxy resin. The metal plate has a screwed hole in the middle and can be connected to the instrument used for tearing by means of a pivot screwed into the hole. The instrument can apply increasing traction until the metal plate tears the tesserae from the mortar (fig. 4).

The mean adhesive strength values of the different mortars are reported in the diagram shown in figure 5. Calix mortar has the highest value, 30 kg/cm². This mortar binds the tesserae more than the others, although the value is not very high. In this way a Calix mortar used in mosaic conservation can be easily removed in the future. In the past, tests of adhesive strength carried out on a Portland cement mortar under the same experimental conditions revealed a mean value of about 100 kg/cm². Of course, it is very difficult to remove this mortar.

Flexural strength tests (3-point test) were carried out on the Brigliadori, TCS NHL 3.5, and Calix NHL 3.5 mortars. The

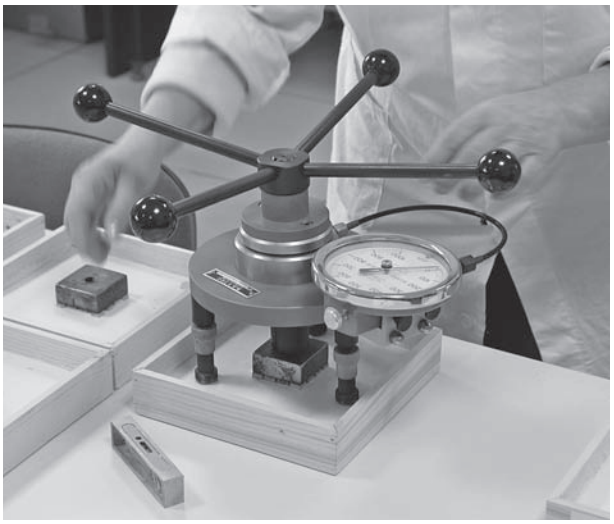


FIGURE 4 Instrument used for adhesive strength tests.

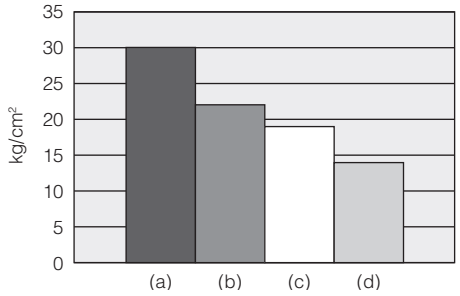


FIGURE 5 Diagram showing the mean values of the adhesive strength of the following mortars: (a) Calix NHL 3.5 mortar, (b) Brigliadori mortar, (c) Berti mortar, (d) TCS NHL 3.5 mortar.

specimens employed were small mortar tiles,[7] with a base of 11 by 5 centimeters and a thickness of 0.5 centimeter. The choice of such thin specimens was made in order to have a complete carbonation in the mortars.

The Calix mortar showed the best mean value, of 20.50 kg/cm² (standard deviation 1.63). The lowest value (7.98 kg/cm², standard deviation 1.15) was detected in the Brigliadori mortar, whereas the flexural strength of the TCS mortar was 11.72 kg/cm² (standard deviation 2.08). The low value of deviation (1.63) shown by the Calix mortar is linked to its particularly homogeneous structure. Adhesive and flexural strength tests pointed out that Calix NHL 3.5 mortar has the best mechanical characteristics.

Based on the analytic data (absence of clinker, low hydraulic degree, negligible concentrations of soluble salts, and the best values of adhesive and flexural strength), ease of use, quick setting times in comparison with the other NHL mortars, and the final color, a Calix NHL 3.5 mortar, with the same composition as the one investigated, was chosen for testing in a conservation intervention of two floor mosaic fragments from the late-antiquity Villa of S. Giusto, North Apulia, Italy (Hilgert 1998). The two mosaics of the villa were detached a few years ago and preserved in the depositories of the local archaeological authorities (fig. 6).[8] The original mortars (bedding and foundation layers) of these mosaics have hydraulic characteristics due to the presence of pozzolana granules among the aggregates.

Calix mortar was used to connect and re-lay two mosaic fragments on a movable support (figs. 7, 8). This mortar revealed a high compatibility with the original material as well as an acceptable degree of reversibility (Fiorella et al. 2006). In fact, the mosaic on the movable support, after two years and being exposed to different environmental conditions (e.g., it was exhibited in the open air without protection for two months in winter), is in very good condition. Disintegration, efflorescence, or color change of the mortar has not been observed.

Last year several NHL mortars, made of limes of different hydraulic properties, were successfully used for in

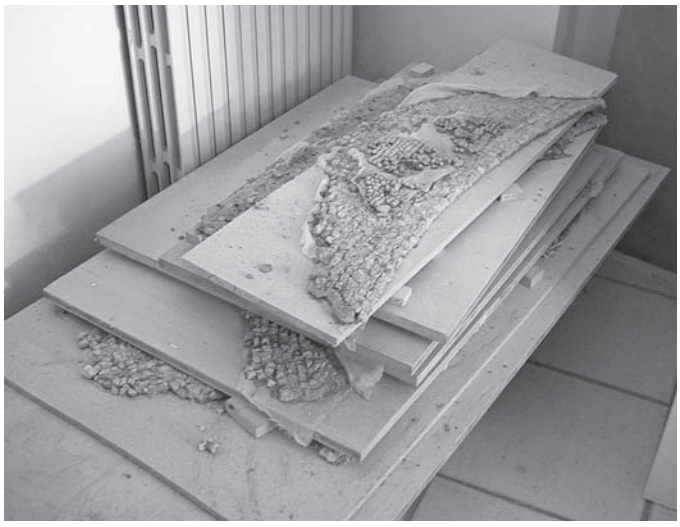


FIGURE 6 The mosaics of the Villa of S. Giusto lifted and divided into different fragments before the conservation intervention.



FIGURE 7 Application of the Calix mortar on the back of the two mosaic fragments.



FIGURE 8 Result of the conservation intervention. The join between the two mosaic fragments, relaid on an Aerolam® panel support, is not visible.

situ conservation interventions in the Archaeological Park of Classe near Ravenna, Italy. The mortars were applied for filling lacunae, for plastering, and for reinforcing wall remains.

Conclusion

This experimental work points out that the Calix NHL 3.5 mortar has the best characteristics (compositional and mechanical) for re-laying mosaic fragments on movable supports. In addition, the study underlines the importance of having a specific International Standard for conservation mortars as soon as possible; otherwise the use of binders and premixed products that are not compatible with the original materials will continue. In order to further our knowledge of conservation mortars, the development of refresher courses on conservation products specifically intended for architects, conservators, and conservation managers would be very useful. And finally, the data obtained in the laboratory studies, even if in the initial phase, and subsequent experience in the field already allow us to identify a good NHL mortar, not only for the filling of mosaic lacunae, but in other conservation contexts as well, for example, for the in situ conservation of archaeological site remains in general.

Notes

1 The list of articles and restoration reports in which cement mortars are not used in conservation interventions is infinite. Rarely, however, are the compositional and/or physicomechanical characteristics of conservation mortars indicated.

2 European Committee for Standardization, 2001.

3 Both manufacturers informed us of the use of anthracite as fuel in the production of these two binders. As this fossil fuel can have appreciable concentrations of sulfur, small quantities of bassanite can appear during the calcinations and the subsequent hydration.

4 The ionic species were determined according to UNI 11087 2003.

5 The identification of these cements follows the European standard. A pure Portland (type I) was not examined because at present in Italy it is not generally used in conservation interventions on ancient mosaics.

6 All tesserae were 1 centimeter high. Six mosaics for every binder were prepared.

7 Five specimens for every mortar were tested.

8 During the lifting phase every mosaic was subdivided in different sections.

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Reburial versus Sheltering: Experiments in Preventive Conservation of the Mosaics in the Roman Villa of Rabaçal, Penela, Portugal

José Lourenço Gonçalves

Abstract: *Two decades after survey and excavations at the Rabaçal archaeological site the mosaics discovered in the Roman villa are still preserved in situ. Although the mosaics were protected by a thin layer of sand, they presented some conservation problems. Between 2003 and 2005 various reburial and sheltering experiments were carried out to determine the most effective means of solving these problems. This paper presents those experiments and their results, as well as the monitoring and maintenance programs that took place over the course of the three years.*

Résumé : *Deux décennies après les sondages et la fouille du site archéologique de Rabaçal, les mosaïques découvertes dans la villa romaine sont toujours préservées* in situ. *Malgré la protection des mosaïques par une couche mince de sable, elles présentent des problèmes de conservation. Entre 2003 et 2005, divers essais ont été effectués pour réenfouir ou mettre sous abri afin de résoudre les problèmes de conservation. Cette communication expose ces expériences et leurs résultats, ainsi que les programmes de suivi et d'entretien mis en œuvre au cours de ces trois années.*

The three components of the Roman villa of Rabaçal (*urbana, rustica,* and *frumentaria*) have been under excavation since 1984. The excavation work in the *pars urbana,* between the date of its discovery and 1992, has made it possible to display about 250 square meters of mosaic flooring of exceptional interest dating from the middle of the fourth century C.E. The area of mosaics preserved in situ is about 50 percent of what is thought to be the total amount of original flooring (Pessoa 1998: 11–52) (fig. 1). In this large area it is possible to observe almost all the problems that can occur in the degradation of floor mosaics, such as the loss of original edges, cracks, lacunae, cavities, detached and deteriorated tesserae, deteriorated preparatory layers, separation of mosaic layers, depressions, rises and bulges, and plant intrusion (Pessoa, Gonçalves, and Catarino 2004: 322–24).

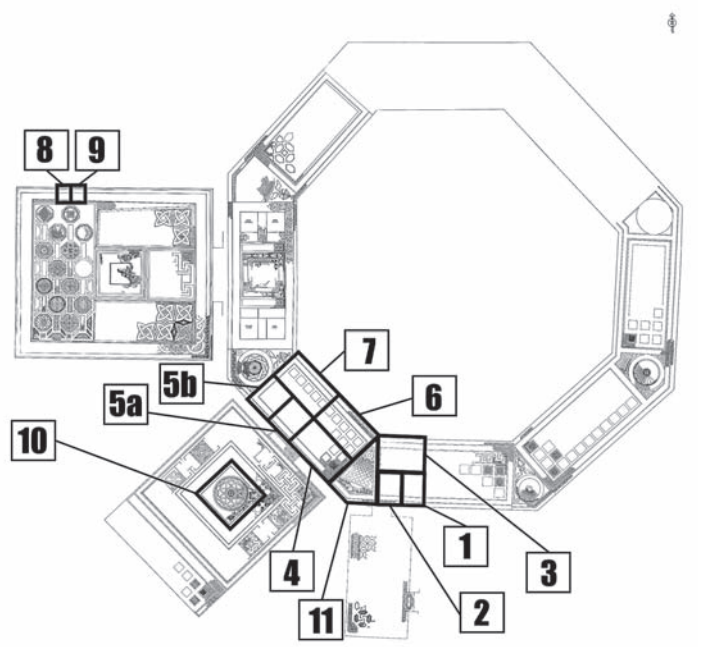


FIGURE 1 Schematic representation of the remaining mosaic floors preserved in situ in the *pars urbana* of the Roman villa. The highlighted areas on the plan correspond to the experiments that were carried out on the mosaics: (1–7) 2003 reburial experiments; (8, 9) 2003 sheltering experiments; (10) 2004 sheltering experiments; (11) 2005 sheltering experiments. Drawing: Jose Luis Madeira.

Conservation Programs and Projects

The team responsible for the archaeological site was fully aware that sudden exposure to the elements could aggravate the damage that typically results from the wear and tear of time. Thus they decided to take preventive measures to protect the surface of the *tessellatum* and covered the floors with a thin layer of sand (10–15 cm thick).

In 1999, with the boundaries of the villa defined and its architecture studied, the conservation and restoration program got under way, with a view to finally exhibiting the floors. The program was presented at the 2002 International Committee for the Conservation of Mosaics (ICCM) conference in Thessaloníki (Pessoa, Gonçalves, and Catarino 2002: 68). It was based on the premise that permanent shelters would first be built to protect all the areas with mosaic floors. Only after that would the sand be removed and the damage assessed in detail. Work could then begin on seasonal conservation and restoration programs established from the perspective of the whole group (Gonçalves 2001).

But the plan to construct a protective cover turned out to be far more complicated than anticipated since its practical implementation entailed technical and financial implications that were difficult to manage (Stubbs 1995: 73–75). Meanwhile, it was observed that despite the protective layer of sand the mosaics were still suffering damage that the sand was unable to prevent (Stewart 2004: 240). Thus in 1997 the first assessment was made of the invasion of weeds, which had taken advantage of lacunae in the *tessellatum* and the moist sand (Gonçalves 1997: 95–97). Other damage and subsequent diagnoses ensued, the most significant of which was the episode of freezing observed in January 2003 (Gonçalves 2003).

Given the various influences at work, the absence of permanent specialized technicians on-site, and the fact that the work done so far on the mosaics was not up to par, an agreement was reached to invite the input of a number of international colleagues.[1] Their wider professional experience, it was thought, could be brought to bear on the problems and the preventive measures attempted so far.

Experiments in 2003 (Reburial versus Sheltering)

At the first meeting in July 2003 the concerns were use of sand as an effective means of preventive protection, how the mosaics might react to another prolonged exposure, and criteria that should govern the design of the shelter structure (Agnew 2001). These concerns led to a series of experiments with preventive protection systems using sand interlaid with geotextile and/or expanded clay, as well as some chemical treatment for the taller weeds (Podany, Agnew, and Demas 1994: 7–11). Those mosaics with significant problems but of lesser aesthetic importance were selected for these tests. The following experiments were conducted in the numbered areas indicated in figure 1:

1. Cutting taller plants immediately above the *tessellatum* surface, then covering the mosaic with Leca® expanded clay pellets, followed by a layer of geotextile (a nonwoven geotextile, 180 g/m², 100% polypropylene, of an unknown manufacturer), and finally a layer of sand (Roby 2004: 231–34).
2. Cutting taller plants immediately above the *tessellatum* surface, followed by injecting the stalk with a systemic herbicide (10% of Roundup®) (Altieri, Poggi, and Ricci 2003: 251–55) and then covering with sand. The sand was subsequently sprayed with the same herbicide.
3. The same treatment as in area 2 but without spraying herbicide in the sand.
4. Cutting taller plants immediately above the *tessellatum* surface and then covering with sand.
5. Chemical treatment with a contact herbicide (10% of Parquato®), without removing the sand (5b) and cutting the plants to the surface of the sand (5a).
6. Cutting taller plants immediately above the *tessellatum* surface, then a cover of geotextile directly on the mosaic, followed by a layer of sand.
7. Cutting taller plants immediately above the *tessellatum* surface and then covering with sand interlaid with a thin, dark geotextile (Roby 2003: 212–14).
8. Removing the sand, cleaning the *tessellatum* surface with water and a neutral pH detergent (5% Teepol® multipurpose detergent, Harvey Waddington; pH 6.5–8.0), preventive consolidation of lacunae, edges, and borders, and filling gaps between the tesserae with a lime mortar (1.5) with sand (1) and *cocciopesto* (brick powder) (0.5) (Roby 1994: 33–36), and, finally, protecting the mosaic with a small temporary shelter.
9. Removing the sand, cleaning the *tessellatum* surface with water and a neutral pH detergent (5%), and, finally, protecting the mosaic with a temporary shelter (Alva Balderrama and Chiari 1995: 104–6).

All these experiments were monitored for a year and inspected every three months.



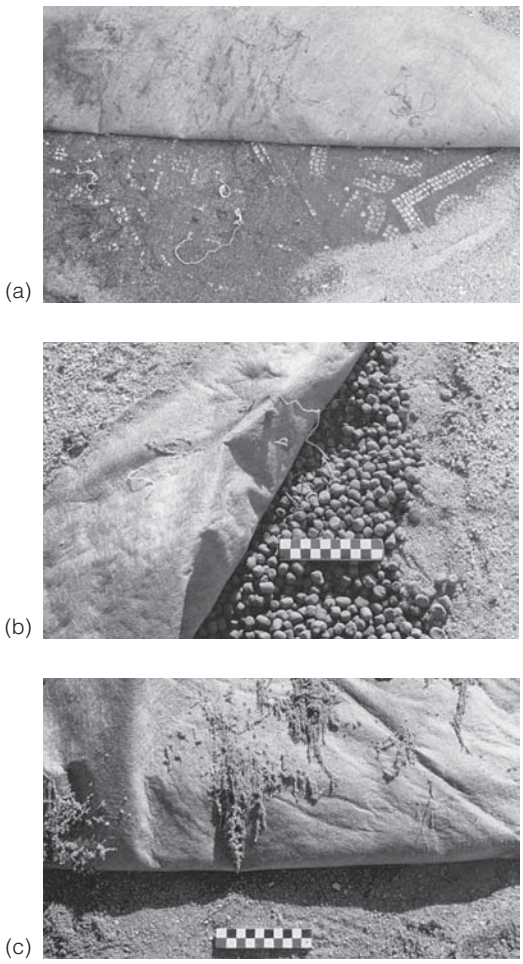
(a) (b)

FIGURE 2A, B Appearance of the sand surface before the experiments (a) and one year later (b).

The monitoring indicated that sand was still the most versatile and effective system overall and that the herbicides significantly reduced weed proliferation without damaging the mosaics' surface (fig. 2). In fact, the growth of the taller plants in areas 2, 3, 4, 5a, and 5b was substantially reduced without compromising the stability of the *tessellatum* surface. However, herbicides have to be applied systematically and regularly (a minimum of every three months) because they have a short chemical decay time.

The experiments used in areas 1 and 6 did not present any advantage and could potentially cause more damage. The experiments in area 1 increased silt deposition on the mosaic surface from the sand and pellets and also a small amount from the surrounding soil. This problem was reduced by washing the sand before placement. The experiment in area 6, in which the geotextile was laid directly on the mosaic, was particularly disastrous due to the accumulation of moisture on the *tessellatum,* which encouraged plant root growth, leading to mechanical attachment between the geotextile and the mosaic.

The best results, as a preventive protection system, were found in area 7, where the geotextile was interleaved between layers of sand, but even here weed growth was not completely avoided (fig. 3). The growth of weeds, with thin roots developing between the *tessellatum* and the geotextile, was confined to the sand layer, away from the mosaic surface. But the advantages of this system were still not promising enough to extend the experiment to the entire area of the mosaic floor. Furthermore, the mosaics exposed to the open air, in areas 8 and 9, reacted positively during the course of the year.



(a)

(b)

(c)

FIGURE 3A–C Different type and rate of root development in areas 6 (a), 1 (b), and 7 (c).

In area 8 the mortar used to reinforce the borders and edges of the mosaic was very effective. It was strong enough to prevent the detachment of any more tesserae without being as hard as cement. According to laboratory analysis, the new mortar was chemically related to the original remaining mortar, which increased compatibility. It was therefore deemed suitable for the occasional consolidation of detached tesserae, needed during the current documentation on the mosaics as well as in other situations where sand has to be removed. It is also suitable for replacing cement that was applied in the early 1980s and has since become detached.

The results of the experiments showed that exposing the mosaic under a shelter was a promising option. The only problems observed were the slight growth of microbiological organisms and incipient salt crystallization or precipitated material (calcite?) due to moisture on the mosaic surface, which can be controlled by a meticulous maintenance program. The positive results obtained for the mosaics under a shelter in areas 8 and 9 led to a similar procedure being followed the next year (fig. 4).

Experiments in 2004 (Preventive Care and Sheltering)

The results of one year of monitoring were presented at a second meeting, in July 2004, and new experiments were devised on the basis of the results. The positive outcome of the exposure and provisional shelter led to a decision to carry out a similar experiment on a larger area in another part of the site where conservation problems were more extensive. The larger area permitted a more accurate evaluation of how the exposed mosaic would respond to protection by a structure.

The experiment was carried out in area 10 (see fig. 1). This is a polychrome mosaic, mainly composed of red, black, and ocher limestone tesserae in *opus tessellatum,* over two layers: a bedding layer made of white lime mortar and a preparatory layer of mortar made with lime, sand, and *cocciopesto.* This mosaic had shown some visible surface problems the previous winter. Wind and rain had washed away the sand, exposing the *tessellatum* to the elements. Subsequently it was protected with geotextile placed directly over the *tessellatum,* followed by a layer of sand. When it was reexposed in 2004 major losses were found compared with the records of the late 1980s. The conditions were as follows:

a. Structural: rises and bulges, depressions, lacunae, loss of individual tesserae, detached and loosened tesserae (some of them scattered), separation between mosaic layers, deteriorated preparatory mortar, lack of mortar between tesserae, and weed intrusion.
b. Surface: soil deposition, pitted tesserae in the pink-white limestone (especially in the south corner), fractures in the white limestone tesserae, disaggregation and color alteration of the black limestone tesserae, and some incrustations.



(a)



(b)

FIGURE 4A, B Two aspects of the mosaic protected by a shelter (1 m^2) one year later (a) and two years later (b).

Given the problems observed, the following procedures were initiated:

1. removing soil deposits with brushes and spatulas;
2. cleaning the surface with water, sponge, and brushes;
3. consolidating preparatory layers and tesserae with Primal AC33® diluted to 20 percent, mainly in the areas where the original mortar in the interstices between tesserae had been replaced by soil deposits;



FIGURE 5 Basic shelter used in areas 10 and 11.



FIGURE 6 Detail of weed growth between tesserae interstices on the mosaic in area 10 one year after sheltering, maintenance, and monitoring.

4. repairing the edges and filling between tesserae and lacunae with a mortar of lime, white sand, and *cocciopesto* (1:1.5:0.5) (Albini and Zizola 2003: 237–40).

As in the previous experiments, this experiment was monitored for a year and inspected every three months. In addition, local permanent technicians (students guarding and maintaining the site on a part-time basis) undertook occasional maintenance interventions, which were done according to the technical methodology learned at the 2004 meeting.

A year later, the following observations were made:

a. The cover structure was too high and did not shelter a large enough area to prevent rain intrusion (fig. 5). It was therefore necessary to reduce the area of exposed mosaic, covering it with a peripheral fringe of sand 50 centimeters wide.
b. The absence of windbreaks in the structure meant that more sand was transported to the mosaic surface, triggering a certain amount of tesserae erosion.
c. Some seasonal sporadic growth of microbiological organisms occurred, requiring treatment with biocides on an as-needed basis.
d. The growth of taller plants continued but was reduced and confined to the *tessellatum* periphery and the lacunae. To prevent further growth, a monthly treatment involving manual cutting and herbicides was instituted.
e. Some sporadic weed growth between the tesserae interstices meant that soil deposits had to be completely removed and replaced with new mortar (fig. 6).
f. The mortar consolidation showed good mechanical resistance, with cracking or detachment just in the places that had direct contact with the old cement (fig. 7).

The positive outcomes of this experience, in conjunction with the data collected during the course of the monitoring and from the two annual meetings, led to a repeat of the experiment the following year.

Experiments in 2005 (Lessons Learned)

A third meeting was held in July 2005, during which it was decided to work on a new area of the mosaic (area 11) (see fig. 1) following the same methodological approach used the previous year. The mosaic here presented more degradation features than the previous intervention area. But it also permitted better rainwater drainage and was more accessible for regular inspections. It is a polychrome mosaic, composed

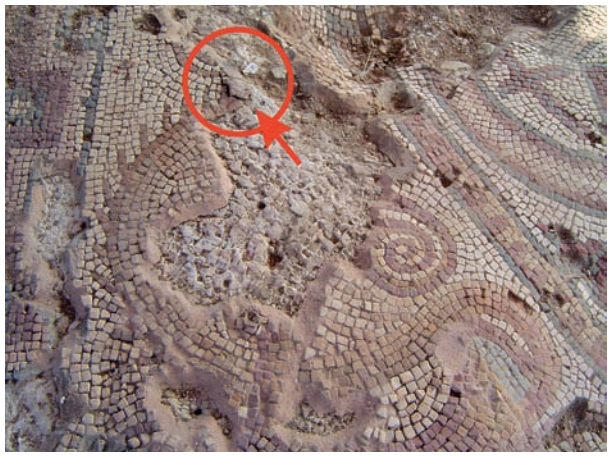


FIGURE 7 One aspect of the mosaic in area 10, one year after sheltering, maintenance, and monitoring. In the marked area it is possible to observe the detachment of the mortar in contact with the old cement.

mainly of red, black, and ocher limestone tesserae in *opus tessellatum,* over two preparatory layers: a bedding layer made of white lime mortar and a preparatory layer made of a mortar with lime, sand, and *cocciopesto.* Like all the other mosaics, it had been protected with sand, the removal of which revealed the following conservation problems:

a. Structural conditions: identical to those observed on the area 10 mosaics, noted above.
b. Surface conditions: soil deposition, fractures in the white limestone tesserae, erosion of the black limestone tesserae.

Given the problems observed, the procedures instituted were similar to steps 1–4 for the area 10 mosaic; in addition, the following treatments were done:

- removing plants with a scalpel and injecting the stalk with herbicide (10% of Parquato®);
- filling small lacunae (1–2 tesserae) with original tesserae collected in the vicinity with a mortar of lime, white sand, and *cocciopesto* (1:1.5:0.5);
- filling bigger lacunae with a mortar of lime and white sand (1:2) to restrict the growth of plants in the preparatory layers; and
- filling cavities that presented subsurface loss with a mortar of lime, white sand, and *cocciopesto* (1:1:1).

As the *cocciopesto* fillings were a reddish pink color, it was decided to do a chromatic reintegration of the mortar, painting the surface with another mortar, very liquid, of lime (1) and white sand (2). As in the previous years, this experiment will be monitored for a year and inspected every three months. According to the technical methodology learned and applied in the meeting, the local permanent technicians will carry out sporadic maintenance interventions during the course of the year (Costanzi and Nardi 2003: 322–34). But this time the number of maintenance operations was increased and standard practices were introduced according to the conservation problems. The necessary cleaning, filling, and consolidation work will be documented in detail on the drawings of the mosaic. A photographic record will also be taken (fig. 8). This methodology will provide a more accurate diagnosis of the interventions' results and of any small changes occurring in the mosaic.

Conclusion

Since fieldwork remains to be done the mosaics need to be protected with easily removable methods. The covering with sand and other methods had certain disadvantages. The preventive shelters had some problems, but they had the advantage of keeping the mosaic surface visible, which proved very useful for monitoring the conservation experiments and also for the site visitors. The sheltering experiments also provided useful information for the project of the permanent shelter to be built on-site.

Most of the experimental procedures were limited by time constraints, which meant that all the proposed interventions were not carried out, though there was enough time to teach the student "technicians" basic conservation procedures. One aim was to introduce these technicians to the practices of preventive conservation and to implement a daily routine of inspection and maintenance. Once in place, the routine will prevent or solve those small problems that occur naturally during the course of the year, or in consequence of the documentation work, inspection, and so on.

Exhibiting the mosaics allows for their permanent observation, which in turn means a prompt response in the event of an emergency. A long-term exhibition with a covering structure will also permit an evaluation of the new environment. Such observations together with the parallel environmental characterization studies, made possible by the installation of a monitoring station on the site, and the laboratory analysis of the mortars and tesserae samples, thanks to Coimbra University,



FIGURE 8 Example of the intervention recording process: (B) herbicide treatment; (C) consolidation with Primal AC33®; (S) filling with lime mortar; (T) filling with one tessera; (To) filling with original tesserae.

will be considered for the final conservation program as well as for the definitive protection studies for the site sheltering.

Notes

1 Participants at the meetings: Francesca Attardo, Florence, Italy (2003, 2004, 2005); Verena Fischbacher, Avenches, Switzerland (2003); Cetty Muscolino, Ravenna, Italy (2004, 2005); Claudia Tedeschi, Ravenna, Italy (2004); Miguel Pessoa, Condeixa, Portugal (2003, 2004, 2005); Lidia Gil Catarino, Coimbra, Portugal (2003, 2004, 2005); Sónia Vicente, Penela, Portugal (2003, 2004, 2005); Carolina Carvalho, Rabaçal, Portugal (2003, 2004, 2005); Ricardo Neto, Rabaçal, Portugal (2003, 2004, 2005); Fátima Abraços, Lisboa, Portugal (2003, 2004, 2005); Luís Ferreira, Tomar, Portugal (2003).

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Consolidation *in situ* de la mosaïque de la grande basilique de Tipasa, Algérie

Sabah Ferdi et Mohamed Chérif Hamza

Résumé : *La mosaïque géométrique polychrome qui décorait la nef centrale de la grande basilique de Tipasa, située au nord-ouest du site, mesure 46,18 m x 13,50 m. Les dégradations occasionnées par les embruns marins, le piétinement et l'exposition permanente aux intempéries depuis sa découverte à la fin du XIX^e^ siècle, ont conduit à la prise de mesures urgentes pour sa préservation. Ainsi, la superficie de 44 m² traitée a fait l'objet d'une documentation graphique et photographique. Ont suivi, le nettoyage de la mosaïque, le remplacement des anciens solins par des nouveaux supports, le traitement des lacunes par consolidation et comblement et le nettoyage final de la surface traitée.*

Abstract: *The polychrome geometric mosaic decorating the nave of the Tipasa basilica, lying to the northwest of the site, measures 46.18 by 13.50 meters. Degradation caused by sea spray, trampling, and permanent exposure to bad weather since its discovery in the late nineteenth century has led to urgent measures being taken to preserve it. Graphic and photographic documentation of the 44 square meters earmarked for treatment was undertaken prior to cleaning, replacement of the old support with a new one, treatment of lacunae by filling and consolidation, and final cleaning of the treated surface.*

Historique

Tipasa, cité prestigieuse de l'Afrique méditerranéenne, a vu s'enchaîner les civilisations les plus diverses : aux stations datées du Paléolithique moyen, de l'Atérien et l'Ibéromaurusien se superposent les Phéniciens au VI^e^ siècle av. J.-C., les royaumes maurétaniens et numides, les Romains, les Vandales, les Byzantins et les Fatimides. Aujourd'hui, les principaux monuments et vestiges de la cité antique se présentent en deux vastes ensembles : la nécropole, implantée sur la colline dite de sainte Salsa à l'est, et le parc archéologique qui présente l'essentiel des ruines monumentales mises au jour, à l'ouest (fig. 1).

Le site de la grande basilique et ses dépendances

Cette basilique occupe une situation privilégiée à un des points les plus élevés face à la colline des temples et du forum. Elle s'étale à l'extrême coin ouest, entre la falaise et la muraille. Sa façade est implantée tout contre la muraille au point que les colonnes du portique qui la précèdent s'insèrent dans un des escaliers d'accès au chemin de ronde.

La construction de son abside nécessita la pose de fondations à six mètres au-dessous du vaisseau central, en contrebas d'une paroi rocheuse verticale où d'importants contreforts en pierres de taille et en blocage ont été aménagés pour sa protection et son maintien.

C'est le plus vaste édifice chrétien d'Algérie. Cette basilique longue de 54 mètres et large de 42 mètres fut sans doute construite au cours du IV^e^ siècle apr. J.-C. et l'essentiel de ses matériaux provient de monuments païens. À l'origine, la basilique comportait sept nefs. Le sol des nefs latérales était revêtu d'une couche de mortier encore visible aujourd'hui, celui de la nef centrale couvert d'une mosaïque géométrique.

Au milieu du V^e^ siècle apr. J.-C., deux rangées de colonnes ont été ajoutées dans la nef centrale et les piliers ont été installés sur le sol, à même la mosaïque, sans fondations.

Au nord de la basilique, subsistent quelques vestiges des bâtiments annexes : une petite chapelle jouxtant

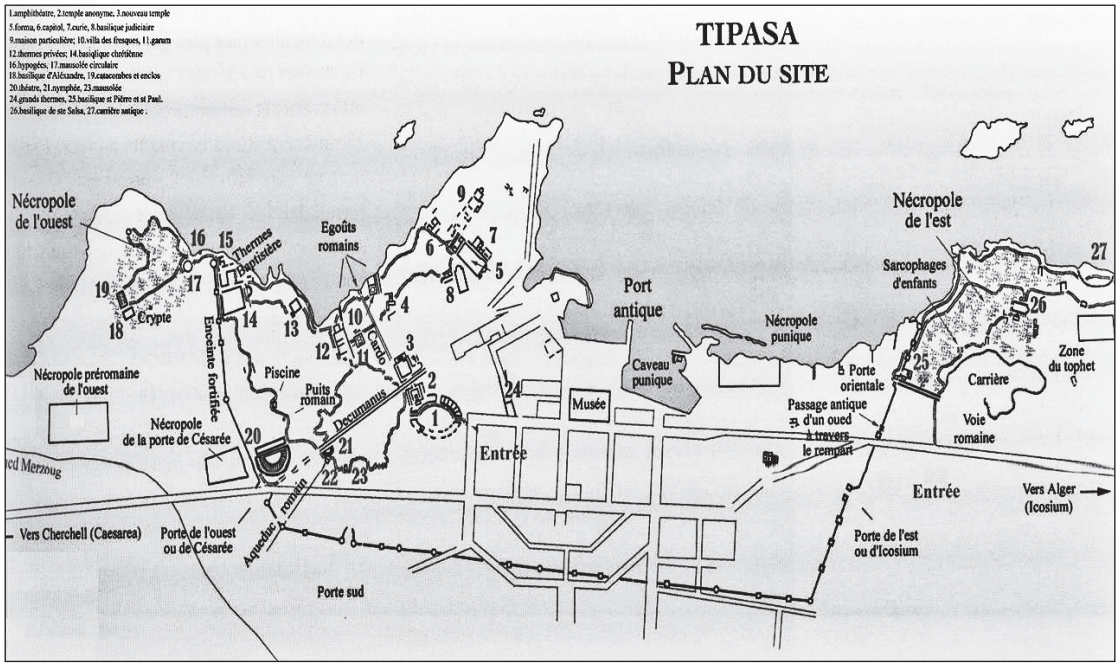


FIGURE 1 Tipasa : Plan du site. © Musée de Tipasa.

la basilique dont le sol présente quelques fragments de tesselles encore *in situ*, un baptistère, des thermes privés et un ensemble de citernes et bassins parcourus de multiples conduites d'eau en pierres (Gui, Duval, et Caillet 1992 : 21–24 ; Lepelley 1981 : 543–546 ; Lancel 1982 : 739–785 ; Février 1990 : 28–29, 95 ; Gsell 1894 : 355–371 ; Pachtère 1916 : 90 ; Gavault 1883 : 400–404).

Le sol de la nef centrale (13,50 m x 46, 18 m) est en contrebas de 0,10 m par rapport au reste de l'édifice ; il comporte un décor géométrique dont 623,43 m² sont encore *in situ* (fig. 2, 3).

Encadrement et champ :

Dimensions : 11 m x 4 m ; densité au dm² : champ : 52 ; bordure : 32 ; tesselles de 1 à 1,5 cm de côté. Polychromie : blanc, rouge brique, jaune, vert, noir et bleu. Matériaux : calcaire, marbre et terre cuite.

La bordure de la mosaïque figure une onde en opposition de trois couleurs (rouge, jaune et vert).

Le champ est une composition de méandre de svastikas à retour simple en épines rectilignes courtes dentelées noires et carrés (côté du carré = 80 cm). Les carrés sont chargés d'une sparterie polychrome ; les intervalles en triple rangée de tesselles rouge brique. Cette composition est apparentée au Décor, I, 192 (fig. 4) (Balmelle, Darmon et al. 1985 : 303).

État de conservation

Les dégradations occasionnées à cette mosaïque par les embruns marins, la prolifération des lichens, muscs et algues sur la surface des tesselles, l'accroissement de la végétation dans les lacunes, le piétinement des visiteurs et des animaux, son exposition, sans couverture, aux actions néfastes des intempéries depuis sa découverte en 1892 ont conduit les responsables de la conservation du site à prendre des mesures urgentes pour sa préservation suite à l'inscription du site de Tipasa sur la Liste du patrimoine mondial en péril en 2002.

A cet effet, un chantier école a été mis en place en novembre 2004, sous l'égide de l'UNESCO et du Comité du patrimoine mondial, en collaboration avec l'ICR de Rome. Dans ce cadre, 14 stagiaires (archéologues et techniciens de l'Agence d'Archéologie d'Alger) ont été accueillis sur le site et sont intervenus sur une petite parcelle de 44 m² pour une période de 15 jours.



FIGURE 2 Vue générale du site de Tipasa. Photo © Musée de Tipasa.

La méthodologie utilisée pour le traitement de cette surface consistait en la constitution d'une documentation graphique et photographique de la parcelle à traiter.

Constat d'état :
L'état de conservation du pavement présentait divers types d'altération :

- Perte du lit de pose entraînant la disparition des tesselles.
- Gondolement, affaissement, soulèvement du *tessellatum* (fig. 5).
- Apparition de fissures.
- Exfoliation des tesselles rouges.
- Désolidarisation du lit de pose en différents endroits.
- Prolifération des lichens.

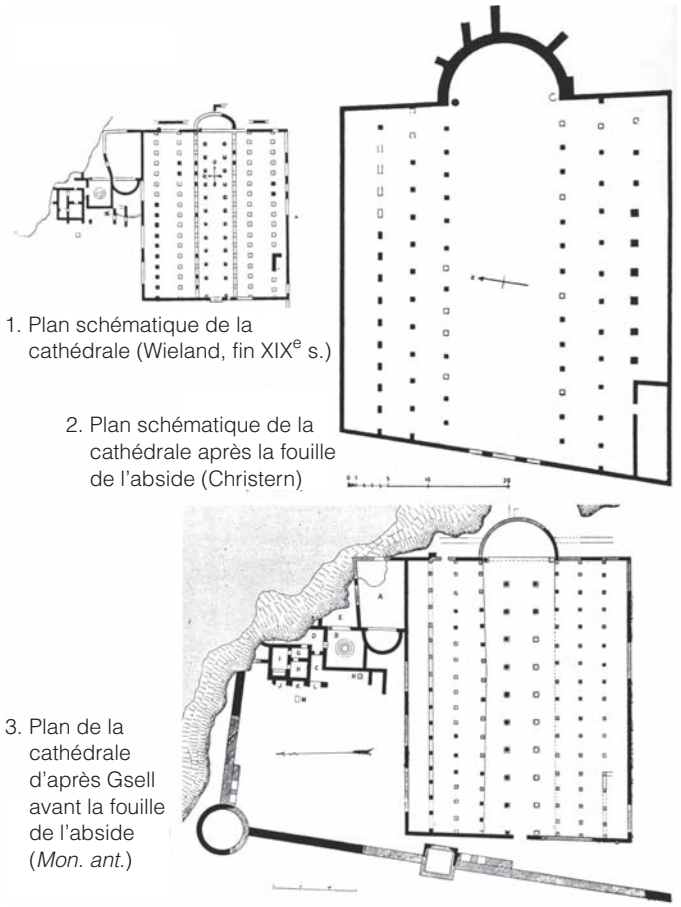


FIGURE 3 Plans schématiques.



FIGURE 4 Vue de la mosaïque *in situ*. Photo © Musée de Tipasa.



FIGURE 5 Gondolement du *tessellatum*. Photo © Musée de Tipasa.



FIGURE 6 Entoilage de la mosaïque. Photo © Musée de Tipasa.

- Compression des bords à la suite d'une ancienne restauration au ciment.

Interventions d'urgence :

- Nettoyage mécanique de la surface du pavement à l'aide de scalpels, de brosses et d'aspersion d'eau afin d'éliminer les dépôts incohérents du *tessellatum* pour assurer une bonne adhésion de la gaze lors de l'entoilage des bords fragiles.
- Entoilage des parties les plus fragiles à l'aide d'une gaze et d'un adhésif (fig. 6).
- Élimination mécanique des anciens solins et enlèvement de la terre accumulée et déposée dans les lacunes, jusqu'à l'apparition des couches originelles.
- Renforcement des parois bien dégagées et nettoyées par un masticage constitué de solin à base de mortier de chaux hydraulique, sable et pouzzolane (fig. 7).
- Traitement des endroits où il y avait détachement des tesselles de leur lit de pose, par des injections de consolidant.
- Comblement des lacunes internes (petites lacunes) par un mortier à base de chaux, sable et gravelet.
- Comblement des grandes lacunes par un mélange d'ancienne terre tamisée et de gravelet mouillé et tassé.
- Désentoilage des parties encollées et nettoyage de la surface de la mosaïque.
- Documentation photographique de la surface traitée (fig. 8).
- Délimitation et protection de la surface traitée au moyen d'un grillage pendant trois mois pour favoriser la consolidation *in situ*.

En conclusion, nous sommes conscients des limites de cette solution expérimentée pour la préservation *in situ* de la



FIGURE 7 Renforcement des parois. Photo © Musée de Tipasa.



FIGURE 8 Documentation photographique après le traitement de la mosaïque. Photo © Musée de Tipasa.

mosaïque de la grande basilique mais nous pensons poursuivre la même démarche pour le traitement de la superficie qui reste à consolider, soit 266 m².

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Les mosaïques de Lambèse, Algérie

Problèmes et perspectives de travail
Amina-Aïcha Malek

Premiers constats sur l'état de la collection
Marie-Laure Courboulès

Résumé : *Dans le cadre de l'élaboration du corpus des mosaïques de Lambèse, une campagne de nettoyage et de consolidation des mosaïques du musée et du site est en préparation. Elle nécessite l'adoption d'une stratégie qui prenne en compte la vétusté d'un musée construit en 1901, les difficultés que rencontrent les conservateurs locaux pour garantir la sécurité des vestiges et le peu de moyens mis à disposition pour gérer un site qui, de par sa situation géographique, souffre depuis dix ans d'un isolement accru. Ce programme, indispensable pour notre recherche, permettra de dynamiser la mise en valeur du musée et des sites de la région.*

Abstract: *As part of the program to establish the corpus of Lambèse mosaics, a campaign is being prepared to clean and consolidate the mosaics in the museum and the site. The strategy adopted will have to take into account the obsolescence of the museum, which was built in 1901; the difficulties local curators experience in ensuring the security of artifacts; and the scarce resources available to manage a site, which because of its geographic situation has become increasingly isolated in the past ten years. The program is crucial to our research, and it will also promote the development of the museum and the sites in the region.*

À la suite de contacts que j'ai pris avec les responsables algériens des services archéologiques, j'ai pu envisager de reprendre l'étude du très riche patrimoine de l'Algérie en matière de mosaïque, patrimoine dont les circonstances, dans la décennie 90, ont considérablement limité l'accès. J'ai choisi, pour relancer le projet de *Corpus des Mosaïques d'Algérie* qui avait été prévu dans les accords algéro-français de 1991–1992, de commencer par le volume consacré au site de Lambèse (Lambaesis, Tazoult, Wilaya de Batna). En effet, les mosaïques de Lambèse avaient attiré mon attention par leur richesse polymorphe tant au niveau pictural – riche palette de couleurs, dimension réduite et pose très serrée des tesselles – qu'au niveau de l'imaginaire qu'elles évoquent, m'invitant à reprendre leur étude de manière plus systématique et plus approfondie.

L'Atelier de conservation et de restauration du Musée d'Arles, à l'occasion de l'Année de l'Algérie en 2003 et de l'exposition sur l'Algérie antique, a aussi porté son choix sur ce site qui renferme quelques uns des plus beaux fleurons de l'art de la mosaïque romaine d'Afrique, menacés cependant par leur état de dégradation. C'est dans le cadre de ses chantiers de coopération avec les pays du Bassin méditerranéen que l'Atelier d'Arles a participé à la sauvegarde des mosaïques algériennes parmi lesquelles la mosaïque des Monstres marins et la mosaïque de la Nymphe Cyrène.

Le corpus qui a pour intitulé *Les mosaïques de Lambèse (Tazzoult, Algérie) première capitale de la Numidie, Essai sur la naissance et le développement d'ateliers régionaux de mosaïque,* s'inscrit en continuité des recherches sur les mosaïques romaines de l'Algérie développées par Suzanne Germain pour Timgad, Michèle Blanchard-Lemée pour Djemila et Sabah Ferdi pour Cherchell (Germain 1973, 1983 ; Blanchard-Lemée 1975 ; Ferdi 2005).

Cette entreprise vise à établir un inventaire sur une base topographique et archéologique des mosaïques de Lambèse, aussi bien des mosaïques conservées au Musée que de celles qui subsistent *in situ* et de celles dont l'existence nous est connue par la bibliographie ou les fouilles de sauvetages ; dans la mesure du possible, sera reconstitué le cadre architectural de leur découverte et son décor (peinture murale, sculpture, etc.).

