

Mosaics In Situ

An Overview of Literature on
Conservation of Mosaics In Situ

Edited by
Thomas Roby and Martha Demas



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THE GETTY CONSERVATION INSTITUTE
LOS ANGELES

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The Getty Conservation Institute works internationally to advance conservation practice in the visual arts-broadly interpreted to include objects, collections, architecture, and sites. The GCI serves the conservation community through scientific research, education and training, model field projects, and dissemination of the results of both its own work and the work of others in the field. In all its endeavors, the GCI focuses on the creation and delivery of knowledge that will benefit the professionals and organizations responsible for the conservation of the world's cultural heritage.

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Foreword

This review of the literature on mosaic conservation emanates from the Getty Conservation Institute's (GCI) many projects related to mosaics beginning in the mid-1980s, and currently under the umbrella of the [MOSAIKON Initiative](#). The aim of these projects has always been to enhance the conservation of ancient floor mosaics (Roman, Byzantine, and early Islamic) in archaeological sites, through contributing to a better understanding of their causes of deterioration; developing methods and approaches to their maintenance and conservation; and improving the skills of technicians and professionals in the areas of maintenance, conservation, and management.

As a basis for pursuing these goals, on-going review of the literature on conservation of in situ mosaics has been undertaken over the years. These have served both as a prerequisite for understanding past practice and the current state of knowledge and for identifying new trends and areas in need of further research, testing, and development. Earlier versions of these reviews have informed workshops, experts' meetings, training courses and project needs. The current compilation of reviews embraces the principal practices of mosaic conservation from published works through 2007.

Although long overdue, we trust this review of the literature is a solid contribution to the field of mosaic conservation that can be built upon in the future, much as this work benefited from the critical review of the literature through 1988 published in 1994 (Nardi 1994).

Jeanne Marie Teutonico

Acknowledgements

The literature review on conservation of mosaics in situ is the result of a team effort with contributions by various Getty Conservation Institute staff (current and former), consultants, and interns over the years. Oversight and editorial review were undertaken by Thomas Roby and Martha Demas. The various sections of the review were written by Rachel Burch (GCI consultant), Martha Demas, Gaetano Palumbo, Francesca Piqué, and Thomas Roby. Elsa Bourguignon, Leslie Friedman, Alice Paterakis (consultant) and GCI interns (former) Chris de Brer, Bettina Lucherini, Kenza Kahrim, Ben Marcus, Sibylla Tringham, and (current) Juana Escobar contributed significantly to research and review, bibliographic selection and updating of annotations. Bibliographic searches and verification of citations were done by Valerie Greathouse, GCI Information Center. And finally, but most gratefully, appraisal and critiques of various sections of the literature review were undertaken by Neville Agnew, Livia Alberti, Eric Hansen, Demetrios Michaelides, Giorgio Torraca, and Denis Weidemann.

Introduction to the Literature Review

To categorize, synthesize, and essentialize a body of published work in a particular area of study – a literature review – is a highly valued endeavor, but one that often proves difficult to achieve as originally envisioned and scheduled. This review is no exception. It has been (too) many years in the making and has altered in its original scope. Initial results of the review on deterioration and treatment of mosaics were disseminated at the 9th ICCM conference in Tunisia and have been published (Ben Abed et al. 2008), an earlier version of the annotated shelter bibliography was published in 2001 (CMAS 2001), and other sections were initially developed for training courses or an experts' meeting. The full literature review consists of six chapters, each with a distinct subject category and associated bibliography, current through 2007 (with a few 2008 exceptions noted, such as the publication of the 9th ICCM conference). The completed chapters will be uploaded as they emerge from their final edit.

The selection of the six subject categories was based on the practice of conservation on mosaic sites and the perceived needs of the field, but also, in the case of Inventories and Corpora, the need to better understand the geographic extent and concentration of the mosaic heritage. The content and coverage of these subject categories are briefly described below. They vary in format and style, reflecting varied authorship and the purpose or audience for which they were originally conceived and written.

Chapter 1. Inventories and Official Corpora of Mosaics (currently available)

A review of existing inventories and Corpora in all countries where ancient floor mosaics have been recorded was undertaken to better understand the global mosaic resource; the existence and type of conservation criteria included in the inventories; and the potential use of inventories as a regional management tool and as a basis for discerning patterns of preservation and deterioration. The result is a compilation and brief analysis, according to a standard format, of published inventories, surveys and official Corpora through 2007.

Chapter 2. Causes of Deterioration (forthcoming)

Understanding the causes of deterioration of mosaics is fundamental to developing methods of treatment and protection. The review of the literature on deterioration brings together the main citations specific to mosaics and attempts to synthesize the state of knowledge and the research and investigation undertaken to date. It also brings

forth where the greatest need for study in the future lie, most notably emphasizing the lack of explicit research into deterioration processes for mosaics.

Chapter 3. Conservation Treatments and Maintenance (forthcoming)

The review of the literature regarding in situ conservation interventions details current and past practice, while at the same time illustrating overall approaches to the challenges of conserving mosaics in the archaeological context. Increasingly, maintenance treatments are implemented to respond to these challenges and are included in this section of the review. Citations through 2007 are organized in text and table form to elucidate the development and stasis of treatment methods and materials over time.

Chapter 4. Protective Shelters for Archaeological Sites (currently available)

The review of the literature on protective shelters is structured differently than the other reviews, having begun its life as a comprehensive annotated bibliography on shelters over archaeological sites. Originally compiled in the early 1990s for a training course, the bibliography has been updated over the years, currently through 2007 (an earlier version was published in *CMAS* 2001). The more comprehensive scope and the use of annotations have been retained in subsequent updates. While the bibliography is not specific to mosaic sites, citations relevant to shelters built to protect mosaics are identified and constitute a large percentage of the citations.

Chapter 5. Reburial and Protective Covering of Mosaics (currently available)

The protection of mosaics by reburial or the use of shallow covering (surface protection) is a well established practice in the conservation tool box for mosaics. Although there exists a wider literature on reburial of archaeological remains, this review only considers literature specific to mosaics. The review looks at the literature over two periods (pre-1990 and post-1990) to reveal the trends toward an increasing use of reburial and shallow covering as a method for both short and long-term preservation, and more experimentation with materials and methods, but it also reveals the weaknesses in methods, materials and publication and evaluation of work undertaken.

Chapter 6. Training and Awareness (forthcoming)

The overview on Training and Awareness was compiled for an experts' meeting on mosaic conservation held in Nicosia, Cyprus in 2002 in order to provide participants with background information to assess the needs. The overview includes an annotated bibliography and a List of Training Programs and Initiatives Relevant to Mosaics Conservation. The bibliography and list of programs were compiled from both published and unpublished reports and have been updated through 2007. It is included here as a summary of available information on mosaic conservation training and a useful reference.