Première capitale de la province romaine de Numidie, Lambèse présente un intérêt crucial pour comprendre comment une province détachée de la proconsulaire, va d'une part, importer et adopter un modèle culturel romain de tradition hellénistique et, d'autre part, créer ce qu'on pourrait appeler une *école* régionale de mosaïque par l'émergence d'ateliers locaux dont les liens avec ceux de Timgad apparaissent désormais très nettement (Germain 1977 ; Malek à paraitre). Cette école est marquée par une originalité profonde par rapport à toutes les productions artistiques en mosaïque dans l'ensemble de l'Empire romain. Tels sont les grands axes selon lesquels s'orienteront les recherches.

Lambèse, située à 12 km à l'est de Batna, est connue de manière très incomplète parce qu'elle a très peu fait l'objet de fouilles systématiques. Les premières explorations ont eu lieu dès 1848 et se sont poursuivies jusqu'au début du XX^{e} siècle, puis plus sporadiquement jusqu'aux années 1980. L'étude des pavements de mosaïques attesterait de l'essor d'une cité qui va se développer autour des camps militaires et dont les monuments épars – un amphithéâtre, des thermes, des temples, un capitole – mis au jour au XIX^{e} siècle, sont les témoins. La richesse épigraphique du site permet de reconstituer son histoire et atteste d'une vie municipale active jusqu'au Bas-Empire[1]. Sa superficie est estimée à 40 ha.

L'aspect militaire de la ville a intéressé particulièrement les historiens de l'Antiquité romaine qui ont fait une très ample moisson d'inscriptions, si bien que cette richesse épigraphique a occulté jusqu'à maintenant l'architecture domestique. Les deux pôles d'attention des historiens sont la ville haute, avec ses temples et ses monuments des eaux d'une part, et les édifices militaires d'autre part. Font exception, les spécialistes de mosaïques en 1977 avec la publication par S. Germain de deux pavements de Lambèse et avec M. Blanchard-Lemée qui commente successivement en 2001 au Colloque de Lausanne et en 2003 à l'occasion de l'exposition « Algérie antique » la mosaïque des Monstres marins et celle de la Nymphe Cyrène de Lambèse (Germain 1977 ; Blanchard-Lemée 2001, 2003).

De nos jours, la petite ville de Tazzoult-Lambèse est avant tout connue pour son pénitencier érigé en 1850 qui fut certes le point de départ de la découverte de l'ancienne cité mais aussi l'obstacle majeur à une étude approfondie et systématique de ses vestiges comme ce fut le cas pour la toute proche Timgad. En effet, la destruction graduelle du site par le pénitencier, le village colonial puis l'agglomération actuelle a rendu d'autant plus difficile la mise en place d'une politique de conservation du site de Lambèse. Construit en 1901, le Musée de Lambèse ne remplit plus sa mission d'espace d'exposition, faute de moyens. Il est réduit à un espace de réserve vétuste qui met en danger les objets qu'il contient. Ce petit musée de site qui a précédé les musées de Timgad et de Djemila n'en possède pas l'ampleur mais renferme les plus spectaculaires mosaïques de l'Afrique romaine. Vingt-deux mosaïques tapissent les murs et le sol du musée et les fragments de trois autres sont conservés dans les vitrines.

Lors d'une mission de préparation à Lambèse, j'ai pu ainsi me rendre compte de l'état de la situation tant au niveau de la gestion, de la conservation des mosaïques et des difficultés de mise en valeur du site qui se sont accrues ces dix dernières années : le musée est fermé depuis 1994, les deux mosaïques qui ont été restaurées par l'Atelier d'Arles n'ont pas été replacées dans leur cadre initial faute de moyens et de projet muséographique.

Ces premiers constats m'ont permis d'ajuster le projet au contexte propre de Lambèse et de le proposer en février 2005 aux représentants du Ministère de la Culture[2]. J'ai obtenu l'autorisation de mettre le projet en place et de signer une convention avec l'Agence Nationale d'Archéologie et de Protection des Sites et Monuments Historiques, l'ANAPSMH.

Le contexte particulier du site de Lambèse nous amène à envisager notre projet de corpus en association étroite avec la mise en valeur et la restauration des mosaïques sous la forme d'interventions de nettoyage et de consolidation, et, dans certains cas, par un traitement de restauration total guidé par les urgences mises en évidence par l'expertise réalisée pendant la première mission de juin 2005. Ce travail de longue haleine envisagé simultanément à l'étude scientifique permet de l'enrichir et la compléter. La conservation des mosaïques de Lambèse pourrait être envisagée comme le point de départ de la formation d'un personnel spécialisé et la création d'un atelier de restauration travaillant pour les sites les plus importants de l'Est de l'Algérie.

Une campagne financée par le service de Coopération d'action culturelle de l'Ambassade de France à Alger, le Centre Culturel français de Constantine et le CNRS[3], a permis du 18 juin au 9 juillet 2005 d'établir une première mission qui avait pour objectif d'une part de recenser et d'étudier les mosaïques et les fragments conservés au musée, de faire un constat approfondi de l'état de conservation des panneaux et de déterminer les priorités dans les interventions de nettoyage et de restauration ; et d'autre part, de cartographier provisoirement les emplacements où des mosaïques ont été reconnues et de déterminer la possibilité de dégagements selon les conditions de conservation de chaque pavement. Ainsi, une partie de la

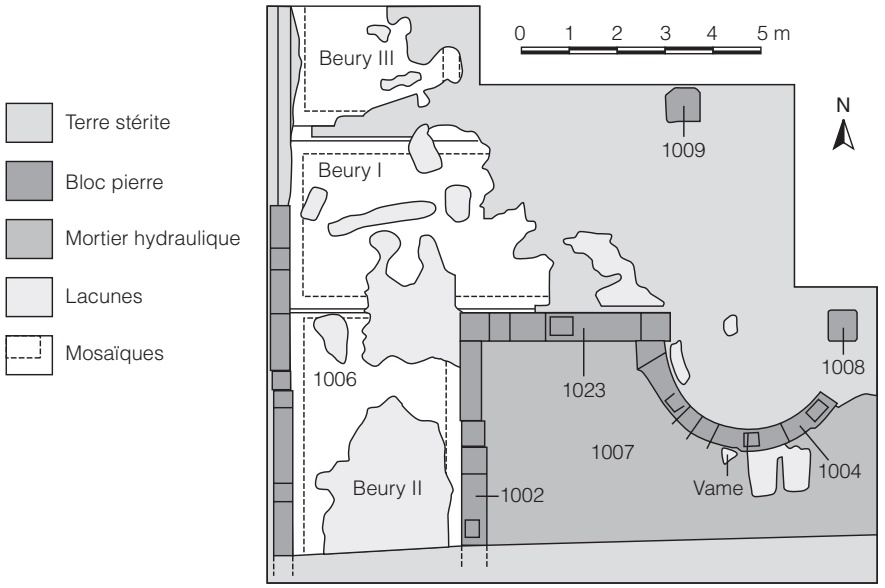


FIGURE 1 Plan de situation, mosaïques Beury I, II, III. © C. Jaquet, B. Naviner.

mosaïque située au nord-est de l'amphithéâtre et mentionnée en 1893 par Beury, puis vue en 1994 lors d'une fouille de sauvetage par A. Guerbabi, ancien conservateur de Lambèse, a été exhumée, étudiée, consolidée et recouverte. La mosaïque Beury, située sur un terrain domanial loué à un agriculteur, est gravement endommagée par les labours (fig. 1). Elle présente trois tapis : un quadrillage de guirlandes de laurier chargées de fruits sur fond noir, une composition en quadrillage de cercles et de fuseaux et une composition de carrés concaves et de croix de « bulbes » peuplées d'oiseaux (fig. 2).

Cette première mission a été effectuée grâce à la collaboration conjointe de trois institutions : l'Agence Nationale d'Archéologie avec Madjid Belkares, Conservateur du site de Lambèse, Ali Guerbabi, Inspecteur des Monuments à la Wilaya de Batna, Abdelkader Bensalah et Mohamed Chérif Hamza, Restaurateurs, respectivement au Musée de Cherchell et de Tipasa, l'Atelier de Conservation et de Restauration du Musée de l'Arles et de la Provence antiques avec Marie-Laure Courboulès et le Centre Henri Stern avec Michèle Blanchard-Lemée, Catharina Jaquet et moi-même.

(A.-A. M.)

Dans le cadre de ses coopérations dans le bassin méditerranéen, l'Atelier de conservation et de restauration du Musée de l'Arles et de la Provence antiques (Conseil Général des Bouches-du-Rhône) a été sollicité pour participer au projet lié à l'élaboration du corpus des mosaïques de Lambèse (Tazzoult, Algérie) mené par le Centre Henri Stern du CNRS. Dans cette équipe interdisciplinaire qui regroupe des chercheurs, des archéologues et des architectes, les conservateurs-restaurateurs de l'Atelier ont pour rôle d'évaluer l'état de conservation des mosaïques de la collection du musée et des pavements dégagés sur le site afin de déterminer les conditions pour leur préservation. Dans une volonté de collaboration avec des spécialistes algériens – déjà initiée avec les travaux menés dans le cadre de l'Année de l'Algérie en France en 2002-2003 –, ce nouveau projet rassemble à nouveau des restaurateurs algériens et français. Cette collaboration permettra ainsi de poursuivre un effort commun pour la formation de spécialistes en Algérie[4].

L'examen de l'état de conservation des pavements du Musée de Lambèse a été réalisé au cours d'une mission sur le site effectuée du 18 juin au 9 juillet 2005. Pendant cette mission, chaque mosaïque a fait l'objet d'une description et d'un diagnostic dont toutes les informations ont été consignées sous forme de fiches dans une base de données. À cette première mission d'expertise ont participé Madjid Belkares, Conservateur du Musée, Abdelkader Bensalah, du Musée de



FIGURE 2 Mosaïque Beury I.
Photo © A.-A. Malek.

Cherchell, et Mohamed Chérif Hamza, du Musée de Tipasa[5]. Parallèlement à ce travail dans le musée, des mesures de conservation *in situ* ont été appliquées sur les pavements dits Beury, redécouverts fortuitement en 1994 dans le secteur de l'amphithéâtre et à nouveau dégagés durant cette mission.

Les mosaïques du musée

L'installation du Musée de Lambèse remonte à 1901. Auparavant, les objets mis au jour sur le site étaient conservés dans le vaste édifice antique se dressant à un carrefour de voies dans la forteresse légionnaire, la *groma*, appelée « *praetorium* » jusqu'à l'identification récente de l'inscription dédicatoire (Lugand 1927 ; Janon et Gassend 2005). L'*Inventaire des mosaïques*, publié par M. de Pachtère en 1911, mentionne 24 mosaïques dont neuf conservées au musée, une au Musée d'Alger, une autre au Musée de Constantine ; quatre ont été laissées en place et quatre autres sont dites détruites. Avec la construction d'un bâtiment neuf, le nombre des objets conservés s'est accru ; les panneaux de mosaïques ont été prélevés plus systématiquement et mis en place sur les murs ou sur le sol de la grande salle du musée.

Construit en pierre, le bâtiment de plan rectangulaire mesure environ 30 m de long sur 6 m de large. Il s'ouvre à l'est sur un jardin clôturé où sont disposés des stèles et différents blocs de pierre antiques provenant des fouilles ; plusieurs d'entre eux sont fixés à même la façade du bâtiment. Le bâtiment est aménagé en espaces distincts : un bureau pour le Conservateur et des salles de travail ; une salle de réserve et de stockage du matériel de fouilles ; un grand espace pour la présentation des œuvres ; enfin, un logement pour le gardien contigu au Musée[6]. La salle du musée est éclairée par deux grandes fenêtres en plein-cintre. La présentation muséographique telle qu'on peut la voir aujourd'hui résulterait d'un réaménagement dans les années 1920 (Lugand 1927 :117). Les statues présentées sur des socles, des fûts de colonne réutilisés, semblent avoir été mises en place à la même période.

La collection de pavements antiques exposée dans le Musée de Lambèse compte dix-huit mosaïques, pour la plupart fragmentaires[7].

La mosaïque de la Nymphe Cyrène (M12), anciennement présentée sur le mur ouest, et celle des Monstres marins (M2) sur le mur nord, ont été prélevés en 2002 puis restaurés en France, à l'Atelier d'Arles, par une équipe algéro-française en vue de leur présentation dans diverses expositions lors de « Djazaïr, l'Année de l'Algérie en France » (Blanc 2003)[8]. Les deux mosaïques sont retournées depuis en Algérie, le panneau de la Nymphe Cyrène est présenté actuellement dans la salle du Musée de Lambèse sur un chevalet indépendant et



FIGURE 3 Vue intérieure du Musée Archéologique de Lambèse, Tazzoult, Algérie. Photo © ACRM / MAPA.

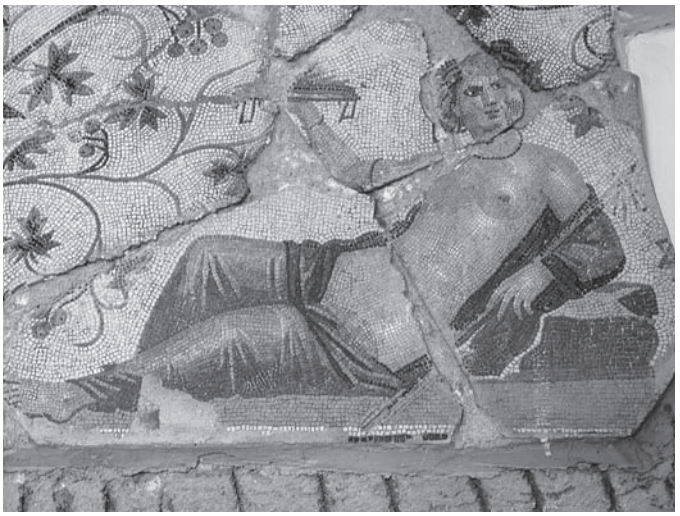


FIGURE 4 Détail des fragments de la mosaïque dionysiaque refixés dans les années 1970. Photo © ACRM / MAPA.

la mosaïque des Monstres marins est conservée « en dépôt » dans le musée voisin de Timgad[9].

Les mosaïques sont présentées sur les murs nord, ouest et sud de la salle d'exposition ; une mosaïque orne le sol du musée (fig. 3). Sur le mur ouest, le plus grand, sont exposés onze panneaux ou fragments de mosaïques, deux sur le mur nord et quatre sur celui du sud. Généralement, les supports antiques ont été retirés et les mosaïques fixées directement au mur par des mortiers modernes ; quelques unes, qui ont conservé une partie de leur support antique, sont plaquées contre le mur, maintenues par de nombreux tenons et des solins en mortier ou en ciment.

C'est le cas vraisemblablement de la mosaïque de Léda et Eurotas (M1) présentée sur le mur nord à l'entrée du musée. C'est l'une des plus anciennes mosaïques découvertes. La mosaïque des Monstres marins était remontée sur le mur nord en une centaine de fragments reposant sur leur support antique. Prélevée puis traitée en 2002–2003 car elle était en danger (fixée au mur depuis plus de cent ans, le montage présentait d'importantes faiblesses), elle repose désormais sur un nouveau panneau en aluminium et les fragments de *vermiculatum* conservent encore aujourd'hui leur support antique.

Sur le mur ouest est fixée la majorité des panneaux de mosaïque. La mosaïque dionysiaque (M3) est présentée en deux ensembles de fragments qui reposent aussi sur leur support antique. Les fragments de la Ménade au thyrse ont été reposés sur du ciment, probablement dans les années 70[10]. C'est au niveau de cette retouche que l'on observe le plus de fragilité : des fissures tant dans les fragments avec pertes de tesselles que dans le ciment, dégradations qui traduisent une contrainte dans les matériaux antiques, provoquée par l'emploi d'un ciment trop dur (fig. 4). Des consolidations ont été entreprises lors de notre passage et l'ensemble des fragments a été contrôlé.

Les quatre *emblemata* (M4, M5, M6 et M8) exposés sur le mur ouest sont fixés au moyen d'attaches métalliques. Ils reposent sur leur support antique en terre cuite et proviennent de la même *domus* romaine, fouillée dans la propriété Bac en 1905. Hormis une mauvaise lisibilité due en partie à l'état même de conservation de ces *vermiculata* fortement calcinés et à un fort encrassement, c'est l'état même du mur, marqué par de nombreuses infiltrations d'eau, qui soulève le plus d'inquiétude. De même, on observe sur la mosaïque des Néréides nimbées (M7), recomposée en une trentaine de fragments sur un fin mortier de chaux, des efflorescences salines dans les joints ; toute la partie supérieure du panneau est marquée par des coulures blanchâtres (fig. 5). Ce mur, qui accueille la majorité des mosaïques, présente de nombreuses traces d'infiltrations d'eau.

Nous avions déjà remarqué ce phénomène et c'est pourquoi la mosaïque de la Nymphe Cyrène présentée anciennement sur ce mur a été prélevée et restaurée en 2002–2003. Elle était fixée aux pierres irrégulières du mur par un fin



FIGURE 5 Observations de la mosaïque des Néréides nimbées touchée par des infiltrations d'eau dans le mur. Photo © ACRM / MAPA.



FIGURE 6 Entoilage d'urgence sur la mosaïque à étoile de trois carrés afin d'éviter la perte de tesselles dans les zones de désagrégation des mortiers. Photo © ACRM / MAPA.

mortier de chaux et les fissures dans la robe de la nymphe trahissaient la dégradation sous-jacente du mortier. Elle est désormais hors de danger et repose sur un nouveau support de restauration.

À l'extrémité du mur ouest, côté sud, la mosaïque géométrique à étoile de trois carrés (M13) illustre parfaitement ces processus de dégradation. Le *tessellatum* se désolidarise du mur dans sa partie inférieure ; le mortier sur lequel elle repose se désagrège fortement. La mise en place d'un entoilage d'urgence a été nécessaire pour éviter l'effondrement du *tessellatum* (fig. 6). La mosaïque végétale avec Amour (M14), exposée sur le mur sud du Musée, a également souffert de ces infiltrations d'eau. Toute la zone du *tessellatum* proche de l'angle des murs sud et ouest avait déjà nécessité un entoilage à la suite d'importants détachements de tesselles à la fin des années 90. L'autre partie du mur sud et le mur nord sont plus sains et ne présentent pas ce type de problème.

Durant notre séjour, le mauvais temps nous a permis d'observer où s'infiltraient les eaux de pluie. La réparation des gouttières et de la toiture suffiraient à stopper les infiltrations responsables de la détérioration des mortiers.

Sur le mur sud, on a pu observer que la mosaïque à abside (M17), celle du dieu fleuve (M15) et celle de *Bonis Bene* (M16) présentent une bonne adhérence des tesselles au mur.

La grande mosaïque à croix de *scuta* et cercles provenant des thermes et pavant le sol du musée est très retouchée. Ce pavement est composé de nombreuses plaques assemblées sur un mortier ; les tesselles réintégrées reposent sur

ce même mortier. Les zones retouchées sont identifiables par leurs joints plus larges, l'utilisation de tesselles différentes, une surface poncée et des motifs peu habiles qui cherchent surtout à combler au mieux les manques.

Les mosaïques *in situ*

Sur le site, nos interventions lors de cette première mission[11] ont consisté à suivre le dégagement, dans la zone située dans la ville basse au nord-est de l'amphithéâtre, des mosaïques dites de Beury[12], du nom de leur inventeur, et d'en assurer le nettoyage et la consolidation (Beury 1893 : 97 ; Pachtère 1911 : n° 181, 182 et 200).

L'ensemble des pavements montre de nombreuses dégradations liées principalement à leur faible enfouissement ; elles n'étaient recouvertes que de 20 à 50 cm de terre. Cette zone du site est louée comme exploitation agricole, le labour a provoqué de nombreux dégâts, les socs de charrues ayant emporté ou fracturé l'assise antique sur leur passage. De nombreuses racines et des radicelles liées aux cultures des céréales ont pénétré dans les joints entre les tesselles, disloquant le tapis en le soulevant, provoquant des lacunes et des décollements. Dans certains cas, elles sont tellement présentes qu'elles forment un véritable tapis sous le *tessellatum* le détachant totalement du *nucleus*.

Le nettoyage de ces pavements très fragilisés s'est fait à la brosse douce et à l'eau (fig. 7). Les concrétions ont été retirées au scalpel mais ont cependant été laissées en place dans les zones les plus fragiles, notamment celles déjointoyées, car ce sont elles qui maintiennent en partie la cohésion du *tessellatum* (fig. 8). Au fur et à mesure du dégagement des pavements, des solins en mortier de chaux, confectionnés avec de la chaux et du sable disponibles sur place, ont été posés afin de bloquer les tesselles et éviter toute dégradation nouvelle du *tessellatum*. Concernant ces mortiers, plusieurs tests préalables ont permis de trouver une dureté et une granulométrie satisfaisantes.

Ces interventions sont une première étape sur un programme qui doit être mené sur trois ans. Là aussi, les nettoyages de surface ont été légers, cherchant seulement à rendre possible l'observation et le diagnostic des pavements afin d'estimer leur état et de les protéger. Après documentation et localisation de la zone, les pavements ont été recouverts de 9 m³ de sable provenant du Sahara. Les mosaïques ainsi ré-enfouies, le secteur a été délimité pour éviter de nouveaux labours.



FIGURE 7 Nettoyage et consolidation des pavements in situ.
Photo © ACRM / MAPA.

Conclusion

Joignant l'étude de l'histoire du Musée de Lambèse aux observations techniques réalisées en 2005 sur des mosaïques



FIGURE 8 Nettoyage et retrait partiel des concrétions sur la mosaïque de Beury 1.
Photo © ACRM / MAPA.

conservées depuis plus de cent ans, plusieurs évidences s'imposent à nous. Le Musée abrite encore aujourd'hui la collection. Dans la mesure où aucun autre lieu n'est actuellement envisagé, il faut l'entretenir. Nous avons cependant noté combien l'état du bâtiment est préoccupant. Comme il influe directement sur celui des mosaïques fixées aux murs, nous veillerons prochainement à établir un constat détaillé et à lancer une étude sur l'état effectif du bâti et son entretien. Ce projet sera mené avec les acteurs locaux, en utilisant les matériaux accessibles sur place. Des réparations d'urgence devront comprendre, en priorité, la réfection du toit et des gouttières afin de stopper les infiltrations d'eau dans les murs car, sans cela, nos interventions de conservation sur les œuvres mêmes seront vaines. Le projet devra aussi chercher à réhabiliter un lieu dans sa dimension locale, dans son rôle de présentation des œuvres et d'accueil des publics.

Cependant, notre première mission s'est attachée principalement aux mosaïques mêmes. Qu'il s'agisse du site ou du Musée, un programme de maintenance doit être déterminé au vu des urgences, et validé avant la prochaine mission prévue en septembre 2006.

Il faudra alors organiser les traitements sur les œuvres, et tout d'abord sur celles conservées au Musée. Selon les urgences qui ressortent de l'expertise, des interventions de consolidation pourront être entreprises sur les panneaux de mosaïques qui se détachent du mur. Les *emblemata* pourraient être retirés temporairement du mur afin de juger de l'état de leur support et d'entreprendre des nettoyages et des consolidations. Ils seront de nouveau présentés dans le Musée avec des nouveaux systèmes d'accrochage – si les conditions le permettent – dans le souci de ne pas disperser la collection. Une étude de dérestauration de la mosaïque dionysiaque pourra être proposée dans le cadre d'une coopération associant la formation d'une équipe. Un programme de nettoyage de l'ensemble des mosaïques devra aussi être mené. Ces interventions de conservation sur les mosaïques seront autant d'éléments pour leur sauvegarde et les observations techniques qui en découleront viendront enrichir et compléter nos connaissances sur cette collection.

Le dégagement des pavements in situ réclame quant à lui de mettre en place un protocole de consolidation et de réenfouissement qui pourrait être reproduit dans d'autres cas similaires. Dès notre première intervention sur les pavements Beury, nous avons commencé à déterminer et appliquer ce protocole. L'étude du rôle du climat et de la végétation sur le site, la recherche de matériaux locaux, mais aussi l'engagement et la formation d'un personnel local initié sont aussi les garants de la réussite de la sauvegarde de ces pavements préservés sur site qui méritent toute notre attention.

(M.-L. C.)

Notes

1 Base de la 3e légion Auguste sous Trajan ou Hadrien, elle fut le quartier général de l'armée romaine d'Afrique. Elle fut promue municipe sous Marc Aurèle et devint capitale sous Septime Sévère avant d'être élevée, après le milieu du IIIe siècle, au statut de colonie. Sous Constantin, elle perdit son rang de capitale au profit de Constantine.

2 Je tiens à remercier vivement Mme Khalida Toumi, Ministre de la Culture et M. Mourad Betrouni, Directeur du Patrimoine au Ministère de la Culture, pour l'intérêt et la confiance qu'ils m'ont témoignés lors de la mise en place du projet.

3 Je remercie vivement M. Michel Pierre, Conseiller de Coopération et d'Action Culturelle et Directeur de l'Office Universitaire et Culturel Français en Algérie, pour avoir permis par son soutien de financer la première mission et je tiens également à remercier M. Philippe Germain-Vigliano, Directeur du Centre Culturel de Constantine en Algérie pour son aide efficace.

4 La poursuite de cette coopération n'aurait pu se faire sans l'intérêt et le soutien que portent le Président du Conseil Général, M. Jean-Noël Guérini et M. Claude Sintès, Directeur du Musée, à l'action internationale menée par l'Atelier.

5 Cette mission n'aurait pu se faire sans le soutien de M. Vigliano-Germain, Directeur du Centre culturel français de Constantine, grâce à qui put être achetée une base de matériel de restauration professionnel.

6 Actuellement une grande partie de cet espace sert de lieu de stockage. La toiture de cette partie est très endommagée.

7 Ne sont concernés ici que les panneaux tapissant les murs et le sol du Musée, des fragments sont aussi conservés dans les vitrines ou dans la réserve du Musée. Les deux mosaïques situées sur le seuil du Musée ont été écartées étant donné leur modernité certaine.

8 M.-L. Courboulès, M. Derram et M. Chérif Hamza.

9 Les musées de Lambèse et Timgad sont fermés au public depuis 1994.

10 Cette intervention a probablement été effectuée par M. Kasdi, alors restaurateur au Service des Antiquités. Bon nombre de ses interventions ont permis de sauver de nombreux pavements, malgré l'utilisation du ciment qui était alors systématique.

11 Ces interventions ont été réalisées avec l'aide de tous, que chacun trouve ici nos chaleureux remerciements.

12 Connues avant 1852, elles n'ont été signalées qu'en 1893 par Beury. Ce sont les n° 181, 182 et 200 dans l'Inventaire de De Pachtère, selon qui le panneau 183, avec Léda et Eurotas, est dans le musée.

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La mosaïque de Grand (Vosges, France) : Un exemple ancien pour la conservation des vestiges archéologiques sur site

Patrick Blanc

Résumé : *Mise au jour en 1875, la mosaïque de Grand a été préservée en place jusqu'à nos jours. Déposée toutefois en 1958–1959, elle a été replacée sur des mortiers de ciment non armé sur le lieu même de sa découverte, transformé en petit musée. Un important dossier d'archives nous renseigne sur les soins portés à cette mosaïque et ajoute à la réflexion sur l'histoire des conservations. Ce dossier montre combien nos prédécesseurs se sont parfois, tout autant que nous, posé des questions et acharné à garantir le maintien* in situ *d'un tel pavement.*

Abstract: *Discovered in 1875, the Grand mosaic has been preserved in situ until today. Although it was lifted in 1958–59, it was placed on a nonreinforced cement mortar and then returned to the spot where it was discovered, now turned into a small museum. Information on past interventions is provided by substantial archives, thereby contributing to knowledge on the history of conservation. This case illustrates the fact that our predecessors were sometimes as concerned as we are to ensure that such a pavement be maintained in situ.*

Situé à côté de Domrémy, Grand (*[A]ndesina* antique ?) est un *vicus* de la *civitas* des Leuques, en Gaule Belgique, où fut mis au jour un sanctuaire gallo-romain protégé par un rempart à 22 tours et portes. Édifié à la fin du I^er^ siècle en l'honneur d'Apollon *Grannus*, dieu solaire guérisseur, ce sanctuaire des eaux reçut la visite de l'empereur Caracalla vers 213 apr. J.-C., et celle de Constantin en 309 ; il semble avoir été détruit au milieu du IV^e^ siècle.

Les premières fouilles remontant à 1760 ont mis au jour notamment un « édifice à arène » (théâtre-amphithéâtre), le temple du sanctuaire, une basilique judiciaire, quatre ensembles thermaux desservis par des aqueducs, des habitats privés, des nécropoles. Parmi les découvertes importantes, deux diptyques en ivoire constituent des tables zodiacales.

L'Atelier de conservation de mosaïques du Musée de l'Arles et de la Provence antiques a effectué, durant l'été 2004, une mission pour examiner l'état de conservation du pavement de la *cella* centrale de la basilique civile et établir un plan d'intervention. L'équipe qui a travaillé avec moi sur ce dossier était constituée de Marie-Laure Courboulès, Patricia Jouquet, Maja Frankovic, alors en stage dans notre Atelier, et Christophe Guilbeaud.

De retour à Arles, je me suis penché sur l'histoire de la protection de ce pavement depuis sa découverte. Cela m'a amené à consulter les documents d'archives rassemblés tant grâce à l'amabilité et à la très grande connaissance du dossier par Chantal et Jean-Pierre Bertaux, archéologues et responsable du site (Ch. Bertaux 1991, 2004 ; J. P. Bertaux 2004), que lors d'une mission effectuée auprès de la Médiathèque de l'Architecture et du Patrimoine à Paris.

Le document est intéressant aussi en cela : l'importance du dossier d'archives relatif aux traitements subis par le pavement, le nombre de courriers, rapports et devis conservés. Il me semble qu'à bien chercher cet exemple, représentatif, n'est pas exceptionnel pour ces anciennes découvertes.

Historique de la découverte

Dès 1873, la présence de tesselles atteste l'existence d'une mosaïque constituée de « crayons de pierre blanche et noire » près de la Maison dite des Sœurs à Grand. En 1875, ce pavement fut classé par les Monuments historiques français en tant qu'« objet mobilier ». Le dégagement n'en fut toutefois achevé que d'avril à juin 1883 lorsque Félix Voulot, conservateur du Musée



FIGURE 1 Le bâtiment à abside abrite la mosaïque ; l'édifice à deux étages est l'ancien bâtiment des Sœurs, aujourd'hui espace d'accueil pour le public. Photo © ACRM / MAPA.

Départemental des Vosges à Épinal, mit au jour l'ensemble du pavement et la salle à abside qu'il ornait à plus de 2 m sous le niveau du sol.

Il en fait aussitôt dresser deux relevés par Henri Poulain, architecte à Grand. Félix Voulot recueille également une grande quantité de plaquettes de marbre et de moulures qui appartenaient à un décor d'*opus sectile* mural, la base des parois étant limitée par un « cordon de marbre rouge » (Voulot 1883a ; 1883b).

Six mois plus tard, en janvier 1884, un bâtiment épousant les formes des structures archéologiques fut construit afin de protéger les vestiges (fig. 1). L'édifice moderne est à l'image d'une basilique, nom qui lui restera accolé (Voulot 1884).

Nous ne pouvons qu'être admiratifs devant la rapidité dans la décision de sauvegarder un tel patrimoine antique et devant les choix effectués alors, même si ceux-ci vont être l'objet de nombreuses discussions jusqu'à nos jours. C'est cette rapidité et la justesse des choix qui assurément nous permettent aujourd'hui de contempler encore ce pavement sur son site, plus de 120 ans après sa découverte.

La mosaïque fut reclassée le 19 janvier 1884 par les Monuments historiques en tant que bien immobilier, cette fois. On examinera ensemble le soin et le suivi attentif dont elle fit l'objet de la part des différents architectes des Monuments historiques.

Description du décor de la mosaïque (fig. 2)

Essentiellement géométrique, le pavement couvre une surface de 232 m², dont 8 m² sont actuellement masqués par un placard. Un tapis rectangulaire décore la salle principale centré sur un panneau figuré (14,12 m × 13,87 m) alors qu'un tapis demi-circulaire orne le sol de l'abside (7,22 m × 5,43 m), séparés l'un de l'autre par deux rallonges rectangulaires parallèles ; caché par le placard, on observe le départ d'un autre tapis n'apparaissant pas sur le montage réalisé par Bernard Prud'homme en 2001. Cet ensemble de mosaïques a été étudié par Henri Stern (Stern 1960), et repris récemment par Jean-Pierre Darmon.

L'abside est ornée d'une composition d'écailles bipartites, noires et blanches. Les deux rallonges, de largeur et longueur différentes, sont décorées l'une d'un rinceau d'acanthe sur fond noir et l'autre d'une bande géométrique alternant cases carrées et cases rectangulaires. Le tapis principal est plus complexe. La bande de raccord à fond blanc est marquée par une ligne de croisettes noires. Le décor du tapis se compose d'un fond en quadrillage de carrés sur la pointe, en noir sur fond blanc, dans lequel s'inscrit un panneau rectangulaire orné d'une composition géométrique polychrome et rallongé du côté de l'abside (au nord) par une rangée de cases carrées chargées de fleurons divers ; l'ensemble ménage au centre un panneau figuré rectangulaire très lacunaire (peut-être une scène de comédie ?).

À sa découverte, la mosaïque présentait des traces d'incendie, vraisemblablement dues à l'effondrement de la charpente au moment de la destruction de l'édifice. Le panneau figuré central, exécuté en tesselles beaucoup plus fines, était aux deux tiers détruit.



FIGURE 2 Vue générale du pavement. Photo © ACRM / MAPA.

Historique des travaux de conservation

Dès janvier 1884, le pavement a été protégé par la construction d'un abri ouvert. En juillet 1912, un rapport du Conservateur des Monuments historiques, conforté par des observations du Maire de Grand, signale que « la mosaïque est protégée des intempéries, mais elle a perdu, au contact de l'air et de l'humidité, une grande partie de son éclat ». Ils demandent que soient effectués quelques travaux : « d'abord, combler les quelques vides qui se sont produits à la suite des anciennes infiltrations, consolider ensuite les parties qui se sont crevassées, et recouvrir le tout d'un vernis transparent qui isolerait la surface de l'humidité de l'air et rendrait un peu de leur éclat aux couleurs » des tesselles.

Le 15 janvier 1913, M. Tillet, architecte en chef, est sollicité pour trouver une solution à ces problèmes. Celui-ci mettra une année pour répondre et, le 10 janvier 1914, propose un devis s'élevant à 2 313,55 francs de l'époque, dont l'essentiel, les 4/5^{e} (1 956,50 francs), pour le financement des travaux. Il envisage de « couler du ciment à la surface pour consolider tous les cubes, de relever les parties effondrées, enfin de poncer au grès toute la surface pour lui rendre son éclat » ; il souhaite également la réfection des motifs géométriques et figurés. Le devis est réduit à 1 181,38 francs, dont 999 francs de travaux, les restitutions de dessin ne seront pas effectuées et le grésage sera remplacé par un lavage à la brosse et au savon noir, suivi d'un passage à la cire. Le 4 mai de la même année, une réponse positive, approuvée le 5 juin, est donnée pour un devis de 1 698,65 francs, car on pose également des châssis pour fermer les baies du bâtiment.

Il n'est pas précisé qui réalisa alors le travail. Toutefois, la documentation conservée nous transmet les discussions internes aux Monuments historiques et on voit les perceptions divergentes des uns et des autres quant au travail de restauration que l'on peut être amené à réaliser. Le commentaire formulé sur le devis fournit par l'architecte en chef Tillet est instructif. On est en 1914. Il y est précisé : « nous pensons qu'on ne peut désirer une remise à neuf qui pourrait faire douter de l'authenticité de l'ensemble et qu'une simple consolidation de ce qui subsiste est seule convenable ».

La première guerre mondiale suspend les opérations et il faut attendre 1928 pour qu'un membre de l'Académie des Inscriptions et Belles-Lettres, spécialiste de la mosaïque (il a participé au premier *Inventaire des mosaïques de la Gaule*, rédigeant, en 1909, le volume II comprenant une notice sur ce pavement, ainsi qu'une *Étude sur la décoration des édifices de la Gaule romaine*, en 1913), Adrien Blanchet s'inquiète du sort réservé au pavement : « Il devient nécessaire de combler par du ciment approprié les excavations produites dans la mosaïque », les tesselles du pavement soulevées à chaque coup de balai (notamment lors des préparations de la fête annuelle du pays qui se tenait là) agrémentaient les collections de souvenirs des particuliers, ajoute-t-il ; mais il faut bien dire aussi que le passage des soldats n'avait pas arrangé les choses. (Blanchet 1909).

Cependant rien n'est fait. Le 4 mai 1937, Paris s'inquiète à nouveau de l'état de la mosaïque. Au printemps 1938, l'architecte en chef des Monuments historiques, Marcel Texier, fait restaurer la couverture et demande à une maison spécialisée, Gentil et Bourdet, de proposer une intervention de nettoyage et de consolidation « des parties en voies de détérioration » ; un devis de 5 000 francs est établi (par rapport au devis de Tillet soumis en 1914, il faut se souvenir que le franc avait été fortement dévalué de 20 % sous le gouvernement Poincaré, en 1928). Alors que Texier ne souhaite que le « bouchage des trous » et la pose de solins sur les bordures, la maison Gentil et Bourdet, qui était intervenue sur les pavements modernes des thermes de Luxeuil-les-Bains, demande comme travaux préliminaires l'établissement d'un relevé précis de l'état de la mosaïque, avec photographies et prélèvement d'échantillons.

Le devis est refusé en juin 1939, notamment au vu des frais de déplacement des spécialistes. Texier contacte également la maison Labouret, qui refuse de se déplacer pour une commande « peu sûre », et l'entreprise Gaudin de Paris, connue par de nombreuses restaurations de mosaïques notamment en Algérie (à Cherchel), qui seule accepte de se déplacer sans demander d'indemnités préalables. Mais la seconde guerre mondiale va interrompre la quête de l'architecte Texier, malheureusement pour la mosaïque. Si le bâtiment a été revu, en revanche, le pavement antique n'a été que peu consolidé.

À la fin de la guerre, la sauvegarde de ce pavement continue à inquiéter Paris. Après s'être rendu sur place à la demande d'Albert Grenier, membre de l'Institut, l'inspecteur général des Monuments historiques Jules Formigé signale le 10 août 1946 que « la mosaïque se désagrège sur ses bords » et qu'« il serait nécessaire et urgent de faire un ourlet en ciment qui arrêterait la désorganisation ».

La fragilisation du support antique est due à des infiltrations d'eau – c'est toujours le problème – car les Vosges sont une région particulièrement humide et pluvieuse. Dès septembre, Texier, qui note que « vers l'abside, on avait l'impression de

marcher sur un sol mou, suite probable d'infiltrations » se voit refuser un budget nécessaire à la réalisation de solins.

Deux ans plus tard, le 15 octobre 1948, M. François Mathey de la Direction de l'architecture rédige à nouveau un rapport alarmiste mentionnant également des risques dus au « vandalisme des touristes » qui prélèvent des « souvenirs » ; il réclame que « au lieu de procéder à des réfections à la petite semaine » le problème soit considéré une fois pour toutes, dans sa totalité. Il souhaite que le « hangar », « d'une médiocre banalité », qui abrite le pavement en laissant passer les eaux de pluies soit remplacé par « une construction moderne, très sobre, entièrement close de vitres » qui « permettrait une protection plus efficace et mettrait en valeur ce magnifique carrelage », écrit-il.

Quelques jours plus tard, le directeur de l'architecture annote ainsi ce rapport : « On nous reprocherait à juste titre de laisser périr un monument de cette importance sous un mauvais hangar qui laisse passer l'eau de partout ». Malgré ces bons sentiments, on constate aujourd'hui que ce « mauvais hangar », réaménagé certes, est toujours en place, qu'il a joué son rôle protecteur et qu'une autre solution va émerger.

Un « Rapport à l'appui d'un projet de travaux pour la restauration de la mosaïque de Grand » est présenté en février 1955 par M. Texier. Ce rapport est accompagné d'un résumé de devis (pour la somme de 8 742 395 francs), mais aussi d'un exposé détaillé des interventions déjà effectuées sur le pavement que la commune de Grand a tenté vainement de céder au Département des Vosges. Cependant, l'état de conservation du pavement se dégrade : « de larges morceaux ont disparu… », « de nombreux fragments s'effritent… », « des affaissements se produisent. En juillet 1955, M. Prieur, de l'Inspection générale des Monuments historiques, mentionne des travaux d'assainissement, la remise en état des maçonneries romaines, l'aménagement d'une galerie périphérique à 1,50 m au-dessus, travaux réalisés vraisemblablement vers 1951. Rénovée depuis, cette galerie qui permet d'éviter de marcher à même la mosaïque, est toujours utilisée. Cependant, en ce qui concerne véritablement la mosaïque, aucune proposition faite par Texier depuis 1939 n'a été retenue.

Texier reprend contact avec la maison Gaudin qui propose alors la dépose complète et le report sur un nouveau béton. Pour la première fois, on note dans les rapports de Texier (peut-être influencé par Pierre Gaudin) un souci d'identification plus technique des matériaux mis en œuvre : tesselles en calcaire « blanc teinté », en « silex » noir de la région, « quelques éléments teintés rouges d'une pierre calcaire » ; les calcaires blancs sont plus usés que les silex ; la surface actuelle du pavement est très irrégulière, est-il précisé.

Nous avons conservé le descriptif très détaillé des travaux soumis par Gaudin. A la réception du document transmis par Texier, M. Prieur s'interroge sur le nouveau support proposé et sur le remplissage des lacunes en « granito », qu'il estime « vulgaire, d'un épiderme trop lisse et d'une coloration difficile à adapter » ; il lui préfère un mortier en ciment d'Origny Sainte-Benoîte donnant « un ton pierre agréable à l'œil », mais reconnaît qu'« il serait cependant prudent de l'échantillonner à l'avance ». Ce sera tout de même le remplissage en granito qui sera réalisé.

Révisé en février 1958 avec un devis complémentaire pour la reconstitution de parties ornementales figurées et géométriques, le devis de Gaudin est finalement accepté en août 1959. On mit donc au total quatre ans à décider des travaux exacts à effectuer, à lancer un emprunt pour financer le devis s'élevant à 9 423 607 francs, financement partagé entre le Département des Vosges et l'Administration générale des Beaux-Arts, et à réaliser l'opération. Le dossier conserve toute une série de courriers, d'avis, de procès-verbaux, d'arrêtés, de décisions, allant de novembre 1955 à novembre 1961 (date de la fin effective de l'opération financière), riche en informations et montrant l'intérêt soulevé par ce pavement jusqu'au plus haut niveau.

Mais dès la fin de ces travaux, une polémique qui durera de septembre 1960 jusqu'en 1965, s'établit entre la Commission de surveillance de la mosaïque de Grand, le successeur de l'architecte en chef Texier, M. Leprevots, et la société Gaudin accusée de ne pas avoir achevé elle-même les travaux de nettoyage. La Commission de surveillance déclare que la mosaïque avait été nettoyée non pas par les restaurateurs mais par le seul gardien, auquel Pierre Gaudin avait pourtant recommandé d'« y toucher le moins possible ». En mai 1962, Pierre Gaudin se défend.

On se plaint à nouveau de l'aspect gris et terne offert par la surface de la mosaïque une fois restaurée. Il semble que cet aspect résulte de l'emploi de ciment dans le nouveau support (et non pas d'un liant de chaux et de sable comme l'annonce Pierre Gaudin dans son devis) ainsi que pour le jointoiement des tesselles, mais probablement aussi de la nature même des pierres calcaires utilisées et des conditions d'abandon du site dans l'Antiquité.

Un des points principaux des discussions tourne autour de l'application d'un vernis « pour améliorer l'aspect de la mosaïque », comme c'était déjà le cas avant la première guerre mondiale, application souhaitée par un Conseiller général des Vosges, le maire de Coussey, celui de Neufchâteau également, qui verraient bien l'afflux de visiteurs autour de cette

merveille. Mais l'emploi de certains matériaux est réfuté par l'architecte Leprevots qui en appelle au Préfet pour empêcher le vernissage. Et Gaudin refuse encaustiquage ou vernissage qui, écrit-il, n'apporteraient aucune amélioration à la surface poreuse et fragile du pavement.

On se retourne alors, en 1964, vers les établissements Bouvier à qui l'on demande de donner un « aspect poli et brillant » à la mosaïque par l'emploi de produit neutre. C'est dans ces échanges seulement qu'apparaissent les premières références précises aux produits mis en œuvre, et leur discussion. Bouvier propose d'utiliser un produit décapant, le DINA, et des vernis et pâtes à lustrage DUROL ; des tests sont effectués sur une partie du pavement. Mais Leprevots maintient ses réserves quant à l'emploi de ces produits modernes et son souhait de voir appliquer de la cire vierge.

En juillet 1968, la mosaïque est encore encaustiquée à la cire. Par la suite, il n'y aura plus que des dépoussiérages réguliers que j'ai relevés en avril 1970, septembre 1971, avril 1973 et 1974.