The basis for the literature reviews were bibliographic searches on mosaic conservation through 2007, resulting in a database of the relevant literature in which references were key-worded to aid searching and categorization. Conservation of mosaics is part of a larger field of archaeological site conservation, to which the GCI has contributed for several decades. This larger field of endeavor informs the literature reviews (especially that of shelters, which includes non-mosaic sites) but limitations were of necessity imposed. The bibliographic searches were focused on in situ ancient floor mosaics and thus exclude the literature on lifting and relaying of mosaics, as well as the extensive non-mosaic-specific literature on materials (e.g. stone, glass, lime), treatments, deterioration studies, and conservation and management of archaeological sites generally, all of which are highly germane to mosaic conservation, but encompass a far greater field of study. Each of the reviews is accompanied by the bibliographic citations selected and consulted.

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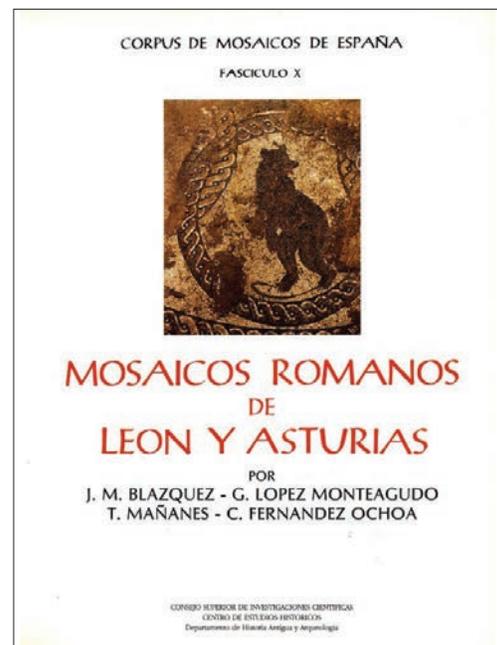
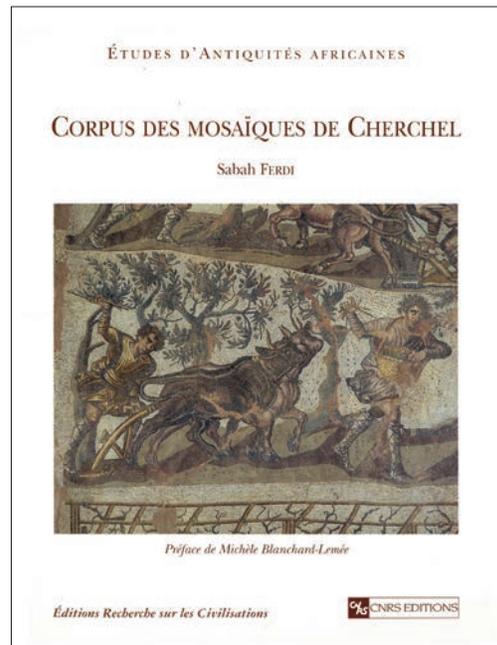
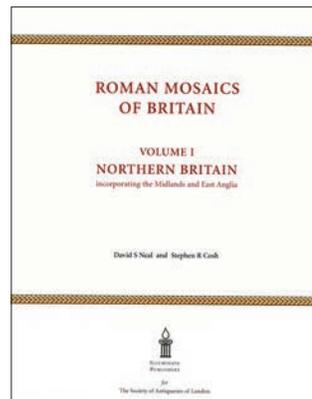
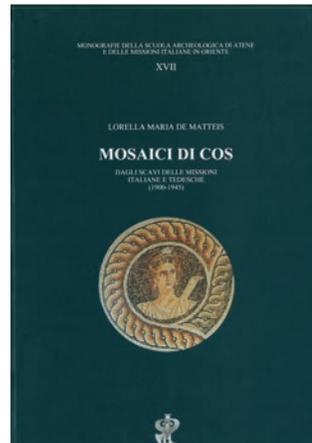
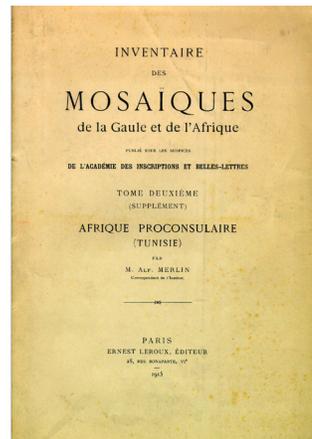
References

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- Ben Abed, Aicha, Martha Demas, and Thomas Roby (eds). 2008. *Lessons Learned: Reflecting on the Theory and Practice of Mosaic Conservation (Proceedings of the 9th ICCM Conference. Hammamet, Tunisia, November 29-December 3, 2005 = Leçons retenues: Les enseignements irés des expériences passées dans le domaine de la conservation des mosaïques: Actes de la 9^{ème} conférence de l'ICCM, Hammamet, Tunisie, 29 novembre–3 décembre 2005*. Los Angeles: Getty Conservation Institute
- CMAS. 2001. Protective Shelters, Special issue, *Conservation and Management of Archaeological Sites* 5 (1 & 2).

CHAPTER 1

Inventories and Official Corpora of Mosaics

Gaetano Palumbo and Martha Demas



Photos of book covers, clockwise from upper left: *Inventaire des mosaïques de la Gaule et de l'Afrique*, 1915; *Corpus des mosaïques de Cherchel*, 2005; *Corpus de mosaicos romanos de España, Vol. X. Mosaicos Romanos de León y Asturias*. 1993; *Roman mosaics of Britain, Vol. I*, 2002; *Mosaici di Cos dagli scavi delle missioni italiane e tedesche (1900-1945)*, 2004.

Inventories and Official Corpora of Mosaics

Introduction

The description and analysis of corpora and inventories of mosaic pavements was undertaken in order to assess the extent to which the global heritage of ancient mosaics has been recorded and the level of information in such inventories related to conservation. The initial compilation for this review was done in 1999, with further updates and revisions undertaken through 2007 (corpora publications after 2007 are noted). The review includes a catalogue of the corpora and general inventories of mosaics principally from the Hellenistic, Roman, and Byzantine periods published in all countries where ancient mosaic pavements exist. Some inventories include wall mosaics but the focus in most inventories and in this review is on floor mosaics (mosaic pavements), notably those constructed in opus tessellatum and opus sectile. The extent to which other mosaic pavement types (e.g. opus signinum, opus figlinum, pebble mosaics, etc.) are included in corpora and inventories has not been analyzed.

Only six countries (Britain, France, Italy, Portugal, Spain and Tunisia) have well-established official mosaic corpora, which are either still in publication or completed (Britain). Other inventories are the result of the efforts of one or more scholars, who have attempted or are attempting the compilation of a corpus. This is the case for Algeria, Egypt, Germany, Greece, Israel, Switzerland, and Turkey, which has recently re-started its corpus project. A few corpora are too old to be considered valid as far as the present condition of mosaics is concerned. They are nonetheless a very important historic tool when used to assess the present state of the resource, and they have been mentioned here; such is the case for Algeria (whose corpus is dated to 1911, but with a recent revival by Ferdi for the site of Chercel), Belgium (1909, 1957, and 1960), Israel (1933–1935 and 1975), and Switzerland (1961). For all countries AIEMA bulletins (*Bulletin de l'association internationale pour l'étude de la mosaïque antique*), which provide bibliographic references about mosaics, are cited through 2007 (Volumes 1-21:1968–2009). Finally, there are numerous studies of independent scholars who have catalogued mosaics in certain sites or regions. These are especially important where no official corpus exists.

Computerized inventories of archaeological and historic heritage that are being established in various countries do, in some cases, list mosaics, but the conservation information is often lacking or insufficient. In the case of the Jordan Database, MEGA-Jordan, for example, the only information available is whether mosaics are present at a site. Mosaic-specific databases, such as that established for the site of

Augusta Rauricorum in Switzerland, and proposed for Syria, are similar in structure to traditional corpora.

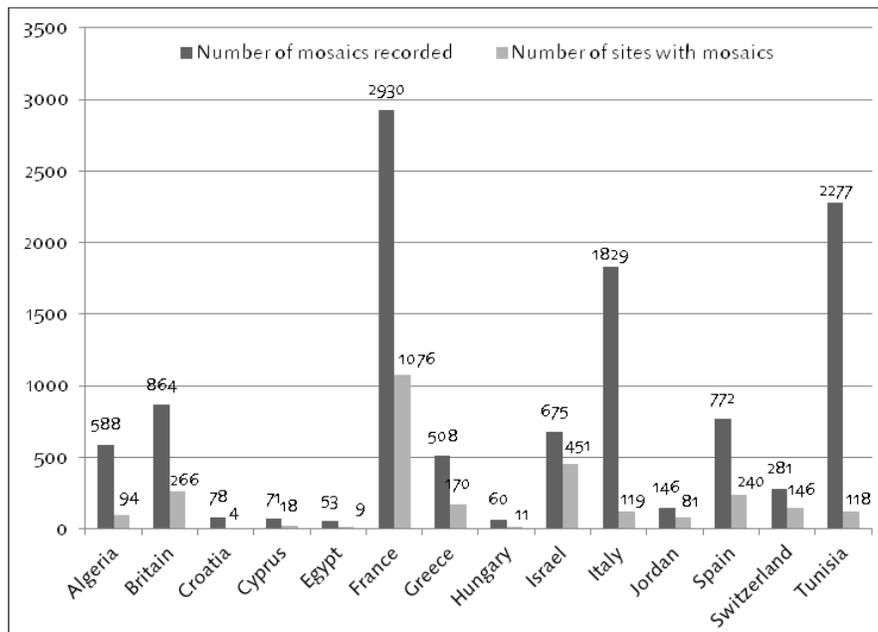
We seem to be in an uncertain transitional period in terms of the creation and continuation of corpora and inventories. The long established corpora and fairly comprehensive regional or country-wide inventories were developed for an art historical and archaeological purpose and were most actively pursued through the 1980s, but seem to have waned or come to a halt in recent decades (France's *Recueil* through 2000; Italy's *Mosaici Antichi* through 1994; Tunisia through 1999); however, others have remained active (Spain's *Corpus de mosaicos* with the most recent publication in 2011 and Britain's sprint to the finish with the completion of its corpus in 2010). Electronic databases have yet to replace them. The database described as being established in Turkey appears to be a working updatable complement to the publication in traditional paper format. Integrating inventories of mosaics into broader archaeological databases has much to recommend it, but until this happens there may emerge a hiatus during which we will have lost considerable information about the number, distribution and status of mosaics.

Very few inventories have conservation information. The only one that explicitly and consistently states whether conservation was performed on a mosaic and the condition of that mosaic when recorded is the Italian corpus (*Mosaici Antichi in Italia*). Most, however, indicate at least the location of the mosaic at the time of recording (whether in situ, in a museum, or lost); a few also indicate whether the mosaic is reburied or under shelter. Inventories are a time-capsule of information and since updating is not part of the process, the condition, location and treatment of the mosaics needs to be seen as a product of its time. This limitation highlights the potential importance of electronic databases, which, in theory at least, are easily updatable. Nevertheless, these inventories are invaluable for regional and site-level assessments as a basis for understanding the state of preservation as well as for gauging the overall trends in mosaic conservation. An example of this is the use of a catalogue of 123 mosaics based on a specific motif (inhabited scroll) and region (Levant) to assess their fate since the time of discovery (Nicholas Stanley Price. 1985. Patterns of survival among some Byzantine floor mosaics in the Levant in *Mosaics no. 3 Conservation in Situ Aquileia* 1983, 49-55. Rome: ICCROM.)

In the catalogue that follows, countries are listed in alphabetical order. Some inventories cover more than one country, and these are indicated; a few countries have changed their names or territories, and these are noted. A brief introductory note explains whether an official corpus is established in the country or not, and whether there are other survey type publications available. These publications are listed in chronological order, generally with a note that includes the structure or intent of the

catalogue. Catalogue entries that have some conservation relevance are presented in bold characters.

The reference to the number of mosaics published in the individual country entries has to be taken with caution. In some inventories each mosaic panel is presented as one mosaic, in others an entire complex is considered one mosaic and each panel is given a sub-number, thus making the count questionable, especially when several overlapping inventories have been published. Nevertheless, the approximate total number of mosaics catalogued in the initial survey undertaken in 1999 and updated through 2007 (**11,132 mosaics** in **2,803 sites**), which excludes Byzantine and medieval wall mosaics, gives a rough indication of the size of this heritage, considering that what is catalogued is usually 'the tip of the iceberg' of a largely unknown patrimony. The number of lost mosaics is also impressive (the number mentioned above includes them) and in some cases amounts to 70 or 80% of the total. In Sardinia, where the catalogue includes conservation information, 50% of the mosaics are lost and only 13% are in relatively good state of conservation. A similar picture is common elsewhere.



The chart shows the estimated number of catalogued mosaics (as of 2007) for countries that have either an established corpus, or publications that have attempted some form of catalogue or survey. The extent to which these numbers reflect the industry of the catalogers in certain countries or the reality of mosaic-making in the ancient world we leave to the scholars for comment. What is clear, however, is the important role played by official corpora and especially by the scholars who dedicated themselves to producing them, in documenting the existence of ancient mosaics, so many of which have been lost or are endangered.

List of Corpora and Inventories by Country

AFGHANISTAN

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Afghanistan: Nos 5:37; 7:74; 9:204; 11:115. References include articles on the Hellenistic mosaics found at Ai-Khanum, a city founded by Alexander the Great.

ALBANIA

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Albania: Nos 1:17; 2:27; 5:39; 6:68-70; 7:76-79; 8:86-87; 9:206-208; 11:117-119; 12:117-118; 13:157-159; 14:112; 15:124-127; 16-500; 17:512-516; 18:579-583, 612; 19:413-418; 20:434-440; 21:961-969. The mosaics of Butrint in particular have received attention.

ALGERIA

No official corpus. Publication no. 1, dated to 1911, is the only attempt at a complete inventory of the mosaic heritage in Algeria. Publications nos 2 and 3 are site-specific inventories. The three inventories provide information about **745 mosaics** in **94 sites**.

The AIEMA bulletin supplies bibliography for mosaics found in Algeria: Nos 1:17-21; 2:28-33; 3:41-47; 5:40-43; 6:70-75; 7:79-82; 8:87-90; 9:208-211; 11:119-122; 12:118-120; 13:159-160; 14:113; 15:128-129; 16:501-505; 17:517-520; 18:584-591; 19:419-427; 20:441-449; 21:955, 957, 970-980.