L'état de conservation actuel

Protégée donc dans un abri fermé, ventilé, réaménagé en 1995 (entrée déviée avec aménagement d'un accueil pour le public dans l'ancien bâtiment des Sœurs), la mosaïque a été maintenue sur son support d'origine jusqu'en 1958–1959, époque à laquelle on procéda, on l'a vu, à sa dépose et à sa mise sur un support moderne constitué de mortier de ciment (fig. 3).

Nous l'avons examinée en détail lors de la mission effectuée en juillet 2004. Globalement, la mosaïque est en bon état de conservation (fig. 4). Elle présente peu de lacunes récentes et offre une bonne adhérence des tesselles à leur support. Nous n'avons pas détecté de zones de soulèvement ni de détachement du *tessellatum*.

Grâce à un sondage réalisé à la base du mur se trouvant à l'est, sous la passerelle, nous avons pu observer quelques vestiges du support antique ainsi que la stratigraphie du support moderne mis en place par Pierre Gaudin à la fin des années cinquante.

Le support antique était constitué de façon tout à fait traditionnelle : le *tessellatum* était pris dans un bain de pose composé de chaux et de poudre calcaire, qui reposait sur les trois couches de support habituelles : le *nucleus*, couche de mortier composée de chaux, de sable et de terre cuite lui conférant une couleur rosée, d'environ 4 à 5 cm d'épaisseur ; le *rudus* composé de chaux, de sable, de petits pierres et de fragments de terre cuite, d'environ 9 à 12 cm d'épaisseur ; enfin le *statumen* constitué de pierres, sur une épaisseur vraisemblable de 15 à 20 cm.

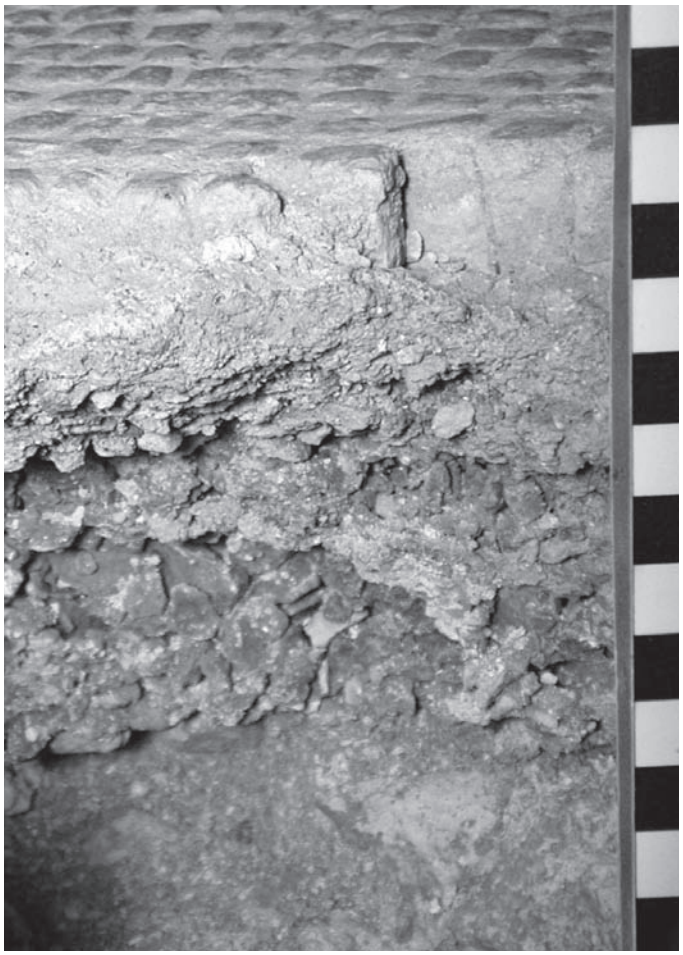


FIGURE 3 Stratigraphie du support mis en place en 1958–1959. Photo © ACRM / MAPA.

Le nouveau support mis en place par Gaudin en 1958–1959 respecte plus ou moins cette stratigraphie. Il est constitué d'un mortier de ciment (« de chaux » dit le devis de Gaudin) et de sable d'environ 5 cm d'épaisseur sur lequel repose directement le *tessellatum*, puis une couche d'environ 12 cm constituée de ciment chargé de petits graviers de carrière et contenant très peu de sable, un « béton cru » ; ce mortier repose lui-même sur le hérisson du *statumen* antique conservé en place.

Avec une source lumineuse rasante, se lisent aisément les formes de certains panneaux déposés puis remis en place, présentant, à la jonction des panneaux, de légères différences de niveau (fig. 5). Lors de la dépose, la découpe avait suivi les

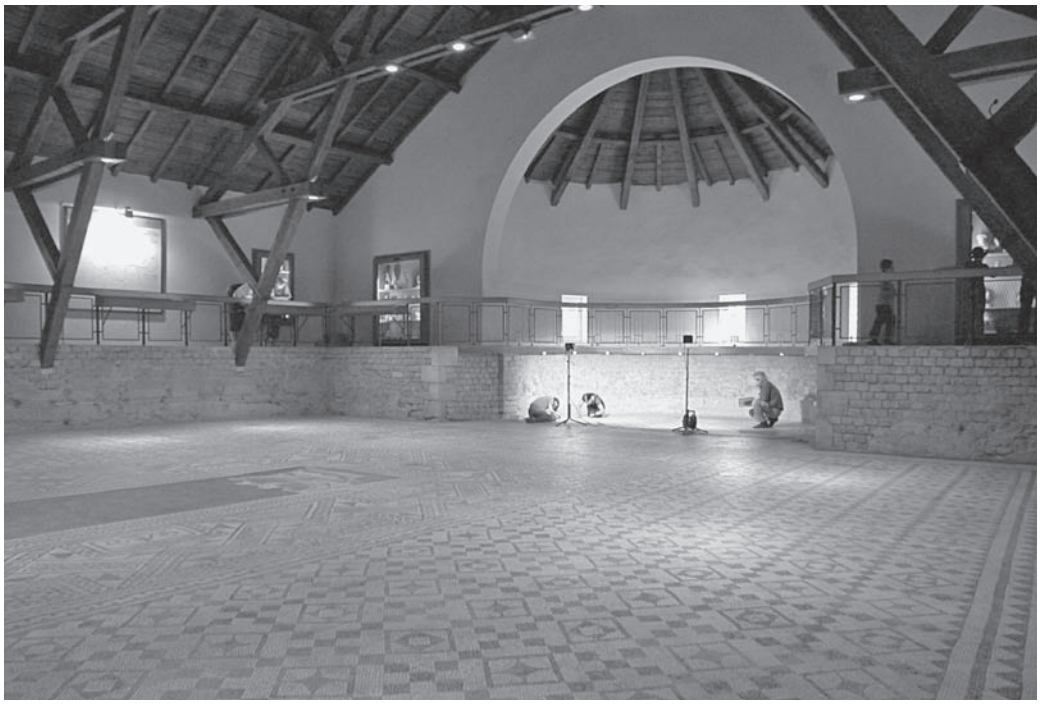


FIGURE 4 Analyse de l'état de conservation de la mosaïque par l'Atelier de conservation du Musée de l'Arles et de la Provence antiques ; on note la passerelle aménagée à 1,50 m en périphérie du pavement. Photo © ACRM / MAPA.

motifs du décor géométrique ; les panneaux réalisés alors étaient de petites dimensions, ce qui a pu faciliter cette dépose mais aussi la remise en place de la mosaïque.

Dans son descriptif des travaux, Pierre Gaudin précise qu'il ne retira qu'une rangée de tesselles qui furent collées immédiatement sur le calque qu'il avait fait lever avant d'intervenir ; après la repose, il put restaurer ces lignes de découpe avec les tesselles d'origine. Après retrait des mortiers antiques au revers des panneaux, la remise en place de la mosaïque s'est effectuée sur un support moderne dont on a vu la stratigraphie.

Selon un article de journal datant de juillet 1959, on note que la mosaïque de l'abside a été la première déposée et remise sur son nouveau support ; fin 1959, la plus grande partie du pavement avait été restaurée. On suppose qu'après la remise en place de l'abside, ce fut le tour du pourtour à décor en noir et blanc, et que toute la partie centrale a été reposée dans un dernier temps.

Réalisée avec un extrême soin, il semble que cette opération n'ait été suivie par aucun archéologue qui aurait pu examiner et fouiller le support antique lequel fut retiré jusqu'au *statumen* avant la remise en place du pavement. Cette dépose a été effectuée avec une grande rigueur comme en témoignent les enduits et placages des murs préservés en place par les restaurateurs.

Dans l'été 1959, les parties perdues du décor géométrique ont été restituées par l'entreprise Gaudin, essentiellement autour du panneau central très lacunaire à la découverte, dans les parties nord et sud, et dans l'abside côté sud (fig. 6). Pour la scène centrale figurée, les restaurateurs



FIGURE 5 Les limites des panneaux déposés en 1958–59 apparaissent en lumière rasante. Photo © ACRM / MAPA.



FIGURE 6 Une restauration effectuée après la remise en place de la mosaïque. Photo © ACRM / MAPA.

n'ont pas essayé d'interpréter le décor ; ils se sont contentés de combler les lacunes avec un mortier de gravier de couleur sombre. On observe que le sol n'a jamais été poncé (fig. 7). Et cela grâce aux résistances de certains devant le souhait des autres. Les archives montrent cependant la pression exercée parfois par les autorités locales pour obtenir les restitutions des parties manquantes, voire le polissage du pavement.

Pour le décor géométrique, les restitutions ont été effectuées avec des tesselles légèrement plus grandes et aux côtés plus anguleux, dont la teinte a été choisie dans des tons distincts, en général plus foncé. Ainsi, maintenant, ces réintégrations sont aisément discernables des parties de mosaïque originales.

Dégradations nouvelles

Actuellement, un encrassement général du tapis de tesselles atténue la distinction entre parties anciennes et restaurations des années 50. Si l'on veut conserver une certaine unité au pavement, il faut absolument mettre en œuvre un nettoyage léger qui ne retirera que le dépôt superficiel, sans trop insister sur les parties restaurées, faute de quoi un déséquilibre visuel pourrait se produire. Avec un nettoyage trop incisif, les zones restaurées pourraient devenir beaucoup plus voyantes et gêner fortement la lecture de la mosaïque.

Un autre phénomène accentue la grisaille générale du *tessellatum* : ce sont les joints entre les tesselles qui ont été recouverts par un mortier de ciment gris. Cette intervention faite, semble-t-il, après la remise en place de la mosaïque, avait pour but de renforcer la cohésion des tesselles et d'unifier l'ensemble du tapis. Faut-il envisager le retrait de ce ciment ?

Lors de nos tests de nettoyage, nous avons pu vérifier que cette couche était mécaniquement retirable ; ce travail, très long (n'oublions pas que cette mosaïque couvre 232 m^2) demande énormément de temps car il ne peut être fait que manuellement, à l'aide de petites pointes et de scalpels. D'autre part, le bain de pose antique n'étant pas toujours préservé sous ce ciment, il sera nécessaire de procéder, sur toute la surface du tapis, à un rejointoyage par un mortier de chaux afin non seulement de consolider le pavement mais aussi d'améliorer son unité, car les joints évidés entre les tesselles créeraient des zones noires, sources de fragilisation du tapis (fig. 8).

Sur l'ensemble de la mosaïque, nous n'avons observé la formation récente que d'une seule petite lacune, le long du mur nord ; elle résulte très certainement d'une faiblesse d'adhérence des tesselles au mortier de restauration.

Par ailleurs, une fissure importante est visible entre l'abside et le reste du pavement ; elle marque l'arrêt de la première partie de mosaïque restaurée en 1959. De plus petites fissures sont présentes également dans les angles nord, est et sud du panneau central et se poursuivent dans le tapis au décor de quadrillage de carrés. Le long de ces fissures, on peut



FIGURE 7 Détail du tableau central où l'on observe que le pavement n'a pas été poncé. Photo © ACRM / MAPA.

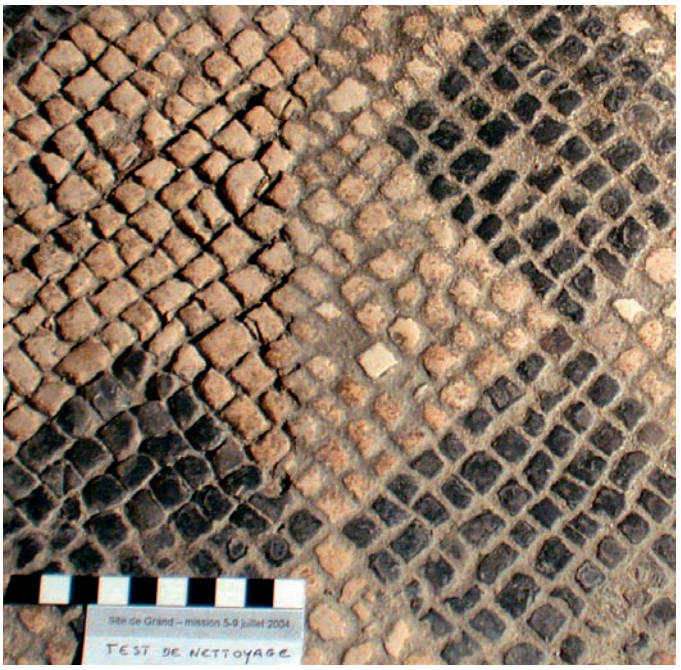


FIGURE 8 Les joints entre les tesselles ont été renforcés par un mortier de ciment dont le retrait peut entraîner une difficulté de lecture du décor. Photo © ACRM / MAPA.

noter quelques tesselles désolidarisées du support, ainsi que de très légers décalages de niveau. Toutes ces fissures correspondent à des tensions lors de la prise du ciment du support moderne.

À la suite de ces observations, nous avons proposé une série d'opérations nécessaires au bon entretien de la mosaïque. Le nettoyage est le point le plus important, mais il devra être léger et adapté, suivant les zones, entre mosaïque originale et parties restaurées. Ce nettoyage devra être complété par quelques consolidations et remise en place de tesselles. Des interventions complémentaires devront être effectuées comme le retrait du placard sous la passerelle qui favorise un microclimat tout en masquant une partie du pavement, la consolidation des mortiers antiques des murs, une amélioration de l'éclairage et un apport d'informations historique et technique pour le public.

En conclusion, ce sont les choix opérés au cours des années passées par ceux qui ont eu la charge avant nous de préserver ce patrimoine qui permettent aujourd'hui à ce pavement d'être conservé en aussi bon état.

On a vu que ce pavement a été souvent observé depuis sa mise au jour. À plusieurs moments cependant, on était prêt à intervenir, mais discussions ou guerres ont retardé ces interventions. L'intérêt manifesté par les habitants et autorités locales ont permis de maintenir cette mosaïque sur son lieu d'origine, alors même que les archives signalent que d'autres propositions ont parfois été avancées dont le transfert de la partie centrale vers un musée éloigné du site.

On peut remarquer que les idées amorcées par nos prédécesseurs étaient proches de celles que nous essayons aujourd'hui de mettre en œuvre. Ce dossier offre aussi la redécouverte de praticiens oubliés qui exerçaient ce métier qui est le nôtre avec souvent une très grande rigueur, refusant certaines interventions, et que l'on critique parfois trop rapidement aujourd'hui.

Pour finir, je ne peux m'empêcher de penser à Pierre Gaudin demandant d'intervenir le moins possible sur le pavement. Cela rejoint nos préoccupations actuelles de restaurateurs concernant la conservation préventive, entretien régulier qui seul peut apporter une réponse à long terme pour une bonne préservation et présentation de mosaïques sur site.

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Backing Roman Mosaics with Glass Fiber Reinforced Cement

Kent Severson and Diane Fullick

Abstract: *From 1990 to 1992 over 80 square meters of heavy paving mosaics were lifted at the ancient city of Sardis, Turkey, to expose the Lydian fortification walls beneath. A new backing system was developed and implemented using alkaline resistant (AR) glass fiber reinforced cement (GFRC) to cast rigid panels on the backs of the individual sections. The GFRC panels are 50 percent lighter and thinner and do not have the distortion or iron corrosion problems associated with traditional iron-reinforced cement panels. Cement-based backing materials have generally been discredited in mosaic backing. With the easy availability of AR glass fibers, cement-based backing may now be reconsidered.*

Résumé : *De 1990 à 1992, plus de 80 m² de mosaïques furent déposées dans la cité antique de Sardis, Turquie, afin d'exposer les fortifications lydiennes sous-jacentes. Un nouveau système de support a été développé et appliqué à base de ciment renforcé à la fibre de verre (GFRC) résistant aux alcalis, coulé en forme de panneaux rigides à l'envers des sections individuelles. Ces panneaux sont 50 % plus légers et plus minces et ne présentent pas les problèmes de distorsion ou de corrosion liés aux panneaux classiques en ciment armé. Les matériaux à base de ciment ont été discrédités pour confectionner les supports pour mosaïques. Actuellement, la disponibilité de fibres de verre résistant aux alcalis permet d'envisager les supports à base de ciment.*

One of the primary goals of the International Committee for the Conservation of Mosaics (ICCM) since its inception has been the elimination of ferroconcrete (steel-reinforced concrete) backing from mosaic conservation practice. The drawbacks of ferroconcrete backings are well known and include distortion of the panels during curing; rusting and associated expansion of the iron reinforcements, resulting in cracking; differential rates of thermal expansion between the iron reinforcements and the matrix; the presence of soluble salts in the cement matrix; problems arising from the weight of the panels; and difficulty of reversibility (ICCROM 1983: 11, 40–43). However, many of these problems can be eliminated by substituting alkaline resistant (AR) glass fibers for the traditional iron bars. Alkaline fibers do not rust and expand, and they have a coefficient of thermal expansion that is much closer to that of cement than iron (Torraca 1981: 36; Saint-Gobain/Vetrotex 2005: 25). In addition, suitably strong panels of glass fiber reinforced cement (GFRC) can be cast much thinner than ferroconcrete backings, reducing the weight of finished panels by as much as half, and with the introduction of an appropriate intervention layer the panels can be made more easily reversible. Under certain circumstances the time and expense of re-laying mosaics on aluminum honeycomb panels with epoxy resins can be prohibitive. GFRC may be considered an alternative backing system that is inexpensive and relatively easy to apply and can provide durable, waterproof, fireproof backings for mosaics that are likely to be stored in field conditions for extended periods or reinstalled in semiexposed conditions for long-term display.

This paper presents a case study wherein GFRC panels were cast directly on mosaic panels lifted during the archaeological exploration of the ancient city of Sardis, Turkey. In the past, mosaics excavated at Sardis had been backed with traditional steel-reinforced cement to create the familiar thick, heavy, ferroconcrete panels. Most of the recently lifted mosaics, however, will in all likelihood be stored in field depots for the foreseeable future or partially reinstalled for public display

with only minimal protection from the weather. Glass fiber reinforced cement was selected to both stabilize the mosaics within the parameters of the field conditions and demonstrate the feasibility of this new backing system.

The Mosaics

The ancient city of Sardis, located at the edge of a broad east-west river valley about 90 kilometers east of modern İzmir in Turkey, was occupied from at least the middle of the second millennium B.C. through the Roman period and into the modern era (Hanfmann 1983: 13-16; Greenewalt 2003: 11–13). Although there are many other large Roman cities in Asia Minor, Sardis is unique in that it was the capital of the Lydian empire, whose greatest power was achieved in the seventh and sixth centuries B.C. The modern archaeological exploration of Sardis, begun in 1958, is cosponsored by the Harvard University Art Museums and Cornell University. Since 1977 it has been under the direction of Crawford H. Greenewalt Jr., professor of classical archaeology at the University of California, Berkeley. The primary goal of the Sardis Expedition has been to explore the history and development of the city as a whole, with a focus on the culture of the Lydians (Greenewalt and Rautman 1998: 471). Since the late 1970s a great deal of attention has been devoted to the exploration of the Archaic Lydian fortification wall (Greenewalt and Rautman 2000: 656–68). The largest section of the wall to be explored runs on a north-south axis at the west end of the city, perpendicular to the modern highway that bisects the site and also perpendicular to a major ancient avenue and a secondary late Roman colonnaded street.

By 1983 an unusual courtyard and an associated dramatic turn in the direction of the wall had been uncovered to the north of the modern highway, suggesting perhaps a gateway. However, the entire area was overlaid by later Roman material, including the major avenue, which in other areas was known to include mosaic paving on either side. Excavation of the area in 1989 (Greenewalt, Ratté, and Rautman 1993: 1–43) revealed a long stretch of well-preserved floor material with a poorly preserved secondary paving installed above the lower mosaic (fig. 1). The mosaics were executed mostly in large black-and-white marble tesserae, up to 2 centimeters square, depicting geometric patterns and including a large dedicatory inscription.

Archaeologists and conservators are in general agreement that a few good reasons exist for lifting mosaics from the structures in which they were made. One is to explore a truly unique deposit beneath. The Lydian fortification wall at Sardis was just such a deposit, so the decision was made to lift the mosaics to access the Lydian material, with the understanding that at least some of the mosaics would be reinstalled in their original locations for public presentation.



FIGURE 1 Mosaics in situ in sector MMS/N, 1990. Photo: Sardis C90.25:07. © Archaeological Exploration of Sardis/Harvard University.

Lifting and Storage

The mosaics were lifted in sections using traditional animal glue facings and rolling. The rolled mosaics were removed to one of two depots and laid facedown on platforms, interleaved with plastic sheets, in stacks of four or five. The work was done over the course of the 1991, 1992, and 1993 summer seasons (Severson et al. 2000: 4–6). The total area of the lifted mosaics was about 90 square meters. Much to the credit of the archaeologists, the expected features in the Lydian wall and the southern side of the gate structure were revealed, justifying the removal of the mosaic floor (Greenewalt, Ratté, and Rautman 1994: 1–36).

Although the depots storing the faced mosaics appeared to be satisfactory, glue and cotton cloth facings are at best temporary stabilization measures, vulnerable to insect and water damage. With this in mind, a project to back the mosaics was begun in 1993. Unfortunately, in 1997 a tremendous fire destroyed the depot housing most of the mosaics (Severson et al. 2000: 6–11). The fire destroyed 20 percent to 30 percent of the mosaics and caused serious damage to many of the remaining panels. In the following years, largely through the efforts of Julie Wolfe and Tracey Richardson, and with help from a long list of Sardis conservators, the surviving mosaics were

re-covered and rehoused. At the same time a second depot housing some of the mosaics had developed roof leaks and was deteriorating rapidly. All this underscored the urgency of the problem and the need for a durable backing system that could be installed quickly and economically.

Glass Fiber Reinforced Cement

As the name suggests, GFRC is simply a sand/cement mix to which glass fibers have been added as a substitute for iron reinforcement. Ordinary glass fibers or fabrics are typically "E" type glass and rapidly become brittle in the alkaline environment of a cement matrix. In the past twenty-five years or so, the special AR glass, developed for use in cement reinforcement, has become widely available. GFRC is currently used in new construction applications as well as in architectural restoration. The material readily conforms to irregular surfaces, is lighter than steel-reinforced cement, and resists crack development as it ages (Gutt and Everett 1980: 133–39; Ramachandran, Feldman, and Beaudoin 1981: 171–204). GFRC is typically mixed and sprayed into molds using a single continuous operation apparatus, but it can also be mixed by machine or by hand. Sprayed into a mold, GFRC can act as a lightweight, low-cost imitation of a variety of materials, including stone, stucco, and terracotta. A vast amount of new information about AR glass fiber characteristics and applications is now available through the manufacturer's website (www.cem-fil.com).

Field Tests

In 1993, to explore the feasibility of working with this material, as well as batching, yield, and the strength of various compositions after a standard curing time, test panels were prepared, approximately 40 centimeters square and 2 centimeters thick. The panels were allowed to cure in a semiprotected environment and examined and tested for strength in 1994. The composition of the test panels was based on proportions of cement, sand, water, and glass fiber reported in the literature (table 1). All panels contained an equal ratio of cement to sand (dry weight), with the percent of glass fiber based on the total (dry) weight of the cement and sand. Local river sand was used, sieved to a maximum particle size of about 1.5 millimeters. The cement was locally available gray cement, in 1:1 proportions. Fibers used were a mixture of Cem-Fil® 60/2 and 62/2, 12 to 24 millimeters in length. The material was mixed by hand to simulate actual conditions, combining the dry components well before adding water. The cement was mixed with as little water as possible to obtain a stiff paste, roughly equal to 1:5 water:cement/sand (by weight). As in many cement mixes, the amount of water in the mix is balanced against workability; a drier mix produces a stronger product but one more difficult to handle. The resulting paste was very stiff, especially in the high fiber–content batches, and needed some troweling to compact the mass into the mold. After twelve to eighteen hours the panels could be unmolded and were kept wet (under plastic) for five to seven days.

The panels were left to age for one year in a semiprotected environment (exposed to occasional wet-dry cycling and outdoor conditions but not directly exposed to the weather). After one year the panels showed no evidence of microcracking, even when examined at low-power magnification.

To assess the overall strength of these panels and to investigate any dramatic difference in strength between the panels with more (or less) glass fiber, they were subjected to a breakage test. The panels were suspended by clamping at all four corners, smooth side up, with mason's clamps and weight applied to a pad approximately 5 by 5 centimeters placed in the

Table 1 Composition of test panels

Panel	Cement	Sand	AR Fibers	% Fibers	Comments
1	2.5	2.5	.25	5	35.6 kg, even thickness, ca. 2.75 cm
2	2.5	2.5	.25	5	included plasticizer in water (about 10%)
3e	2.5	2.5	.18	3.6	33.2 kg, about 2.50 cm thick
3f	2.5	2.5	.18	3.6	31.8 kg, thin, even thickness, about 2.25 cm
4a	2.5	2.5	.12	2.4	40.6 kg, slightly thicker

Note: All weights are in kilograms. Percentages of glass fiber are to dry weight of sand/cement mix.

center of the panel (table 2). Although this is only a very small sample of possible cement mixes, it is remarkable how strong all the panels that were tested proved to be. Panel 1, with 5 percent glass fiber and about 2.75 centimeters thick, performed as well as Panel 4a, with 2.4 percent glass fiber but slightly thicker, suggesting that a slightly thicker panel with less fiber may substitute for a thinner panel with more fiber. The material and time estimates needed to execute the entire project could be made based on these tests.

To make this backing system more reversible than the traditional cement backings, an intervention layer was developed to provide a slightly softer interface along which the mosaic might be separated from the backing in the future. A pure lime-based mortar would have been ideal, but it was feared that the heavy tesserae, held only by a small area of contact on the back, would not be sufficiently adhered. In addition, the time needed to develop enough strength in a lime-based intervention layer would have had a significant impact on the execution of this already urgent project. A small range of intervention layer formulations, consisting of a slaked lime-based slurry, a high lime content/white cement slurry, and a white cement slurry were tested subjectively. The white cement slurry was clearly too hard, but the high lime-content mix appeared to provide a comfortable balance between setting time and sufficient hardness.

The issue of soluble salts efflorescing from the cement paste with aging was not extensively investigated. However, a test backing was prepared in 1994 with a small section of lifted mosaic (approximately 30 by 40 cm), using the cement mixes described above. To see if the panel would effloresce, it was positioned on edge, oriented outward to the weather, just inside a portico where it would be occasionally wet by driving rain, setting up a drying front on the back side. After two years in this position, no soluble salt efflorescence was observed. Likewise, test panels subsequently left out in direct weather, in various orientations and partially under cover, showed no salt efflorescence. One explanation for this may be the relatively small volume of cement needed to create these panels.

Backing with GFRC

The backing project was begun in 2000, under the direction of Carolyn Ricardelli, who worked out all the details and procedures and compiled them into a manual that could be used to train new personnel in coming seasons. The project was continued under Diane Fullick from 2001 through 2004 and was completed in summer 2005 under the direction of Tina March. Documentation consisted of individual written reports on each panel, recording its history, condition, and all interventions; black-and-white and color photography; and, later in the project, digital imaging.

The GFRC mosaic backing process begins by laying the panels facedown on a clean, flat surface, such as purpose-built tables covered with galvanized steel and a layer of plastic sheeting. The backs of the panels were cleaned of any loose mortar fragments or burned debris from the fire, using small brushes, tweezers, and a vacuum cleaner fitted with a mesh screen. Because the mosaics were lifted by rolling, very little original mortar remained on the backs. During cleaning, loose tesserae were temporarily readhered to the facing with Primal® AC-33 or generic PVA emulsion. No attempt was made to restore losses at this point, beyond replacing a single missing tessera or two in clearly visible patterns.

The panels were then fit with molds using straight pieces of timber along the cut edges or flexible galvanized steel along fragmentary edges. Each panel was fitted with at least one flat edge for storage, and these were oriented parallel to the pattern. With the molds clamped in place, large losses were filled with

Table 2 Break testing

Panel	Applied Weight	Failure	Comments
1	164.9	no	highest proportion of glass fiber, no sign of strain
2	108.8	yes	although soft at time of casting, strength noticeably improved after standard cure time of one year
3e	115.2	no	similar in thickness to test panel with mosaic
3f	136.5	yes	slightly thinner than 3e; failure occurred as an even fracture down middle
4a	164.9	no	like 3e in thickness but with less glass fiber

Note: All weights are in kilograms.

sand and bound with a water-soluble adhesive, such as animal glue or methylcellulose gel. These temporary infills prevented the backing material from surrounding the tesserae completely and were washed out later on, resulting in empty spaces where the losses are and giving the visible backing around the mosaics a pleasant appearance. Gaps between the tesserae were also filled with dry sand, both to prevent backing materials from leaking through to the front and to improve appearance.

The interface between the tesserae and the backing consisted of a high lime-content white cement intervention layer (as described in the testing phase above) consisting of one part fine sand, three parts white cement (dry), one part slaked lime putty (by volume, wet), and enough water to make a slurry the consistency of heavy cream (fig. 2). The back of the mosaic was sprayed lightly with 5 percent Primal® AC-33 and the slurry splashed over the surface from a trowel to a thickness of about half a centimeter. The intervention layer was allowed to set for several hours, just until slightly firm. In the meantime the volume of GFRC mix needed for each panel was calculated (based on the batch yield as determined in the field testing phase). The cement mix used in this project consisted of two parts cement to one part medium-grade sand, to which about 6.3 percent AR glass fibers (by dry volume) were added. As in the field tests, the glass fibers used were a mixture of Cem-fil® 60/2 and 62/2, manufactured by Saint-Gobain/Vetrotex (see Suppliers, below), in chopped strands 12 to 24 millimeters long.

Just enough water was added to the dry mix to make a stiff paste, typically around 1 liter water for 4 liters dry mix. To make mixing easier, a small amount of lignosulfonate-type water reducer and slump enhancer (a compound frequently added to cement mixes to increase flow without additional water) was added to each batch. The resulting paste was a low-water mix that could easily be pressed into the mold (fig. 3). The paste was troweled and leveled, identification numbers were incised in the smoothed surface, and it was covered with wet burlap and plastic sheeting. After twenty-four hours the mold could be removed and the edges of the panel trimmed.

Each panel was then wet-cured for a minimum of three days, after which it could be carefully turned faceup. With nothing more than water from a running hose and a scrub brush, the facings could be removed and the mosaic surface that had been hidden for over ten years revealed (fig. 4). Additional cleaning included some mechanical removal of intervention mortar that might have leaked through to the front as well as removal of softened adhesive residues that may have been used to secure tesserae. The panels were further wet-cured after cleaning for at least two more days, though



FIGURE 2 Applying the intervention layer. Photo: Kent Severson. © Archaeological Exploration of Sardis/Harvard University.



FIGURE 3 Pressing the cement paste into the mold. Photo: Diane Fullick. © Archaeological Exploration of Sardis/Harvard University.



FIGURE 4 Removing the facing with running water. Photo: Kent Severson. © Archaeological Exploration of Sardis/Harvard University.

usually it was for a longer period. Large panels that were not wet-cured for a minimum of five days sometimes exhibited slight warpage away from the tessera side. This is likely due to preferential shrinkage on the backing side during drying, before the cement matrix had sufficient time to form. Panels that were wet-cured for longer periods showed no warping.

In section the finished panels are 3 centimeters thick (fig. 5). The intervention layer covers the backs of the tesserae and barely extends around to the sides. The temporary fills are washed out, leaving a surface recessed from the top of the tesserae, which is covered with a layer of sand. The total weight of the panels is about 60 kilograms per square meter, so two people can handle a smaller piece, while three or four are needed for the largest panels. Still, this is half the weight and almost half the thickness of traditional ferroconcrete backings. The finished panels were labeled and are now stored on edge in welded steel racks in the mosaic depot. Only minimal shifting is required to examine any individual panel. In the end, a total of about 81 square meters of backed mosaic were produced in 107 panels.

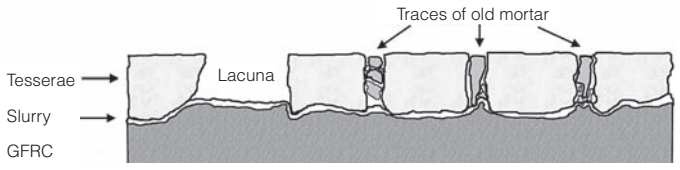


FIGURE 5 Diagram of a GFRC panel in section. Courtesy of Diane Fullick. © Archaeological Exploration of Sardis/Harvard University.

To investigate the reversibility of this application, one small panel was removed from the GFRC backing. In theory the intervention layer should provide a plane along which the backing can be separated from the mosaic. To test this we faced a small panel and removed it by splitting along the intervention layer with cold chisels. This process actually very much resembled the original lifting process, and it certainly involved some physical force. However, with a strong facing, the tesserae do indeed come away from the backing with few traces of cement.

Discussion

While this project demonstrates the feasibility of using GFRC to back lifted mosaics, further investigation of alternative intervention layers could ease reversibility and help to ensure against soluble salt problems. Where time constraints would allow for proper curing, pure hydraulic lime intervention layers could certainly be used with GFRC. A move to a pure lime mortar intervention layer should probably be preceded by tests to improve and ensure adhesion between the lime mortar and the cement, possibly even incorporating the AR glass fibers into the intervention layer or as a joining mechanism between the layers.

Thinner panels could undoubtedly be fabricated for more delicate mosaics, with improved mixing techniques and higher glass fiber content. Given a sufficiently large number of mosaics and a large enough workshop space, it might be economically feasible to use industrial spray equipment to mix and install the material. Other techniques could also be employed to make more precise molds around irregular fragments.

Conclusion

This project was completed in 2005 after six seasons' work. The team each season consisted of one project supervisor assisted by one or two regular workmen, with a little help from other Sardis conservation staffers. In general, people liked doing this work. While rubber gloves were essential, there was no need to work with organic solvents in the hot weather, and working with plenty of water was a bonus. The cost of materials and equipment was minimal and consisted of simple things



FIGURE 6 Laying out the panels for final assessment in 2006. Photo: Kent Severson, Sardis SD 2006.0459. © Archaeological Exploration of Sardis/Harvard University.

such as cement, sand, lumber, and plastic sheeting; even the glass fibers were inexpensive. In 2006 all the panels were laid out in a flat space on wooden blocks to document the surviving assemblage and to test handling, storage, and recording systems (fig. 6). Locating the panels in their storage racks and transporting them to the workplace was easily accomplished. While setting the panels out in their correct orientation took some time, all the panels of the lower mosaic were hand carried back to their storage racks in one day by a team of six workmen. GFRC is not the ideal material for backing all mosaics. It does, however, provide an alternative to more expensive and labor-intensive aluminum panel backings in those situations in which mosaics are to be stored in less-than-ideal conditions for extended periods. GFRC backing is a quick, rough-and-ready way to economically stabilize even mosaics made from large tesserae in field conditions.

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Materials and Suppliers

Alkaline Resistant Glass Fibers

Manufacturer:
Saint-Gobain Vetrotex España, S.A.
Ctra. Madrid-Barcelona, Km. 34,500
Apartado 60
28800 Alcalá de Henares,
(Madrid), SPAIN
Tel: +34 91 885 5803, Fax: +34 91 885 5810
Email: carmen.gadea@saint-gobain.com

The supplier for material used in this project (Korimpeks, Istanbul) no longer distributes Cem-fil® products.

Cem-fil® distributors are available from their Web page: www.cem-fil.com/cf_location_con.html.

The current listed Istanbul supplier is:
Mertex Temsilcilik Danismanli ve Dis Ticaret
Ahmet Taner Kisiali Cad. Aydin Sitesi
A2 Blok No:6 34800
Yesilkoy - Istanbul
Turkey
Tel:+ 90 5333686736, Fax: +90 5333190478
Email: mertex@superonline.com

Primal® AC-33 acrylic emulsion

Manufacturer:
Rohm and Haas Company
100 Independence Mall West
Philadelphia, PA 19106-2399
Tel.: 215-592-3000, Fax: 215-592-3377

Distributor (Turkey):
Art and Restoration
Karaça Sokak 18
Dolapdere – Beyoğlu
Istanbul, Turkey
Tel.: +90 2122384511

Flow Inducer (lignosulfonate type)

The materials used in this project were typical products acquired from several local cement factories; Flow Inducer is widely used in the industry and readily available locally. An equivalent product is Sikament N®.

Manufacturer:
Sika Corporation
201 Polito Avenue
Lyndhurst, NJ 07071
Tel.: 201-933-8800, Fax: 201-933-6225
www.sikaconstruction.com

Discussion—Session 7: Case Studies

Président/Chair: Fathi Bejaoui and Charalambos Bakirtzis

Discussion following Michele Macchiarola Presentation

FRED GIRARDET: J'ai une remarque générale concernant la chaux hydraulique, ce n'est pas vraiment une question. Monsieur Van Balen a fait une étude sur les chaux hydrauliques, des comparaisons entre les chaux hydrauliques, et il a relevé qu'il y avait une grande différence entre ces matériaux. Il a constaté notamment qu'il pouvait y avoir beaucoup de sodium, qu'il y a des éléments très dangereux pour la conservation des matériaux, surtout en présence d'eau et si on a des sulfates. Il y a aussi une remarque qu'il faut faire à ce sujet si les chaux hydrauliques sont utilisées sur des mosaïques sous abri soumises à des remontées d'eau apportant des sulfates, ce sont les sels qu'on retrouve le plus couramment. Pour les chaux hydrauliques qui contiennent des aluminates notamment, on a un risque de formation d'ettringite, qui est extrêmement dommageable parce que c'est un sel qui produit une expansion très forte. Donc, dans les études qui doivent être faites pour choisir les chaux hydrauliques, il est très important de considérer la sensibilité de ces chaux hydrauliques aux sulfates notamment.

MICHELE MACCHIAROLA: The NHL, the natural hydraulic limes, don't have cement inside, so you don't have sulfites or sulfate inside. For example, I have some results for sulfite content in an NHL: Calix is 0.06 percent, and TCS, the other NHL, is 0.04 percent, very, very low. In a cement, you have 2 or 3 percent, and sulfation is possible, which is very dangerous for conservation. But for these mortars, prepared with natural hydraulic limes, we haven't had this problem; we haven't had the soluble salts. And you have mechanical properties similar to the ancient materials, which is very important, and these mortars are highly durable in wet conditions, which is good.

FRED GIRARDET: C'est juste une remarque, effectivement, il y a un malentendu. Ce n'est pas les sulfates dans le ciment qui posent un problème, c'est ceux qui viennent de l'extérieur. Pour les ciments à base de chaux hydrauliques, même si elles sont naturelles, c'est une réaction avec les aluminates. Dans le ciment, il y a toujours des sulfates, ça fait partie de sa constitution, c'est nécessaire à sa prise, mais je parle des sulfates qui viennent du milieu, c'est à dire de l'eau qui va venir à la surface des mosaïques et s'évaporer si les mosaïques sont sous abri et c'est ces sulfates-là qui réagiront avec les aluminates des chaux. Alors, selon les types de chaux hydraulique, il peut y avoir ou non de réaction. Donc, il faut être attentif à ce problème là et les chaux hydrauliques, les mortiers de chaux hydraulique, doivent être testés avec des sulfates, en milieu sulfates, pour être sûrs qu'ils ne réagissent pas, et c'est spécialement important si les mosaïques sont sous abri et que l'eau remonte et s'évapore à la surface.

JACQUES NEGUER: I want to know if you have more information about the other producers of hydraulic limes in the European market.

MICHELE MACCHIAROLA: This study is in the beginning phase; it is a work in progress. At this time, we have only one or two other limes but not all the analyses for them, such as in this case. We are studying other limes, for example, the hydraulic lime, cement, and calcium hydroxide, from Fassa Bartolo, another manufacturer in Italy. But I think that the natural hydraulic limes are better for our problems, generally. I would like to say a few words about the other question. This mortar,

the mortar prepared with natural hydraulic lime, has two components: calcite after the setting phase and silicate and calcium silicates. And if you have an atmospheric deposition, pollution, wet and dry, of sulfur, you have a sulfation with ancient materials, with stones and with these mortars. When you have calcite, there is always the problem of sulfation. You have the same problem, the sulfation process, with the limestone tesserae due to the interaction between the calcite and atmospheric deposition; we have sulfur, wet and dry, deriving from the combustion of fossil fuels. This is a big problem. But when you want to conserve a monument, you have to work both on the monument—on the materials—and on the environment. It's very important.

ABDELILAH DEKAYIR: Est-ce que vous avez fait des tests expérimentaux pour connaître la cinétique de la dissolution de ces mortiers lorsqu'ils sont en contact avec de l'eau et quel type d'eau ?

MICHELE MACCHIAROLA: It is a hydraulic lime, and in this way, in water, you don't have a problem; the setting phase can be in water. As with the cement, there is no dissolution. In this mortar, you don't have soluble compounds; you have calcite, silicon, and calcium silicates; you have sand but not soluble components. Why dissolution?

ABDELILAH DEKAYIR: Parce que, par exemple, on sait que les eaux qui montent par capillarité, c'est généralement des eaux qui sont plus ou moins acides, parce que généralement il y a des micro-organismes et il y a de l'activité biologique. Il y a des acides qui sont de type acide fulvique par exemple et qui peuvent attaquer ces mortiers avec des pH qui sont très bas. Mais je reviens à la calcite. On sait tous que la calcite est très vulnérable à des pH très acides. La calcite se dissout facilement dans des milieux qui sont acides. On sait ça, parce que si on met une goutte de HCl sur de la calcite, on connaît bien la réaction.

MICHELE MACCHIAROLA: I don't know. Our problem is to have a mortar more compatible with the ancient material. If the ancient materials, the ancient mortars, are not soluble, why should my mortar be soluble? I don't know.

Discussion following Fathi Bejaoui Presentation

ÉVELYNE CHANTRIAUX: Je voudrais réagir sur votre question finale, c'est-à-dire faut-il déposer toutes les mosaïques, faut-il les reposer sur des supports légers ? Je voudrais remarquer que dans la salle il y a des historiens, des archéologues, des chercheurs, des restaurateurs, et que ça représente une communauté qui, pour chaque personne, a des niveaux de pouvoir décisionnel totalement différents. J'aurais tendance à répondre par d'autres questions. Dans le cas de chaque opération, qui définit les objectifs ? Qui établit la programmation ? À quel moment les restaurateurs sont associés ? Et qui décide en dernier lieu ? Parce que les restaurateurs ont en général assez peu de pouvoir. On a vu dans l'exemple de Tournus que c'était finalement les autorités locales qui avaient tranché dans le cas d'un conflit entre l'atelier et les architectes des monuments historiques. Dans le cas de Sbeitla que vous avez montré, est-ce qu'on peut voir une programmation ou plusieurs ? Puisqu'on a vu des consolidations *in situ* qui sont dans une perspective minimaliste, mais il y a eu également des réintégrations assez générales, qui, apparemment, sont plutôt maximalistes. Et le dernier exemple, c'est celui de Loukou, où Denis Weidmann montrait très justement que les solutions à trouver devaient concilier des impératifs de conservation et des objectifs de recherche. Donc, c'est simplement une remarque en disant que les solutions techniques sont à rechercher à partir du moment où les programmations sont correctement et bien établies.

HANDE KÖKTEN: Rather than ask questions, I would like to make a few comments because we have the same problem of illegal excavations in Turkey. This is a very common problem. So I will make some comments on how to try to stop these in terms of education, rather than comments on conservation approaches, because I know that many times conservation is not even applicable due to the swift action of smugglers; they work faster than we do. I will give a few examples, a few experiences, from Turkey. Education in schools is one of them. Beginning in the primary schools, the importance of and need to protect cultural heritage should be learned; this should be taught to students from the beginning level. Meetings with local people, especially in coffeehouses in villages—I believe we have the same tradition—helps a lot. Some of our excavators used this as a method to explain to local people how important it is to save the artifacts and ruins, and it works very well. Announcing all damage to all lifted archaeological material is a good way of informing people about what happens when they are damaged—the loss of value and the loss of national heritage. Local radio and television stations are very good tools for educating people about the importance of cultural heritage. Since there is a great project of training conservation practitioners, I believe that technicians themselves may help the local people, their own people in villages or small towns, by speaking about the importance of cultural heritage.