1. *Inventaire des mosaïques de la Gaule et de l'Afrique*. Paris: E. Leroux.

Tome III - M.F.G. de Pachtère. 1911. *Afrique Proconsulaire, Numidie, Maurétanie (Algérie)*.

This inventory contains information about **458 mosaics** in **94 sites**. The structure is similar to the other volumes of the *Inventaire* (see France):

- Number
- Name of site
- Location within site
- When found
- Dimensions of mosaic
- Description of mosaic

- **Present location (in situ, in museum, lost)**
- Bibliography

2. S. Germain-Warot. 1969. *Inventaire des mosaïques de Timgad*. Paris: CNRS.

This inventory contains information about **235 mosaics** from Timgad. **105** of these mosaics were already published in the *Inventaire*. The catalogue contains the following information:

- Number
- Location within site
- Mosaic dimensions
- **Present location (in situ, in museum, lost, etc.)**
- Description
- Bibliography

3. S. Ferdi. 2005. *Corpus des mosaïques de Cherchel*. Paris: CNRS.

This inventory contains information about **195 mosaics** from Cherchel; only 8 are still in-situ, the others are in the Musée National des Antiquités d'Alger and in the Parc de la mosaïque de Cherchel. (The mosaics of Cherchel were found in 30 vast private houses, 2 baths, 2 mausolea, a civil basilica and a Christian basilica). **38** of these mosaics were already published in the *Inventaire*. The catalogue contains, when available, the following information:

- Location
- Number
- Date and circumstances in which the mosaic was found
- Mosaic dimensions when it was found
- Actual mosaic dimensions, colors, materials and tesserae density
- **Present location (in situ, in museum, lost, etc.)**
- Description
- Bibliography
- Illustrations and references to illustrations already published
- Proposed dating
- Bibliography

ARMENIA

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Armenia: Nos 1:98; 2:123; 5:184; 6:257; 8:243; 9:402; 11:292–294; 13:344–345.

AUSTRIA

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Austria: Nos 1:27-28; 2:34-35; 3:48-49; 5:45-46; 6:80-81; 7:86-87; 8:94; 9:213-214; 11:124; 12:121; 13:161-163; 14:113; 15:130; 17:521-527; 18:605-607; 19:443-444; 20:456-459; 21:1997-1004.

BELGIUM

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Belgium: Nos 1:28; 3:49-50; 5:46-47; 6:82-83; 7:88-89; 8:95; 9:214; 11:125; 12:122; 13:163; 14:114; 15:130-131; 17-594; 21:1006.

Publications no. 1, dated to 1909, and no. 2, dated to 1957-1960, include some sites in Belgium as part of a comprehensive corpus of the Gallia region.

1. *Inventaire des mosaïques de la Gaule et de l'Afrique*. Paris: E. Leroux.

Tome I, 2 - A. Blanchet. 1909. *Lugdunaise, Belgique et Germanie*. See under France

2. *Recueil général des mosaïques de la Gaule. Supplément a "Gallia."* 1957-1960 Paris: CNRS.

Volume I, 1 - H. Stern. 1957. *Province de Belgique, Partie Ouest*.

Volume I, 2 - H. Stern. 1960. *Province de Belgique, Partie Est*.

See under France. Volume I, 1 contains information about mosaics in **9 sites**,

Volume I, 2 contains information about mosaics in **23 sites**.

BOSNIA and HERZEGOVINA (Bosnia prior to 1992)

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Bosnia: Nos 1:98-100; 2:123-124; 3:200; 8:245-246; 9:403-412; 11:295-296; 12:239-245; 16:521-524; 17:591.

BRITAIN

Official Corpus. A corpus project began to emerge in the seventies, under the initiative of D.J. Smith (see no. 1), but did not come to fruition until 2002 when the corpus

project was revived. Publications nos 1 and 2 contain some conservation information, for example, whether the mosaic, if in situ, is exposed, buried, or roofed. A systematic corpus project was renewed in 2002 under the auspices of ASPROM, the Association for the Study and Preservation of Roman Mosaics (the British branch of AIEMA), and published by the Society of Antiquaries of London. This undertaking supercedes the previous gazetteers. Volumes 1 and 2, within the chronological scope of this survey, have published information about **864 mosaics** in **266 sites**. Volumes 3 (2009) and 4 (2010) are outside the chronological scope of this review, but they complete the catalogue of all known mosaics in Britain.

See also AIEMA bulletins Nos 1:23–27; 2:55–58; 3:92–97; 5:100–105; 6:130–141; 7:130–135; 8:136–142; 9:263–276; 11:171–180; 12:156–160; 13:204–211; 14:142–152; 15:183–190; 16:890–933; 17:811–843; 18:860–896; 19:598–627; 20:667–734; 21:1258–1329.

1. A. Rainey. 1973. *Mosaics in Roman Britain. A Gazetteer*. Newton Abbott: David and Charles.

This gazetteer, written "pending the publication of a corpus of mosaics found in Britain, by D.J. Smith of Newcastle-upon-Tyne" (p. 9) contains information about **703 mosaics** in **186 sites**. These are covered in the publication of the corpus project no. 3.

Each mosaic is described as follows:

- Site name
- Ordnance survey reference
- Site description
- Date found
- Dating of mosaic
- **Present location (in situ, in museum, lost, etc.)**
- **If in situ, whether it is exposed, buried, or roofed over.**
- Location within site
- Description of mosaic
- Bibliography

2. D.S. Neal. 1981. *Roman Mosaics in Britain: an introduction to their schemes and catalogue of paintings*. London: Society for the Promotion of Roman Studies.

Information on **87 mosaics** from **30 sites**. Most of these mosaics were published in Rainey's *Gazetteer* (no. 1) and are covered in the publication of the corpus project (no. 3).

The structure of the catalogue is as follows:

- Site name
- Location within site
- Dating of mosaic
- Dimensions of mosaic
- **Present location (in situ, in museum, lost, etc.)**
- **If in situ, whether it is exposed, buried, or roofed over.**
- Description of mosaic
- Bibliography

3. D. S. Neal and S. R. Cosh. *Roman mosaics of Britain*. London: Illuminata Publishers for the Society of Antiquaries of London.

This publication series is the official corpus of Britain. Site by site it includes descriptions, drawings, and photographs taken at the time of the discovery wherever possible, plans of relevant structures, a bibliography and meticulous reconstruction paintings by the authors. The Corpus is organized alphabetically by county and place name, with short, general introductions to each county and the larger sites. Where possible, the entries record the location and broader context of the mosaics, frequently marking them on a building plan. Colors and dimensions of tesserae are described (not always materials, though this subject is covered generally in the introduction) and condition is noted. Volumes 1 and 2 were published through 2007:

Volume 1: 2002. *Northern Britain incorporating the Midlands and East Anglia*.

418 mosaics found at **152 sites**.

Volume 2: 2005. *South-West Britain*.

446 mosaics found at **114 sites**.

Volume 3 (2009. *Roman Mosaics of Britain: South-East Britain*) and Volume 4 (2010. *Roman Mosaics of Britain: Western Britain*) have been published, but their numbers have not been included in the count of mosaics since they were published after 2007.

The structure of the description is as follows:

- Site name
- Date of discovery
- Individual mosaic catalogue entries
- Dimensions
- Color and size of the tesserae
- Dating
- **Condition**

- Location
- Source and basis of the illustration

BULGARIA

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Bulgaria: Nos 1:28-29; 2:35; 3:50-51; 5:47; 6:83-88; 7:89-90; 8:95; 9:214-216; 11:125-126; 12:122-123; 13:163-164; 14:114; 15:131; 16:525-530; 17:595-597; 18:613-619; 19:447-455; 20:460-470; 21:1007-1010.

CZECH REPUBLIC

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of the Czech Republic: Nos 15:1908; 20:1359; 21:2433-2452.

CROATIA

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Croatia: Nos 1:99-100; 2:123; 3:200; 5:187; 6:260-265; 7:250-252; 8:245-248; 9:403-412; 11:294-299; 12:239-245; 13:345-349; 14:119-120; 15:137; 16:581-589; 17:623-625; 18:608-611,669-682; 19:466-477; 20:478-482; 21:954, 1005, 1037-1046.

The work by M. Donderer (no. 1) lists mosaics in Croatia.

1. Michael Donderer. 1986. *Die Chronologie der römischen Mosaiken in Venetien und Istrien bis zur Zeit der Antonine*. Berlin: Gebr. Mann Verlag.

78 mosaics from **4 sites** in territories belonging to Croatia, Slovenia, and Italy.

CYPRUS

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Cyprus: Nos 1:30-31; 2:35-37; 3:51-54; 5:47-50; 6:83; 7:91-94; 8:96-99; 9:217-221; 11:127-130; 12:123-126; 13:164-168; 14:115-119; 15:131-137; 16:531-580; 17:598-622; 18:620-668; 19:456-465; 20:471-477; 21:1011-1036.

D. Michaelides and W.A. Daszewski have published surveys of the mosaics of Cyprus.

1. D. Michaelides. 1987. *Cypriot Mosaics*. Nicosia: Department of Antiquities.

Contains information about **71 mosaics** (including Byzantine wall mosaics) from **18 sites**, with the following structure:

- Mosaic number
- Site
- Dimensions
- Context
- Description

2. W.A. Daszewski and D. Michaelides. 1988. *Mosaic Floors in Cyprus*. Ravenna: Edizioni del Girasole.

Contains information about Roman mosaics in Paphos and floor mosaics of Byzantine churches, with numerous examples but without making a formal list.

EGYPT

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Egypt: Nos 2:37; 3:54; 5:50–52; 6:88–90; 7:94–95; 8:99–100; 9:222; 11:130–132; 12:126–127; 13:168–169; 14:120–121; 15:137–139; 16:590–606; 17:626–630; 18:683–704; 19:478–483; 20:483–495; 21:1047–1051.

Publication no. 1 is the effort of a single scholar, supported by the Polish Archaeological Institute in Egypt. It is one of the few catalogues, however, that mentions the state of preservation of a mosaic.

1. W.A. Daszewski. 1985. *Corpus of Mosaics from Egypt, I*. Mainz am Rhein: Verlag Philipp von Zabern.

Contains information about **53 mosaics** in **9 sites**, with the following structure:

- Mosaic number
- Name of site
- Location of mosaic within site
- When found
- **Present location (in situ, etc.)**
- Description of mosaic

- Dimensions of mosaic
- **State of preservation**
- Dating
- Bibliography
- Commentary / parallels

FRANCE

Official corpus. The first attempt (*Inventaire...*) is dated to 1909, and listed **1,675 mosaics** (including medieval) in **850 sites** (including sites in Belgium, Luxembourg, Germany and Switzerland). The present, and ongoing corpus (*Recueil...*) started in 1957 and has published so far **2,930 mosaics** in **1,076 sites** (including a few sites in Belgium and Luxembourg, but excluding from this count the medieval mosaics, which are also published in the corpus). Reflecting the art historical and archaeological origins of corpora, there is an emphasis on the iconography of the mosaics, and the context, while presented, is not described in detail. There is no mention of the condition of the mosaics other than present location.

More bibliography is available in AIEMA bulletins: Nos 1:35-48; 2:43-55; 3:63-92; 5:72-99; 6:102-130; 7:102-129; 8:112-135; 9:232-263; 11:143-171; 12:137-156; 13:182-204; 14:129-142; 15:153-182; 16:729-885; 17:679-807; 18:765-858; 19:513-597; 20:556-666; 21:1139-1258.

1. *Inventaire des mosaïques de la Gaule et de l'Afrique*. Paris: E. Leroux.

Tome I, 1 - G. Lafaye. 1909. *Narbonnaise et Aquitaine*.

Contains information about **701 mosaics** in **310 sites**.

Tome I, 2 - A. Blanchet. 1909. *Lugdunaise, Belgique et Germanie*.

Contains information about **974 mosaics** in **540 sites** (including sites in Belgium, Luxembourg, Germany, and Switzerland).

Tome II is dedicated to Tunisia, Tome III to Algeria (see under those countries).

The *Inventaire* has the following structure:

- Number of mosaic
- Name of site
- Location within site
- When found
- Dimensions of mosaic

- Description of mosaic
- **Present location (in situ, in museum, lost)**
- Bibliography

2. *Recueil général des mosaïques de la Gaule. Supplément a "Gallia"* (10 vols). 1957–2000. Paris: CNRS.

All of the *Recueil* volumes incorporate the mosaics of the *Inventaire*, but include further information and updates on their location, as follows:

Volume I, 1 - H. Stern. 1957. *Province de Belgique, Partie Ouest*.

Adds 49 mosaics to the previous *Inventaire*, for a total of **140 mosaics** in **54 sites**.

Volume I, 2 - H. Stern. 1960. *Province de Belgique, Partie Est*.

Adds 44 mosaics to the previous *Inventaire*, for a total of **122 mosaics** in **91 sites**.

Volume I, 3 - H. Stern. 1963. *Province de Belgique, Partie Sud*.

Adds 116 mosaics to the previous *Inventaire*, for a total of **212 mosaics** in **105 sites**.

Volume II, 1 - H. Stern. 1967. *Province de Lyonnaise, Lyon*.

Adds 118 mosaics to the previous *Inventaire*, for a total of **156 mosaics** in **1 site**.

Volume II, 2 - H. Stern and M. Blanchard-Lemée. 1975. *Province de Lyonnaise, Partie Sud-Est*.

Adds 99 mosaics to the previous *Inventaire*, for a total of **183 mosaics** in **69 sites**.

Volume II, 3 - J.-P. Darmon and H. Lavagne. 1977. *Province de Lyonnaise, Partie centrale*.

Adds 139 mosaics to the previous *Inventaire*, for a total of **197 mosaics** in **83 sites**.

Volume II, 4 - M. Blanchard-Lemée. 1991. *Province de Lyonnaise, Partie occidentale*.

Adds 144 mosaics to the previous *Inventaire*, for a total of **201 mosaics** in **107 sites**.

Volume II, 5 - J.-P. Darmon. 1994. *Province de Lyonnaise, Partie Nord-Ouest*.