An example came to my mind from a completely different project in Turkey. Shepherds are very important, I believe. They have a very important role because they go to the far corners of the fields, and they may work like reporters if they are trained, if they are involved in such a program of communication. They may find out about illegal excavation and inform the authorities immediately. We have an experience with sponge divers in Turkey who were trained by the Bodrum underwater archaeology museum. They were given the description of copper ingots as big biscuits with ears, and that helped in the discovery of the famous shipwreck at Uluburun. So these are my comments about educating the local people about how bad it is to smuggle things.

FATHI BEJAOUI: Oui, vous avez entièrement raison de préciser que nous sommes pratiquement dans le même cas que la Turquie et que tout cela se fait depuis quelques années. Bien entendu, l'éducation est la base de la sensibilisation, par radio, à l'école, il y a même des visites obligatoires à certains niveaux de l'école primaire sur les sites archéologiques pour la sensibilisation, des visites obligatoires dans les musées, etc. Mais vous avez prononcé le mot berger, lorsqu'un berger, qui a quand même quelques difficultés à vivre, est appréhendé, ce sont en fait des commandes. C'est un trafic international, c'est pas le Tunisien, c'est pas l'Algérien, c'est pas le Marocain qui a besoin d'une mosaïque pour décorer sa demeure. C'est un trafic international et on le sait tous, parce qu'il y a une commande alléchante avec des dizaines de milliers de dinars. Vous savez, la tentation est assez, pas compréhensible, non, mais cette personne lorsqu'elle se trouve devant cette somme et que c'est pour une mosaïque à déposer, même pour la déposer partiellement, et pour la vendre. Je crois que c'est également là le problème, c'est quand même un problème matériel, pas de survie pour le berger, mais c'est quand même la tentation.

Discussion following Patrick Blanc Presentation

JEAN-PIERRE DARMON: Je voulais d'abord rendre à César ce qui appartient à Henri. La première importante et essentielle étude de la mosaïque de Grand a été faite par Henri Stern et elle a paru dans le deuxième fascicule du premier volume du corpus, du recueil général de mosaïques de la Gaule. Moi, je n'ai fait que revenir là-dessus à l'occasion d'un colloque qui a eu l'année dernière pour essayer, à la lumière des nouvelles découvertes, de préciser des éléments, surtout concernant la datation que je propose de remonter vers le milieu du second siècle, et concernant l'identification de la scène de comédie. En ce qui concerne ma question à Patrick, au moment du remontage par ceux qui ont déposé la mosaïque, est-ce qu'il y a pu avoir des confusions d'emplacement ? Parce que l'ordonnancement de l'alternance des motifs inscrits, qui sont tantôt des carrés droits, tantôt des carrés concaves, dans l'état actuel de la mosaïque présente des irrégularités incompréhensibles. Est-ce que ça peut être dû au remontage ou bien est-ce que c'est dû à la fabrication ? Est-ce que vous avez eu des éléments sur le dossier du remontage ?

PATRICK BLANC: Pierre Godin dit qu'il a pris toutes les précautions. À l'époque ils ont fait des saignées, ils ont prélevé les tesselles, ils les ont recollées sur le calque. Ce qu'on a pu voir aussi, c'est que les panneaux étaient assez petits, donc je pense qu'ils n'ont pas pu se tromper. Mais, il se peut très bien qu'il y ait eu des employés, qu'il y ait pu avoir des accidents et que les restaurateurs aient pu interchanger certains panneaux, mais c'est quand même difficile à croire. Le démontage, c'est comme un puzzle. Donc soit il y a un morceau qui s'est brisé à ce moment-là et ils ont été obligés de le refaire, mais on ne le voit pas ça, non, parce qu'on distingue bien, je n'ai pas pu aller jusqu'au bout et je m'en excuse, j'ai été trop long, mais les parties restaurées sont très distinctes, donc, ça me paraît soit un accident, soit une remise en place de tesselles anciennes.

Discussion following Kent Severson Presentation

ISABELLE SKAF: Pour ne pas prendre la parole deux fois, je veux juste faire un petit commentaire sur la première communication au sujet du trafic d'antiquités. Je suis d'accord avec monsieur Bejaoui que c'est un problème économique et je pense qu'il y a certainement un travail à faire au niveau de l'offre et au niveau interne en Turquie, en Syrie, au Liban, mais je pense qu'il y a aussi un travail à faire au niveau de la demande, parce que tant qu'il y a de la demande, il y a une offre de l'autre côté. Et la demande, comme vous l'avez dit, elle vient du Liban et d'Europe, donc c'est aussi à ce niveau-là qu'il y a un travail quand même important à faire. Pour monsieur Severson, what facing adhesive, what glue, did you use that you removed so easily with the hose?

KENT SEVERSON: The miracle facing adhesive is animal glue, protein glue.

ISABELLE SKAF: But wasn't the heat—it is probably very hot in Turkey in the summer? It's hot enough for you to remove it with cold water?

KENT SEVERSON: We put wet cloth on it and covered it with plastic sheets and let it sit in the warm sun for an afternoon. It comes right off.

HANDE KÖKTEN: Was it the archaeologists' or the conservators' decision to use glass fiber reinforced cement, or was priority given to using an inexpensive material on this project?

KENT SEVERSON: Great question. How to phrase this? There is pressure—I think anyone working in the field knows there is monetary pressure and there is time pressure to execute these projects quickly and efficiently. With this particular project, there is also the issue of the material deteriorating fairly quickly. Should I have taken years, or even one season, to raise funds to execute honeycomb backings on these things? And the time it would take to actually do it [was a consideration], because the time when we have access to the materials is very limited each year. Everyone realized something needed to be done very quickly. It was my idea to do this in particular. The archaeologists had no idea what to do about it; they just knew that something needed to be done. This was especially urgent after the fire, although the mosaics that didn't get burned were really on the brink of collapse as well. If I can just make a couple of comments associated with this. This is a strange idea, and you may be horrified that I brought up this idea of cement again, especially considering the long battles this group has fought to get cement out of the conservation of mosaics. But if you start to think about the problem, it's not just the cement that's the problem; it's the iron, really, that creates most of the problems. And then there's the issue of efflorescence and soluble salts in the cement matrix, particularly sulfates, and then microcracking. Well, some of those problems are solved by using glass fiber reinforced cement, and I think the reversibility can be enhanced through softer intervention layers. There are a great number of possibilities, so I envision that this is maybe a way forward. We had the report about our Syrian colleagues and a huge backload, 3000 square meters of unfaced, unbacked mosaics in depots. It may be a way for someone to get a grip on these things without spending ten years doing fund raising. I'll just leave it at that.

PART EIGHT

Summary Conclusions and Recommendations

Summary Conclusions and Recommendations

Jeanne Marie Teutonico and Roberto Nardi

The following conclusions were presented at the closing session of the conference. Essentially, they represent an overview of the main issues, trends, and observations that emerged during the various thematic sessions. Summary points from each session were recorded in the first instance by a group of conference rapporteurs. These session summaries were then distilled and synthesized for final presentation at the closing session.

Obviously, it is impossible to capture all the ideas that emerged from more than forty papers, as well as the rich and dynamic discussions that followed each session. However, it is hoped that the following overview provides some indication of the major points raised at the conference and illustrates significant trends in thinking. For ease, this summary is organized according to the thematic areas used to structure the conference. However, these areas are clearly interrelated and should be considered together for the most complete understanding of the subject.

Evaluating Mosaic Practice

- Evaluation of past interventions and practices is essential to improving current and future practices but is largely dependent on accurate and accessible documentation.
- The practice of mosaic conservation has evolved from one of limited options (detachment), materials (cement), values (aesthetic), and stakeholders (professionals) to one involving complex decision making and planning with a range of viable in situ options (both temporary and long term), the use of scientific methods and compatible materials, and the recognition of multiple values and varied stakeholders.
- Conservation interventions are sustainable only when there is a clear vision, an effective management structure and planning process in place, trained personnel, and regular maintenance and monitoring.
- Decisions about how to treat a mosaic must be made on a case-by-case basis (there is no single formula that can be applied to all mosaics on a site). They are the result of thorough assessment and need to be based on defined criteria and guidelines.
- An understanding of causes of deterioration to in situ mosaics requires recognition of unsolved problems, implementation of long-term and in-depth investigations, and wide dissemination of the results.

Caring for Mosaics in Museums

- Decisions need to be shared by curators and conservators in order to achieve successful and sustainable conservation solutions.
- Previous conservation interventions can sometimes be detrimental to the condition of mosaics in museums; negative effects of past treatments (such as embedded iron rods) can often be mitigated or slowed through preventive conservation measures, such as the control of temperature and relative humidity in both gallery and storage conditions.
- It is important to consider both the objects and the building envelope in making conservation decisions about mosaics displayed in museums; poor storage conditions are a subject of increasing concern.
- Where adequate documentation does not exist, analysis of past treatments and treatment materials may

be necessary in order to develop appropriate conservation measures; historical photographs can also be useful in understanding the change in an object's condition over time.
- In some cases, past interventions have become important to the history of the object and merit conservation in their own right.
- Interpretation and presentation to the public are important values in museum conservation; treatments carried out in full view of the public can be useful in increasing understanding of and support for conservation.

Documenting and Assessing Sites at Risk

- Mosaic corpora that include conservation information and risk assessment strategies undertaken at the national or regional level can be significant tools for the conservation and management of the mosaic heritage.
- It is important to establish systematic documentation standards and protocols to facilitate decision making and to improve practice.
- Attention should be given to the development of documentation strategies that permit improved sharing of information, perhaps through more effective use of digital technologies and the Web.
- Archaeologists and conservators must work together effectively on rescue excavations to ensure that the decisions made are those that are best for the heritage at risk.

Managing Sites with Mosaics

- There is a clear trend emerging to look at sites holistically and to undertake more systematic assessment and planning before arriving at decisions regarding conservation and management of sites.
- Stakeholder participation is crucial in gaining support for in situ preservation and in the prevention of looting.
- Techniques such as geographic information systems (GIS) may be useful in documenting, monitoring, and managing the mosaic heritage.
- There are multiple options for mosaic conservation that include conservation in situ, detachment and replacement in situ, detachment and replacement in a museum, and reburial. These choices should be made through a systematic study of the entire site that considers the condition of each mosaic and its treatment history, the environment, the desirability of presentation to the public, and the cost.
- Better and more comparable information is needed regarding the relative costs of various types of treatment in order to make informed decisions regarding site conservation.
- Further research may be required regarding reburial methods and the nature of the reburial environment.

Sheltering Mosaics

- The assessment of existing shelters, with regard to protection, cost, and maintenance, for example, can lead to a better understanding of the criteria that affect shelter performance and provide valuable information for the design of new shelters.
- Shelter evaluation should be based on a study of the nature and rate of deterioration in relationship to environmental conditions in the sheltered space. Various types of monitoring strategies may be used to better understand conditions and to assess risks in the sheltered environment.
- Decision making regarding the design of a shelter must be informed by a number of factors, including performance criteria, stakeholder concerns, interpretation and presentation issues, and cost.
- The real cost of a shelter includes not just the initial cost but also that of "cost in use," that is, the cost over the life of a shelter to maintain it in good condition. Too often the need to maintain a shelter is overlooked.
- Shelters cannot be considered in isolation. A shelter affects the entire site, including its condition, appearance, and use. Long-term planning can prevent unintended consequences.

Training of Conservation Practitioners

- Training is needed at all levels, from that of mosaic technician to conservator and site manager. The sustainability of a training initiative will be based on a number of factors. These include:

- the use of tools, materials, and techniques appropriate to the resources and skills in the local environment;
- training that is not confined to a single experience but involves a continuous effort over time; and
- the existence of a management context in which those trained will find employment and support once their training is complete.

- Regional, international, and institutional partnerships can be of great value in training initiatives. Partnering can take many forms, including collaboration in national or regional training initiatives and the exchange of personnel or periods of supervised work in centers of expertise.
- The coordination of training activity for mosaic conservation and of the larger issues of site management is increasingly important. This will allow for the better use of resources, prevent duplication of effort, and facilitate the sharing of didactic materials and strategies.

Conclusions de la conférence

Jeanne Marie Teutonico et Roberto Nardi

Les conclusions suivantes ont été présentées lors de la session de clôture de la conférence.

Elles représentent essentiellement les grandes lignes des problématiques, tendances et observations principales issues des différentes sessions thématiques. Un compte rendu sommaire de chaque session a initialement été dressé par le groupe de rapporteurs de la conférence. Ces comptes rendus ont fait l'objet d'une synthèse générale pour aboutir à une présentation finale lors de la session de clôture.

Il est, bien entendu, impossible de refléter toutes les idées émanant de plus de quarante présentations et des vifs et très riches débats qui ont suivi chaque session. Toutefois, il est espéré que la synthèse suivante fera apparaître les thèmes majeurs évoqués au cours de la conférence et illustrera les tendances significatives en matière de pensée. Afin d'en faciliter la présentation, ce résumé est organisé selon les domaines thématiques qui ont servi à structurer la conférence. Cependant, ces domaines sont évidemment interconnectés et pour une compréhension plus complète du sujet il convient de les appréhender dans leur ensemble.

Évaluation de la pratique de la mosaïque

- L'évaluation des interventions et des pratiques du passé est essentielle pour permettre d'améliorer les pratiques actuelles et futures, mais celle-ci est tributaire d'une documentation précise et accessible.
- La pratique de la conservation des mosaïques a évolué en partant d'une pratique recourant à des options (dépose), matériaux (ciment), valeurs (esthétiques) et acteurs (professionnels) limitées pour aboutir à une pratique impliquant des décisions et une planification complexe avec un éventail d'options *in situ* viables (temporaires et à long terme), l'utilisation de méthodes scientifiques et de matériaux compatibles, et la reconnaissances de valeurs multiples et d'acteurs variés.
- Les interventions de conservation ne peuvent être durables que s'il existe une vision claire, une structure de gestion efficace et un processus de planification en place, un personnel formé et un entretien et un suivi réguliers.
- Les décisions concernant le traitement d'une mosaïque doivent être prises au cas par cas (il n'existe pas de formule unique qui puisse être appliquée à toutes les mosaïques sur un site). Elles découlent d'une évaluation minutieuse et doivent être fondées sur des critères et des lignes directrices définies.
- Une connaissance des causes de détérioration des mosaïques *in situ* implique la capacité à reconnaître les problèmes non résolus, la mise en œuvre d'investigations approfondies et à long terme et une large diffusion de leurs résultats.

Soins apportés aux mosaïques dans les musées

- Les décisions doivent être partagées entre les conservateurs et les conservateurs-restaurateurs afin d'assurer des solutions de conservation efficaces et durables.
- Les interventions de conservations précédentes s'avèrent parfois néfastes pour l'état de conservation des mosaïques dans les musées ; les effets négatifs des traitements précédents, tels que les armatures en fer enfouies peuvent souvent être atténués ou ralentis par des mesures de conservation préventive, tels que

le contrôle de la température et de l'humidité relative aussi bien dans les salles que dans les réserves.
- Il est important de tenir compte à la fois des objets et du bâtiment les abritant lorsqu'il s'agit de prendre des décisions en matière de conservation concernant les mosaïques exposées dans les musées ; les mauvaises conditions dans les réserves constituent de plus en plus un sujet de préoccupation.
- Lorsqu'il n'existe pas de documentation adéquate, une analyse des traitements précédents et des matériaux employés peut s'avérer nécessaire afin d'élaborer des mesures de conservation appropriées ; les photographies historiques peuvent aussi aider à comprendre l'évolution de l'état de conservation d'un objet à travers le temps.
- Dans certains cas, les interventions précédentes assument une importance dans l'histoire de l'objet et méritent d'être conservées en tant que telles.
- L'interprétation et la présentation au public constituent des valeurs importantes dans le cadre d'un musée ; les traitements effectués devant le public peuvent aider à sensibiliser celui-ci vis-à-vis de la conservation et renforcer son soutien.

Documentation et évaluation des sites encourant des risques

- Les corpus de mosaïques comprenant des informations sur la conservation et des stratégies d'évaluation des risques effectuées aux niveaux nationaux et régionaux peuvent constituer des outils importants pour la conservation et la gestion du patrimoine de mosaïques.
- Il est important de mettre en place des normes et des protocoles de documentation systématique afin de faciliter la prise de décision et améliorer la pratique.
- Une attention particulière devrait être attachée à l'élaboration de stratégies de documentation qui permettent d'améliorer le partage de l'information, éventuellement à travers une utilisation plus efficace des technologies numériques et de l'Internet.
- Lors des fouilles de sauvetage, les archéologues et les conservateurs-restaurateurs doivent travailler efficacement ensemble afin de garantir que les meilleures décisions soient prises pour le patrimoine en danger.

Gestion des sites à mosaïques

- Une tendance claire est en train d'émerger : adopter une vision holistique d'un site et recourir à une évaluation et à une planification plus systématiques avant de prendre des décisions concernant la conservation et la gestion des sites.
- La participation des acteurs est essentielle afin d'assurer leur soutien pour la préservation *in situ* et pour prévenir le pillage.
- Les techniques telles que les systèmes d'information géographiques (SIG) peuvent être utiles pour documenter, faire le suivi et gérer le patrimoine de mosaïques.
- Il existe de nombreuses options pour la conservation des mosaïques, comprenant la conservation *in situ*, la dépose et la repose *in situ*, dépose et repose dans un musée et le réenfouissement. Ces choix devraient être faits après une étude du site dans son ensemble qui tient compte de l'état de conservation de chaque mosaïque et de l'historique de son traitement, de l'environnement, de l'opportunité de sa présentation au public et du coût.
- Il est nécessaire de disposer d'informations plus précises et plus facilement comparables concernant les coûts relatifs des différents types de traitement afin de permettre la prise de décisions mieux informées concernant la conservation des sites.
- Davantage de recherche pourrait être nécessaire concernant les méthodes de réenfouissement et la nature du milieu de réenfouissement.

Couverture des mosaïques

- L'évaluation des abris existants par rapport à la protection assurée, le coût, et l'entretien, par exemple, pourrait aboutir à une meilleure connaissance des critères qui affectent la performance des abris et fournir des informations précieuses pour la conception de nouveaux abris. L'évaluation des abris doit être basée sur une étude de la nature et du rythme de détérioration par rapport aux conditions du milieu dans un espace abrité. Différents types de stratégies de suivi peuvent être mis en œuvre afin de mieux comprendre les conditions et d'évaluer les risques dans un milieu abrité.

- La prise de décision concernant la conception d'un abri doit être informée par un certain nombre de facteurs, y compris les critères de performance, les préoccupations des acteurs, la problématique de l'interprétation et de la présentation et le coût.
- Le coût réel d'un abri comprend non seulement le coût initial mais aussi le « coût de son utilisation », à savoir les coûts encourus durant toute la durée de vie de l'abri pour le maintenir en bon état. Trop souvent on ne tient pas compte du besoin d'entretenir un abri.
- Les abris ne peuvent pas être perçus en isolation. Un abri a un impact sur l'ensemble du site, y compris son état de conservation, son apparence et son utilisation. Une planification à long terme peut prévenir les conséquences inattendues.

La formation pour les praticiens de la conservation

- Une formation est nécessaire à tous les niveaux, du technicien de la mosaïque jusqu'au conservateur-restaurateur et gestionnaire de site. La durabilité d'une initiative de formation dépend de plusieurs facteurs, y compris :
  - l'utilisation d'outils, matériaux et techniques appropriées aux ressources et aux compétences de l'environnement local ;
  - un effort de formation qui ne se limite pas à une seule expérience mais implique un effort continue à travers le temps ; et
  - l'existence d'un contexte de gestion dans lequel ceux qui sont formés trouveront du travail et un soutien une fois leur formation terminée.

- Des partenariats régionaux, internationaux et institutionnels peuvent être très importants en matière d'initiatives de formation. Ceux-ci peuvent prendre plusieurs formes y compris la collaboration dans des initiatives de formation nationales ou régionales ainsi que l'échange de personnel ou des stages de travaux supervisés dans des centres d'expertise
- La coordination des activités de formation pour la conservation des mosaïques et la problématique plus large de la gestion des sites prennent de plus en plus d'importance. Cela en vue de permettre une meilleure utilisation des ressources, prévenir le double emploi et faciliter le partage des supports didactiques et des stratégies.

PART NINE

Posters

Mosaic Icons in Greece: Techniques and Methods of Conservation

Panayota Assimakopoulou-Atzaka, Eleni Chrysafi, Christine Papakyriakou, Magda Parcharidou-Anagnostou, and Anastassia Pliota

Abstract: *In Greece only twelve mosaic icons have survived, dating from between the eleventh and the second half of the fourteenth century. Their iconography includes Christ, the Virgin, saints, and scenes depicting the Twelve Feasts. They originate from Constantinople or northern Greece. The foundation of these icons is a wooden tablet cross-hatched with a lattice pattern to help adhere the applied layer of wax mixed with mastic. In earlier times a wax and mastic mixture was used to conserve and restore the mosaic surface of the icons. Today the most common method is to leave the lacunae without any filling.*

Résumé : *Seules douze icônes en mosaïque ont survécu en Grèce, datant du onzième à la deuxième moitié du quatorzième siècle. Cette iconographie comprend le Christ, la Vierge, des saints et des scènes figurant les Douze fêtes. Elles proviennent de Constantinople ou du nord de la Grèce. Le support de ces icônes est constitué d' une tablette en bois entaillé pour faciliter l'adhésion d'une couche faite d'un mélange de cire et de mastic qui la recouvrait. Par le passé, une couche du mélange de cire et de mastic était utilisée pour conserver et restaurer la surface en mosaïque de l'icône. Aujourd'hui, la méthode la plus couramment employée est de ne pas remplir les lacunes.*

Mosaic icons are luxury objects intended for private worship. According to ancient written sources (Theophanes, Theodoros Metochites, Manuel Philes), they have been in use since the dawn of the Byzantine Empire.[1] In Greece, as far as is known, only twelve mosaic icons have survived, dating from the eleventh to the second half of the fourteenth century. The majority of these are small and meant for private worship; the few larger ones were used as portable kneeling icons (*proskynetaria*) or in the iconostasis (*despotikes*) in churches. These mosaic icons are magnificent objects of high artistic quality, and research has indicated that some of them, originating from Constantinople or workshops in northern Greece, were associated with the imperial family or upper echelons of the aristocracy (Buschhausen 1995: 57–66; Loverdou-Tsigarida 2003: 241–54). Their iconography includes Christ, the Virgin, saints, and, more rarely, scenes depicting the Twelve Feasts.

The foundation of such icons was a wooden tablet cross-hatched with a lattice pattern to help adhere the applied layer of wax mixed with mastic (nos. 7, 10) (fig. 1). The tesserae consist of fine and semiprecious stones, gold, silver, glass, and beaten copper; in the small icons these tesserae are tinier than the head of a pin, proof of the artist's skill. In earlier times a wax and mastic mixture was used to conserve and restore the mosaic surface of the icons. Where a part of the subject was missing, the restorer would fill the lacunae using color mixed with wax (nos. 1, 6, 9, 11) (figs. 2–4) or paint or even engrave the missing section on newly applied wax (nos. 2, 3, 12) (figs. 5–7).

Today the most common method is to leave the lacunae without filling them (nos. 4, 5, 6, 7, 8, 9, 12) (figs. 3, 7, 8). Sometimes the lacunae are filled with a wax and mastic mixture (no. 6) (fig. 3) or, using the method of linear completion, with watercolor (*rigatino*) (nos. 2, 3) (figs. 5, 6); in two cases the lacunae of the background were filled with tesserae (nos. 2, 3) (figs. 5, 6). In cases in which the damage was severe (e.g., nos. 4, 5) (fig. 8), parts of the wooden surface were replaced.

Catalogue of Mosaic Icons in Greece

1. *Saint Nicholas*, *14 × 10 cm, Holy Monastery of Saint John the Theologian, Patmos, eleventh century* (fig. 1). The earlier conservation, although not particularly artistic, fully respected the subject matter. The material used was wax with mastic and red coloring, which stabilized the tesserae and extends across the work without, however, attempting to replace the missing portions. During later conservation, both the wooden base

and the mosaic surface were cleaned and stabilized without moving the red filling (Hellenic Ministry of Culture, conservator Ph. Zachariou) (Furlan 1979: 35–36, pl. 1; Chatzidakis 1995: 44–45, pl. 1, 77).

2. *Saint George, 136 × 65 cm, Holy Monastery of Xenophontos, Mount Athos, ca. 1079* (figs. 2, 3) (Demus 1991: 26–28, pl. 4; Tavlakis 1998: 46–59, 282). Mosaic icons sometimes bear a strong resemblance to wall mosaics, raising many questions about their original use: Were they wall mosaics taken down and reused as portable icons, or did the style of portable icons imitate wall mosaics?[2] Either way recent conservation work has proved that this icon belongs to the second category (Hellenic Ministry of Culture, conservator J. Daglis). As for its earlier conservation, the attempt to restore the missing part of the subject by painting the tesserae in the lower part of the icon was apparent. During recent restoration work, the missing tesserae with the gold background were replaced with new, gold ones, and the painted tesserae were removed (Minos 1999: 248, 252, 255–58).

3. *Saint Demetrios, 136 × 73 cm, Holy Monastery of Xenophontos, Mount Athos, ca. 1079* (Demus 1991: 15–18, pl. 5; Tavlakis 1998: 46–59, 282). This kneeling icon (*ikona proskyniseos*) and the matching icon of Saint George from the monastery of Xenophontos were placed on the facade of the pilaster of the templon in the main church (*katholikon*). During the recent conservation and restoration of both icons, the damage to the lower part of the subject was treated with *rigatino*

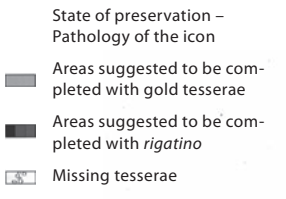
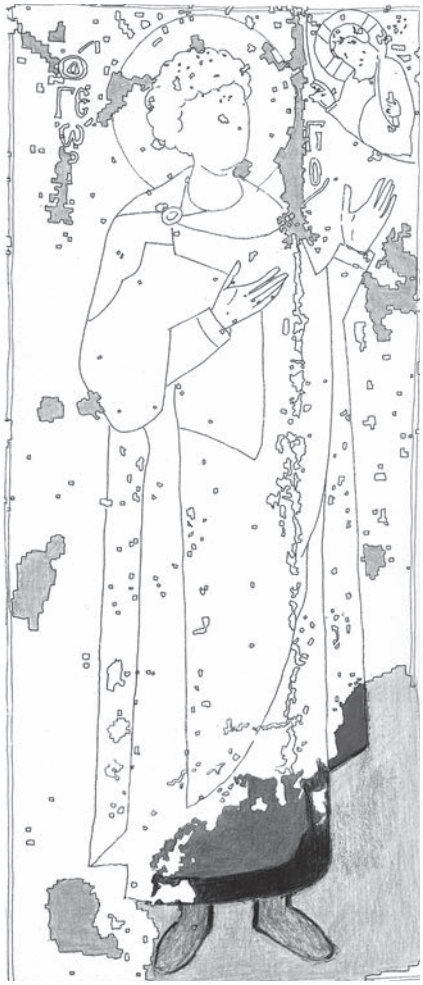




FIGURE 1 Saint Nicholas, 14 × 10 cm, Holy Monastery of Saint John the Theologian, Patmos, eleventh century. From M. Chatzidakis, *Εικόνες της Πάτμου. Ζητήματα βυζαντινής και μεταβυζαντινής ζωγραφικής* (Athens, 1995), pl. 1. Used with permission.

FIGURE 2 Saint George, Holy Monastery of Xenophontos, Mount Athos, ca. 1079, drawing. Origin: N. Minos, Η συντήρηση των εικόνων, in Ιερά Μονή Ξενοφώντος. Εικόνες, ed. E. N. Kyriakoudis et al. (Holy Mount, 1998), p. 248. Used with permission.

FIGURE 3 Saint George, 136 × 65 cm, Holy Monastery of Xenophontos, Mount Athos, ca. 1079. Origin: J. Tavlakis, Ψηφιδωτά 11ου αιώνα, in Ιερά Μονή Ξενοφώντος. Εικόνες, ed. E. N. Kyriakoudis et al. (Holy Mount, 1998), p. 50. Used with permission.





using linear completion rendered in watercolor on a bedding of wax, mastic, and chalk so that the form of the depiction as well as the modern intervention would be apparent (Hellenic Ministry of Culture, conservator J. Daglis) (Minos 1999: 251, 252, 255–57).

4. *Virgin Hodegetria, 57 × 38 cm, Holy Monastery of Chilandar, Mount Athos, ca. 1200.* This icon was in use at least up to the early twentieth century. During its recent conservation, the overpainted layer was removed and the damaged wooden surface replaced with new wood (Hellenic Ministry of Culture, conservator J. Daglis) (Demus 1991: 19–22, pl. 2; Petković 1997: 21, 65).

5. *Christ the Man of Sorrows (Utmost Humiliation), 17.5 × 13 cm, Holy Monastery of Tatarna, Eurytania, early fourteenth century* (fig. 5) (Furlan 1979: 70, pl. 21; Dositheos 2004: 20, 24, 26). The unstable tesserae of this icon used for private worship were fixed with a mixture of wax and mastic using an infrared lamp at 35°C; missing tesserae were not replaced. The voids in the wood surface were filled with balsa wood (Hellenic Ministry of Culture, conservator Stavros Baltoyiannis) (Chatzidakis 1965: B1 Chronique, 12–13).

6. *Saint Nicholas with the Oyster, 42.5 × 34 cm, Holy Monastery of Stavronikita, Mount Athos, fourth quarter of thirteenth century* (fig. 6). The excellent state of preservation of this icon allowed restoration to be confined to the wood surface, where an area of missing tesserae was substituted with wax, mastic, and color (Karakatsanis 1974: 138–40, figs. 7, 53; Demus 1991: 23–25, pl. 3).

7. *Virgin Eleousa the Episkepsis, 83 × 58 cm, Byzantine and Christian Museum, Athens, end of thirteenth to early fourteenth century.* Earlier conservation work included removing layers of paint and soot and stabilizing the wood surface. During recent conservation, the surface with the lattice pattern for locating the tesserae was revealed (Xenopoulos 1925: 44–53; Demus 1991: 15–18, pl. 1; Acheimastou-Potamianou 1998: 34–35).

8. *The Crucifixion, 19 × 16 cm, Holy Monastery of Vatopedi, Mount Athos, end of thirteenth to early fourteenth century.* The missing parts have never been replaced (Tsigaridas 1996: 368, 369, 371 [fig. 314], 372, 643–44).

9. *Saint John the Theologian, 17 × 12.2 cm, Holy Monastery of Great Lavra, Mount Athos, ca. 1300.* An earlier attempt was made to preserve the icon by mounting it in a metallic frame. The missing parts of Saint John's body were rendered in a colored mixture



FIGURE 4 Christ Pantokrator, 15.5 × 7.2 cm, Holy Monastery of Esphigmenou, Mount Athos, second half of fourteenth century. Origin: St. M. Pelekanides et al., Οι θησαυροί του Αγίου Όρους. Εικονογραφημένα χειρόγραφα, τ. Β΄ (Athens, 1975), p. 205. Used with permission.



FIGURE 5 Icon, for private worship, with Christ the Man of Sorrows (Utmost Humiliation), 17.5 × 13 cm, Holy Monastery of Tatarna, Eurytania, early fourteenth century. Origin: J. A. Koumoulidis et al., Το μοναστήρι της Τατάρνας. Ιστορία και Κειμήλια (Athens, 1991), p. 48. Used with permission.

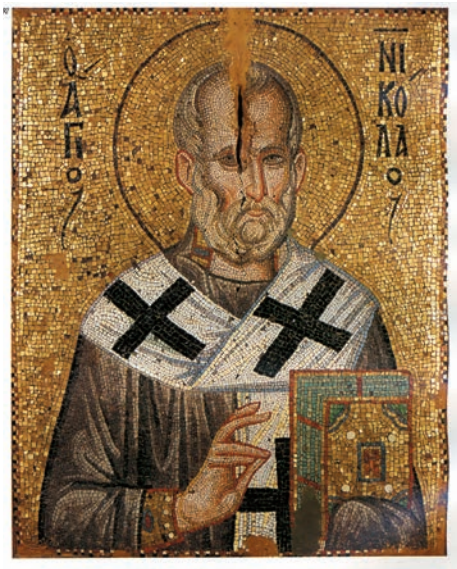


FIGURE 6 Saint Nicholas with the Oyster, 42.5 × 34 cm, Holy Monastery of Stavronikita, Mount Athos, fourth quarter of thirteenth century. Origin: P. Vokotopoulos, Βυζαντινές εικόνες (Athens, 1995), pl. 92. Used with permission.

of wax and mastic; the missing parts of the gold background were left without any filling (Chatzidakis 1972: 73–81, pls. 1–13).

10. *Christ Pantokrator, 18 × 11 cm, Holy Monastery of Great Lavra, Mount Athos, ca. 1300* (fig. 7). The lamentable state of the icon enables us to see the bedding of the mosaic: vertical and diagonal lines were engraved on the wood surface, forming a lattice pattern, each lozenge of which bears a depression connected to a groove, facilitating the adhesion of the subsequent wax layer (Chatzidakis 1973–74, 149–57, pls. 53–56).

11. *Christ Pantokrator, 15.5 × 7.2 cm, Holy Monastery of Esphigmenou, Mount Athos, second half of fourteenth century* (fig. 4) (Pelekanides et al. 1975: 204, 205; Furlan 1979: 89, tav. 35). Areas of missing tesserae can be observed on the lower section and also on other parts of the icon (i.e., Christ's hand). Moreover, other unrestored sections on the lower part of the icon are obvious where the existing wax and tesserae layers have blistered.

12. *Saint Ann and the Virgin, 9 × 15 cm, Holy Monastery of Vatopedi, Mount Athos, end of thirteenth to early fourteenth century* (fig. 8). During earlier conservation work, the missing parts of the subject, especially on the lower left part of the icon, were replaced with wax and mastic engraved to resemble tesserae. The back of the icon was covered with cloth in 1530/32–60, on which an inscription was written (Tsigaridas 1996: 368–69, 370: figs. 313, 643).



FIGURE 7 Christ Pantokrator, 18 × 11 cm, Holy Monastery of Great Lavra, Mount Athos, ca. 1300. Origin: M. Chatzidakis, Ψηφιδωτή εικόνα του Χριστού στη Λαύρα, *Deltion Hristianikes Archaiologikes Etaireias* 7 (1973–74): pl. 53. Used with permission.



FIGURE 8 Saint Ann and Virgin, 9 × 15 cm, Holy Monastery of Vatopedi, Mount Athos, end of thirteenth to early fourteenth century. Origin: E. N. Tsigaridas, Φορητές εικόνες, in *Ιερά Μεγίστη Μονή Βατοπαιδίου Παράδοση – Ιστορία – Τέχνη*, v. B΄ (Holy Mount, 1996), p. 369. Used with permission.

Acknowledgments

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Notes

1 For mosaic icons generally, see Furlan 1979; Demus 1991; Effenberger 2004: 209–41.

2 For a discussion of this matter, see Pasi 1995: 245–50.

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L'*emblema* découvert en mer, au large d'Agde : Technique de fabrication – traitement de conservation

Luc Long, Véronique Blanc-Bijon, Patrick Blanc et Marie-Laure Courboulès

Résumé : *La restauration par l'Atelier de conservation du Musée de l'Arles et de la Provence antiques d'un* emblema *en* opus vermiculatum *découvert au large du Cap d'Agde en 2003 et conservé au Musée de l'Éphèbe, a été l'occasion de premières observations techniques. Réalisé probablement par un atelier œuvrant à Rome au I^er^ siècle avant J.-C., cet* emblema *présente un certain nombre de spécificités : support en travertin, tesselles en marbre, verre et faïence, traces de peinture. Son excellent état de conservation a permis d'appliquer un traitement léger, sans apport ou surcharge, révélant toutes les qualités esthétiques et techniques de l'œuvre.*

Abstract: *The restoration by the conservation workshop of the Musée de l'Arles et de la Provence antiques of an* opus vermiculatum emblema *discovered off the coast of Cap d'Agde in 2003 and conserved in the Musée d'Ephèbe provided the opportunity for the first technical observations. The* emblema, *probably executed by a workshop in Rome in the first century* B.C.E., *presents a number of distinctive features: travertine support; marble, glass, and faience tesserae; and traces of paint. In view of its excellent state of conservation, a light treatment was applied with no additions, revealing all the aesthetic and technical qualities of the work.*

Un exceptionnel *emblema* (fig. 1) a été mis au jour par 6 m de fond, le 10 mai 2003, au large du Cap d'Agde (Hérault, France), au voisinage des deux statues en bronze découvertes dans le même secteur en décembre 2001. Des premières recherches effectuées par le Département des recherches subaquatiques et sous-marines (DRASSM) confirment que les trois chefs-d'œuvre pourraient faire partie de la même épave, dont la date du naufrage se situerait dans les dernières années du I^er^ siècle av. J.-C.

Parmi les différents épisodes du défi musical entre Apollon et Marsyas, le mosaïste a représenté la fin du concours, lorsque, après sa victoire, le dieu prononce la sentence à laquelle Marsyas sera condamné.

Mise en œuvre

Support en travertin

Pour supporter, et transporter, ces tableaux en mosaïque que sont les *emblemata*, deux solutions ont été adoptées par les mosaïstes antiques : soit un caisson en marbre, en pierre ou en céramique avec des bords remontant, visible donc dans le pavement une fois l'emblema mis en en place ; soit un support formé d'une plaque en céramique – brique, *tegula* ou plat réalisé sur mesure – qu'aucune trace n'identifie en surface du pavement.

La mosaïque trouvée au Cap d'Agde s'inscrit dans un bloc mesurant 47,6/48 cm de large pour 48,8/49 cm de haut, en travertin provenant peut-être de la région de Tivoli (fig. 2). D'une épaisseur de 7,5/8 cm, la pierre est grossièrement équarrie sur sa face inférieure ; les côtés et le rebord supérieur ont été travaillés plus finement.

On a pu observer l'emploi de semblable support en travertin sur plusieurs *emblemata* italiens. Les dimensions peuvent en être parfois relativement importantes : l'Académie de Platon de Pompéi, mesurant 86 cm sur 85, semble le plus grand. À l'arrivée du travertin des carrières de Tivoli sur le marché en Italie, et d'abord dans le Latium, ce nouveau matériau fut utilisé par les artisans mosaïstes du I^er^ siècle av. J.-C. Cependant, cette technique offrait peu de garanties de sécurité : le travertin, fragile, devait être conservé sur une importante épaisseur, aussi l'ensemble était-il relativement lourd. Le travertin paraît avoir été rapidement supplanté par un matériau plus aisé à mettre en œuvre, et d'un poids nettement inférieur : la terre cuite. De dimensions à peine inférieures (44,5 × 45,5 cm), un *emblema* d'Utique sur caisson en céramique[1] pèse environ 10 kg, alors que celui d'Agde pèse 37,5 kg.

Stratigraphie interne

Une lacune fait apparaître la préparation interne. Laissant un rebord de 1,3 cm, le réceptacle en pierre est creusé sur plus de 1,8 cm. Un mortier de tuileau grossier comportant de nombreux fragments de céramique – dont des fragments d'amphores à pâte pompéienne – tapisse le fond du creusement qui a dû être piqueté pour en assurer l'accrochage. Sur cette couche grossière repose un fin mortier ocre, épais de 0,5 cm environ, sur lequel ont été posées les tesselles.

Tesselles

De 3 à 4 mm de côté, les tesselles ont une très grande régularité dans les fonds ; pour les détails, elles affectent des formes plus irrégulières, toujours extrêmement fines. Elles ont une épaisseur de 2 à 3 mm, comme cela est fréquent pour l'*opus vermiculatum*. Les tesselles sont taillées dans des pierres calcaires, du marbre ; nous avons aussi noté la présence de cubes en verre, ainsi qu'en faïence (fig. 3).



FIGURE 1 L'*emblema*. Photo Michel Lacanaud © MAPA.

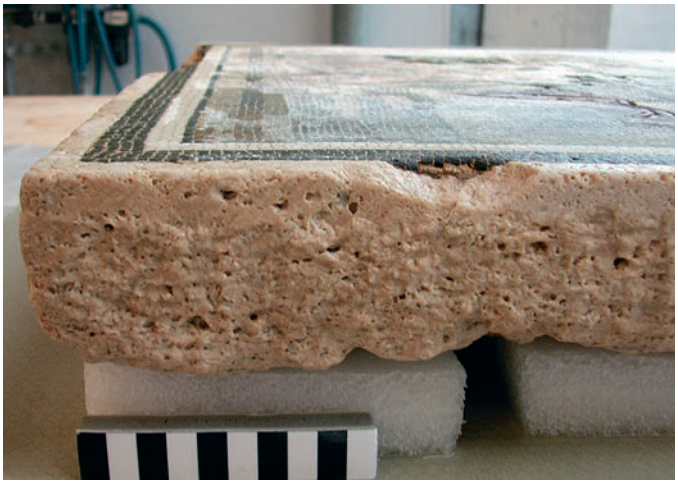


FIGURE 2 Le support en travertin. Photo © ACRM / MAPA.



FIGURE 3 Les tesselles. Photo © ACRM / MAPA.

Verre

Des recherches nouvelles sur la fabrication du verre ont montré que si le sable le plus fréquemment employé est celui du Belus en Syrie-Palestine, d'autres sables sont également utilisés, provenant d'Égypte, de Rome ou de Campanie. Des analyses sont en cours pour tenter d'identifier les sables mis en œuvre dans l'*emblema*. On sait maintenant que le verre est un matériau qui voyage sous une forme brute, importé en lingots, se fond dans des ateliers secondaires et se recycle pour des raisons techniques tout autant qu'économiques. Les tesselles en verre opaque utilisées pour le bleu clair et le mauve dans notre *emblema* présentent ces séries de petits points, signes d'une découpe dans du verre étiré en fil.

Faïence

Quant à la faïence, matière artificielle constituée de pâte siliceuse recouverte d'une glaçure, elle permettait aux mosaïstes de rendre certains bleus et verts n'existant pas dans la nature, voire des jaunes ou des blancs. Sur cet *emblema*, la plupart des tesselles en faïence ne montrent plus que des vestiges de pâte, verdâtre ou jaunâtre ; dans quelques cas, la surface glaçurée a été partiellement ou entièrement préservée lorsque la tesselle avait été basculée sur la tranche.

Si les chemins de sa diffusion ne sont pas encore reconnus, il est vraisemblable que la matière, dont l'origine est assurément égyptienne, devait circuler sous une forme finie ou non. Là aussi, des recherches récentes tendent à démontrer la présence de tesselles en faïence sur une série d'*emblemata* italiens.

Joints peints

Jouant de la multiplicité des matériaux, la palette est accrue encore par l'emploi de peinture. L'*emblema* d'Agde offre aussi cette technique permettant de dissimuler la discontinuité des cubes de pierre en apposant un mortier coloré à la façon de touches de pinceau. Ces traces sont conservées tant dans les joints que sur le dessus de certaines tesselles.

La palette ainsi constituée est riche et diversifiée, offrant une très grande variété de nuances. La mosaïque est alors véritablement une « peinture de pierres ». L'*emblema* d'Agde ne peut rivaliser toutefois avec les plus fins *emblemata* de la maison du Faune ou de la Villa Hadriana ; en revanche, un parallèle proche est l'*emblema* au Chat provenant de la villa de la Cecchignola, au sud de Rome, également sur travertin.

A.-M. Guimier-Sorbets considère le caisson à rebord comme une innovation « à mettre en relation avec le commerce qui en a été fait sur de grandes distances ». Notre *emblema*, s'il provient bien d'une épave antique, tendrait à renforcer ce dernier point. Des analyses en cours sur les matériaux permettront d'en préciser l'origine.

Conservation

État de conservation avant intervention

À son arrivée à Arles, l'*emblema* se présentait dans un état remarquable de conservation. Seule, la pierre en travertin du support avait été érodée par l'eau de mer ; sa porosité s'en est accrue, particulièrement visible au revers du bloc qui était également attaqué par des vers marins tubicoles. Outre la fracture laissant entrevoir le mortier de support, des croûtes calcaires râpeuses produites par des animaux marins (bryozoaires) et quelques fissures sont également visibles. Cependant, dans l'ensemble, le support en pierre est sain et ne présente pas d'altération qui risquerait de le fragiliser.