Adds 104 mosaics to the previous *Inventaire*, for a total of **165 mosaics** in **83 sites**.

Volume III, 1 - H. Lavagne. 1979. *Province de Narbonnaise, Partie centrale*.

Adds 170 mosaics to the previous *Inventaire*, for a total of **213 mosaics** in **55 sites**.

Volume III, 2 - J. Lancha. 1981. *Province de Narbonnaise, Vienne*.

Adds 133 mosaics to the previous *Inventaire*, for a total of **212 mosaics** in **96 sites**.

Volume III, 3 - H. Lavagne. 2000. *Province de Narbonnaise, Partie sud-est. Cité des Allobroges, Vocontii, Bodiontici, Reii, Salluuii, Oxubii, Deciates, Vediantii.*

Adds 554 mosaics to the previous *Inventaire*, for a total of **633 mosaics** in **163 sites**.

Volume IV, 1 - C. Balmelle. 1980. *Province d'Aquitaine, Partie méridionale (Peimont pyrénéen).*

Adds 126 mosaics to the previous *Inventaire*, for a total of **170 mosaics** in **42 sites**.

Volume IV, 2 - C. Balmelle. 1987. *Province d'Aquitaine,*

Adds 269 mosaics to the previous *Inventaire*, for a total of **326 mosaics** in **127 sites**.

No further volumes in this series have appeared since the publication of Vol. III, 3 in 2000.

In total, the *Recueil* has so far published **2,930 mosaics** (excluding the medieval ones) in **1,076 sites** (including some sites in Luxembourg and Belgium)

The mosaics are described as follows:

- Number of mosaic
- Name of site
- Location within site
- When found
- Description of site
- Dimensions of mosaics and tesserae
- **Present location (in situ, in museum, lost, etc.)**
- Description of materials or colors
- Description of iconography
- Dating
- Bibliography

GEORGIA

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Georgia: Nos 1:98; 2:123; 3:197; 6:258; 7:248; 9:402–403; 11:292–294; 13:344–345; 14:142; 15:182–183; 16:886–889; 17:808–810; 18:859.

GERMANY

No official corpus. Publication no. 1 is part of the early corpus of France that includes some sites in Germany. The work by Parlasca (no. 2 below) describes a good number

of mosaics found in Germany; no. 3 is a site-specific catalogue.

The Bulletin of AIEMA has published bibliographic references on the mosaics of Germany: Nos 1:21–23; 2:34; 3:47–48; 5:43–45; 6:75–80; 7:82–86; 8:91–93; 9:212–213; 11:122–124; 12:120–121; 13:160–161; 14:113; 15:129–130; 16:506–520; 17:521–527; 18:592–604; 19:428–442; 20:450–455; 21:986–996.

1. *Inventaire des mosaïques de la Gaule et de l'Afrique*. Paris: E. Leroux.

Tome I, 2 - A. Blanchet. 1909. *Lugdunaise, Belgique et Germanie*. See under France. This corpus contains information about mosaics in Trier (Treviri), Köln, and Bonn, besides other sites in Germany.

2. K. Parlasca. 1959. *Die römischen Mosaiken in Deutschland*. Berlin.

This is not a corpus, but nonetheless describes a number of mosaics from **88 sites** in Germany.

3. P. Hoffmann, J. Hupe und K. Goethert. 1999. *Katalog der römischen Mosaiken aus Trier und dem Umland*. Selbstverlag des rheinischen Landemusens Trier; in Kommission bei Philipp von Zabern, Mainz am Rhein.

One of a number of publications on the mosaics at Trier (Treviri); see also no. 1.

GREECE

No official corpus for all the mosaics, but there is a corpus project for Byzantine mosaics (no. 3 below) and an individual study (no. 4 below) which is a corpus of mosaics from the 4th to the 6th centuries A.D. They were preceded by an inventory study of Byzantine floor mosaics done by J.P. Sodini (no. 1). Greek and Roman mosaics are presented in excavation reports and studies of individual scholars, such as nos 2, 5 and 6 below.

The Bulletin of AIEMA has published bibliographic references on the mosaics of Greece: Nos 1:48–55; 2:58–69; 3:97–119; 5:106–116; 6:142–158; 7:136–151; 8:142–160; 9:276–297; 11:180–197; 12:161–176; 13:211–240; 14:152–180; 15:190–218; 16:934–1166; 17:844–1059; 18:897–1121; 19:628–782; 20:735–879; 21:1330–1476.

1.1. J.P. Sodini. 1970. Mosaïques paléochrétiennes de Grèce. *Bulletin de correspondance hellénique* 94: 699–753.

1.2. J.P. Sodini. 1971. *Mosaïques paléochrétiennes de Grèce. Bulletin de correspondance hellénique* 95: 581–584.

This catalogue contains information about **61 mosaic** floors in **45 sites**. The structure of the catalogue is simple:

- Site
- Context
- Description
- Dating
- **Present location (also if the mosaic is reburied or exposed)**

2. G. Asimakopoulou. 1973. *Mosaïques romaines avec figures humaines dans le territoire grec. Hellenica* 26: 216–254.

Lists **70 mosaics** with human figures.

3.1. S. Pelekanidis. 1974. *Corpus mosaicorum christianorum vetustiorum pavimentorum graecorum I. Graecia Insularis. Monumenta Byzantina. Thessaloniki* (in Greek).

The first volume of this corpus lists **149 mosaics** from **65 sites** in the Greek islands. The corpus displays the following information:

- Site name
- Location
- Location within site
- Dimensions
- Color of tesserae
- Description
- Bibliography

3.2. P. Assimakopoulou-Atzaka. 1987. *Corpus mosaicorum christianorum vetustiorum pavimentorum graecorum II. Paeoponnesum-Graecia centralis. Monumenta Byzantina. Thessaloniki* (in Greek).

3.3. P. Assimakopoulou-Atzaka. 1998. *Σύνταγμα των παλαιοχριστιανικών ψηφιδωτών της Ελλάδος III. Μακεδονία – Θράκη 1. Τα ψηφιδωτά της Θεσσαλονίκης. [=Corpus of early Christian mosaics of Greece. III. Macedonia – Thrace 1. The mosaics of Thessaloniki]. Monumenta Byzantina 9. Thessaloniki* (in Greek).

4. M. Spiro. 1978. *Mosaic Pavements on the Greek Mainland, Fourth to Sixth Centuries, with Architectural Surveys*. New York: Garland.

Lists **228 mosaics** in **60 sites**. The data is presented as follows:

- Mosaic number
- Site
- Location within site
- Architectural context
- Dimensions
- Description
- Dating
- **Present location**
- Bibliography

5. Ph. Bruneau. 1972. *Exploration archéologique de Délos: Les mosaïques*. Paris: Editions E. de Boccard.

Includes a catalogue of the mosaics excavated at Delos until 1971.

6. L. M. De Matteis. 2004. *Mosaici di Cos dagli scavi delle missioni italiane e tedesche (1900–1945)*. Monografie della Scuola Archeologica di Atene e delle Missioni Italiane in Oriente XVII. Athens: Scuola Archeologica di Atene.

Lists **84 mosaics** from the **island of Kos**. 38 are conserved in situ, 33 are exposed in museums (Rodi, Catello del Gran Maestro, Archaeological Museum of Kos and in Istanbul), and 13 in unknown locations.

HUNGARY

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Hungary: Nos 1:55–56; 2:69; 3:120–122; 5:116–118; 6:159–160; 7:152–153; 8:160–161; 9:297–298; 11:198; 12:176–177; 13:240–241; 14:180–181; 15:218–220; 16:1167–1172; 17:1060–1063; 18:1122; 19:783–790; 21:1477–1478.

The publication mentioned here is the most comprehensive, but it is 25 years old and contains no conservation related information.

1. A. Kiss. 1973. *Roman Mosaics in Hungary*. Budapest: Akademiai Kiadó.

Contains information about **60 mosaics** in **11 sites**, with the following structure:

- Site name
- Mosaic number

- When found
- Context
- Description
- Dating
- Bibliography

IRAN

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Iran: Nos 5:118–119; 6:160–161; 7:154; 8:161; 9:298; 11:199; 13:242; 15:220; 21:2368–2370.

Some mosaics in Iran were found in Sasanian buildings. The ones found in Bishapur were created by mosaicists from Antioch deported to Persia.

IRAQ

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Iraq: Nos 5:119; 7:154.

ISRAEL

No official corpus. The pioneer work by M. Avi-Yonah was followed by an updated inventory in 1975, but this latter work, by R. and A. Ovadiah, did not attempt to improve what was missing in the earlier catalogues, that is, specific information on the present location, context, and conditions of the mosaics. The Conservation Department of the Israel Antiquities Authority has made a computerized inventory of mosaics, based on a country-wide risk assessment of 100 sites with mosaics (see J. Neguer. 2003. *Conserve.... and forget. Conservation program for the mosaics of archaeological sites in Israel*. In *Les mosaïques: Conserver pour présenter? VIIème Conférence du Comité international pour la conservation des mosaïques, 22–28 novembre 1999, Musée de l'Arles antique, Arles, Musée archéologique de Saint-Romain-en-Gal: Actes = Mosaics: Conserve to Display? VIIIth Conference of the International Committee for the Conservation of Mosaics: Proceedings*, ed. Patrick. Blanc, 29–33. Arles: Musée de l'Arles et de la Provence antiques).

In total the two completed corpora (nos 1 and 2 below) provide information about **675 mosaics** in **451 sites**.

See also AIEMA bulletin Nos 1:56–62; 2:70–78; 3:122–135; 5:119–128; 6:161–176; 7:154–165; 8:162–171; 9:298–315; 11:199–218; 12:177–186; 13:242–255; 14:181–191; 15:220–234; 16:1173–1277; 17:1064–1136; 18:1123–1219; 19:791–865; 20:880–966; 21:2371–2397.

1. M. Avi-Yonah. Mosaic Pavements in Palestine. *Quarterly of the Department of Antiquities of Palestine (QDAP)* II (1932): 136–181; *QDAP* III (1933): 26–47, 49–73; *QDAP* IV (1935): 187–193.

This corpus contains information about **424 mosaics** in **320 sites**, according to the following structure:

- Site name
- Map reference (to the Survey of Palestine map sheets)
- When found
- Dimensions
- Density of tesserae per 10 cm²
- Colors
- Description and type of patterns
- Dating
- Bibliography

2. R. and A. Ovadiah. 1987. *Mosaic Pavements in Israel*. Roma: L'Erma di Bretschneider.

This corpus contains information about **251 mosaics** in **131 sites**. According to the authors, this is an extension of the work conducted by Avi-Yonah and the structure of the description is similar.

ITALY

Official corpus: *Mosaici Antichi in Italia*. The corpus includes 8 volumes to date (no. 3). There are also numerous studies by individual scholars or as part of excavation reports. The publication *Notizie degli Scavi* regularly publishes information on new excavations and discoveries. There is also an association (AISCOM, *Associazione Italiana per lo Studio e la Conservazione del Mosaico*) that has published its annual conference proceedings since 1993.

The Italian corpus, while providing some information on the state of conservation and context of the mosaics, has been slow in appearing: eight volumes have been published over a period of 30 years (1967–1994). An estimate on the number of mosaics in situ

in Italy is almost impossible, but they are easily in the thousands. A quick survey of the corpus revealed information for about **1,829 mosaics** from **119 sites**, but many more publications are available, including the complete photographic catalogue of the paintings and mosaics of Pompeii (no. 6 below).

See also AIEMA bulletin Nos 1:62–81; 2:78–95; 3:135–156; 5:129–158; 6:176–212; 7:166–208; 8:171–205; 9:316–363; 11:218–259; 12:186–211; 13:255–306; 14:192–227; 15:234–286; 16:1278–1658; 17:1137–1763; 18:1220–1647; 19:866–1261; 20:967–1214; 21:1479–2293.

1.1. M.E. Blake. 1930. The Pavements of Roman Buildings of the Republic and Early Empire. *Memoirs of the American Academy in Rome* VIII: 7–160.

1.2. M.E. Blake. 1936. Roman Mosaics of the Second Century in Italy. *Memoirs of the American Academy in Rome* XIII: 67–214.

1.3. M.E. Blake. 1940. Mosaics of the Late Empire in Rome and Vicinity. *Memoirs of the American Academy in Rome* XVII: 81–130.

These extensive articles give a vivid and comprehensive picture of the variety of Roman mosaics.

2. G. Becatti. 1961. *Scavi di Ostia IV. Mosaici e pavimenti marmorei*. Roma.

Lists **445 mosaics** from Ostia and 4 other sites in its vicinity. The general structure of the catalogue is as follows:

- Mosaic number
- Dimensions
- Dimensions of tesserae
- Colors
- Context
- Description
- **Present location**
- Dating

3. *Mosaici Antichi in Italia*. Roma.

This publication series is the official Italian corpus. Of all the volumes published so far, only one (Sardinia) publishes the mosaics of an entire region, rather than of a single site (see below 1981 volume).

1. M.L. Morricone Matini. 1967. *Regione Prima. Roma: Regio X Palatium.*

The Roma-Palatium volume describes **100 mosaics**.

2. G. Becatti et al. 1970. *Regione Settima. Baccano: Villa Romana.*

The Baccano volume describes **29 mosaics**.

3. M.L. Morricone Matini and V. Santa Maria Scrinori. 1975. *Regione Prima. Antium.*

The Antium volume describes **60 mosaics** from **5 sites**. 9 mosaics have been detached and kept in museums and 3 no longer exist.

4. F. Berti. 1976. *Regione Ottava. Ravenna: I.*

The Ravenna volume describes **82 mosaics** from **6 sites**. 3 of these mosaics are from unknown provenance.

5. S. Angiolillo. 1981. *Sardinia.*

The volume on Sardinia describes **287 mosaics** from **42 sites**. A breakdown of these mosaics by state of conservation reveals that 145 are lost, 27 in museums, 115 in situ. Of those in situ, 3 are reburied, 6 in excellent state of conservation, 29 in good state, 12 in fair state, 23 in poor state, 42 in very poor or desperate state of conservation. This means that of 287 mosaics for which some information was collected, only **38 (13%) survived in situ in relatively good state of conservation** in 1981.