Quelques tesselles noires de la bordure de 4 files ont disparu à la hauteur de la fracture, ainsi que sur le bord droit où un choc (sur 6 cm) a fait disparaître une petite partie du support de pierre. Des tesselles en verre manquent également dans les vêtements des Scythes, dans le drapé d'Apollon, dans le ruban reliant les deux tubes de la flûte ; leurs empreintes dans le mortier sont très franches, bien conservées. Quant aux tesselles en faïence, la plupart ne sont plus conservées que par la pâte siliceuse retenue dans les alvéoles du mortier du lit de pose.

Traitement de conservation

Pour conserver cette œuvre exceptionnelle, il était nécessaire de lui prodiguer des soins en plusieurs interventions. Tout d'abord, il fallut extraire les sels solubles provenant de l'eau de mer. Si ceux-ci ne sont pas retirés, ils risquent lors de cycles de cristallisations, au séchage, de créer de fortes contraintes qui provoqueraient de nombreuses altérations des matériaux constitutifs de l'*emblema*. Après ce traitement de dessalement et le séchage complet de l'œuvre, il fallut vérifier son homogénéité et pallier d'éventuelles faiblesses par des consolidations ponctuelles.

Dessalement et séchage

L'*emblema* a été disposé dans des bains d'eau déminéralisée, renouvelés plusieurs fois. Avant chaque immersion, il est rincé à l'eau déminéralisée en prenant un soin tout particulier pour la surface du *vermiculatum*. A chaque changement, sont mesurés à température constante la salinité (SAL), les solides totaux dissous (TDS-mg/l) et la conductivité (µS/cm). Quand les mesures furent stables sur plusieurs bains, l'extraction des sels solubles a été considérée concluante et le traitement de dessalement s'est arrêté. L'assèchement progressif de l'*emblema* et sa stabilisation avec le microclimat extérieur se sont faits sous contrôle visuel régulier.

Nettoyage

Un nettoyage sous binoculaire a permis de retirer mécaniquement, au scalpel, les croûtes calcaires produites en surface du *vermiculatum* par les bryozoaires. Dans le mortier du bain de pose, les empreintes de tesselles disparues ont été dégagées, à l'aide d'aiguilles en bois, des résidus marins

(algues, micro-coquillages) et du sable agglomérés dans les alvéoles.

Consolidation de surface

Une consolidation des empreintes de tesselles dans le lit de pose a été réalisée par imprégnations au pinceau d'une émulsion acrylique (Primal AC33) à 3 % dans de l'eau déminéralisée. L'ensemble des joints en mortier de chaux a été également consolidé avec cette même émulsion acrylique. Les tesselles les plus altérées, en particulier la pâte siliceuse des tesselles en faïence, ont été consolidées et protégées par une solution acrylique (Paraloïd B72) à 3 % dans de l'éthanol, appliquée localement au pinceau. Enfin, le support en pierre a été imprégné par un consolidant inorganique de type silicate d'éthyle.

Documentation

Une documentation minutieuse a été réalisée sur l'état de conservation de l'*emblema*, les matériaux constitutifs et les interventions de conservation. Ces nombreuses informations ont été enregistrées sur des relevés graphiques (fig. 4) et photographiques.

Le 27 mai 2004, l'*emblema* est retourné au Cap d'Agde où il est présenté depuis au Musée de l'Éphèbe.

Notes

1 Conservé par le Musée du Louvre, sa restauration a été présentée sous forme de poster lors de la conférence d'Hammamet par Mmes Laurence Krougly et Magda Monraval Sapiña, que nous remercions ici.

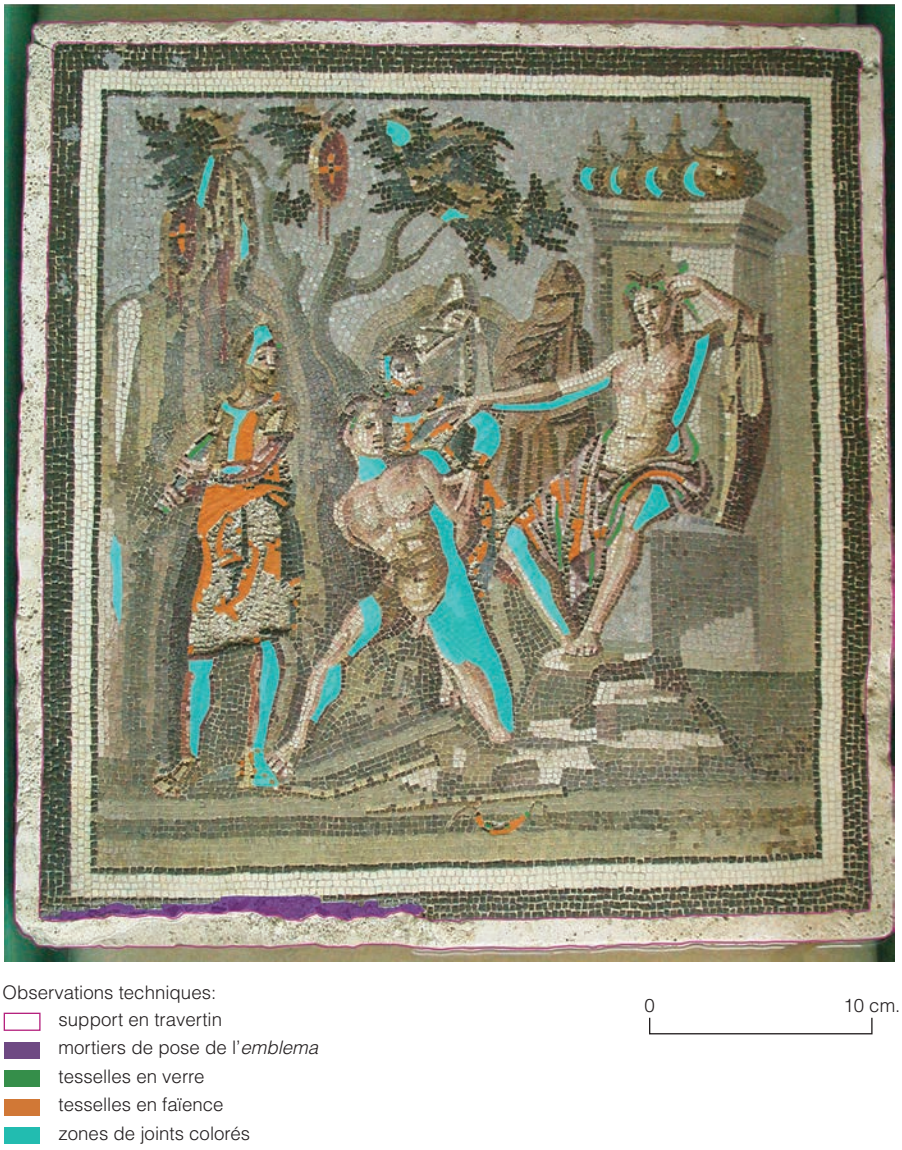


FIGURE 4 Relevé technique de l'*Emblema du supplice de Marsyas* – Musée de l'Ephèbe, Agde. M.-L. Courboulès © ACRM / MAPA.

La restauration de la mosaïque du VI^{e} siècle de Qabr Hiram (Liban) par l'Atelier de restauration de mosaïques de Saint-Romain-en-Gal

Évelyne Chantriaux, Marion Hayes, Christophe Laporte, Andréas Phoungas et Maurice Simon

Résumé : *L'un des derniers projets du Musée du Louvre est la création d'une salle où seront regroupées les œuvres de l'Antiquité tardive du bassin méditerranéen, jusqu'alors dispersées dans les différents départements du musée ou entreposées dans les réserves. La programmation a intégré l'aménagement, en sous-sol, d'un vaste espace permettant la présentation de la mosaïque de l'église Saint-Christophe de Qabr Hiram. À la suite des travaux de restauration qui se sont échelonnés sur une dizaine d'années, tout le pavement de l'église est prêt à être installé, près de cent cinquante ans après sa découverte.*

Abstract: *One of the Louvre Museum's latest projects is the creation of a room that will group together works from the Mediterranean basin dating to late antiquity that hitherto had been scattered in various museum departments or stored in the reserves. Planning included fitting out a large space in the basement in order to display the mosaic from the Church of Saint Christopher from Qabr Hiram. Following restoration work that took place over ten years, the complete church pavement is ready to be displayed in its entirety, almost five hundred years after its discovery.*

Présentation de l'opération

Cet ensemble de mosaïques, remarquable par ses dimensions, la qualité de son décor et son état de conservation couvrait, sur une surface de plus de 100 m^2, le sol de l'église Saint-Christophe de Qabr Hiram, à une quinzaine de kilomètres de Tyr. Découvert en 1861 par Ernest Renan lors de sa mission en Phénicie (Renan 1864–1874), le pavement a été entièrement déposé et transporté au Louvre en 1862. Après son remontage trente ans plus tard sur un support de ciment armé, il est resté en l'état, hormis le tapis de la nef centrale qui a été transféré sur un support de plâtre en 1979 (Bagatti 1963 ; Duval 1977 ; Baratte 1978 ; Donceel-Voûte 1990).

La totalité des tapis de mosaïque, découpés en quatre-vingts panneaux, n'a cependant jamais donné lieu à une présentation globale. Longtemps disposés en désordre dans une galerie du Louvre, puis partiellement assemblés pour l'exposition temporaire des « Arts de la Méditerranée » dans les années 1970, la majeure partie des panneaux a été ensuite mise en réserve et seuls quelques fragments sont restés présentés au public.

C'est à l'initiative de Catherine Metzger, conservatrice au Département des Antiquités grecques, étrusques et romaines au Musée du Louvre, que la reprise du traitement a été envisagée en 1988 à des fins de présentation globale. La restauration, confiée à l'atelier de Saint-Romain-en-Gal a été engagée en 1994. L'achèvement de l'opération en 2004 va permettre la future présentation du pavement dans une salle du Louvre en cours d'aménagement. Dans cet espace qui sera consacré aux civilisations du pourtour méditerranéen, les mosaïques seront visibles dans leur totalité, et dans la configuration qu'elles présentaient au sol de l'église de Qabr Hiram (fig. 1).

Le remontage sur un nouveau support

Après l'enlèvement des anciens supports de ciment et de plâtre (fig. 2, 3), les quatre-vingts éléments de la mosaïque – soit une surface de 100 m^2 – ont été remontés sur trente panneaux de nid d'abeilles. L'ensemble a été mis en place au sol de l'atelier (fig. 4) selon l'organisation générale du pavement donnée par le plan d'Ernest Renan. La recomposition du chœur a permis de restituer les bandes de fleurettes qui avaient été compactées sur ciment en un bloc. L'opération finale a consisté à réaliser le traitement des espaces correspondant aux bandes de *tessellatum* blanc qui raccordaient initialement les différents tapis de mosaïque.



FIGURE 1 Vue générale de la mosaïque à l'issue de la restauration telle qu'elle sera présentée au Musée du Louvre.
Cliché: Alain Basset.



FIGURE 2 Nef nord avant traitement. Cliché: atelier.

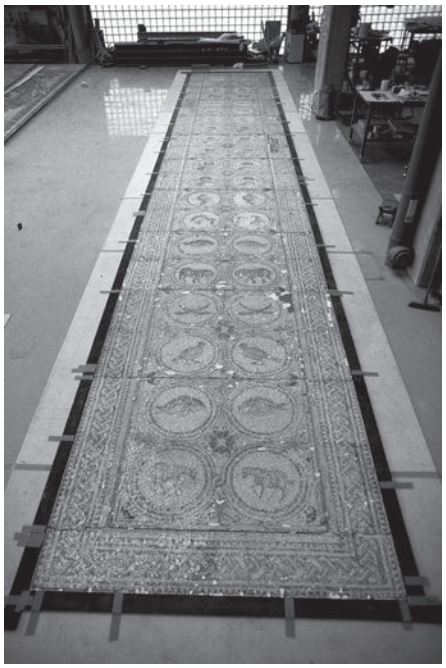


FIGURE 3 Recomposition de la nef nord à l'envers après enlèvement du support de ciment.
Cliché: Paul Veysseyre.



FIGURE 4 Mise en place de l'ensemble des panneaux et recomposition du chœur.
Cliché: Paul Veysseyre.

Ces bandes de liaison, représentant une surface de 20 m², ont été matérialisées par un enduit de teinte neutre par rapport à la tonalité générale du pavement. Ce revêtement a été appliqué sur des supports de nid d'abeilles comblant tous les vides entre les différents panneaux de mosaïque (fig. 5). Les bases de colonnes séparant les trois nefs sont indiquées par un enduit de teinte plus sombre, avec une légère surépaisseur pour les détacher du niveau du pavement ; des décaissés carrés marquent les emplacements des supports du chancel.

Le rétablissement de la continuité du *tessellatum*

Les cadres de fer correspondant à l'ancien découpage de la mosaïque occupaient la largeur d'une rangée de tesselles. Le comblement de ces vides et des zones périphériques dégradées a été effectué – sur une longueur de 100 m – avec des tesselles taillées dans des calcaires compatibles avec les pierres d'origine et avec celles des restaurations précédentes. Ces interventions successives sont restées localisées dans les filets de bordures (fig. 6) et dans les zones de liaison entre les cercles. La dépose a en effet privilégié la sauvegarde des parties figurées, mais la plupart des motifs géométriques – sans doute partiellement détruits – ont été refaits lors du premier remontage effectué à la fin du XIX[e] siècle, comme en témoignent la nature différente des tesselles dans ces zones et le fait que des parties brûlées s'arrêtent nettement aux contours de certains médaillons (fig. 7).



FIGURE 5 Vue partielle du pavement après traitement des surfaces de liaison. Cliché: atelier.



FIGURE 6 Repose de tesselles à la jonction des plaques après enlèvement des cadres de fer. Cliché: Paul Veysseyre.



FIGURE 7 Détail d'une zone brûlée et des restaurations anciennes autour du médaillon. Cliché: Paul Veysseyre.



FIGURE 8 Médaillon lacunaire et restaurations anciennes entre les enroulements du rinceau (nef centrale). Cliché: Paul Veysseyre.

Le traitement des lacunes

Bien que la trame ornementale des mosaïques des nefs (rinceaux du panneau central et motifs géométriques entre les médaillons des bas-côtés) ait largement été reconstituée, les restaurations précédentes ont épargné les représentations figurées qui étaient détruites ou endommagées à des degrés divers. Les sujets manquants ou fragmentaires sont ainsi restés dans l'état qu'ils présentaient à leur découverte : notre intervention s'est limitée à remplacer par des enduits de chaux les anciens comblements qui avaient été appliqués dans les lacunes (fig. 8).

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Study of the Mineralogical and Chemical Characteristics of Materials Used in the Construction of Roman Mosaics in Volubilis, Morocco, with a View toward Their Conservation

Abdelilah Dekayir, Marc Amouric, Juan Olives, and Abdelkader Chergui

Abstract: *The Roman city of Volubilis, located 30 kilometers northwest of the city of Meknes, contains many* opus tessellatum *mosaics, some of which have detached tesserae and cracks due to deterioration and aging. Before undertaking the conservation of these mosaics, a thorough knowledge of the structure of the various materials used to construct them had to be obtained. The mineralogical analysis by X-ray diffractometry of the coarse mortar and the bedding mortar taken from the Flavius Germanus mosaic indicates that it was made of quartz and calcite, with a variable quartz/calcite ratio. The white, brown, and pink tesserae show a petrographic facies ranging from micritic limestone to oolitic limestone. The chemical analysis of the limestone using inductively coupled plasma shows that the color of the tesserae depends on the iron content. On the other hand, the black and red tesserae were made respectively from marble and sandy limestone. The other colors, such as yellow, blue, green, and gray, were achieved using glass paste of different chemical compositions.*

Résumé : *La cité romaine de Volubilis, située à 30 km au nord de Meknès, renferme plusieurs mosaïques de type* opus tessellatum*, certaines exhibant des pertes de tesselles et des fissures. Leur conservation requiert une connaissance approfondie de la structure des matériaux constitutifs. L'analyse minéralogique par diffraction des rayons du mortier grossier et du lit de pose de la mosaïque de Flavius Germanus montre une composition de quartz et de calcite avec un rapport quartz/calcite variable. Les tesselles blanches, brunes et roses montrent un faciès pétrographique allant du calcaire micritique au calcaire oolithique. L'analyse chimique des calcaires par ICP révèle que la couleur dépend de la teneur en fer. Les tesselles noires et rouges ont été confectionnées respectivement avec du marbre et du grès rouge. Les autres couleurs, comme le jaune, le bleu, le vert et le gris, ont été fabriquées en pâtes de verre de différentes compositions chimiques.*

In the Mediterranean region Roman mosaics have been the subject of mineralogical and chemical investigations (Bergamini and Fiori 1999; Capedri et al. 2001; Galli et al. 2004; Domínguez-Bella et al., this volume; Boschetti et al., this volume). At the archaeological site of Volubilis, 30 kilometers from the city of Meknes, the mosaics are of the *opus tessellatum* type (i.e., made of tesserae of equal size) (Limane 1998; Panetier and Limane 2002) (fig. 1). The most famous ones portray Orpheus, Ephebus, Venus, Bacchus, and the Four Seasons. These mosaics suffer a great deal from the effects of weathering and aging. The conservation and restoration of the mosaics at Volubilis require a good knowledge of the nature and characteristics of the initial components (stones and mortars) used to build them. The results presented here summarize the previously published study of the petrological, mineralogical, and geochemical characteristics of these materials (Dekayir et al. 2004).

Materials and Methods

The Roman mosaics at Volubilis, like other mosaics in the Mediterranean region, consist of several layers: (a) statumen, a layer of large stones; (b) rudus, a mixture of lime mortar and stone rubble; (c) nucleus, a mixture of thin lime mortar and fine aggregate; (d) bedding layer, a thin coating of lime-rich mortar; and (e) *tessellatum,* the tesserae and the mortar filling the interstices between them. The analyzed mortars of the nucleus (FGMG) and bedding (FGLF) layers were taken from the Flavius Germanus (FG) mosaics; tesserae samples were collected from other mosaics. Mineralogical and chemical analyses were done under both binocular and scanning electron microscopy (SEM). Nucleus and bedding layer mortar samples were analyzed by X-ray diffraction (XRD). Chemical analyses of tesserae and mortars were obtained by inductively coupled plasma (ICP).

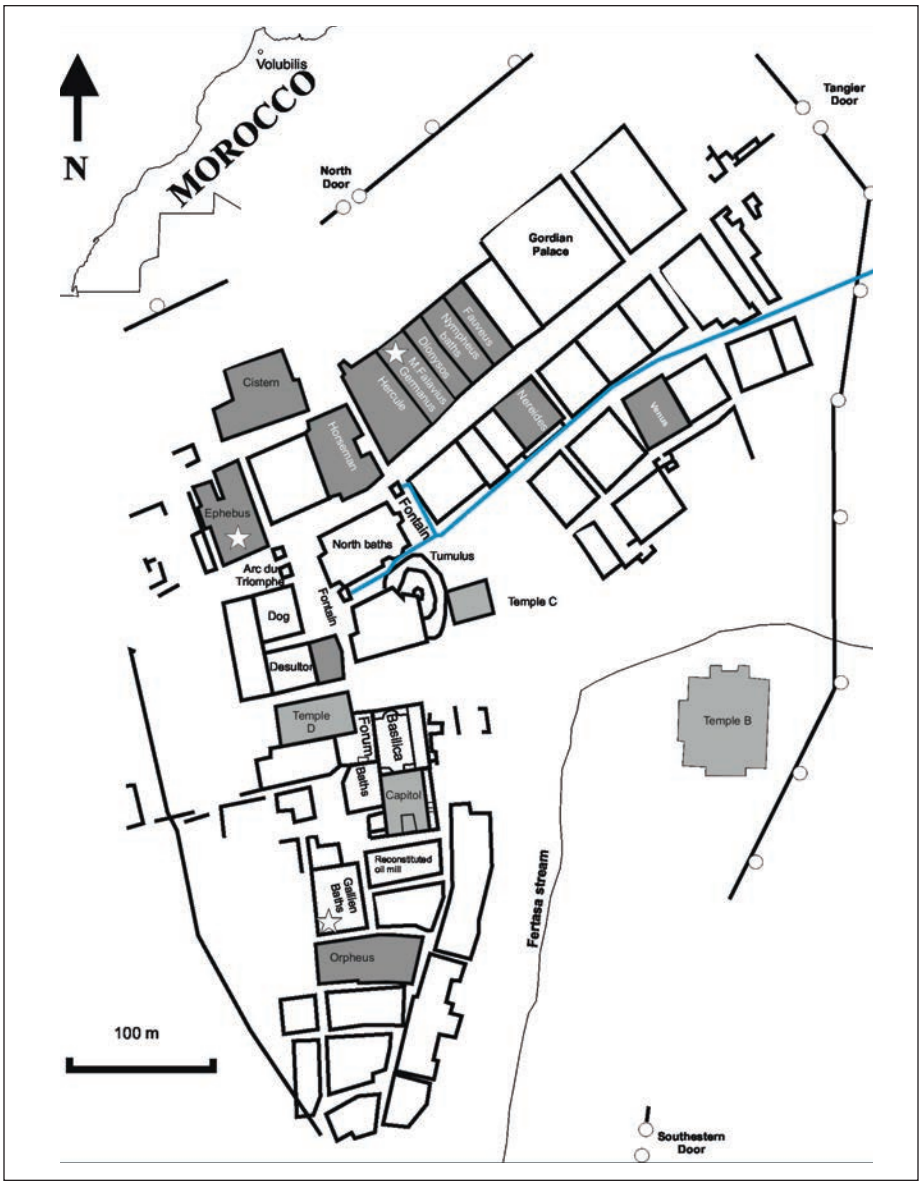


FIGURE 1 Map of Volubilis city, with location of samples.

Results

Mineralogical and Chemical Characterization of Tesserae

In situ observations of Volubilis mosaics reveal that tesserae are divided into two classes: stone, the size of which varies from 1 to 2 centimeters; and glass, of a few millimeters in size.

Stone tesserae. White tesserae (TSW) represent a large percentage of most of the Volubilis mosaics. They are made of limestone, characterized by radial ooliths linked by sparite, with some traces of foraminifera. The pink tesserae (TSP) show ooliths linked by microsparite. In the brown tesserae (TSB), the ooliths are not well individualized and are colored by iron of diagenetic origin. The red tesserae (TSR) are made of sandy limestone (quartz grains cemented by calcite) or fired clay materials. Black tesserae (TSBK) and white onyx tesserae (TSO) are made of marble. Detailed petrographic observations of these tesserae reveal that they consist of calcite with some feldspar minerals. In onyx tesserae, calcite is coarse grained with rare feldspar and muscovite (table 1). XRD spectra of TSW, TSP, TSBK, and TSO tesserae show dominance of calcite, while those of TSR and TSB show the presence of calcite and quartz. (See fig. 2.)

Glass tesserae. As other colors were needed, Roman artists at Volubilis used some yellow, dark blue, dark green, and gray glass tesserae. Observations of these tesserae with SEM show different chemical compositions,

Table 1 Color, facies, and chemical composition of various stone tesserae, nucleus, and bedding layer mortars from Flavius Germanus mosaic (all results from one analysis of each sample)

a)

Chemical Composition wt (%)	FGMG	FGLF	TSW (white)	TSP (pink)	TSB (brown)	TSR (red)	TSO (onyx)	TSBK (black)
Facies	Nucleus mortar	Bedding layer mortar	Oolithic limestone	Oolithic limestone	Oolithic limestone	Sandy limestone	Marble	Marble
Minerals	Calcite, quartz, feld., mica	Calcite, quartz	Calcite	Calcite	Calcite	Quartz, calcite	Calcite, feld., muscovite	Calcite, feld., muscovite
SiO_2	35.63	14.36	6.71	1.25	8.50	13.53	4.77	4.33
Al_2O_3	3.21	2.39	1.85	0.92	2.43	2.21	1.83	1.51
Fe_2O_3	1.19	0.85	0.59	0.29	2.46	4.93	0.52	0.48
MnO	0.03	0.02	0.01	0.01	0.07	0.08	0.02	0.01
CaO	30.29	44.38	51.78	57.23	47.10	43.73	46.71	51.76
MgO	0.56	0.35	1.43	0.41	0.80	0.71	4.45	1.17
Na_2O	0.20	0.15	0.07	0.06	0.12	0.23	0.61	0.09
K_2O	0.93	0.50	0.20	0.11	0.43	0.42	0.28	0.23
TiO_2	0.16	0.10	0.07	0.02	0.11	0.15	0.10	0.05
P_2O_5	0.41	0.55	0	0	0.64	0.20	0.40	0
LOI	26.75	36.98	38.10	39.70	38.15	34.63	40.32	41.93
Total	99.36	100.63	100.81	100	100.81	100.82	100.01	101.56

b)

	Glass Tesserae				
wt (%)	TSVF (dark green)	TSJ (yellow)	TSV (green)	TSB (blue)	TSG (gray)
Si	48.18	57.6	57.62	60.71	40.28
Pb	23.82	10.06	5.56	4.18	2.13
Al	3.47	4.57	3.62	1.53	2.62
Ca	8.91	11.44	11.42	15.29	6.79
Na	15.62	16.32	16.36	13.15	11.06
Cl	-	-	3.11	3.06	1.58
K	-	-	2.3	0.59	0.64
F	-	-	-	-	36.55

- = not detected

as seen in figure 3, dominated by Si with small amounts of Al, Pb, Na, and Ca.

Mineralogy of the Nucleus and Bedding Layer Mortars

XRD analysis of the nucleus mortar (FGNU) shows dominance of quartz, calcite, and some feldspar and probably mica and dolomite, while XRD spectra of the bedding layer mortar (FOBL) show the presence of calcite and quartz without feldspar or mica (fig. 4). This mineralogy is supported by the given chemical data of the two mortars (see table 1).

Discussion and Conclusion

Petrographic, mineralogical, and chemical data show that all the Roman mosaics at Volubilis were built with the same materials. White, pink, and brown tesserae are made of oolithic limestone, red tesserae

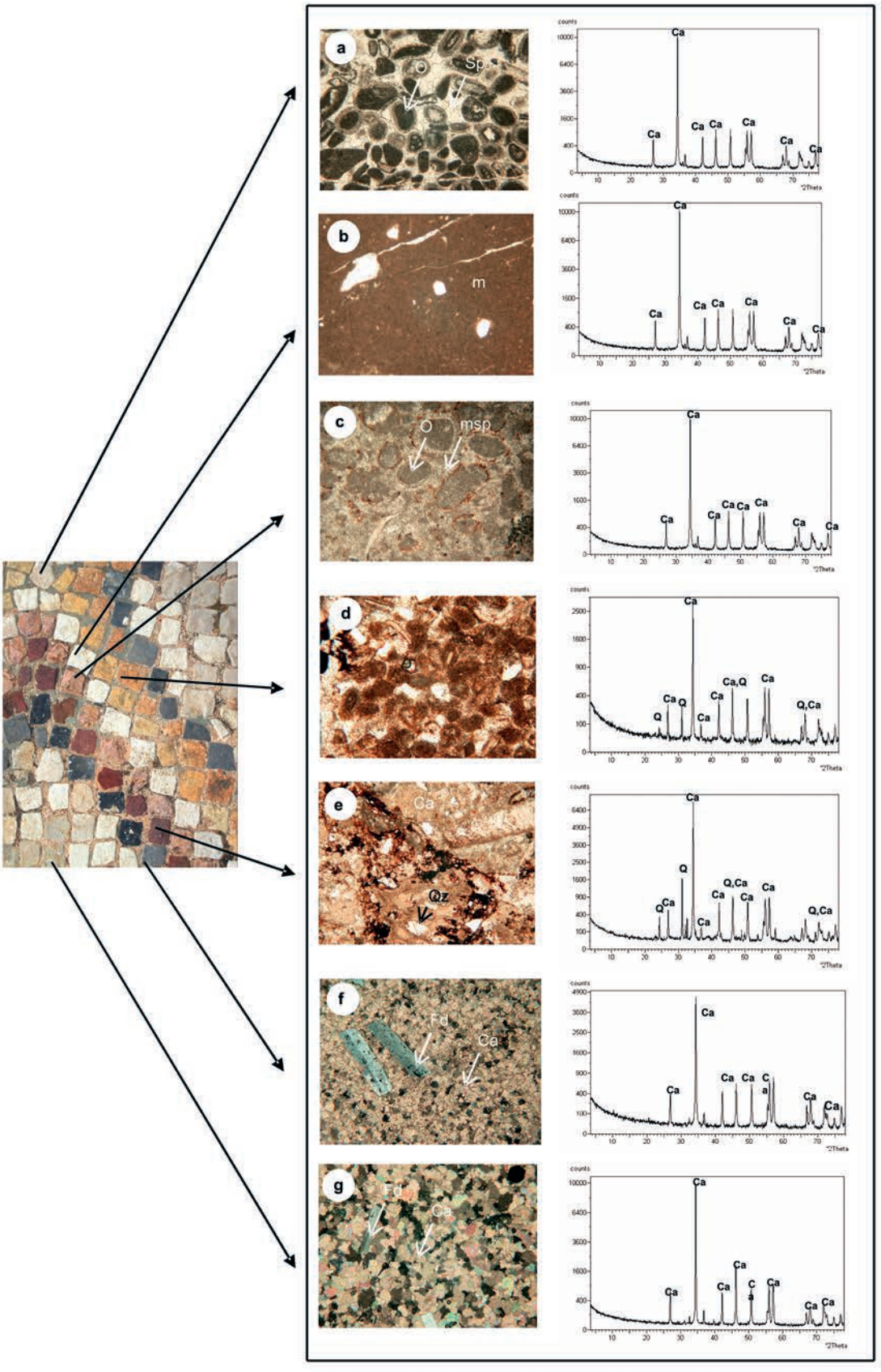


FIGURE 2A–G Petrography and XRD spectra of different stone tesserae: a) TSW (x4); b) TSW bis (x4); c) TSP (x10); d) TSB (x10); e) TSR (x4); f) TSBK (x4); g) TSO (O = oolith; Ca = calcite; Fd = feldspar; M = micrite; Qz = quartz; Sp = sparite; Msp = microsparite).

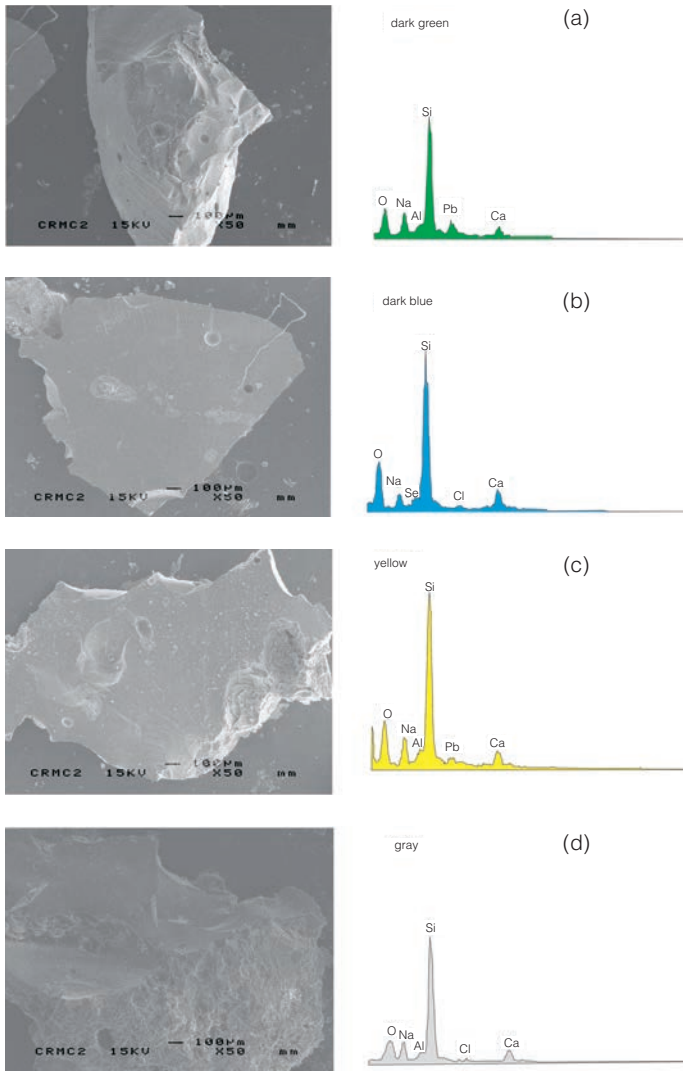


FIGURE 3A–D SEM and EDX analysis of (a) dark green glass tesserae; (b) dark blue glass tesserae; (c) yellow glass tesserae; (d) gray glass tesserae.

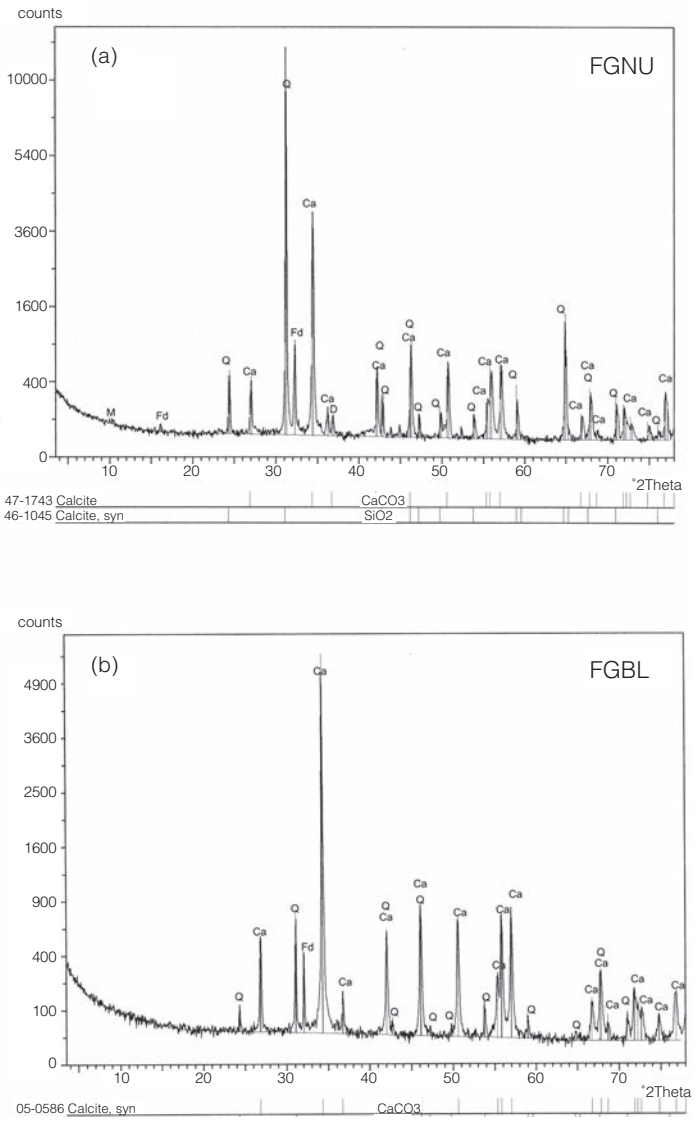


FIGURE 4A, B XRD patterns of (a) nucleus mortar (FGNU) and (b) bedding layer mortar (FGBL). (Q = quartz; Ca = calcite; D = dolomite; F = feldspar; M = Mica.)

of sandy limestone. The quarries of these stones are partly found near Volubilis, in Aalenian and Bajocian geologic formations (Faugères 1978). Since black and white onyx marbles are absent in this region, they were probably imported. In these mosaics, other tesserae (yellow, blue, green, and gray) made from glass and fired clay were used. The mineralogy of the bedding layer and the nucleus mortars is quite similar, with variable quartz/calcite ratios. The mortars that have been studied were made of lime, which sets according to the following process:

$CaCO_3 = CaO + CO_2$ (lime preparation);
$CaO + H_2O = Ca(OH)_2$ (portlandite)

$Ca(OH)_2 + CO_2 = CaCO_3 + H_2O$ (mortar setting and carbonation of the matrix)

Roman mosaics are precious masterpieces. This site has been considered with special care since it was listed as a World Heritage Site by UNESCO in 1997. The results acquired in this study are of great importance, first for improving our knowledge but also for the understanding of the weathering process of these mosaics.

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The Lifting Procedure of the Bacchus Mosaic from the Roman Villa in Barrio Jarana, Cádiz, Spain

Salvador Domínguez-Bella, María Luisa Millán Salgado, and Ana Durante Macias

Abstract: *In September 2004 a Roman villa was discovered during the construction of a new lane of the N-IV highway, near Barrio Jarana, Puerto Real, in the Cádiz province of Spain. Only one room with a mosaic pavement was discovered in the excavated area. This mosaic, measuring 4 by 3 meters, represents a central face, which probably depicts Bacchus. The provisional dating of the villa has been estimated as the second century C.E. This poster presents the lifting process and its transportation to the provincial museum where it will be restored.*

Résumé : *En septembre 2004, une villa romaine a été découverte pendant l'aménagement d'une nouvelle voie de l'autoroute N-IV près de Barrio Jarana, Puerto Real, dans la province de Cadix en Espagne. La fouille n'a révélé qu'une pièce comportant un pavement en mosaïques. Celle-ci mesure 4m x 3m et représente une figure centrale, probablement celle de Bacchus. La datation provisoire fait remonter la villa au IIe siècle après J.-C. Cette communication évoque le processus de dépose et son transfert vers le musée provincial où il subira une restauration.*

The ceramic production of amphorae in different areas of the Bay of Cádiz is widely documented and indicates activity from Phoenician times to the Roman era (fourth century C.E.). Cádiz province is situated on the Atlantic coast along the northern side of the Straits of Gibraltar. Gades, founded by the Phoenicians, is one of the oldest cities in western Europe and during the Roman Empire had great commercial and geopolitical importance. In addition to Gades, located in a group of islands in the center of a bay formed by the mouth of the Guadalete River, industrial centers such as Puente Melchor–Barrio Jarana, near the modern city of Puerto Real (fig. 1), had great importance for the Bay of Cádiz area. An important ceramic production center is located in this area, as evidenced by a large number of documented pottery workshops. The existence of local geological outcrops of raw materials necessary for the production of pottery (Gutiérrez Mas 1991: 315) and their proximity to the coastline with a good port for shipping, as well as a rich fishing industry, permitted the installation and development of ceramic production in this area during Roman times (beginning of the first century C.E. to end of the fourth century). Many archaeological sites and pottery workshops such as Torre Alta and Puente Melchor–Barrio Jarana have already been well studied (García Vargas 1998: 408; Millán and Lavado 2000).

From October to December 2004, M. L. Lavado directed a rescue excavation of the villa that had been discovered in September of that year. Up to the present, 2000 square meters have been excavated. This villa may have been part of the great Roman industrial complex in the area, specializing in the production of amphorae used to transport goods such as olive oil, wine, and fish derivatives. This archaeological site is also interesting for its size and luxurious decoration, including polychromatic wall paintings in almost all the rooms, as well as decorative stone pavements and dados.

The Bacchus Mosaic

Only one room with a mosaic pavement has been discovered in the villa. This mosaic presents a central face, probably a representation of Bacchus. It is surrounded by a black-and-white circular design with concentric bands of triangles (fig. 2a) and four small figures. Two are polychromatic representations of birds, and two are black-and-white figures of kraters. A rectangular sector with a line of four small faces appears below this square, which may correspond to representations of the four seasons (fig. 2b). The two scenes present the same iconographic theme. The villa has been provisionally dated to the second century C.E. (M. L. Lavado, pers. comm.). In this poster we present the procedure for lifting and transport-



FIGURE 1 The province of Cádiz in southwestern Spain; the Puente Melchor–Barrio Jarana Roman villa is shown in the inner part of the Bay of Cádiz. Map by Emil Askey, GCI © J. Paul Getty Trust.



FIGURE 2A The appearance of the Bacchus mosaic surface after in situ removal of mineral encrustations, prior to its transfer to the museum. Photo by Francisco Marin and María Luisa Millán.

FIGURE 2B Upper part of the Bacchus mosaic, with four faces, probably a representation of the four seasons. Photo by Francisco Marin and María Luisa Millán.

ing this mosaic to the provincial museum where it will be restored and where its archaeometric study by the University of Cádiz is now in progress.

Mosaic Description and Condition

The pavement of this small room was decorated with stone tesserae, generally black and white and in many designs, and with glass paste tesserae of various colors bedded in a mortar layer very rich in lime that rests on the *rudus*. The mosaic is in an inverted "T" shape and has a surface area of 28.10 square meters.

On its discovery the mosaic was very fractured. One of the main problems was ten large cuts on the mosaic surface that had been caused by a steel disk plow running over it, a result of agricultural activity in the area. Among the most serious types of damage that this pavement presents, we note the following:

- Cracks in the surface and in the support layers
- Detachment of mosaic bedding layers
- Loose tesserae
- Loss or lacunae in the mosaic in the tesserae layer, especially where the plow passed; in the upper left corner of the pavement; and in the mortar bedding layers, especially in the lower perimeter
- Loss of volume under the tesserae, caused by water dissolution and/or loss of the mortar bedding layer
- Structural movement of the mosaic bedding layers that produced serious deformations in the mosaic surface
- 20-centimeter-deep depression in the pavement (with respect to the rest of the surface) in the lower right corner

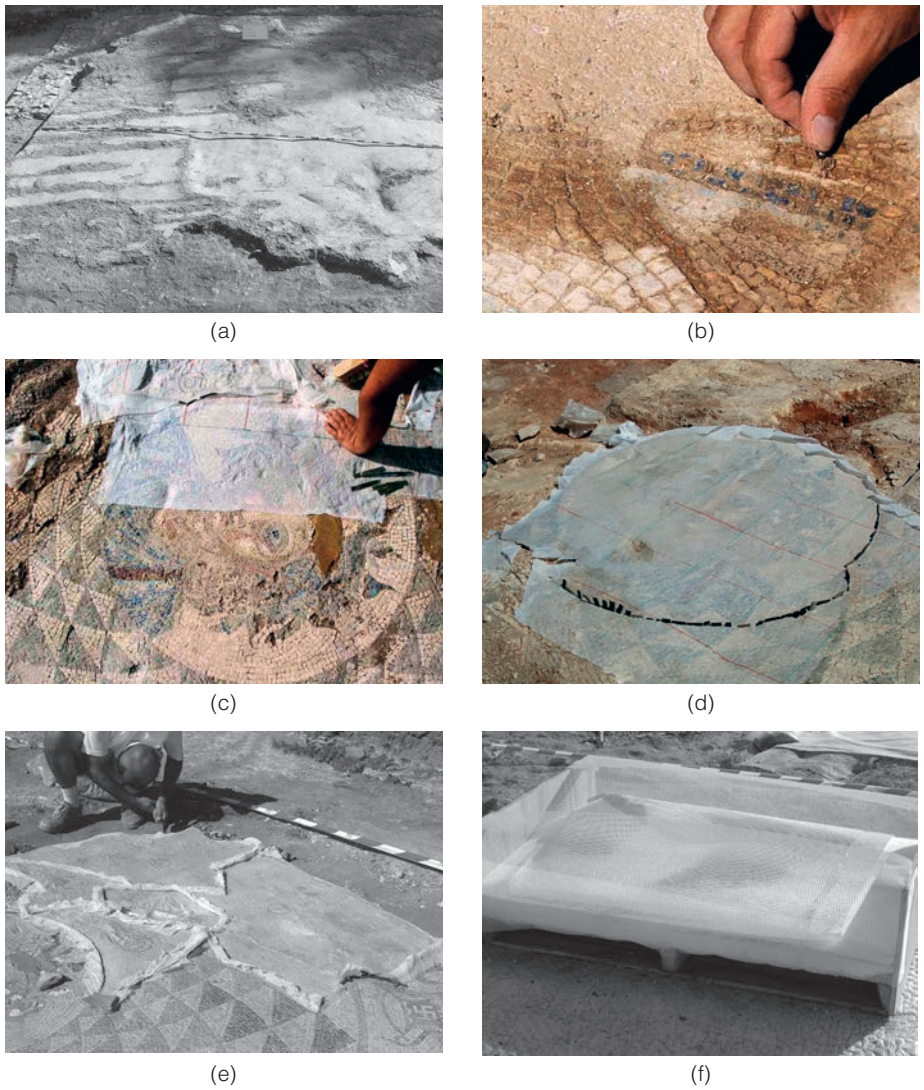


FIGURE 3A–F The steps of the lifting procedure of the Bacchus mosaic: (a) original condition of the mosaic surface with a layer of mineral encrustation; (b) removing the carbonate crust with a scalpel; (c) facing the mosaic with a cotton fabric and PVA adhesive and drawing a square grid for 2-D mapping of sections; (d) cutting the cotton fabric following the section lines and inserting metallic sheets between tesserae; (e) detachment process of the predefined sections under the *rudus*; and (f) final packing of the sections for transport to the museum. Photos by Francisco Marin and María Luisa Millán.

- Separation between the tesserae, produced by roots and seeds, and their subsequent movement
- Disintegrated tesserae, specifically, the black tesserae, which have been reduced to powder and small particles
- Eroded and exfoliating surfaces of the black tesserae
- Numerous fractured tesserae resulting from agricultural activity
- Formation of mineral encrustations on the mosaic surface, which has hidden the pavement design and produced a hard and compact crust on the tesserae surfaces (fig. 3a)

Lifting Procedure

The lifting and cleaning procedures and the condition of the mosaic have been documented photographically. Before the lifting a partial cleaning of the mineral encrustations was carried out by mechanical methods using a scalpel and spatula (fig. 3b), aided by previous wetting of the surface. This work was done very carefully because some tesserae were sensitive to the treatments. The edges of the pavement, which presented a major risk of detachment, were consolidated with a siliceous sand and hydraulic lime mortar in a 3:1 proportion.

Two fabrics were used to face the mosaic (fig. 3c), one made of 100 percent cotton with an open weave of 22 threads per square centimeter, and the other with a more open weave, which was boiled prior to being used. Before proceeding with the facing, some decorative details of the mosaic, made of glass tesserae, were protected with Paraloid® B72, diluted in acetone at 5 percent. The adhesive used for the gauze facing was polyvinyl acetate in emulsion, with polyvinyl alcohol diluted with water to improve the acetate reversibility. For preventive purposes, 2 grams per liter of a fungicide (hipagine) was added to the water.

After covering the mosaic with the fabric, a regular 20-centimeter-square grid was drawn with colored pencils to facilitate the cutting into sections (fig. 3c). All the mosaic sections have been noted in a scale drawing, each fragment numbered and located in the 2-D plan. The mosaic was divided into a total of seventy-six fragments, which completed the lifting preparations. Cutting lines for the lifting were executed following the presence of previous damage to the mosaic surface such as cracks and lacunae and also along the design lines in the pavement, or between different-colored tesserae (fig. 3d). To delimit these lines, many steel strips were introduced in the tesserae interstices. Chisels were introduced under the *rudus* to extract each fragment and to remove all the loose mortar remains from under the tesserae (fig. 3e). Each fragment was marked with the same number that appeared in the plan of the mosaic. Ten numbered wooden cases were constructed to transport the mosaic fragments to the museum. A layer of polystyrene was placed inside the case, and the mosaic fragments were placed upside down on this layer. On the last layer of fragments a plastic net was fixed to the wooden case (fig. 3f).

Conclusion

The lifting and cleaning of seventy-six numbered sections of the mosaic were carried out after the sections were recorded in a 2-D coordinate system. This is probably the biggest and most important Roman mosaic discovered in the Bay of Cádiz area in recent years that has been lifted using a modern methodology. An archaeometric study of the composition of the tesserae is under way for the first time in southern Spain.

Acknowledgments

The authors are grateful to the collaboration of M. L. Lavado, director of the excavation of the villa; L. Aguilera, a member of the archaeological team, and the restorers F. Marin Albadalejo and M. A. Bueno for their participation in the lifting process.

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Comparison of Conventional and Photogrammetric Documentation of Mosaics at the Agora of Perge

Işıl R. Işıklıkaya

Abstract: *A new project on in situ mosaics in Perge has provided an opportunity to study the most efficient method for documenting the largest number of panels within the restricted period of yearly excavation campaigns. In summer 2004 two different methods were used; this paper compares the results. Photogrammetric documentation proved very suitable for the documentation of in situ mosaics, providing such precise results that computer drawings of the panels could be based on them.*

Résumé : *Un nouveau projet sur les mosaïques* in situ *de Perge a permis de rechercher la méthode la plus efficace pour documenter le plus grand nombre possible de panneaux pendant la courte période d'une campagne annuelle de fouille. Au cours de l'été 2004, deux méthodes différentes ont été utilisées et cette communication en compare les résultats. La documentation photogrammetrique s'est avérée très appropriée à la documentation des mosaïques* in situ, *donnant lieu à des résultats si précis qu'ils ont pu servir de base pour les dessins des panneaux réalisés sur ordinateur.*

Situated on the southern coast of modern Turkey, Perge is one of the most prominent ancient cities in Pamphylia. Excavations at the site began in 1946 and are currently being carried out by Haluk Abbasoğlu of Istanbul University. During excavations conducted in the 1970s and 1980s, mosaic pavements were unearthed in three main areas of the lower city (Mansel 1975; Abbasoğlu 2001), the Agora, the north-south Colonnaded Street, and the Southern Baths (fig. 1). These were photographed and conserved according to the methods of the time. In 2004 a new project was initiated to document the mosaics preserved in situ, to make necessary restorations, and to recover them using modern methods.

Objective and Method

The main aim of the 2004 campaign was to find out the most suitable and effective method for a systematic documentation of the mosaics. Various techniques of drawing and photographing (both conventional and modern) were applied. These experimental techniques were carried out mainly at the Agora, where mosaic pavements were known to exist at the porticos as well as at the northern and western entrances (fig. 2). The different methodologies and their results are summarized below using drawings and photographs of panel E2 at the northeast corner of the Agora as a case study (fig. 3).

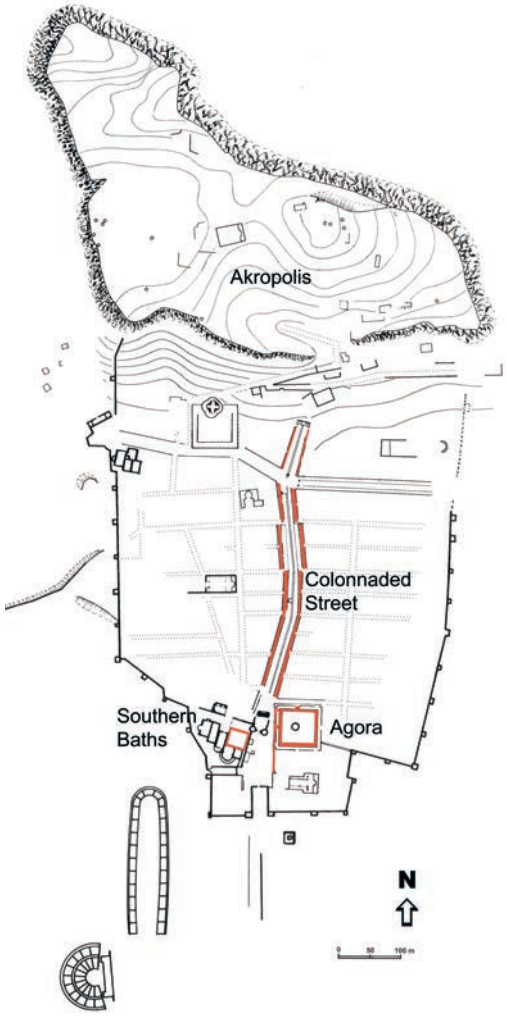


FIGURE 1 Overall plan of Perge. Areas in the lower city where mosaic pavements are known to exist are marked in red. Drawing by A. Şakar, from Perge Archives, İstanbul University. Courtesy of Haluk Abbasoğlu.

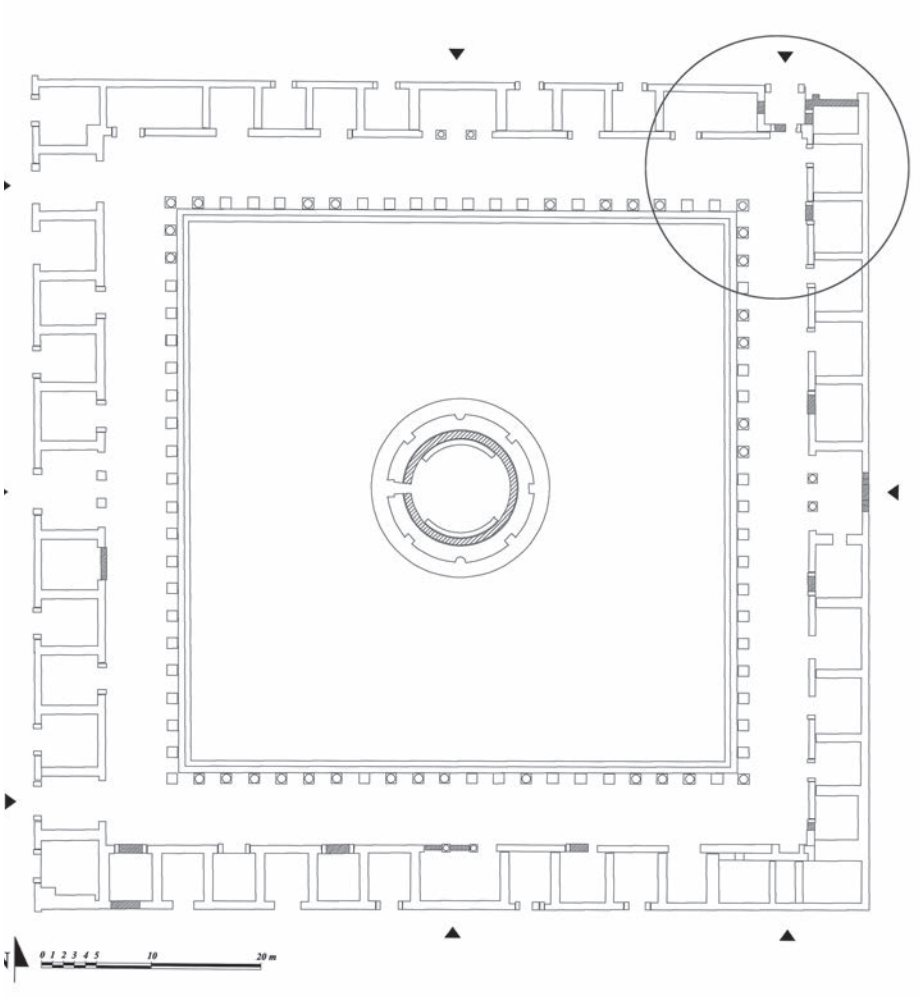


FIGURE 2 Plan of the Agora of Perge. Panel E2 is situated in the northeast corner of the porticos. Drawing by Ü. İzmirligil, Perge Archives, İstanbul University. Courtesy of Haluk Abbasoğlu.



FIGURE 3 General view of panel E2 after restoration in 1980 (view from the south). From Perge Archives, İstanbul University. Courtesy of Haluk Abbasoğlu.

Method 1: Conventional Documentation

In the first half of the campaign mosaic panels were drawn manually. First, 1:20 scale ink drawings of the general patterns were made (fig. 4), and then the individual motifs on the panels were drawn in 1:1 scale showing each tessera in color. After being scanned and reduced to 1:20 scale, these tessera drawings were placed on the ink drawings (fig. 5). Although this type of drawing shows the size and color of the tesserae, as well as how they are arranged to form geometric patterns, it had three main disadvantages:

- The time and labor invested in 1:1 tessera drawings make it inefficient to use on a larger number of panels.
- Due to the limited number of colors available in the palette of water-resistant, nonporous surface markers, the true colors of the tesserae cannot be documented.
- The transparent sheet laid on the tesserae to make 1:1 drawings expands in the sun, causing a divergence of 2 percent to 3 percent in the diminished format.

Method 2: Photogrammetric Documentation

In the second half of the campaign the same mosaic panels were documented using photogrammetric methods. Depending on the level and angle from which the photographs were to be taken, measurement points were laid at intervals of approximately 2 meters. The spatial coordinates (X, Y, and Z) of these points were measured by a total station. The mosaic panel was digitally photographed in a series of shots, each bordered by four of the measurement points. These shots were rectified according to the coordinates pre-

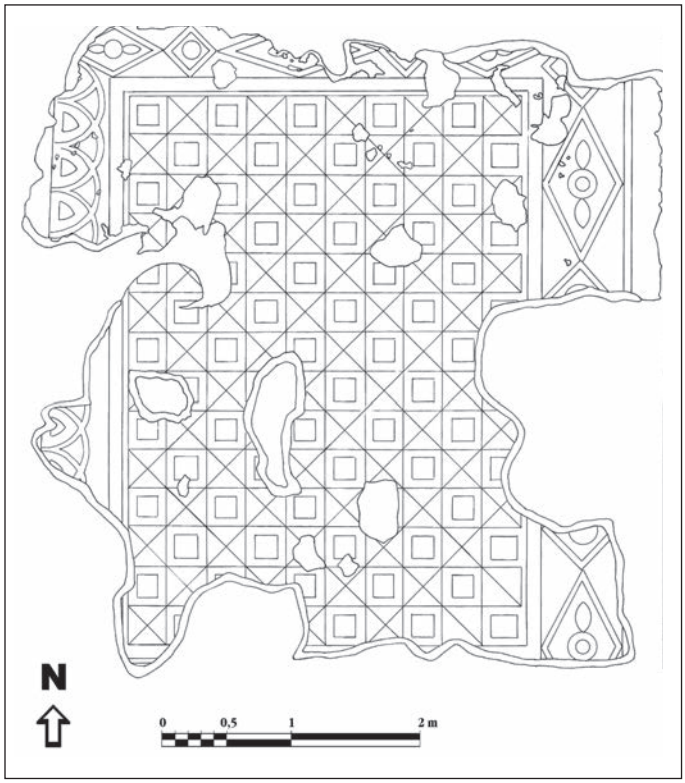


FIGURE 4 Ink drawing of panel E2. From Perge Archives, İstanbul University. Courtesy of Haluk Abbasoğlu.

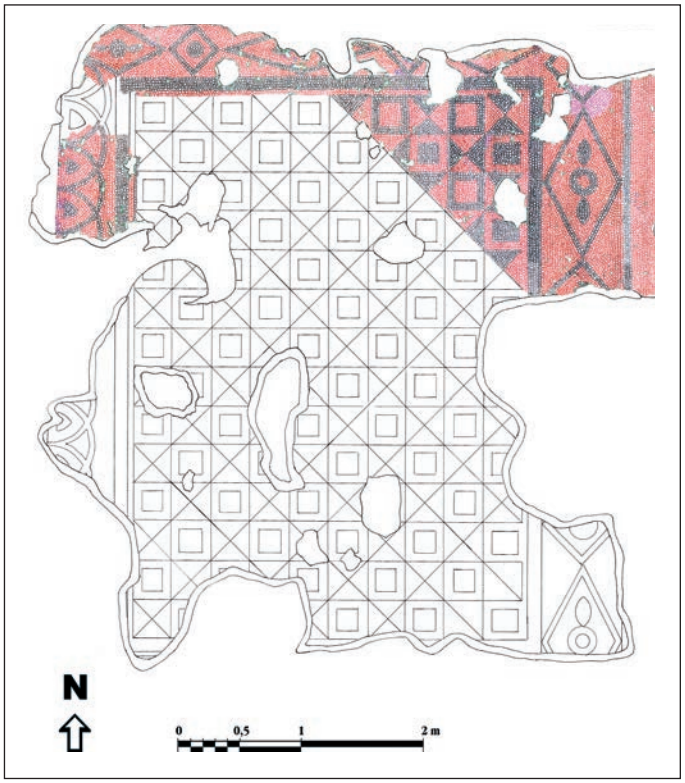


FIGURE 5 Tessera drawing of panel E2 laid on the ink drawing of the panel. From Perge Archives, İstanbul University. Courtesy of Haluk Abbasoğlu.



FIGURE 6 Rectified photogrammetric view of panel E2.



FIGURE 7 CAD drawing of panel E2 based on the rectified photogrammetric view.

viously calculated and combined to provide a 90° bird's-eye view of the whole panel (fig. 6). Following the documentation on-site, the patterns on the mosaic were drawn based on the photogrammetric images using AutoCAD software.

A disadvantage of photogrammetric documentation is that the result is aesthetically not very pleasing, for it is a combination of several photographs taken from different angles, with different shades of color.

The advantages of photogrammetric documentation are as follows:

- It provides 90° bird's-eye documentation of the whole panel. The image is technically exact and can be used to make computer drawings of the mosaics (fig. 7).
- The method is useful for documenting mosaic panels in cases in which it is not possible to shoot large areas in one photograph (e.g., by climbing up high or using a crane).

Conclusion

The documentation of mosaics using photogrammetric methods proved much more efficient than the conventional methods based on hand measurements. This up-to-date method provides scientifically reliable photographs of the panels and therefore also enables the excavator to prepare a precise computer drawing of the panel after the excavation.

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Un *emblema* provenant d'Utique conservé au Musée du Louvre

Laurence Krougly et J. M. Monraval

Résumé : *Cette communication évoque le thème des réintégrations partant des caractéristiques techniques de l'*emblema *sélectionné par le Musée du Louvre, pour une exposition aux États-Unis en 2007. La mosaïque a fait l'objet d'un minutieux nettoyage de surface et d'un traitement de consolidation du support d'origine. Lors de notre intervention, le caisson antique demeurait peu visible sous les mortiers appliqués lors de la découverte de l'*emblema *en 1881. La scène mythologique lacunaire, très encrassée, se lisait difficilement. Une fissure importante traversait le tiers supérieur droit de la scène, ainsi que le caisson sur toute son épaisseur. Ces divers « paramètres » ont déterminé les options prises pour le traitement et pour la présentation de cette pièce dans son contexte muséographique particulier.*

Abstract: *This presentation concerns the topic of reintegration, referring to the technical characteristics of the* emblema *selected by the Louvre Museum for an exhibition in the United States in 2007. The mosaic surface was meticulously cleaned, and its original backing received consolidation treatment. When work began, the ancient support was hardly visible under the mortar applied at the time the* emblema *was discovered in 1881. The mythological scene presented lacunae and was very grimy, making it difficult to read. A large crack crossed the upper right of the picture as well as the entire thickness of the backing. These various "parameters" determined the options for treatment and display of this work in its museographical context.*

Nous apporterons quelques informations sur les caractéristiques techniques de l'*emblema*, jusqu'à présent conservé dans les réserves du Musée, et nous aborderons le thème des réintégrations, qui semble d'actualité.

Cet *emblema*, sélectionné par le Département des Antiquités grecques, étrusques et romaines du Musée du Louvre[1] pour une exposition aux États-Unis en 2007, a fait l'objet d'un minutieux nettoyage de surface et d'un traitement de consolidation du support d'origine.

Lors de notre intervention, au cours de l'été 2005, le caisson antique conservé demeurait peu visible sous les mortiers appliqués au moment de la découverte de l'*emblema* en mars 1881. La scène mythologique lacunaire, très encrassée, se lisait difficilement (fig. 1). Une fissure importante traversait le tiers supérieur droit de la scène, ainsi que le caisson sur toute son épaisseur.

Ces divers paramètres ont déterminé les options prises pour le traitement et pour la présentation de cette pièce dans son contexte muséographique particulier.

L'*emblema*[2]

Cet *emblema* provenant d'Utique est entré au Musée Africain du Louvre en 1882 (Baratte 1971, 1978) où, selon la fiche informatique actuelle, il a été donné au musée en 1885, par la Société des fouilles d'Utique[3].

Datation : Fin du III[e] - début du IV[e] siècle. (datation du CMT mise en doute par Fr. Baratte.)

Décor : Scène mythologique érotique à cinq personnages, lacunaire, encadrée par deux rangées de tesselles noires. A gauche, un jeune homme ailé étreint une jeune femme nue, vue de dos ; à droite, deux femmes, elles-mêmes à demi dénudées, tentent de cacher le couple avec un pan de tissu ; au-dessus d'elles, un amour ailé tient une branche de rose ; la scène se déroule au bord d'une nappe d'eau figurée au premier plan. Interprétée comme une représentation d'Éros et Psyché par P. Gauckler.

Technique : Cet *emblema* de mosaïque figurée, repose dans un caisson de terre cuite. Il s'agit d'un *opus « quasi vermiculatum »* réalisé en tesselles de marbre et de calcaire polychromes sur fond clair. Les tesselles mesurent plus ou moins 3 mm de côté et la densité est de 400 cubes/dm^2.

Dimensions :

Face : - Caisson : 44,5 cm x 45,5 cm (nous supposons que le support de ciment réalisé

le 10 mars 1881 correspond à des dimensions relevées lors de la découverte.

- *Opus quasi vermiculatum* : 41,5 cm × 41 cm.
- Épaisseur du caisson : 35 mm/40 mm. Fond irrégulier légèrement convexe. Un phénomène de rétraction à la cuisson est peut-être à l'origine de cette déformation.

Revers : Le caisson est d'une forme légèrement pyramidale (fig. 2), la base étant plus grande : 45 cm x 45,8 cm. Cette dernière dimension est aléatoire car l'un des bords est restitué.

Stratigraphie cachée de l'*emblema*

Après avoir éliminé le ciment qui colmatait la cassure du bord gauche de l'*emblema*, les épaisseurs des différentes strates du support d'origine ont été relevées :

Profondeur du caisson de céramique sous le *tessellatum* : 5 mm/8 mm.

La surface du support de terre cuite en contact avec le mortier de pose semble travaillée pour offrir un aspect rugueux facilitant l'accrochage du mortier. Il n'a toutefois pas été possible de déterminer si ce traitement a été appliqué avant ou après cuisson.

- Une couche d'environ 5 mm d'épaisseur de mortier de chaux blanc chargé de fragments de terre cuite de 1 mm/4 mm.
- Un lit de pose blanc d'environ 1 mm/2 mm d'épaisseur.

De la *profondeur* de la lacune

Les consolidations et le nettoyage achevés, différentes possibilités de présentation de l'*emblema* ont été envisagées, en considérant l'état de conservation de la partie gauche et la possibilité de présenter cette pièce *recto verso*.

Étant donnée la difficulté de lecture de la scène et la présence de l'importante fissure située à droite, il nous a semblé préférable de restituer le volume manquant, afin de recréer une certaine unité, recentrant la scène et permettant la conception d'un support moderne assurant la bonne conservation de la pièce et la présentation de son revers.

Des orifices, provoqués par des bulles d'air lors de la cuisson du caisson de céramique, ont été mis à profit pour ancrer une structure de tiges de fibres de verre et résine époxy, conçue pour recevoir les différentes couches de mortiers de réintégration de la grande lacune (fig. 3).

Côté face, la fissure a été comblée avec un enduit fin de chaux en pâte et poudre de



FIGURE 1 *Emblema* avant traitement. Photo Krougly/Monraval.

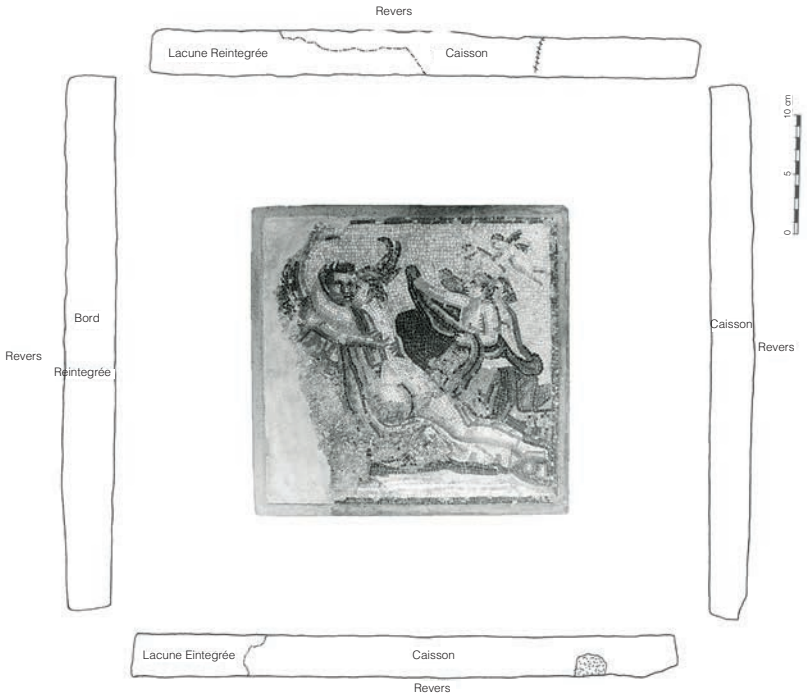


FIGURE 2 Relevé des tranches du caisson de terre cuite. Monraval.



FIGURE 3 *Emblema* traité. Photo Krougly/Monraval.

marbre, sur lequel a été peint un léger glacis à l'aquarelle.

Le type de réintégration dépend-il de l'objet, de son lieu d'exposition, de son public ? Peut-il exister un risque de mimétisme, un risque d'abandon du critère de distanciation comme valeur éducative ?

Les règles déontologiques que nous suivons depuis quelques décennies doivent-elles s'adapter à une nouvelle demande, liée à un public différent et « massifié » ?

Tant de questions ne sont-elles pas synonymes de la nécessité d'aborder chaque cas en fonction de sa spécificité et d'une décision pluridisciplinaire respectueuse de l'*objet* présenté dans son contexte actuel ?

Dans notre cas, la forme retrouvée participe au processus de consolidation et joue un rôle préventif.

Notes

1 Nous tenons à remercier Mme C. Giroire, conservateur aux AGER du Musée du Louvre, d'avoir accepté que nous présentions ce poster.

2 Nous tenons à remercier Mme V. Blanc-Bijon (CNRS, Centre Camille Jullian, UMR 6573, Aix-en-Provence), pour ses suggestions et informations

3 N° catalogue : MA 1800. N° inventaire : Utique 754 (Hérisson 1881: 160, 165). CMT265 (M. Alexander et M. Ennaïfer, 1976: 15–16, 73).

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The Project for the Conservation, Maintenance, and Utilization of the Pavement of the Cathedral in Spoleto, Italy

Ilaria Pennati, Carlo Lalli, Annamaria Giusti, Giancarlo Raddi delle Ruote, Giordana Benazzi, and Michele Macchiarola

Abstract: *A multidisciplinary study was conducted to formulate an appropriate plan for the conservation, maintenance, and utilization of the pavement of the cathedral in Spoleto, which had undergone numerous rebuilding and restoration interventions beginning in the medieval period and ending in 1951. This study concerned principally the last sector in the center of the nave, where cosmatesque sections are located. In situ observations and various analytical techniques were employed for characterizing the pavement materials and identifying the products and mechanisms of deterioration. The thermo-hydrometric parameters in the cathedral were also investigated. In addition, several in situ and laboratory tests were carried out so that the best conservation materials and treatment methodology would be chosen. On the basis of the analytical study and liturgical requirements a conservation and utilization project was developed. Finally, an appropriate program of scheduled maintenance was proposed.*

Résumé : *Une étude multidisciplinaire a été réalisée pour dresser un plan de conservation, maintenance et utilisation du pavement de la Cathédrale de Spolète, qui a subi plusieurs reconstructions et restaurations dans le passé. L'étude concerna la section centrale de la nef comportant des sections de cosmatesque. Des observations* in situ *et des techniques analytiques ont servi à caractériser les matériaux constitutifs du pavement et à identifier les mécanismes de détérioration. Une étude des paramètres thermo-hydrométriques dans l'église a été faite ainsi que diverses analyses* in situ *et en laboratoire pour aider au choix des meilleurs produits de restauration.*

The beautiful pavement of the Spoleto Cathedral was constructed using the following techniques: *opus sectile, opus tessellatum, opus alexandrinum, niello,* and *cosmatesque.* A large number of different materials used in the pavement can be identified, including forty-three lithotypes (11 local stones and 32 stones from other locations), glass tesserae of many different colors, and various types of plasters and bedding mortars. The present appearance of the pavement is the result of various rebuilding and restoration interventions in the past. In fact, the coexistence of several floor sections, different in period and style, can be identified, such as those from the medieval (Guidobaldi and Angelelli 2002) and Renaissance periods, the seventeenth century, and the restoration work of the Opificio delle Pietre Dure in 1951.

Study of the Pavement

In situ observations and an archaeometric study using a number of analytic methodologies were performed in order to characterize the pavement materials, to identify the products and the mechanisms of deterioration, and to determine the different construction techniques. All these data enabled us to carry out an appropriate program of conservation and to answer some questions about the floor's history. Materials and the conservation operations were chosen on the basis of in situ and laboratory tests. In situ and laboratory analysis, obtained by means of nondestructive or microdestructive techniques, was also an indispensable base for developing the correct maintenance plan.

The multidisciplinary study was concerned principally with the last sector of the pavement in the center of the nave, where *cosmatesque* sections, consisting of marble slabs with glass or hard stone ornaments, are located (fig. 1). The study revealed that the sections were set in their current position during the second half of the sixteenth century. These marble slabs originally covered the external walls of the *schola maior,* which was built in the second half of

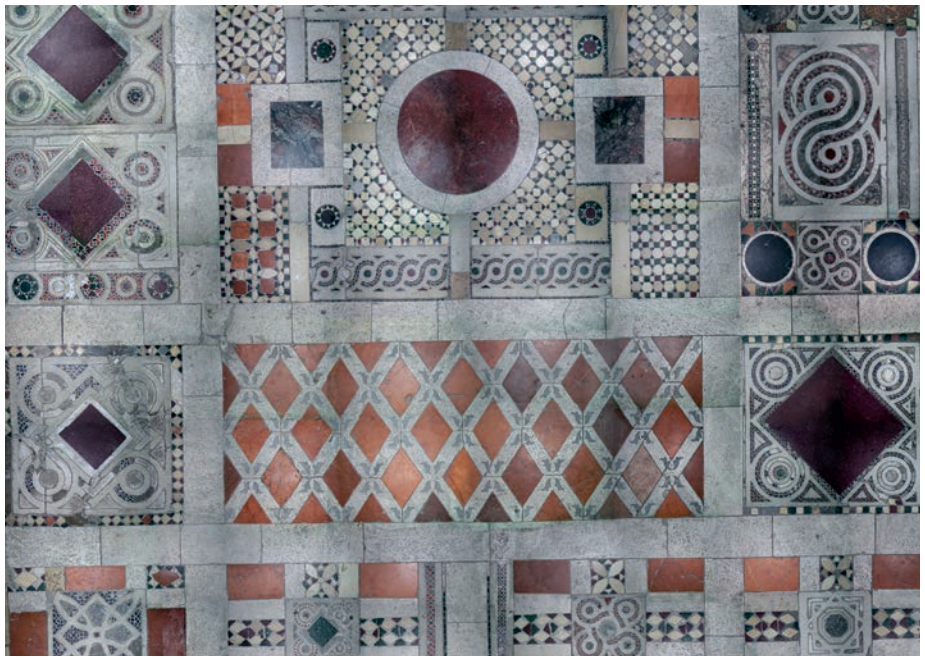


FIGURE 1 Detail of the floor located in front of the transept, where the cosmatesque-style sections are installed.

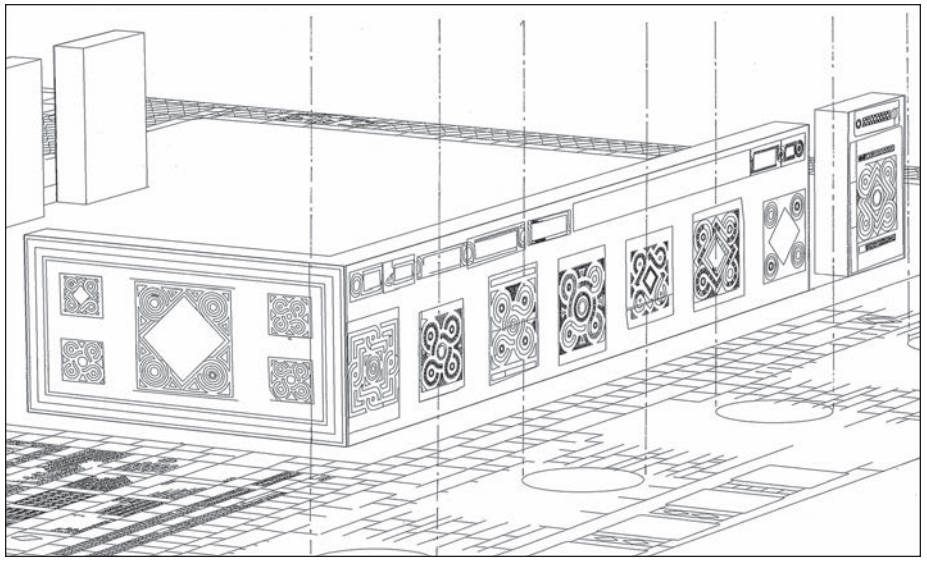


FIGURE 2 Hypothetical reconstruction of the *schola cantorum*.

the twelfth century, but were removed and subdivided in 1535. A digital 3-D reconstruction of the ancient *schola* was obtained from the data collected during the recording by 1:1 scale tracing and from comparisons with a few similar examples (fig. 2).[1] The analysis of the glass tesserae confirmed their suspected historical dating and the homogeneity of the cosmatesque sections and revealed their poor condition, especially the gold leaf tesserae.[2] In fact, some of these tesserae had completely lost both the protective *cartellina* and the gold leaf (fig. 3).[3]

The study showed that the floor was in poor condition. One can observe deposits of salts (fig. 4), the fracturing of glass tesserae, the disintegration of mortars, the detachment of tesserae from the bedding mortar, and large lacunae. Several of the deterioration processes identified are the result of the use in the past of restoration materials (e.g., cement, gypsum) incompatible with the original materials. The relative humidity measured in the cathedral is very high and extremely variable. The frequent cycles of condensation/evaporation are a serious threat to the conservation of glass. In addition, the high levels of humidity prevent the polymerization of some consolidation and protection products.

Conservation of the Pavement

Several cleaning tests were performed (Lazzarini and Tabasso 1986: 135–37; Bandini 1988). The best result was shown by poultices of ammonium bicarbonate (Matteini and Moles 1989: 131) at different lengths of time and in different percentages (fig. 5).

Two typologies of reintegration of lacunae on movable supports have been proposed: one using tesserae made of resin, the other using glass tesserae contained by a frame composed of small glass fragments (figs. 6–8).

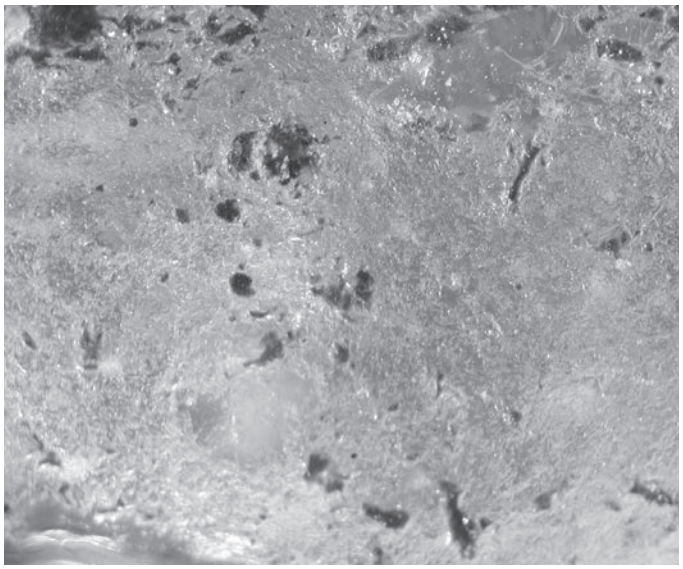


FIGURE 3 OM microphotograph. Detail of what is probably the glass base support of a gold leaf tessera. The glass tessera base has completely lost both the *cartellina* and the gold leaf. Corrosion phenomena and blackish deposits are visible on the surface.

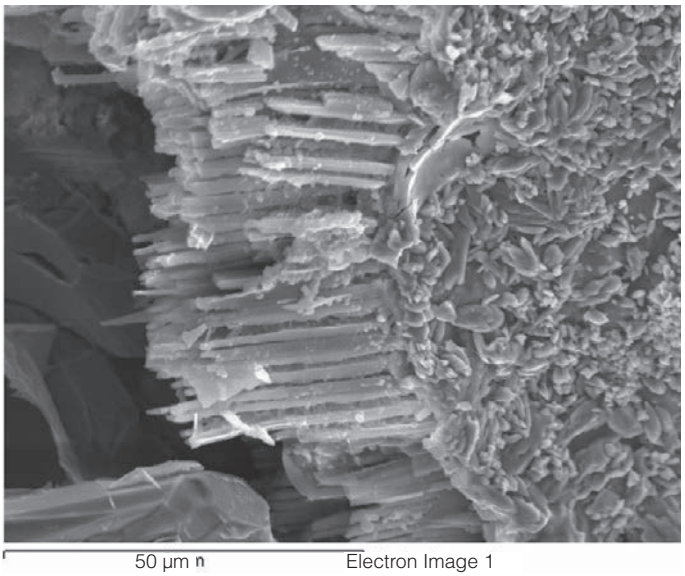


FIGURE 4 SEM microphotograph. Gypsum crystal deposit on the surface of a red glass tessera.

One particular intervention has been developed for the conservation of the plasters that decorate the rectangular slabs in *niello* style. The analytical study has distinguished different types of original plasters: those that are red in color are pigmented with cinnabar, the black ones with coal. A number of plasters present several lacunae, and in these cases the intervention is limited to maintaining the material as found, without imitating the ancient technique.[3]

A program of cleaning, consolidation, use of mortar for the filling of lacunae, and protection was planned. Periodic maintenance interventions and the prohibition of people walking on some parts of the floor were also decided on.



FIGURE 5 Result of cleaning test with a poultice of a 7 percent ammonium bicarbonate solution applied for fifteen minutes.

Conclusion

The utilization and maintenance program for the pavement in the Spoleto cathedral considers both the liturgical and the conservation requirements. Fixed itineraries



FIGURE 6 Lacunae in a cosmatesque-style section.



FIGURE 7 Removable reintegration of lacunae placed in situ.



FIGURE 8 Different typologies of reintegration on removable supports: resin tesserae or glass tesserae contained by a frame of small glass fragments.

for both tourists and worshipers will be requested. Project information will be collected in databases, and didactic panels on different technological, historical, and conservation aspects of the cathedral pavement also will be prepared.

Notes

1 For example, a typical medieval *schola* can be observed in Giotto's fresco in the cathedral of Assisi showing the Creche of Greggio.

2 In ancient mosaics the glass bases of the gold leaf tesserae are generally transparent and colorless or transparent and amber in color. But sometimes they can be green or red, and more or less transparent; in this way the gold leaf tesserae have different color qualities. This study detected three kinds of glass bases of gold leaf tesserae in the pavement of the cathedral in Spoleto: (1) transparent and colorless, (2) green and transparent, and (3) pale green and trasparent with red opaque laminas.

3 We preferred to fill lacunae with a reversible material in order to restore visual unity to the reading of the work of art, without creating a historical forgery. For this reason we decided to fill the numerous gaps with a fluorinated resin (Akeogard CO, a reversible product soluble in acetone and delifrene) mixed with coal in the case of the black plasters or with cinnabar for the red ones.

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Problématique posée par les réintégrations des lacunes dans la mosaïque des Monstres Marins de Lambèse-Tazoult, Algérie

Aurélie Martin

Résumé : *A l'occasion de la restauration par l'Atelier du Musée de l'Arles et de la Provence antiques de l'exceptionnelle mosaïque dite des Monstres marins provenant de Lambèse et conservée dans le musée du site, s'est posé le problème du traitement des lacunes. Découverte en 1905 dans un état extrêmement fragmentaire (plus d'une centaine de fragments effondrés dans un hypocauste), cette véritable « peinture de pierres » de très grandes dimensions – 4,39 x 1,24 m – nécessitait une réflexion spécifique quant au rendu final de la restauration menée en coopération avec les restaurateurs algériens, dans le cadre de « Djazaïr, l'Année de l'Algérie en France ». Devant l'exceptionnelle finesse de la mosaïque réalisée en* opus vermiculatum *(tesselles de 2 à 3 mm de côté ; densité max. : 670 tesselles/dm²), une technique pointilliste à l'aquarelle a été mise en œuvre pour réduire l'effet de fragmentation de l'ensemble de la scène.*

Abstract: *The problem of the treatment of lacunae arose when the workshop of the Musée de l'Arles et de la Provence antiques undertook the restoration of the exceptional mosaic from Lambèse known as the "marine monsters mosaic," which is conserved in the site museum. Discovered in 1905 in a very fragmentary state (more than a hundred fragments collapsed in a hypocaust), this true "stone painting" of exceptional size—4.39 by 1.24 meters—required special consideration with respect to the final appearance of the mosaic after restoration, carried out in cooperation with the Algerian restorers within the framework of "Djazair, l'Année de l'Algérie en France" (Algeria Year in France). In view of the exceptional fineness of the mosaic, executed in* opus vermiculatum*, a pointillist technique in watercolors was used to reduce the fragmentary aspect of the overall composition.*

Mosaïque et peinture se définissent toutes deux par une image bidimensionnelle. Au-delà de la valeur documentaire et esthétique de l'image, mosaïque et peinture se présentent aussi comme un volume, avec une superposition de strates aux composants variés.

La restauration de la mosaïque des Monstres marins a offert la possibilité de rendre visibles ces multiples dimensions. En effet, à côté de l'exceptionnelle qualité de la représentation, le mortier antique de ce pavement, toujours présent, est apparent dans les lacunes et les fissures.

L'aspect très fragmentaire de la mosaïque nous a amenés à réfléchir sur des interventions de réintégrations qui permettraient une lecture plus large et plus affinée de l'œuvre, de sa technique et de son support. Ceci afin que celui qui regarde, n'étant pas forcement spécialiste, puisse comprendre et apprécier l'objet dans son intégralité.

Des comblements par des mortiers de chaux ont été réalisés sur plusieurs niveaux en suivant les strates d'origine. La couleur est alors intervenue sur des zones précises, soit par glacis, soit par juxtaposition de petits points pour un rendu presque illusionniste (fig. 1, 2).

Présentation de la mosaïque des Monstres marins

Opus vermiculatum
H : 1,26 m / L : 4,35 m
Tesselles de marbre, calcaire et verre, dimensions : 2 à 5 mm
Densité : 480 à 670 tesselles au dm²
Épaisseur du support antique conservé : 3 cm
Fin du II^e^ - début du III^e^ siècle de notre ère
Lambaesis (Lambèse-Tazoult)
Musée de Tazoult (Algérie)

Cette mosaïque a été découverte en 1905 à Lambèse, dans les ruines d'une *domus* romaine. Elle pavait une salle rectangulaire à hypocauste. Les nombreuses fractures sont dues à l'histoire et à la fonction même du pavement qui a été retrouvé brisé en fragments, au niveau des pilettes de l'hypocauste.



FIGURE 1 Mosaïque des Monstres marins, travail de réintégration des lacunes. Photo © ACRM / MAPA.

La scène présente trois Néréides portées par des monstres marins – un tigre, une panthère et un *ketos,* de gauche à droite –, et servies par des amours. Une inscription en lettres grecques est placée sous la patte de la panthère : « les monstres d'Aspasios », donnant peut-être le nom d'un peintre de l'époque hellénistique.

Contexte des interventions – Traitement spécifique des lacunes

Après sa découverte, cette mosaïque conservée en une centaine de fragments reposant sur leur assise antique (*rudus*, *nucleus*, lit de pose) a été reconstituée au Musée de Lambèse. Les fragments ont été maintenus au mur par des tenons métalliques bloqués par des mortiers de chaux et de ciment en 1906. En 2002, l'état de ce pavement présentait des risques pour sa conservation : fissurations, perte et décollement de tesselles. C'est pourquoi la mosaïque a été prélevée du musée en deux grands panneaux. Après

FIGURE 2 Détail de la technique picturale mise en œuvre. Photo © ACRM / MAPA.



démontage à l'Atelier de Conservation et Restauration du Musée de l'Arles et de la Provence Antiques, fragment par fragment, la mosaïque a été transférée sur un support aérolame.

Pour la conservation du *tessellatum*, un premier comblement a été nécessaire, avec un mortier de chaux, dans les lacunes et les fissures. Après ces interventions, la mosaïque des Monstres marins présentait encore une surface divisée, fissurée, offrant une image parasitée (cassures créées par l'effondrement de l'hypocauste). Se posait alors la question des réintégrations. Celles-ci étaient indispensables pour obtenir une meilleure lecture, l'objectif étant de mettre en évidence le potentiel pédagogique de cette mosaïque et de proposer ainsi un voyage à travers tous les aspects documentaires énumérés ci-dessous :

Aspects picturals

- Finesse des tesselles.
- Variété des couleurs et précision de leur utilisation : traitements des volumes, des reliefs, de l'ombre et de la lumière, des détails.
- Composition s'appuyant entièrement sur les courbes et contre-courbes : courbes des corps féminins, courbes des voiles, courbes des monstres marins.
- Présence d'un rythme spécifique : trois néréides, trois voiles, trois monstres marins, trois amours.

Aspects techniques

- Superposition du *rudus*, du *nucleus* et du lit de pose, empreintes des tesselles dans le lit de pose.
- Par endroit, traces colorées sur le lit de pose (résultant d'une esquisse préparatoire ?).

Traces d'une histoire et d'une fonction

- Montage sur pilettes de l'hypocauste : salle chaude.
- Usure de la zone centrale (?) : possible zone de passages.

Les différents types de réintégrations réalisées (tableau 1 et fig. 3)

Pour l'évolution de ces choix, les discussions se sont d'abord effectuées en équipe, se basant sur des formations et des compétences variées ; puis, des tests sur

TABLEAU 1 Tableau des différents niveaux de comblements et réintégrations picturales correspondantes

Strates originales	Objectifs	Niveaux des Mortiers de restauration	Réintégrations picturales correspondantes
		Mortier de comblement	
1 *Rudus*	• Rendre l'idée de l'épaisseur et du volume en laissant apparaître les strates originales	• Mortier de fond dans les grandes lacunes Niveau laissant apparaître le *rudus* (sable, terre cuite, chaux hydraulique, liant acrylique)	
2 *Nucleus* Lit de pose	• Différencier des strates Harmoniser les tons et le dessin • Atténuer l'aspect fragmentaire	• Mortier de comblement des fissures et petites lacunes peu importantes • Niveau en retrait par rapport à celui des tesselles et du lit de pose (sable, terre cuite, chaux hydraulique, liant acrylique)	• Mortier atténué par un glacis dans les zones sujettes à interprétation (pigments et liant acrylique)
		Mortier fin de réintégration	
3 Lit de pose Tesselles	• Lecture des lignes principales de la composition • Atténuer les ruptures dans les courbes • Lecture harmonieuse des différentes figures et parties de la mosaïque inégalement lacunaires • Respecter les vibrations colorées créées par les différents composants du pavement	• Par-dessus le mortier de comblement, niveau légèrement en retrait par rapport à celui des tesselles et du lit de pose (chaux hydraulique, poudre de marbre, liant acrylique)	• Réintégrations picturales par juxtaposition de points de couleurs dans les zones non sujettes à interprétation (aquarelle)

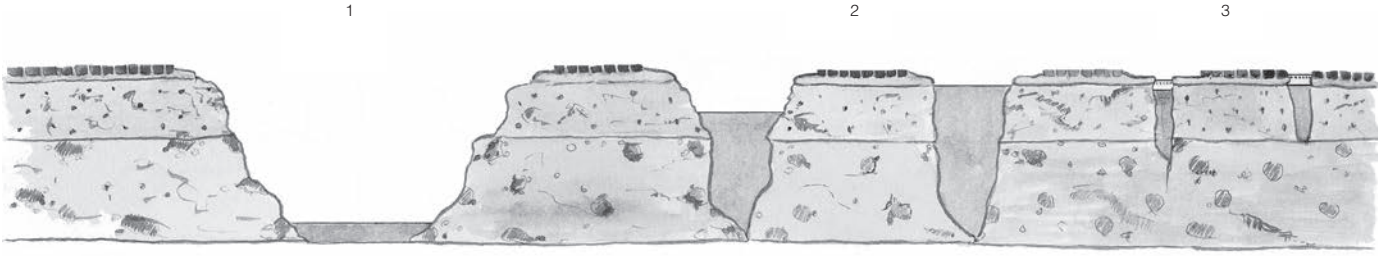


FIGURE 3 Schéma de la coupe stratigraphique du pavement et des différents niveaux de comblement et de réintégrations (cf tableau).
© ACRM / MAPA.

maquette ont été réalisés. Nous avons tenu à garder des limites bien définies respectant le document archéologique : image, technique, histoire et fonction.

Nos interventions picturales se veulent aisément repérables de près, et totalement réversibles. Elles sont effectuées dans des zones qui n'étaient pas sujettes à interprétation, respectueuses de la vibration d'une infinité de nuances colorées, du volume des strates originales volontairement conservées (fig. 4 – 6).

Note : La restauration de la mosaïque des Monstres marins a été effectuée dans le cadre d'une coopération franco-algérienne réunie autour de la préparation de plusieurs expositions archéologiques pour « Djezaïr 2003. L'Année de l'Algérie en France », sous la co-direction de Kader Ben Salah, responsable de l'Atelier de restauration des musées de Cherchell, et de Patrick Blanc, responsable de l'Atelier de conservation et de restauration (Musée de l'Arles et de la Provence antiques - Conseil général des Bouches-du-Rhône).

Ont participé à cette restauration pour la partie française Marie-Laure Courboulès, Élise Devidal, Patricia Jouquet, Ali Aliaoui, Gilles Ghiringhelli et Hafed Rafaïf, et pour la partie algérienne Zineb Rebzani, Abdelmajid Belkares, Mohamed Chérif Hamza, Mouloud Derram, Ahmed Djellilahine, Moussa Djemmal, Hassiba Kaci, Mourad Zerarka.



FIGURE 4 – 6 Évolution du travail de réintégration à l'emplacement d'une large fracture située dans le *kétos*. Photo © ACRM / MAPA.

The Byzantine Painted Floor in Salamiya, Syria: Possibilities for Conservation and Presentation

Ewa Parandowska

Abstract: *Salamiya (ancient Salamias) lies about 30 kilometers east of Hama in Syria. In the 1990s a Byzantine painted pavement with floral motifs was discovered during ground-leveling work around the Fatimid-period Imam Ismail mosque and subsequently reburied. In 2001 it was reexcavated with the intention of transferring it to the Archaeological Museum in Hama, but lifting the thin layer of plaster involved a high degree of risk. The pavement was therefore reburied following documentation and protective measures. To exhibit the floor, a permanent roof that would respect the surrounding Islamic architecture was envisaged, but for several reasons the idea was abandoned, and it remains uncertain if the pavement will ever be presented to the public.*

Résumé : *Salamiya (ancienne Salamias) se trouve à environ 30 kilomètres de Hama, Syrie. Dans les années 90, un pavement byzantin peint avec des motifs floraux fut découvert au cours des travaux autour de la mosquée fatimide d'Imam Ismail et aussitôt réenfoui. En 2001, il fut de nouveau dégagé pour le transférer au Musée archéologique de Hama, mais la dépose de la fine couche de plâtre comportait un grand risque. Il fut donc réenfoui après documentation et traitement de protection. Afin de présenter le pavement, un toit permanent qui respecterait l'architecture islamique environnante a été envisagé, mais pour plusieurs raisons, l'idée a été abandonnée et on ne sait si le pavement sera jamais présenté au public.*

Archaeological Information and Technical Data

Salamiya (ancient Salamias) lies about 30 kilometers east of Hama in Syria (fig. 1). Syrian archaeologists first discovered and reburied the Byzantine painted floor from Salamiya in the 1990s. In May 2001 a team of Polish restorers undertook rescue measures at the request of the former director of the Archaeological Museum in Hama, Abdel Razzaq Zagzoug, who had discovered the pavement. Upon exploration of the fill, the preserved fragment (290 by 310 cm) was found to be no more than 20 percent of the original pavement surface (fig. 2). The decoration was composed of circular and square medallions with various species of fruit trees (fig. 3). Acanthus scrolls and stylized plant motifs were used as a border (fig. 4). The painting was executed in a water-resistant technique on thin lime plaster (0.5–3 cm), perfectly flattened on the surface, and applied on a thick (25–40 cm) bedding layer composed of large pebbles, gravel, and soil. Red, yellow, green, black, white, and blue colors were used for decoration.

Pottery finds give a provisional late-sixth-century date for the pavement. It is about 1 meter below ground level, and its northern edge was covered by the Fatimid foundation of the mosque's south wall (fig. 5). During a short, one-week campaign, the pavement was recorded and treated. The team of Polish restorers unearthed, cleaned, and protected the pavement. For documentation purposes, 1:1 tracing of a pattern on a transparent sheet and color photography were done (figs. 6, 7). After mechanical cleaning with soft brushes and moistened sponges, cracks and lacunae were filled with a mortar composed of lime, sand, and marble powder. The same mortar was also used to protect the southern edge of the pavement and the edges of large lacunae.

While awaiting the final decisions regarding the pavement, it was decided to rebury it. The surface was covered with a layer of washed and sifted sand (20 cm thick) isolated with polyethylene sheets from an 80-centimeter stratum of soil and paving stones on the top. In spite of its fragmentary preservation, the high artistic quality of the decoration and unusual execution



FIGURE 1 Map of Syria. Map drawn by Emil Askey, GCI. © J. Paul Getty Trust.

would qualify this important discovery for display. Representatives of the Directorate General of Antiquities and Museums and local authorities discussed two options with us: transfer the pavement to the museum in Hama or preserve and exhibit it in situ on the original bedding.

The option of transferring the pavement was rejected because of the technical complexity involved and because of lack of interest by the local inhabitants. It was suggested that it be left in place, protected by a simple permanent roof. The protective structure would have to be designed with respect for the existing environment (the mosque). But this option also seemed risky because the pavement lies below the paved walkway along the south wall of the mosque and beneath the mihrab foundations, the lowest point of the area. This left it in danger of deterioration from water penetration. Neither the authorities nor the residents of Salamiya see any need to exhibit this fragment of Byzantine decoration that is within an Islamic architectural surrounding.



FIGURE 2 The fragment of painted floor beneath the mihrab foundation.



FIGURE 3 Detail of an *emblema* representing a tree.



FIGURE 4 Detail of a frame with an acanthus scroll.



FIGURE 6 Documenting the floor by tracing the decoration.

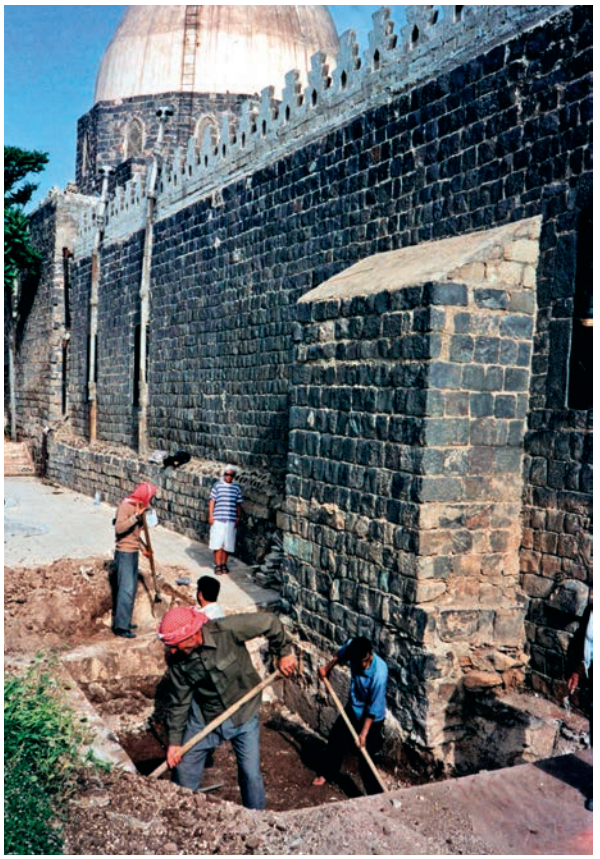


FIGURE 5 Uncovered fragment of the floor after cleaning.

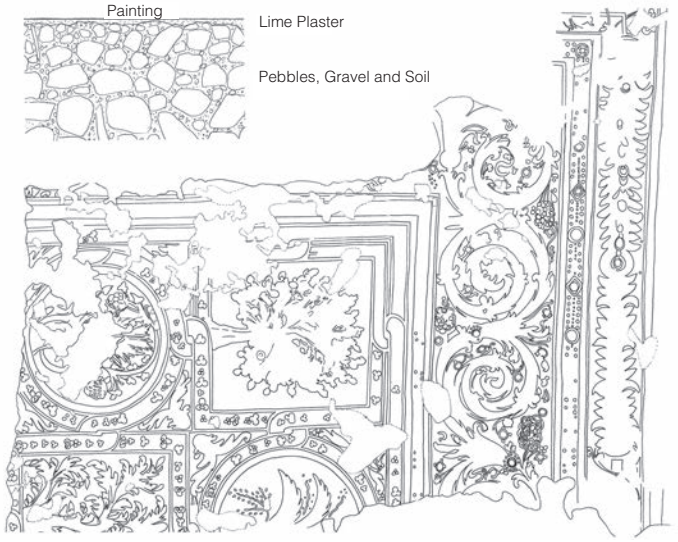


FIGURE 7 Scale drawing of a decorative pattern.

Conclusion

Social and economic factors limited the scope of the research, making it impossible to exhibit the pavement to the public. A permanent shelter and an exhibition will not be possible without a budget for an aesthetic design that will secure access, take into consideration the lighting and rainwater runoff, and include a proper maintenance schedule. With decisions for the project pending, reburial of the pavement is the cheapest and safest solution for its temporary protection. Thus, for the time being, the painted floor remains hidden beneath the ashlars of a walking path that encircles the mosque (fig. 8).



FIGURE 8 The decorated floor reburied below the pavement.

The Syrian Mosaic Pavement Documentation Training Program

Konstantinos D. Politis, Amr Al-Azm, and Charalambos Bakirtzis

Abstract: *A mosaic documentation training program that uses modern methods has been established in Syria. It is jointly sponsored by the Syrian and Greek governments in an effort to increase collaboration between the two countries and further the study of mosaic art.*

Résumé : *Un programme de formation en documentation sur la mosaïque a été mis en place en Syrie. Utilisant des méthodes modernes, il est soutenu conjointement par les gouvernements syrien et grec, pour faire avancer l'étude de l'art mosaïque.*

In 2004 a collaborative training program was begun to prepare Syrian personnel to fully document mosaic pavements in the Syrian Arab Republic. The trainees are University of Damascus archaeology students and postgraduates. The participating institutions are the European Centre for Byzantine and Post-Byzantine Monuments (EKBMM) and the Centre for Archaeological Research of the Department of Archaeology at the University of Damascus. The program has the full cooperation of the Syrian Directorate of Antiquities and Museums (DGAM) and is funded by EKBMM with additional support from the above-mentioned institutions.

The main aims of the program are to establish a new database in order to fully document mosaic pavements in Syria using modern methods and to conduct a training course for Syrians to carry out this process (fig. 1). The end product will be the publication of a usable corpus of mosaics from Syria for future analysis and study.



FIGURE 1 Trainee calculating tessera density of a mosaic at the Damascus Museum. Photo by Konstantinos D. Politis.

Initial Work

In 2004–5, the first year of the program, a database was formulated and training courses were held at Damascus University and at the Damascus and Mara'at Nama'an



FIGURE 2 Damascus University training students measuring the dimensions of a mosaic at Mara'at Nama'an Museum. Photo by Konstantinos D. Politis.

museums involving eight Syrian trainees who will be carrying out the bulk of the mosaic documentation (fig. 2).[1] Several hundred mosaic pavements were photographed, many of which were recorded in the new database. The training program was conducted by Konstantinos Politis, program coordinator and chairperson of the Hellenic Society of Near Eastern Studies; Amr Al-Azm, program coordinator and lecturer in archaeology at Damascus University; Vicken Abajian, database programmer at DGAM; and Ma'amoun Abdelkarim, lecturer in classical archaeology at Damascus University. Charalambos Bakirtzis of the Greek Ministry of Culture acted as liaison with the EKBMM.

A series of lectures on the history of mosaics and their documentation process was begun and continued into 2006. A summary of these lectures will be published by EKBMM as a handbook to aid the documentation process in the future.

A Memorandum of Understanding for the collaborative program was signed by the presidents of Damascus University and EKBMM. It was agreed that the first phase of the program would be concluded by September 2006.

Recording Strategy

The recording process aims to collect all available information on both treated and untreated mosaic pavements found in Syria. The main sources of information are the mosaic pavements themselves, either

on display or in storage, but records kept by the DGAM were also used. The DGAM records include original plans and photographs of the mosaics in situ prior to their removal. In order to present the information in a meaningful way, it was necessary to formulate a standardized, systematic method for describing and recording the mosaic pavements. However, this documentation procedure is intended not to include comprehensive analyses, but rather to act as an aid for that purpose.

A relational database was created for optimal data storage and management. It is designed to record, retrieve, search, compare, and cross-reference data quickly and accurately. The information can then be made widely available by permitting access to the database through the Internet.

Conclusion and Future Prospects

The first year of the program successfully established a new database for all available information on the mosaics of Syria. Eight young Syrian archaeologists began training to accurately document and record the mosaics using this database. This process was first applied to mosaics in the Damascus and Mara'at Nama'an museums.

In order to further the understanding of mosaics and the methods to more accurately record them, the lecture series was continued and expanded during 2006. It grew to include the principles of conservation and heritage management and a basic course in ancient Greek.

Notes

1 The trainees were Khaled Hiatlih, Rasha Haqi, Nivin Saad al Deen, Basel Zeno, Ola Abu Rached, Manal Ganem, Samara Ramadan, and Lorna Asaad.

Étude sur l'état de conservation des mosaïques du Musée National d'Iran à partir de vestiges du site archéologique sassanide de Bîchâpour

Elyas Saffaran

Résumé : *Au cours des diverses civilisations antiques, la mosaïque a été utilisée pour décorer le sol, les murs ou les voûtes d'un édifice. En Iran, lors de la période sassanide, de 241 à 272 apr. J.-C., la mosaïque a été utilisée dans le palais de Chapour I^er^ à Bîchâpour (province du Fars). La plupart des vestiges archéologiques de cette époque sont conservés au Musée National d'Iran à Téhéran. La mosaïque de Bîchâpour possède de magnifiques éléments artistiques d'influence sassanide. Une étude scientifique a été réalisée pour déterminer son état de conservation et ses éléments historiques et artistiques. Cette présentation concerne les résultats de cette étude, notamment la découverte du site archéologique de Bîchâpour et de ses mosaïques ; l'étude scientifique pour déterminer les causes de détérioration des mosaïques ; et les travaux de conservation et de restauration des mosaïques, de leur* tessellatum *et de leur environnement.*

Abstract: *In antiquity various civilizations used mosaics to decorate the floors, walls, or vaults of buildings. In Iran during the Sassanid period, from 241 to 274 C.E., mosaics were used in the palace of Chapour I in Bîchâpour (Fars province). Most archaeological remains from this period are conserved in the National Museum in Tehran. The Bîchâpour mosaic has magnificent artistic features of Sassanid influence. A scientific study was made of its condition and historical and artistic features. This paper discusses the discovery of the archaeological site of Bîchâpour and its mosaics, the scientific study to determine the causes of deterioration, and conservation and restoration work on mosaics, their* tessellatum, *and their environment.*

Aspects historiques et artistiques de la découverte du site archéologique de Bîchâpour et de ses mosaïques

Les recherches et les documents archéologiques mis au jour nous ont révélé de nombreuses informations historiques et artistiques (fig. 1).

L'art sassanide, à ses débuts, hérite en totalité du passé iranien. L'art des provinces orientales romaines va faire intervenir un style qui modifiera l'agencement des formes. Tout en étant composite et éclectique, l'art iranien, fondu et retravaillé, va s'affirmer au niveau national en s'associant à un programme politique encore influencé par le prestige des fastes achéménides.

Peu après, ou peut-être avant sa victoire sur Valérien, le roi Chapour se fait construire une résidence dans sa province natale du Fars (l'ancienne Perside). Il choisit un paysage qui rappelle celui où son père éleva la ville de Firozâbâd. Ce lieu prend le nom de Bîchâpour – « la belle (ville de) Chapour ». Son plan n'est plus celui des villes circulaires parthes mais s'inscrit dans un quadrilatère délimité par un mur d'enceinte et des fossés. La ville s'appuie sur la montagne où la protège une forteresse, avec tout un réseau de murailles et de fortins. Elle est en outre bordée par la rivière (fig. 2).

La découverte et l'exploration du site royal de Bîchâpour ont commencé en 1935 et ont été reprises en 1939, 1940 et 1941 (fig. 3).

À Bîchâpour, le sol d'un triple *iwan* (vaste porche voûté), ouvert sur une large cour à l'est de la grande salle, était dallé de pierres et entouré de panneaux de mosaïque. Ce décor – mélange d'éléments iraniens et romains – s'inspire peut-être d'un tapis persan de l'époque (fig. 4). Il est essentiellement évocateur et tend à illustrer, avec son répertoire d'images, l'ambiance de ces lieux où se tenaient les banquets. On y voit des dames de la cour, les unes mollement accoudées sur des coussins, les autres, vêtues de longues robes, tenant des bouquets et des couronnes de fleurs et participant à la cérémonie (fig. 5, 6). Figurent aussi des portraits de personnalités de la famille royale ou des classes privilégiées (fig. 7). Des danseuses, joueuses de harpe et tresseuses de couronnes, leur nudité à peine voilée d'une écharpe, animent la scène et en précisent le sens.

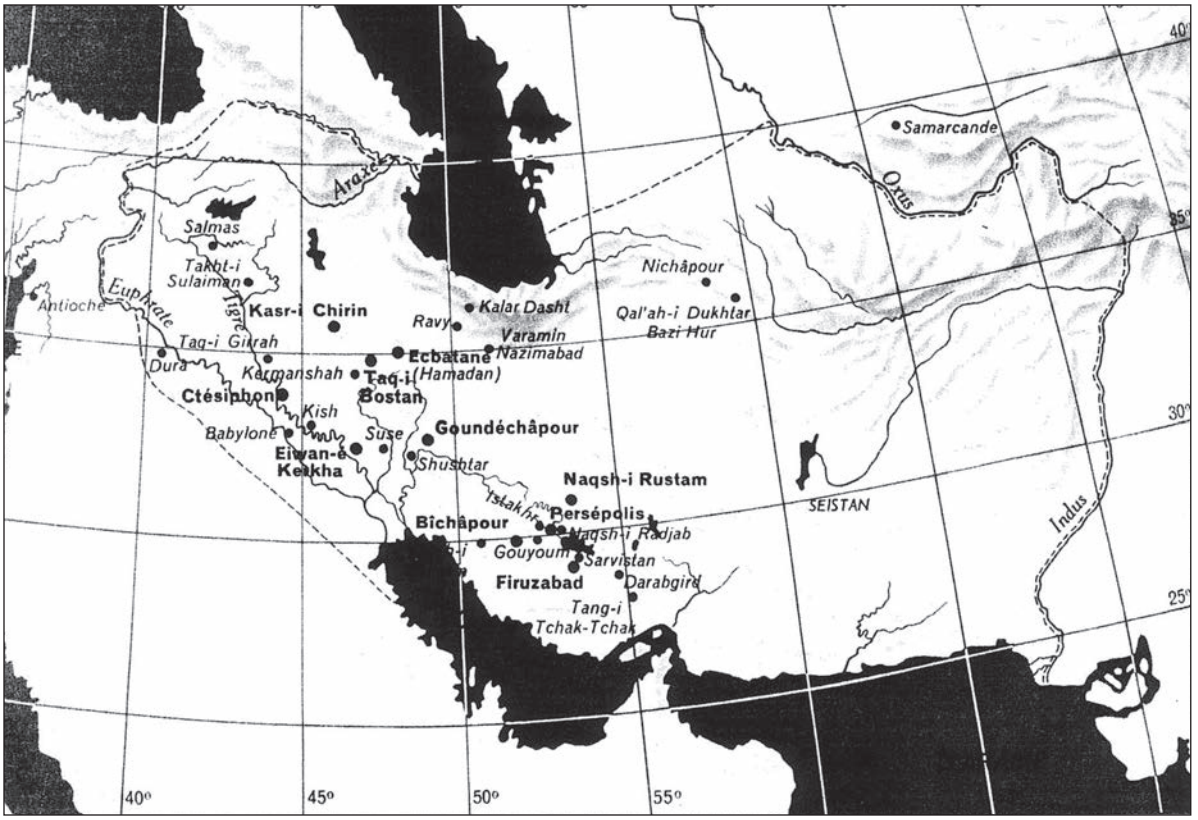


FIGURE 1 Carte de l'Empire sassanide. E. Saffaron et R. Ramani, avec le soutien de M. Karegar, directeur Musée National d' Iran à Téhéran.

Étude scientifique et pratique pour déterminer les causes de détérioration des mosaïques

Mes études et celles de Mme Ghourgie montrent toute la difficulté qu'a représenté l'enlèvement des mosaïques après les fouilles archéologiques. On manquait à la fois à cette époque d'outillage approprié et de personnel compétent. Les panneaux ont été séparés à la scie, qui, après l'enlèvement d'une rangée de tesselles, a traversé l'épaisseur du mortier. Des tranchées ont été creusées sous les fondations de galets et les panneaux enlevés l'un après l'autre. L'état actuel des mosaïques est suffisamment stable pour en



FIGURE 2 Vue aérienne de Bîchâpour. E. Saffaron et R. Ramani, avec le soutien de M. Karegar, directeur Musée National d' Iran à Téhéran.

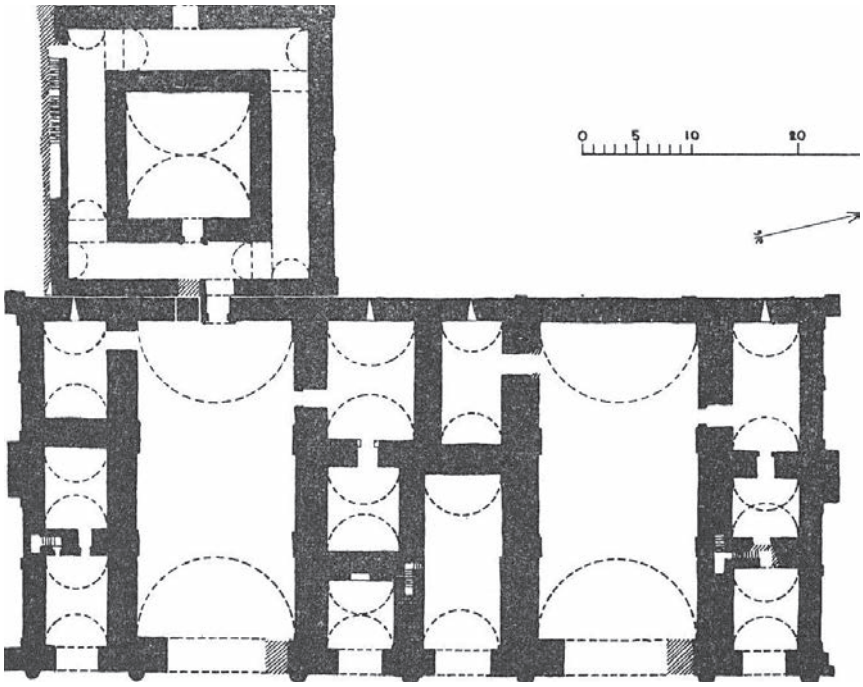


FIGURE 3 Plan du palais de Bîchâpour. E. Saffaron et R. Ramani, avec le soutien de M. Karegar, directeur Musée National d' Iran à Téhéran.



FIGURE 4 Carafe en argent doré sassanide. E. Saffaron et R. Ramani, avec le soutien de M. Karegar, directeur Musée National d' Iran à Téhéran.

autoriser le dépôt ou l'exposition au Musée National de Téhéran (fig. 8).

Travaux de conservation et restauration des mosaïques

Lors de leur découverte, les mosaïques étaient en très mauvais état, y compris celles des panneaux complets ou quasi complets. Le mortier de couleur grise censé maintenir les tesselles formait une surface unie avec celles-ci mais les tesselles n'y adhéraient plus. De plus, des formations calcaires recouvraient un grand nombre de panneaux. Notre premier soin a donc été de consolider les tesselles en coulant du ciment très liquide dans les interstices. Cela fait, nous avons renforcé au ciment les bords abîmés, puis nous avons procédé au pon-çage de toutes les parties envahies par les sels. Depuis, l'état de la mosaïque s'est stabi-lisé et ne pose plus de problème.

Conclusion

La mosaïque de Bîchâpour est romaine par sa technique et par son style, iranienne par sa composition et ses particularités nationales. C'est là un des aspects les plus caractéristi-ques de l'art iranien qui reprend les apports artistiques de pays voisins ou éloignés pour s'en inspirer, sans jamais se limiter à une simple imitation. Adoptés et refondus dans le creuset iranien, retravaillés et acclimatés, idées et motifs étrangers vont renaître sous un nouvel aspect qui se veut national. Ainsi, par exemple, le masque représenté sur ces mosaïques renouvelle la vieille tradition de l'art iranien de Sialk et du Luristan.

Il faut donc commencer par prendre les mesures nécessaires pour mieux compren-dre les œuvres et maîtriser les causes de leur détérioration si l'on veut en améliorer l'état et en assurer la pérennité.



FIGURE 5 Fragment d'un panneau de mosaïque de Bîchâpour. E. Saffaron et R. Ramani, avec le soutien de M. Karegar, directeur Musée National d' Iran à Téhéran.



FIGURE 6 Fragment d'un panneau de mosaïque de Bîchâpour. E. Saffaron et R. Ramani, avec le soutien de M. Karegar, directeur Musée National d' Iran à Téhéran.

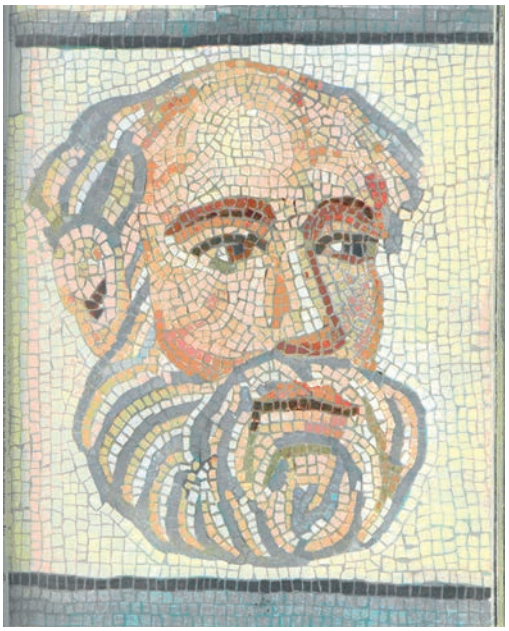


FIGURE 7 Fragment d'un panneau de mosaïque de Bîchâpour. E. Saffaron et R. Ramani, avec le soutien de M. Karegar, directeur Musée National d' Iran à Téhéran.



FIGURE 8 Differents fragments des panneaux de mosaïque de Bîchâpour au Musée National d'Iran. E. Saffaron et R. Ramani, avec le soutien de M. Karegar, directeur Musée National d' Iran à Téhéran.

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Archaeometric Analysis and Weathering Effects on Pompeii's *Nymphaea* Mosaics

Cristina Boschetti, Anna Corradi, Bruno Fabbri, Cristina Leonelli, Michele Macchiarola, Andrea Ruffini, Sara Santoro, and Paolo Veronesi

Abstract: *The archaeological and archaeometric study of the mosaics of Pompeii's* nymphaea a scala, *conducted since 2003, have provided an opportunity to collect data to build a database on glass tesserae used during the first century* A.D. *The observation of different kinds of vitreous materials also provides an understanding of the deterioration processes and agents.*

Résumé : *L'analyse archéologique et archéométrique des mosaïques des nymphées de Pompéi « a scala » en cours depuis 2003, a permis de collecter des données pour constituer une base de données sur les tesselles en verre utilisées au cours du 1er siècle ap. J.-C. L'étude de différents types de matériaux vitreux a également permis de comprendre les processus et les agents de détérioration.*

The Project

The present work characterizes and evaluates the conservation status of the mosaic materials that comprise Pompeii's *nymphaea a scala.* It has been conducted within the framework of the Interuniversity National Project, funded by the Italian Ministry of University Education and Research (MIUR) and aimed at the multidisciplinary study of the architectural heritage of Pompeii, for both surveying and conservation purposes.[1] The project is directed by the Bologna University Archaeology Department and involves a number of operational units. In the first stage it focused on a specific block of the town (Insula del Centenario). The *nymphaea a scala,* or *a scaletta,* are architectonic structures typical of open spaces encircled by tall walls, such as gardens or triclinia for summer use. In Pompeii thirteen *nymphaea a scala* (dated from A.D. 35 to the years before the eruption in A.D. 79) have been discovered. They constitute a fountain niche with stairs (usually made of marble); the niche is decorated with mosaics made of glass tesserae, stone pieces, and shells (fig. 1). The



FIGURE 1 The Casa del Centenario's *nymphaeum a scala.*

analytic study of the tesserae and fragments of mortar from the *nymphaea* was started two years ago and provided an exhaustive database of color measurements, characterization of materials, and evaluation of the degradation.

Deterioration Phenomena in Pompeii's Glass Tesserae: An Example of Color Change

The analytic data detected the following degradation phenomena in the glass tesserae: leaching, erosion, exfoliation, iridescence, change of color, formation of deterioration deposits, reduction in thickness, loss of surface gloss, and a general decrease in mechanical properties. Some glass tesserae were subjected to profound surface degradation: they appear to be covered by a green layer of a few micrometers on each side and are vivid red inside. This paper discusses this unusual case of degradation on an archaeological site. The tesserae are made of leaded glass with a high amount of copper and discrete concentrations of antimony. The concentrations of magnesium and potassium are very low. This glass was obtained by melting a batch composed of silicocalcareous sand with lead and natron, the glass technology used by the Romans. The red color is due to

dendritic cuprite crystals formed inside the glass during the fusion; the green surface layer is the result of copper and lead ions migrating to the surface. This type of red glass, usually called "sealing wax glass" in the literature,[2] has been known in ancient Egypt since the Nineteenth Dynasty in the Mesopotamian area (Lucas and Harris 1962–99). Thanks to an extensive study conducted by the British Museum, it is possible to compare Pompeii's tesserae with a glass cake from a workshop found in Nimrud's Royal Palace dated to about the fourth century B.C. (tables 1, 2) (Cable and Smedley 1987).

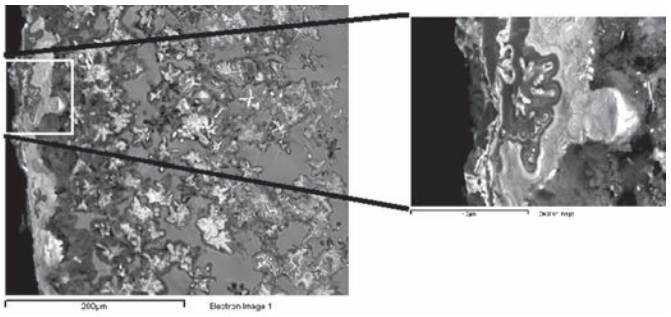


FIGURE 2 SEM image of a cross section of the red tessera with the green surface: it is possible to see the dendritic cuprous oxide crystals and, on the left, its deterioration layer. In the magnification, crystal sulphures, with a characteristic mammillary shape, are detected as deterioration products.

Table 1 ICP analysis on Pompeii's tesserae

Elements	(%)
SiO_2	43.97
Na_2O	11.84
CaO	3.16
PbO	27.67
K_2O	0.25
Al_2O_3	1.63
CuO	8.18
Fe_2O_3	0.68
MgO	0.51
Sb_2O_3	1.13
SnO_2	0.54
ZnO	0.10

Table 2 EDS analysis on Nimrud glass

Elements	(%)
SiO_2	42.28
Na_2O	9.46
CaO	3.82
PbO	24.96
K_2O	1.43
$Al_2O_3 + Fe_2O_3$	1.11
Cu_2O	8.58
Sb_2O_3	4.19

The energy dispersion X-ray florescence analysis of the Nimrud sample shows that it is a leaded glass with high concentrations of copper and antimony; the discrete concentrations of potassium indicate the use of coastal plant ashes. According to the glass technology of this period and area, the Nimrud red glass was obtained from a batch composed of siliceous sand, lead, and coastal plant ashes. The two types of glass have the same color and texture due to the presence of cuprite crystals in the lead vitreous matrix (fig. 2). The main disparity between the two types is the use of different sodic fluxes together with lead: natron, in Pompeii's red tessera; coastal plant ashes, in the Nimrud red sample.

The Iridescence Phenomenon

In a group of blue tesserae it is possible to see the iridescence phenomenon in two stages of deterioration, iridescence and low iridescence. In the scanning electron microscope (SEM) images one can see the different structural details (fig. 3). In the iridescent blue it was possible to detect a leached surface with the formation of a deterioration deposit, while in the low iridescent sample it is, in fact, only an exfoliation phenomenon.

The Brown Deterioration Layer

Some glass tesserae (green and light blue) and the Egyptian blue tesserae are covered with a brown deterioration layer, a deposit of carbonates and sulfates formed as a consequence of leaching effect (tables 3, 4; fig. 4). The highly porous structure of the Egyptian blue is strictly connected to the decomposition of calcium and copper carbonate during the thermal cycle used for its production. Some crystals have turned green, forming the so-called Egyptian green (Bianchetti et al. 2000). The highly blistered structure of the green glass is correlated to the deterioration layer. Here it is possible to recognize the deterioration phenomenon on the surface and in the inner part of the glass. X-ray diffraction (XRD) indicated the presence of different sulfates and carbonates.

Conclusion

The analytic data detected particular degradation phenomena, leading to a surface chromatic alteration of some glass tesserae. The characterization of the materials used for the mosaics, together with the identification of degradation products and processes, is a prerequisite for defining appropriate restoration techniques and for the future maintenance of the mosaics.

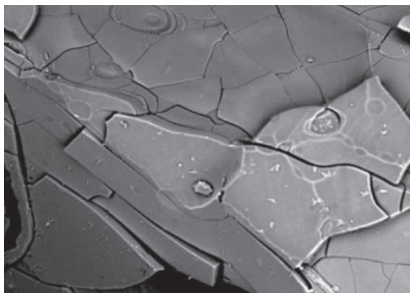
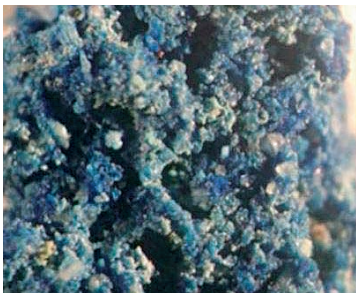


FIGURE 3 SEM image of the surface exfoliation in the blue tessera.



(a)



(b)

FIGURE 4A, B Optical microscopy images of the Egyptian blue sample: the nondeteriorated inner part (a) and the brown deterioration layer on the surface (b).

Table 3 ICP analysis on low iridescent blue tesserae

Elements	(%)
SiO_2	63.57
Al_2O_3	2.41
BaO	0.03
CaO	8.04
CoO	0.14
CuO	0.43
Fe_2O_3	1.81
K_2O	0.61
MgO	0.57
MnO	0.34
Na_2O	16.67
P_2O_5	0.08
Sb_2O_3	5.16
SnO	0.01
SrO	0.05
TiO_2	0.06
ZnO	0.01
ZrO_2	0.01
	100.00

Table 4 ICP analysis on semiopaque green

Elements	(%)
SiO_2	65.65
Al_2O_3	2.54
CaO	7.09
CuO	1.76
Fe_2O_3	1.07
K_2O	1.05
MgO	0.95
MnO	0.46
Na_2O	16.45
P_2O_5	0.30
PbO	2.25
Sb_2O_3	0.25
SrO	0.05
TiO_2	0.14
ZrO_2	0.01
	100.00

Notes

1 The aims of the project were drawn up in the proceedings of the 10th AISCOM Congress (Santoro et al. 2005). The results from the second year of research were presented at the 11th Congress (Santoro et al. 2005). A detailed archaeometric study on the mosaic of the fountain in Casa del Centenario (Pompei, IX, VIII) will be published, along with the results from five years of research on Pompeii's Insula (Boschetti et al. forthcoming[a]). An early report on the archaeometric analysis and archaeological investigation of Pompeii's *nymphaea a scala* was presented in a thesis at Parma University (Speranza 2005).

2 "Sealing wax" red glass in Egypt is mentioned only in the Lucas and Harris work on Egyptian materials (Lucas and Harris 1962–99); for the Middle East, the first investigation is in Brill 1970. An experiment reproducing Nimrud's glass cakes was conducted in the 1980s by scientists from the British Museum (Cable and Smedley 1987). Nimrud glass was analyzed again in 2000 by Raman spectroscopy (Withnall et al. 2000). Problems linked to the technique of producing opaque red glass are treated in a paper on Sardis's red glass (Brill and Cahill 1988) and in two other contributions about the relationship between glassmaking and metallurgy (Mass, Wypyski, and Stone 2002; Rehren 2003). According to Brun and Pernot (1992), Roman-age sealing wax glass seems to have been reused during the Middle Ages for cloisonné enamels. There is currently

little in the literature on Roman-age sealing wax red glass. During the characterization of Pompeii's *nymphaea a scala* it was possible to study sealing wax red glass used in mosaic tesserae (Corradi et al. 2005; Santoro et al. 2005; Boschetti et al. forthcoming[a]) and also in glassware (Boschetti et al. forthcoming[b]) during the period between the end of the second century B.C.E. and the second half of the first century C.E.

3 Egyptian blue is a synthesized material used for wall mosaics between the end of the first century B.C.E. and the first half of the first century C.E.; if powdered, it can be used as a pigment for painting. The sharp blue color is due to a copper and calcium silicate called cuprorivaite. A first-century C.E. workshop for the production of Egyptian blue in Liternum, near Puteoli, has been documented (Gargiulo 1998; Platania et al. 1999).

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An Assessment of Recent in Situ Conservation Treatments of Mosaics in Turkey

Y. Selçuk Sener

Abstract: *There has been a dramatic increase in the conservation and restoration of mosaics excavated in Turkey. There has also been an increase in problems emerging in different stages of conservation treatment. This poster discusses studies carried out during the in situ conservation of mosaics, focusing on certain finds from Aizanoi, Sagalassos, Bodrum, Side, and Zeugma in Turkey. The case studies and discussions of the conservation-restoration approaches demonstrate that although the methods appear to have been appropriate at the time they were carried out, it is not necessarily true that they have proven to be the best ones.*

Résumé : *Une augmentation substantielle de travaux de conservation et restauration sur les mosaïques mises au jour en Turquie a été constatée ainsi qu'une multiplication des problèmes à différents stades des traitements de conservation. Cette étude réalisée lors de la conservation in situ des mosaïques, se penchera sur des découvertes à Aizanoi, Sagalassos, Bodrum, Side et Zeugma en Turquie. Ces études de cas et discussions sur les approches choisies en matière de conservation-restauration montrent que si ces approches semblaient appropriées à l'époque, elles ne se sont pas nécessairement avérées être les plus adéquates.*

During archaeological excavations in Turkey, countless finds have been unearthed whose value to the history of art and culture is indisputable. As much as the finds themselves, the preservation of the materials obtained during these excavations is gaining importance. Efforts to restore and preserve the excavated mosaics are on the rise. Unfortunately, however, some of these interventions aimed at preservation have caused problems. This type of work needs to be revised in terms of planning and implementation. The aim here is not to present problems encountered during the in situ conservation of mosaics but to lay the ground for a discussion on the subject by presenting examples of errors in planning and ill-advised interventions done in the past that were identified during more recent mosaic conservation work carried out at different times in the ancient towns of Aizanoi, Sagalassos, Bodrum, Side, and Zeugma.

Preservation Problems

The first example is the floor mosaic at the Roman baths in the ancient city of Aizanoi (modern Cavdarhisar, Kutahya). The first intervention aimed at conserving the mosaic was carried out in the early 1980s. During later conservation work, it was determined that in 1993 liquid cement mortar had been poured into those interstices where the original grout had worn away on the surface of the mosaic; that areas with lacunae, both large and small (some 10–15 cm square), had been filled with cement mortar; and that this had resulted in active water movement from the ground that concentrated in other areas, causing localized bulging and depressions. Interventions aimed at solving these problems were carried out from 1994 to 1995 (Kökten 1997: 467–71). The restoration process on the Aizanoi mosaic demonstrates how applying the wrong material can lead to greater damage within as few as ten years (figs. 1–3).

The floor mosaic of the Neon Library in Sagalassos, which has been dated to the Roman era, is another case in which the wrong material was used. After the protective building was constructed, on a request from the director of the excavation, permanent conservation work was started in 1996. What was encountered while uncovering the mosaic and determining the existing state of preservation was quite surprising: the borders of the lacunae had been edged with cement mortar in the initial intervention (in the early 1990s), and large cracks and fractures had been filled, not with lime mortar, as was specified in the



FIGURE 1 Aizanoi, Roman bath. Filling of interstices with cement mortar (1994). Photo by Y. Selçuk Sener.

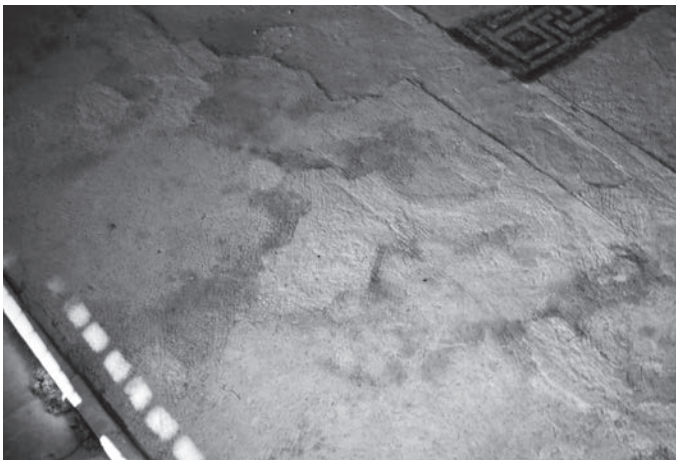


FIGURE 2 Aizanoi, Roman bath. Localized wet surfaces due to active rising damage (1994). Photo by Y. Selçuk Sener.

operational report, but with cement mortar as well (Waelkens et al. 2000: 419–47). This treatment was ill-advised in that white cement mortar, which is not appropriate for the original material, was used. Given the time and effort spent cleaning the applied mortar, it presents an example of unnecessary work that was done in haste and that runs counter to proper planning practice (figs. 4, 5).

Conservation of the mosaics at the late Roman–early Byzantine necropolis at Myndos Gate, Bodrum, was carried out in March–April 1999, and mosaics on the colonnaded avenue and mausoleum in the ancient town of Side underwent conservation treatment in December 2002–February 2003. After the treatment, no protective roof was erected over either of the mosaics. In fact, it was determined in our investigations of 2004 in Bodrum that mortar fills on the restored areas of the mosaic had deteriorated to a great extent.

The mosaics at the colonnaded avenue in the ancient town of Side shared the same fate. Here, the protective cover was not built because it was felt that it would mar the overall appearance of the site. Instead, the mosaics were covered with a layer of geotextile, sand, and soil (Sener 2005: 53–66).

Most of the mosaics uncovered at Zeugma in 1999–2000 (Zone A) were retrieved and transported to the museum in spring and early summer 2000. We know that some of the mosaics uncovered during the excavations carried out in summer 2000 (Zone B) were left at the site. However, on our visits to Zeugma in 2004 and 2005, it was observed that the retaining wall was ruined, the reburial fill on the mosaics was



FIGURE 3 Aizanoi, Roman bath. Detachment of tesserae (1994). Photo by Y. Selçuk Sener.



FIGURE 4 Sagalassos, Neon Library. Grouting of the cracks with cement mortar, general view (1996). Photo by Y. Selçuk Sener.



FIGURE 5 Sagalassos, Neon Library. Grouting of the cracks with cement mortar, detailed view (1996). Photo by Y. Selçuk Sener.



FIGURE 6 Zeugma. Condition of the shoreline where the mosaics have been reburied (2004). Photo by Y. Selçuk Sener.



FIGURE 7 Zeugma. Condition of mosaics after reburial in 2000 and subsequent flooding (2004). Photo by Y. Selçuk Sener.

no longer in place, and the mortar applied on the surface for protection had crumbled away and/or was damaged along with the mosaics (figs. 6–8). Zeugma stands as an example of bad planning that should be carefully examined as it shows us the damage that can be caused by the implementation of an in situ preservation decision that may seem right in theory but has not been successful.

Conclusion

Problems related to in situ mosaic preservation in Turkey were examined through the conservation work on the mosaics at Aizanoi, Sagalassos, Bodrum, Side, and Zeugma. The principal problems encountered in these examples are as follows:

1. New damage was caused over time by previous conservation interventions.



FIGURE 8 Zeugma. Condition of mosaics after reburial in 2000 and subsequent flooding (2004). Photo by Y. Selçuk Sener.

2. Overzealous interventions on mosaics that were completely excavated had been carried out when what was required instead was planning for active conservation treatments at a later date.
3. During rescue excavations, it was determined that mosaics that could not be preserved on-site for various reasons were nonetheless subjected to in situ preservation and left to their fate without the necessary and sufficient preservation measures.

In conclusion, however much interventions aimed at preservation may be regarded as proper and sufficient during their implementation, they do not always result in the preservation of the mosaics as intended and can even lead to new damage or complicate subsequent preservation projects.

Given the diversity of the problems, the solutions require a series of different approaches, ranging from educational to legal measures. Nevertheless, the most effective solution might still be the monitoring and evaluation of conservation efforts.

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An Evaluation of the Preservation of Reburied Mosaics in Cilicia

Füsun Tülek

Abstract: *The corpus of mosaics in Cilicia covers all the known mosaics from the region. Many aspects of the mosaics are evaluated in the corpus, including their state of preservation. Most of them seem to have received preliminary maintenance and consolidation. There are five principal methods used to preserve the Cilician mosaics. Among these, reburial was the most common method. However, in most cases reburial has been practiced as an intuitive preservation strategy. Reburial implementation in Cilicia needs to be examined further in order to identify what factors determined the choice of this method.*

Résumé : *Le corpus de mosaïques en Cilicie couvre toutes les mosaïques connues de la région, en évalue plusieurs aspects et fournit une base de données sur leur état de conservation. La plupart de celles-ci semblent avoir reçu un entretien et une consolidation préalable. Cinq méthodes principales existent pour conserver les mosaïques ciliciennes. Parmi celles-ci, le réenfouissement constituait la solution la plus usuelle. Cependant, dans la plupart des cas, le réenfouissement a été pratiqué en tant que stratégie de conservation intuitive. Le réenfouissement en Cilicie nécessite d'être approfondi afin de comprendre les facteurs qui ont déterminé la décision de recourir à cette méthode.*

The corpus of Cilician mosaics encompasses more than 150 individual panels from forty-two sites (Tülek 2004). Each site either constitutes a single structure carpeted with floor mosaics or is an ancient settlement yielding numerous structures decorated with floor mosaics. Some of these mosaics are available for hands-on examination, though most are inaccessible, and others are lost. The mosaic corpus documents the present state of Cilician mosaics and provides an account of the preservation methods (if any) (fig. 1). Among the preservation methods that have been recorded, reburial was the most common solution chosen in Cilicia. In some cases reburial was implemented as a temporary solution but turned out to be a long-term one.

Examination of the Cilician mosaics reveals two types of interventions: lifting mosaics to museums or leaving them in situ. Lifting was the least common. Eighteen floor mosaics from seven locations were lifted to museums. Of these, fifteen are on display; the others are stored. Nineteen floor mosaics from eleven sites have been categorized as "lost." This category comprises primarily those mosaics that were left in situ and could not be found during the field survey. They may have been looted or destroyed, or they may have deteriorated as a result of being exposed to the weather, as in the case of the mosaic left in situ at Imbriogon kome, whose tesserae disintegrated into "sugar lumps." Further, two of the Cilician floor mosaics were found in chunks, mixed into the soil during the cultivation of wheat and cotton fields.

The in situ mosaics have been found in the following five conditions:

- displayed in situ in a museum;
- reused as floors of modern village houses built over them;
- exposed without maintenance;
- recorded in the survey but not yet excavated;
- reburied.

The Misis, Narlıkuyu, and Anazarbus mosaics are displayed in situ as distant related exhibits of the local archaeology museums. The Misis and Narlıkuyu mosaics have received full conservation and restoration and are sheltered by protective structures built over them; the two figural panels of Anazarbus have been protected only by a shelter supported on four posts. Three of the in situ mosaics belong to a single monument and are being reused as the floors of present-day homes. These mosaics have been kept in fairly good

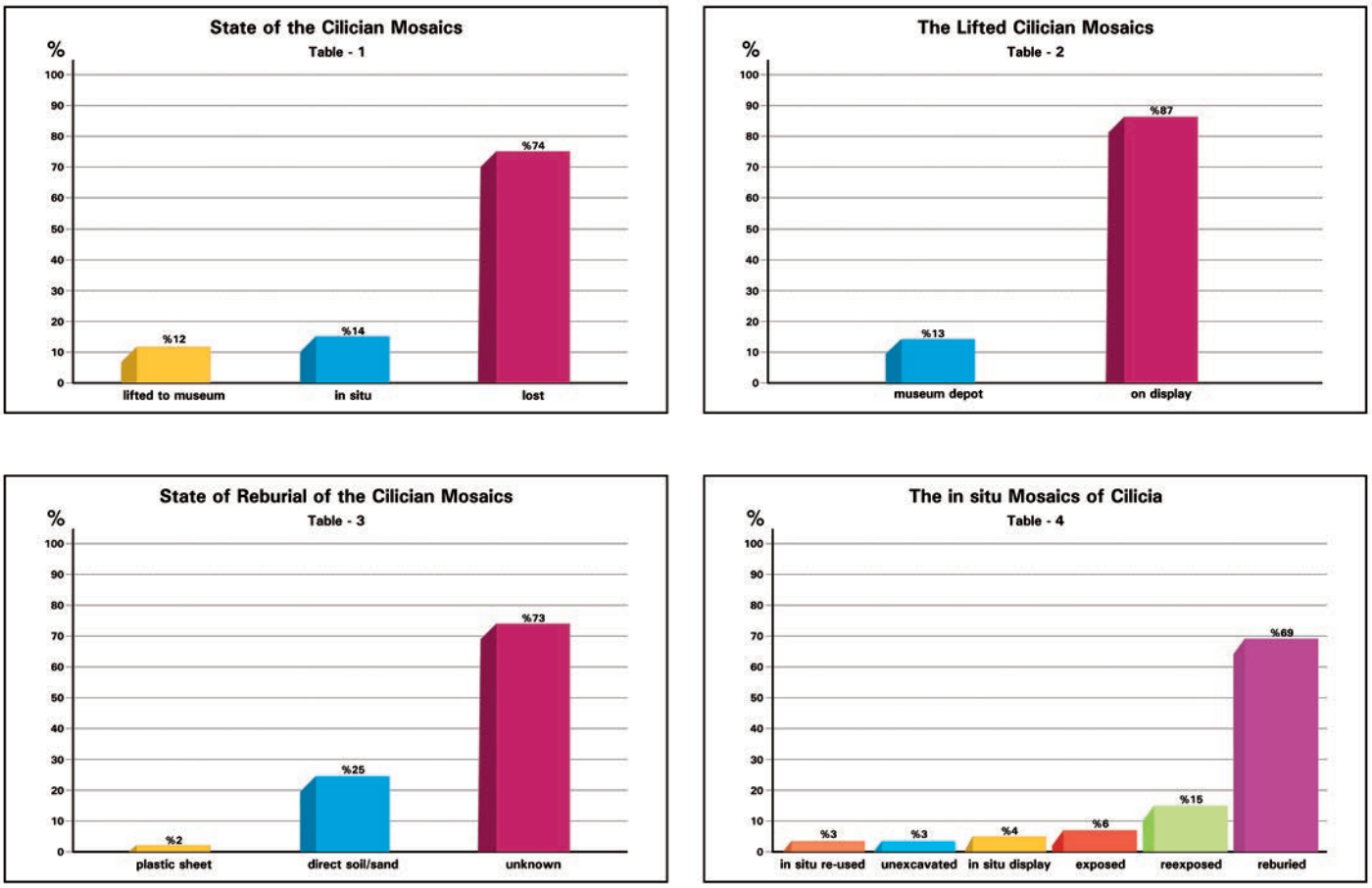


FIGURE 1 State of the Cilician mosaics.

condition compared to the exposed in situ floor mosaics, which have received little or no maintenance or protection. Five of the in situ floor mosaics have been exposed via natural causes or human vandalism, yet there has been no intervention to maintain and preserve them.

Reburied floor mosaics belong to twenty sites and number up to thirty-two mosaic panels. Some of the reburied mosaics have been reexposed. The reexposed mosaics come from sites such as Al Oda, Konacık, and the ancient settlement of Anemurium (figs. 2–4). The excavations of these sites have been concluded. These mosaics had once received consolidation



FIGURE 2 Anemurium mosaic.



FIGURE 3 Anemurium mosaic.



FIGURE 4 Anemurium mosaic.

and backfilling but were recently exposed due to erosion of the backfill by rains or the curiosity of tourists or tour guides. The present situation of the Anemurium mosaics indicates that reburial was chosen as the major strategy to preserve most of the floor mosaics, except for a few that were lifted to the museum.

The reburial practices implemented for these mosaics are varied. Since all the reburied mosaics are not available for examination—for example, those at Korykos, Meryemlik, and Dağ Pazarı—all the types of reburial are unknown. The mosaics available for examination have three backfill materials: sand, soil, and gravel. They were mostly used in direct contact with the mosaic surface. The use of a plastic sheet or geotextile as a horizon marker could not be detected. Maintenance and intervention records of these mosaics were not available for the present study. It was observed that the edges of the mosaic panels were consolidated with cement. Tall grass encloses these mosaic panels, some of which have been cracked and fragmented, and each fragment has also been surrounded by grass that dissects the mosaics and destroys the unity of the designs. However, there is no vegetation trailing over the surface of the mosaics. It is not clear whether pesticide was applied to the mosaics. On some, plastic sheets were used as horizon markers, though most of the sheets have decayed.

The Anemurium mosaics had no horizon markers on them. It is not clear whether they existed at the outset and were removed by the locals. However, the floor mosaic of Burial B1 16b at Anemurium had a deep backfill. The Alacami and Domuztepe floor mosaics were reburied with sand. The Domuztepe mosaic was covered with a layer of soil laid over the sand. Plastic sheet was not used in the maintenance and preservation of either mosaic. In Karlık a plastic sheet covers the mosaic, on top of which



FIGURE 5 Karlık mosaic.



FIGURE 6 Soli mosaic.

is a layer of sand (fig. 5). In Kadıpaşa and Güneyköy river sand is in direct contact with the surface of the mosaic. One of the two Kadıpaşa mosaics, the one reburied beneath the road, has also been covered with a deep layer of soil to protect it. The Ovacık floor mosaic is also covered with river sand in direct contact with the mosaic surface and has no plastic sheet for protection.

The mosaics at ongoing excavations such as Celenderis and Elaiussa are backfilled with sand and receive annual maintenance. Similarly, the Soli mosaic (fig. 6) receives annual maintenance and was initially covered with a plastic sheet, on top of which was a layer of sand. In this case the plastic sheet promoted deterioration by sealing the damp and humidity over the surface of the mosaic, already heavily damaged when found. Roots and moss covered the surface of the mosaics like a spider web. The tesserae of the mosaic were in flakes, making it impossible to discern the figures depicted on it. However, the other half of the mosaic, excavated during my study, was in a fairly good state, with some effects of salt and roots on the surface. After consolidation and maintenance, 12-denier-thick woven geotextile was used as the horizon marker.

In conclusion, archaeologists at Cilicia preferred to preserve the floor mosaics in situ by backfilling them. The decision-making process is not clear. However, it seems that the reburial practices were mostly intuitive. In particular, the reburials implemented with soil or sand in direct contact with the mosaic surface seem planned as short-term strategies. There is still the intention to display some of the mosaics as in situ exhibits. Practitioners are aware of the damage caused by plastic sheets, and there is a conscious tendency not to use them as horizon markers. The use of geotextile as horizon markers is quite new for Cilician mosaics. Future examination of the Soli mosaic will provide more experience in the application of this material in the region.

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The Lifting of a Mosaic from the Site of Letoon and Its Replacement with a Replica

Şehrigül Yeşil Erdek

Abstract: *When a mosaic floor is treated as an architectural decoration, the preferred method is to preserve it in situ, to be displayed as a whole in its architectural context. However, occasionally, for reasons such as weathering and insufficient protection, an in situ mosaic needs to be removed and displayed at a local museum. It is for these reasons that it was decided to lift the Letoon mosaic and preserve it in the Fethiye Archaeological Museum and replace it on-site with a replica in order to enable visitors to appreciate the mosaic in its original setting. This poster presents how these operations were carried out.*

Résumé : *Lorsqu'un pavement en mosaïque constitue un décor architectural, la méthode préférée est celle de la préservation* in situ, *afin de le montrer dans l'ensemble de son contexte architectural. Cependant, il arrive que pour des raisons liées au milieu ou à l'insuffisance de protection, une mosaïque* in situ *doive être déposée et exposée dans un musée local. Pour ces raisons, il a été décidé de déposer et de préserver la mosaïque de Letoon dans le musée et de la remplacer par une réplique afin de permettre aux visiteurs d'apprécier la mosaïque dans son cadre d'origine.*



FIGURE 1 The Temple of Apollo in Letoon with the original mosaic pavement in the foreground. Photo by the author, with the permission of Dr. Didier LaRoche, Letoon project director.

A mosaic was found during the excavation of the Temple of Apollo in the ancient city of Letoon/Lykia, near modern Fethiye in southwestern Turkey (fig. 1). The mosaic is 226.2 by 111.8 centimeters, and the area between the mosaic panel and the surrounding walls is paved with *opus signinum* consisting of lime-based mortar. The mosaic contains three symbols of Apollo in three individual panels: a bow and quiver, a rosette, and a lyre. The panel is framed by three bands, the central one of which is made of terracotta tesserae. Lead contours



FIGURE 2 The mosaic of the Temple of Apollo. Photo from Letoon Project archive with the permission of Dr. Didier LaRoche, Letoon project director.

were used to separate each figure and panel from the others (fig. 2).

Conservation Process

The conservation of the mosaic was carried out in five stages over a period of three years, 2003 to 2005. Due to weathering and insufficient protection, this in situ mosaic had to be removed and protected at the local museum. In order to show visitors the original decoration of the temple the mosaic has been replaced with a replica.

Documentation

Prior to the lifting process, the mosaic was photographed using planar photography. The photo-editing software Adobe Photoshop 7.0 was used to merge the obtained images so as to generate precise drawings of the mosaic using the latest CAD software. The colors of the mosaic were transferred to drawings generated from digital photographs using the same software.

Lifting the Original Mosaic

The mechanical strength of the terracotta tesserae was improved by applying the acrylic resin Paraloid B 72 at 10 percent in acetone by brush. A 6- to 7-centimeter-wide strip from the *opus signinum* pavement around the mosaic was removed. Cotton gauze and canvas were glued onto the mosaic surface with polyvinyl acetate. The mosaic was detached by inserting five metal rods, 150 centimeters long and spaced 40 centimeters apart, between the nucleus and the bedding layer. The wooden panel used for transportation and temporary storage was placed on the upper side of the mosaic and then turned upside down in order to lift the entire panel in one piece.

Replacement with the Replica

The original location of the mosaic was cleaned of the remaining mortar. New *statumen* and *rudus* layers were prepared and applied to the ground where the mosaic was located. In order to place the replica, a wooden frame was first temporarily fixed onto the *rudus* layer. As the replica was made in eleven sections, smaller temporary frames were formed insider the larger frame prior to placing each section. For each frame, the nucleus, bedding layer, and *tessellatum* layer were placed respectively. After placement, the smaller frames were removed and the same procedure applied for the other pieces. Lead strips were mounted to separate the main figures from each other as in the original mosaic (fig. 3). The space between the *opus signinum* pavement and the mosaic was leveled to obtain a smooth transition surface. Parts of the pavement damaged during the lifting process were reconstructed and indicated by creating a slightly different texture (fig. 4).

Conservation of the Original Mosaic

Conservation work was carried out in 2004. The mortar behind the tesserae was removed while the mosaic surface was sup-

ported by the cotton gauze/canvas already applied during the lifting process. Damage, such as cracks on lead strips, was strengthened by applying Paraloid B 72 at 10 percent in acetone by injection and brush. The *tessellatum* bedding layer was applied on the back of the mosaic using lime mortar. In 2005, after the curing process of the mortar was completed and it had reached adequate mechanical strength, the mosaic was glued to an aluminum honeycomb panel with epoxy resin, Eposet R5 and its hardener. The cotton gauze/canvas applied during the lifting process was then removed by a solvent mixture of alcohol:acetone:hot water (1:1:2). The space between the tesserae and tesserae surfaces was cleaned of the adhesive mechanically. Areas with lost tesserae were filled with new ones also used for the replica (fig. 5). Larger lacunae were filled with lime mortar (fig. 6). The composition of this mortar was sand, brick dust, and limestone dust (1:1:1) as aggregates and slaked lime and hydraulic lime (0.75:0.25) as binders. The mortar used to fill the lacunae was engraved in the form of tesserae so as to preserve the general aesthetic appearance.



FIGURE 3 The mosaic reproduction. Lead strips were mounted to separate the main figures from each other, as in the original mosaic. Photo from Letoon Project archive with the permission of Dr. Didier LaRoche, Letoon project director.



FIGURE 4 The replica mosaic on-site in the Temple of Apollo. Photo by the author, with the permission of Dr. Didier LaRoche, Letoon project director.

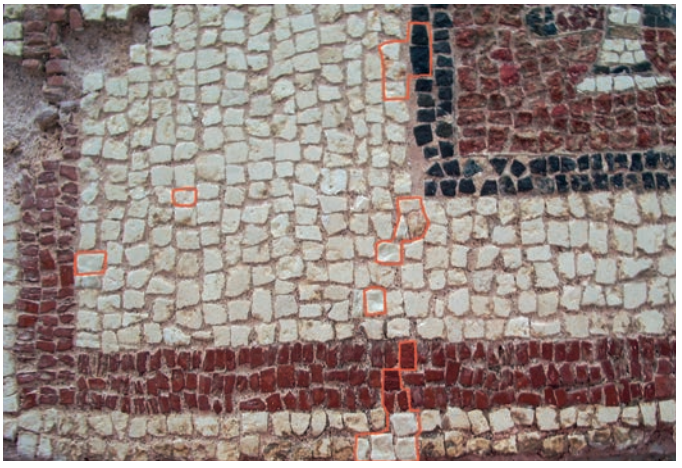


FIGURE 5 Areas of surface loss have been reconstructed with new tesserae. Photo by the author, with the permission of Dr. Didier LaRoche, Letoon project director.

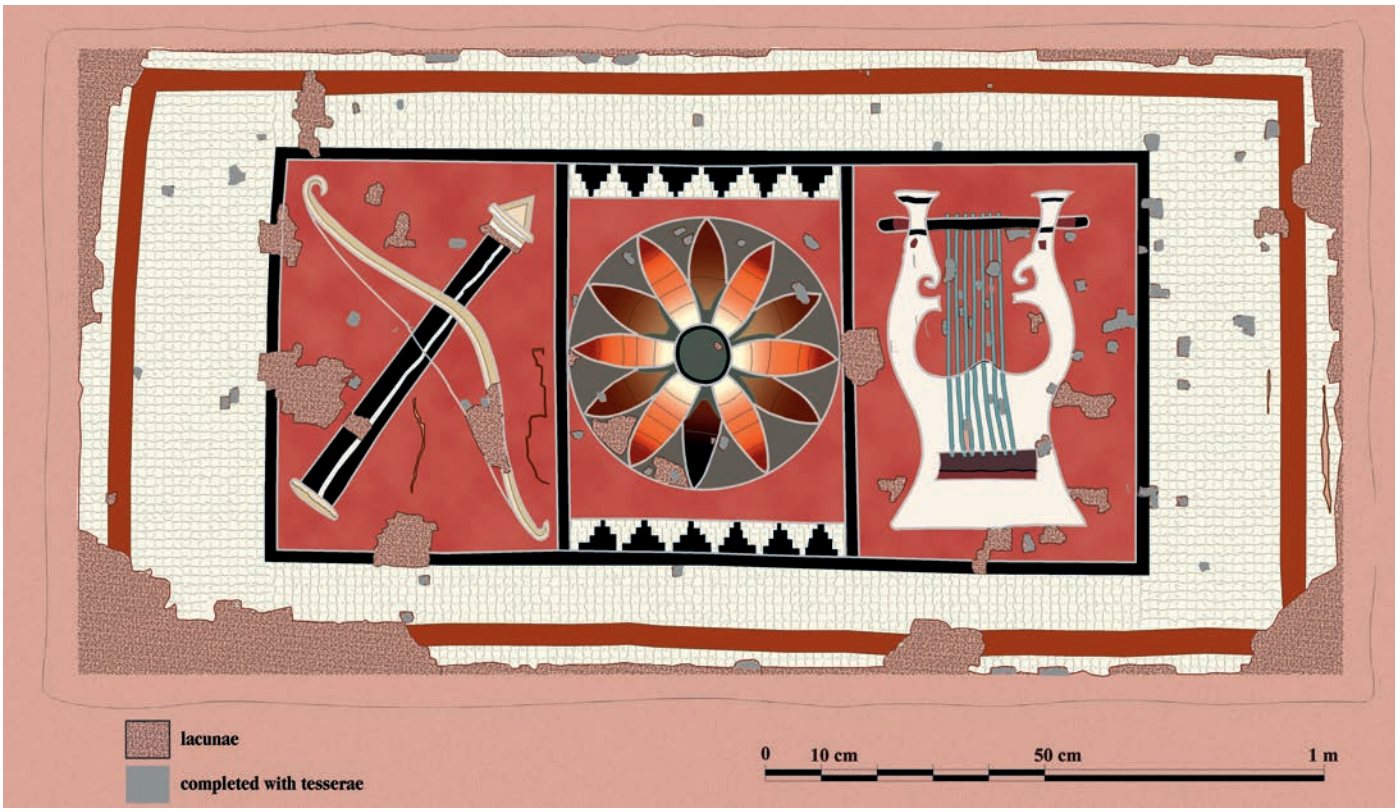


FIGURE 6 Graphic documentation of lacunae filled with mortar and those filled with tesserae. Drawing by the author.

Installation of the Original Mosaic in the Museum

The mosaic was moved to an exhibition hall in the museum and framed with specially constructed stainless steel (fig. 7). The metal construction used for the installation has been designed so that it can be easily dismantled from the mosaic. The mosaic was installed at a 10° angle from the floor for better viewing (fig. 8). The original function of the mosaic is described on the adjacent information panel.

Conclusion

The mosaic was small enough to be lifted as a single piece. This method conserved the lead strips that otherwise could have been damaged. Replacing the original mosaic with a replica enables visitors to appreciate the mosaic within its architectural environment in an ancient city. The materials used to conserve the mosaic were selected based on the compatibility of their mechanical, chemical, and aesthetic properties with the original. Mortar-filled lacunae were engraved in the shape of tesserae in order to obtain the continuation of the patterns, and small losses on the surface of the mosaic were filled with tesserae similar to those used in the replica to assure aesthetic unity. At the museum the installation of the mosaic and the information panel has been organized to direct visitors to the ancient city; and at the site the exhibition of the mosaic has been organized to direct visitors to the museum.

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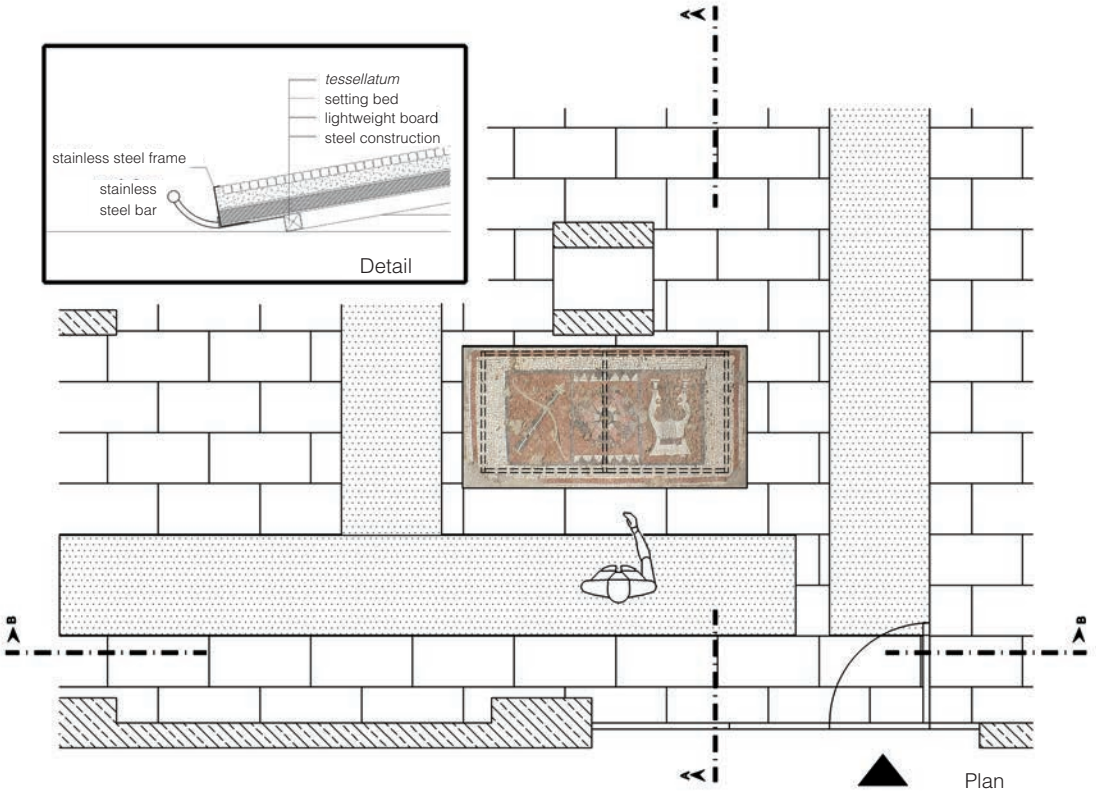


FIGURE 7 The installation plan of the original mosaic in the museum. Drawing by the author.

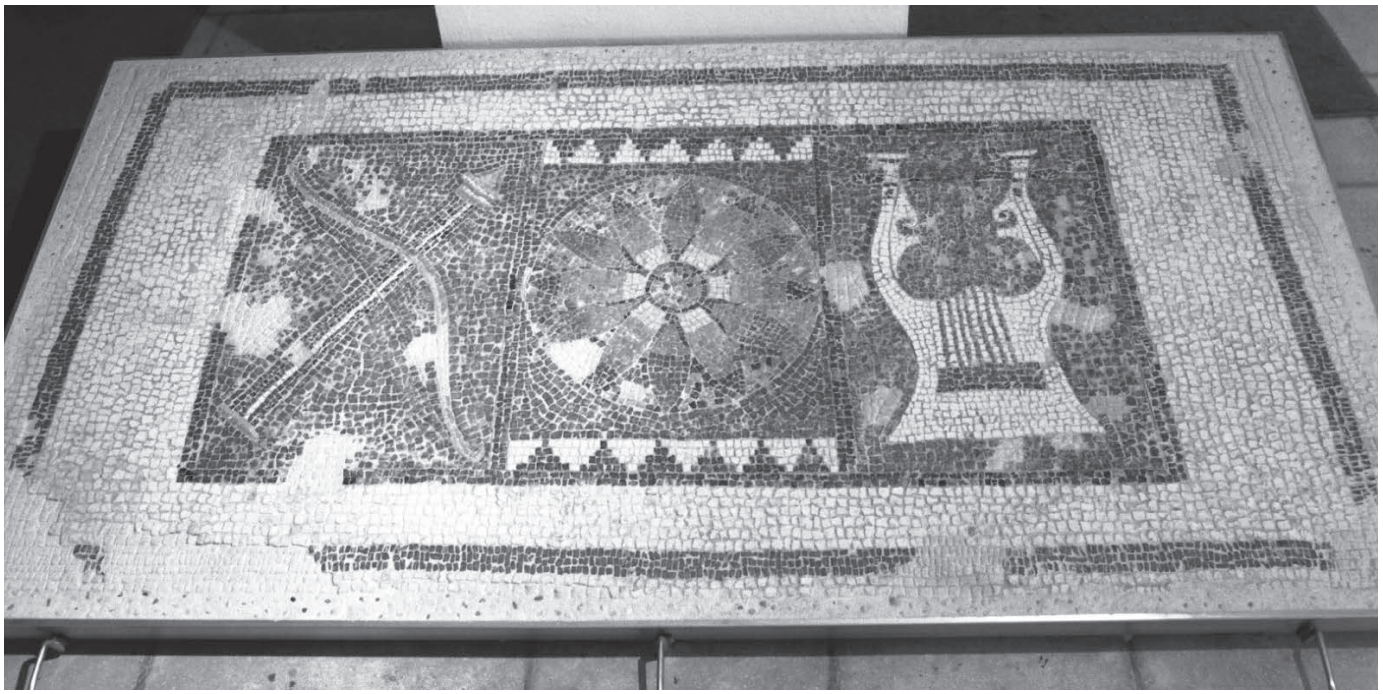


FIGURE 8 The original mosaic installed in the exhibition hall of the Fethiye Archaeological Museum. Photo by the author, with the permission of Dr. Didier LaRoche, Letoon project director.

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María Luisa Millán Salgado has a degree in fine arts (conservation and restoration) from the Universidad de Sevilla. She works as a restorer on excavations and in public institutions. She has been collaborating on various restoration and rescue interventions on Roman monumental and artistic heritage, such as mosaics and wall paintings. She also works in the restoration of historic altarpieces.

Antonia Moreno Cifuentes has worked in the restoration laboratory of the National Archaeological Museum of Madrid since 1992. She is a member of several scientific research projects on the conservation of archaeological sites, including a project on the Roman paintings of Tiermes, Spain, and the Spanish archaeological missions in Pompeii and Herakleopolis Magna, Egypt.

Roberto Nardi was trained in archaeology at the University of Rome and in conservation at the Istituto Centrale per il Restauro in Rome. In 1982 he founded the Centro di Conservazione Archeologica (CCA), a private company that undertakes conservation and training projects (in Italy, South America, the Middle East, and countries of the Mediterranean area), which emphasize in situ conservation, preventive measures and maintenance, and raising awareness of cultural heritage.

Jacques Neguer graduated from the Polytechnic of Sofia, Bulgaria, in 1986 with an M.S. in engineering science in chemistry. Between 1979 and 1992 he was conservator at the National Institute for Historical Monuments, Sofia. Neguer has also specialized in mosaics conservation at the Istituto Centrale per il Restauro (ICR), Rome, Italy. Since 1993 he has worked as a conservator in the Conservation Department of the Israel Antiquities Authority. He became head of the Art Conservation Section of the department in 1994. He has been a member of ICCM since 1996.

Juan Olives is a researcher at the French CNRS and also works at the Aix-Marseilles II University, France. He has a Ph.D. in physical mineralogy and specializes in condensed matter and nanosciences. He is the author of many papers on nanostructures and thermodynamic properties in minerals, especially clays.

Gaetano Palumbo is director of archaeological conservation at the World Monuments Fund. He was senior lecturer at the Institute of Archaeology of University College London from 2000 to 2002, when he also codirected the Volubilis project with Hassan Limane and Elizabeth Fentress. Previously, he was project specialist at the Getty Conservation Institute in Los Angeles.

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Ewa Parandowska is head of the Stone Sculpture Conservation Studio at the National Museum in Warsaw, Poland. She has fieldwork experience in the preservation and conservation of archaeological finds (architectural details, mosaics, wall paintings). She collaborates with the Polish Center of Mediterranean Archaeology, Warsaw University, and has participated in several conservation projects supervised by ICCROM, Leiden University, and the American Research Center in Cairo.

Magda Parcharidou-Anagnostou is a Ph.D. archaeologist in the 12th Ephorate of Byzantine Antiquities, Kavala (Hellenic Ministry of Culture). She specializes in Byzantine and post-Byzantine iconography (mosaics, mural paintings, and portable icons). She is also interested in the relationship between iconography and written sources (texts and inscriptions).

David Parrish received his Ph.D. in classical art history and archaeology from Columbia University. He is currently professor of art history at Purdue University. His research inter-

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Francesca Piqué received a degree in physical chemistry from the University of Florence and a postgraduate diploma in the conservation of wall paintings (1988–91) from the Courtauld Institute of Art, University of London. She also received an M.S. degree in science for conservation (1992) from the Courtauld Institute. From 1993 to 2004 Piqué was on staff at the GCI and worked on several projects in her dual role as conservator and scientist, including the earthen bas-reliefs at the Royal Palaces of Abomey; the hominid trackway in Laetoli, Tanzania; and the Cave 85 Project at Mogao, China. Since 2004 she has been based in Italy, working as a private professional in conservation.

Nikos Pitsalidis is a conservator in the Ninth Ephorate of Byzantine Antiquities (Hellenic Ministry of Culture).

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Konstantinos D. Politis, chair of the Hellenic Society for Near Eastern Studies, has directed several excavations in Jordan and Oman, most notably the Sanctuary of St. Lot about which a book has recently been published by the British Museum Press. He leads a heritage management program in Jordan, conserving mosaics from St. Lot's for exhibition in the new on-site museum that he has designed. Politis also coordinated the Syrian mosaic documentation program and is currently developing the Ras al-Hadd castle for visitors with the Omani government.

Giancarlo Raddi delle Ruote has been technical director and a teacher at the Opificio delle Pietre Dure (Florence) since 1978. He works in the Department of Restoration of Mosaics and is an expert in Florentine *commesso* technique. He has supervised many mosaic restoration interventions in Italy and abroad. In addition, he collaborates as lecturer and adviser with many institutions and universities.

Thomas Roby is an architectural conservator with training from the University of Virginia, the University of York, and ICCROM. He has worked for twenty years on archaeological sites in the Mediterranaean area, primarily as a private conservator on excavation projects. Since 2001 he has worked for the Getty Conservation Institute and has managed the training project for mosaic maintenance technicians in collaboration with the Institut National du Patrimoine of Tunisia.

Andrea Ruffini has a Ph.D. in chemistry from the University of Bologna and in 2004 undertook a postdoctorate at the CNR's Institute of Science and Technology for Ceramics in Faenza, Italy. Ruffini's major research interests are chemical, physical, and structural studies of ceramic materials, stones, glass, and pigments; and developing and applying combinatorial nondestructive and micro-destructive methods for ancient ceramics.

Derya Şahin received her doctorate in classical archaeology from the Science and Literature Faculty at Selçuk University in Konya. She is currently a lecturer in classical archaeology in the Science and Literature Faculty at Uludag University in Bursa. Her research interests include Roman mosaics.

Mustafa Şahin received his B.A. in 1985 from Atatürk University. His M.A. thesis is titled "Hermogenes" (1988), and his Ph.D. dissertation is titled "Grave and Votive Steels from Miletopolis" (1994). In 1990 he was a research assistant in the Archaeology Department at Selçuk University and became a professor in the department in 2003. Currently, he is head of the Archaeology Department and director of the Center of Mosaic Research (AIEMA-Turkey) at Uludag University.

Sara Santoro is a professor of Greek and Roman archaeology at Parma University. Since 2004 she has been scientific director of the Italian archeological mission in Dürres, Albania. She has directed archaeological excavations in Pompeii and in

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Elyas Saffaran est directeur du département d'archéologie et d'art de l'Université de Sharekord, Iran, où il est également professeur après avoir dirigé le département de conservation et de restauration de l'Université d'Art de Téhéran. Titulaire d'un doctorat en archéologie et art, il est membre du comité scientifique de plusieurs universités à Téhéran et fait partie de plusieurs centres de recherche et d'associations scientifiques. Auteur de plus de 55 articles scientifiques dans des revues et magazines scientifiques et lors de conférences nationales et internationales, il a aussi publié plusieurs livres.

J. M. Monraval Sapiña est archéologue diplômée de l'Université de Valence, Espagne, et spécialisée en conservation-restauration de mosaïque et peinture murale.

Niki Savvides is currently a research student at the Institute of Archaeology, University College London (UCL). She received her master's degree in managing archaeological sites in 2002 from the Institute of Archaeology, UCL. Her M.A. thesis was titled "Methods of Protection of Mosaics Floors in the Mediterranean: An Overview of Current Practice."

Y. Selçuk Şener received his B.A., M.A., and Ph.D. degrees from the Department of Art History, Ankara University. He studied archaeological conservation at the College of Antonino de Stefano in Sicily and received a certificate in conservation of stone (from the Istituto Centrale per il Restauro, Rome) and in wall paintings (from the Centre d'Étude des Peintures Murales Romaines [CEPMR], Soissons, France). In addition to teaching, he is director of the Restoration and Conservation Program and vice-director of Baskent Vocational School at Ankara University.

Kent Severson completed conservation training at the New York University Institute of Fine Arts Center for Conservation and Technical Studies in 1985. Since then he has participated in fieldwork in Greece, Turkey, and Egypt and is currently senior field conservator for the New York University Aphrodisias Excavations. He maintains a private conservation practice in Boston, Massachusetts.

Taghrid Shaaban, an expert in mosaic art, is a professor at the Damascus University in Syria. Since 2003 she has been the local coordinator for Syria of the Bilad al-Sham training course in ancient mosaic restoration.

Isabelle Skaf is a conservator who began art history studies in the United States and then graduated from the University of London (B.Sc. archaeological conservation, 1985). Formerly, she was head of the Conservation Laboratory at the Directorate General of Antiquities, Lebanon. She has completed an M.B.A. at the École Supérieure des Affaires in Beirut. Currently in private practice, she is working on archaeological material and sites and coordinating conservation projects.

John Stewart is senior architectural conservator at English Heritage, London, and board member of the International Committee for the Conservation of Mosaics. He has experience with mosaics throughout England and the Mediterranean and is undertaking a survey of shelters in England.

Jeanne Marie Teutonico is associate director, Programs, at the Getty Conservation Institute in Los Angeles. An architectural conservator with over twenty years of experience in the conservation of buildings and sites, she was previously on the staff of the International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM) in Rome and later of English Heritage in London.

Sibylla Tringham completed her M.A. in the conservation of wall paintings at the Courtauld Institute in 2004. After working briefly at English Heritage, she undertook an internship at the Getty Conservation Institute, where she joined the Conservation of Mosaics in Situ project team. Tringham is a freelance conservator currently working with the Courtauld Institute on projects in India and China.

C. Mei-An Tsu is an associate conservator in objects conservation at the Museum of Fine Arts, Boston. She graduated from the University of Delaware/Winterthur Museum with an M.S. in art conservation in 1995. She specializes in the conservation of archaeological materials and has worked as a field conservator in Turkey, Pakistan, Israel, and Honduras.

Füsun Tülek received a B.A. in fine arts at Dokuz Eylül University, İzmir, in 1984 and an M.A. in the history of art at Ege University, İzmir, in 1996. In 2004 he received his Ph.D. from the University of Illinois at Urbana-Champaign. Tülek currently teaches the history of architecture and art, mythology, and humanities at Kocaeli University.

Styliani Vassiliadou is an archaeologist with the Ephorate of Byzantine Antiquities of Eastern Macedonia and Thrace. He received a master's degree in Byzantine archaeology from Aristotle University in Thessaloniki and is currently a Ph.D. candidate in Byzantine archaeology there.

Paolo Veronesi has a Ph.D. in materials engineering from Modena and Reggio Emilia University, where he has been a researcher in metallurgy since January 2005. His research activity is focused on materials science, studying and experimenting with new processing routes using microwave-assisted heating and electromagnetic field-matter interaction modeling. He is the author of more than fifty papers on metallic and ceramic materials processing and characterization.

Robert (Chip) Vincent Jr., as cultural heritage manager at the American Research Center in Cairo, Egypt, directed more than fifty conservation projects (most now completed) over a period of twelve years. He was educated at Yale University and the University of Pennsylvania Law School and pursued a career in archaeological and conservation fieldwork and project management, mostly in the Middle and Near East. For five years he was president of the Institute of Nautical Archaeology at Texas A&M University.

Şehrigül Yeşil Erdek has an undergraduate degree from Mimar Sinan University, Institute for Architectural Restoration, and a graduate degree from Istanbul University's Department of Restoration and Conservation of Artifacts. She specializes in the conservation of mosaics and wall paintings.

Denis Weidmann est archéologue cantonal depuis 1977, responsable du patrimoine archéologique du Canton de Vaud, Suisse, où il est chargé de la protection et de la conservation des sites, de l'organisation des interventions et des études. Après des études classiques et scientifiques et une Licence en sciences naturelles, il mène, depuis 1963, des investigations archéologiques en Suisse et en Égypte (archéologie préhistorique, gallo-romaine, copte, médiévale).

Konstantinos L. Zachos is an archaeologist specializing in Aegean prehistory and Roman archaeology and the region of Epirus. After graduate studies at Boston University, he entered the Greek Archaeological Service. Since 1998 he has been director of the 12th Ephorate of Prehistoric and Classical Antiquities in Ioannina and president of the Scientific Committee of Nikopolis at Preveza. He has excavated widely in Epirus, the Peloponnesus, and, most recently, Albania.

Chiara Zizola is certified in paintings and mosaics conservation from the Istituto Centrale per il Restauro in Rome (ICR). She is a senior conservator and project manager at the Centro di Conservazione Archeologica (CCA), Rome, where she has been employed since 1989. She has led several conservation projects in the Middle East.

List of Conference Participants

Affiliations are given as of the time of the conference.

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First name	Last name	Affiliation	Country
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Denis	Weidmann	Archéologie Cantonale, Vaud	Switzerland
Timothy	Whalen	Getty Conservation Institute	USA
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Julie	Wolfe	J. Paul Getty Museum	USA
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Figure 2. Courtesy Society of Antiquaries, London.

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Figure 4. Courtesy of Ramboll.