6. M.S. Pisapia. 1989. *Regione Prima. Stabiae.*

The Stabiae volume describes **124 mosaics** from **6 sites**.

Monograph series:

Volume I - M.L. Morricone Matini. 1971. *Pavimenti in signinum repubblicani di Roma e dintorni.*

Not available for consultation.

Volume II - F. Guidobaldi. 1994. *Sectilia pavimenta di Villa Adriana.*

The Villa Adriana volume describes **180 mosaics**

The mosaics of the Italian corpus are among those with the most comprehensive description, not only in terms of context, but also as far as conservation information is concerned.

- Site
- Mosaic number
- Location within site
- Architectural context
- Dimensions
- Dimension of tesserae
- Density of tesserae per 10 cm²
- Materials and color
- **Present location (in situ, in museum, lost)**
- Ancient repairs
- **State of conservation**
- Description and discussion
- Dating
- Bibliography

4. D. von Boeselager. 1983. *Antike Mosaiken in Sizilien*. Roma: Bretschneider.

Information about **82 mosaics** in **33 sites** in Sicily with the following structure:

- Site
- Location within site
- When found
- Description
- Dating
- **Present location**
- Bibliography

5. Michael Donderer. 1986. *Die Chronologie der römischen Mosaiken in Venetien und Istrien bis zur Zeit der Antonine*. Berlin: Gebr. Mann Verlag.

Publishes information about **446 mosaics** in **20 sites** in Northeast Italy (including 143 mosaics from Aquileia) with the following structure:

- Site name
- When found
- **Present location**
- Dimensions
- Description
- Dating
- Bibliography

6. G. Pugliese Carratelli, ed. 1990–1994. *Pompei. Pitture e mosaici*. Roma: Istituto dell'Enciclopedia Italiana. 5 Volumes.

This photographic catalogue has information about every wall painting and mosaic in Pompeii. Unfortunately there is no general index. The publication is over 5,000 pages, and the number of mosaics published might be easily in the hundreds.

- Location within site
- Dimensions
- Density of tesserae per 10 cm²
- Description
- Dating

JORDAN

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Jordan: Nos 1:89–90; 2:104; 3:171–173; 5:169–171; 6:212–215; 7:209–210; 8:206–208; 9:363–371; 11:259–267; 12:211–217; 13:306–319; 14:227–233; 15:286–296; 16:1659–1738; 17:1764–832; 18:1648–1710; 19:1262–1297; 20:1215–1261; 21:2398–2412.

The Jordan Antiquities Database and Information System (JADIS) lists **81 sites** with mosaics, but it does not provide information on the context, or state of conservation of these mosaics. In 2010 JADIS data was transferred to MEGA-Jordan (Middle Eastern Geo Database for Antiquities, Jordan, see www.megajordan.org). Among recent publications on mosaics the most comprehensive is that by M. Piccirillo (no. 1).

1. M. Piccirillo. 1993. *The Mosaics of Jordan*. Amman: ACOR.

This publication describes **146 mosaics** in **53 sites**, but provides little information beyond the iconography of the mosaics.

LEBANON

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Lebanon: Nos 1:82; 2:96–97; 3:156–158; 5:158–160; 6:216–218; 7:210–212; 8:209–210; 9:372–373; 11:267–268; 12:217–218; 13:319; 14:234; 15:296; 16:1739–1744; 17:1833–1846; 18:1711–1726; 19:1298–1300; 20:1262–1266; 21:2413–2431.

The publication by M. Chehab is 40 years old and was not available to consult. There are some works published by individual scholars taking into consideration one site or period, such as publication no. 2.

1. M. Chehab. 1958–1959. Mosaïques du Liban. *Bulletin du Musée de Beyrouth* 14–15.
2. P. Doncel-Voûte. 1988. *Les pavements des églises byzantines de Syrie et du Liban*. Louvain-la-Neuve: Collège Érasme.

Contains information about **78 churches** with mosaics in **69 sites** in Syria and Lebanon.

LIBYA

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Libya: Nos 1:82–83; 2:97–99; 3:158–159; 5:160–161; 6:218–219; 7:213–215; 8:210–211; 9:373–374; 11:268–269; 12:218–220; 13:319–321; 14:234; 15:296–297; 16:1745–1750; 17:1847; 18:1727–1741; 19:1301–1305; 20:1267–1277; 21:955, 2294–2310.

Hundreds of mosaics have been found at sites such as Cyrene, Lepcis (Leptis) Magna, Sabratha, and Zliten. The works of Aurigemma (nos 1 and 2) and Michaelides (no. 4) include both general and site-specific surveys. Publication no. 3 is a regional catalogue of Byzantine mosaics from Cyrenaica.

1. S. Aurigemma. 1926. *I mosaici di Zliten*. Milano: Società Editrice d'Arte Illustrata.

This publication presents mosaics found at the site of Zliten (especially those from the Roman villa of Dar Buc Ammera). Emphasis is on iconography and techniques.

2. S. Aurigemma. 1960. *L'Italia in Africa. Le scoperte archeologiche (a. 1911 - a. 1943). Tripolitania Vol. I – I Monumenti d'Arte Decorativa. Parte Prima – Immosaici*. Roma: Istituto Poligrafico dello Stato.

3. E. Alfoöldi-Rosenbaum and J. Ward-Perkins. 1980. *Justinianic Mosaic Pavements in Cyrenaican Churches* (Monografie di archeologia libica XIV). Rome: "L'Erma" di Bretschneider.

Part II by Ward-Perkins is a descriptive catalogue, with emphasis on material, colors and patterns, of 5th-6th C church mosaics in Cyrenaica excavated up to 1963. The churches are in Apollonia, Cyrene, Qasr-el-Lebia, Ras-el-Hilal and Tokva.

4. D. Michaelides.1998: *Excavations at Sidi Khrebish Benghazi (Berenice)*, Vol. IV.I. *The mosaic and marble floors (Supplements to Libya Antiqua V)*. London.

This is a catalogue of **34 mosaics** (including very fragmentary and lost mosaics) from several houses in **1 site** (Berenice) dating from the 2nd – 3rd centuries A.D.

The catalogue includes the following information for each mosaic:

- Date of excavation
- **State of preservation at the time of discovery**
- Dimensions
- **Present location**
- Bibliography
- Analytical description
- Technical data (materials, colors, dimensions, etc.)
- Comments and discussion

LUXEMBOURG

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Luxemborg: Nos 2:99; 5:161; 6:219; 7:215–216; 8:212; 9:374; 11:269–270; 13:321; 14:234; 16:1751–1753; 17:1848–1850.

Other information derives from the *Inventaire* and the *Recueil* published in France (see France)

1. *Inventaire des mosaïques de la Gaule et de l'Afrique*. Paris: E. Leroux.
Tome I, 2 - A. Blanchet. 1909. *Lugdunaise, Belgique et Germanie*. See under France.

2. *Recueil général des mosaïques de la Gaule*. X Supplément à *Gallia*. Paris: CNRS.

Volume I, 2 - H. Stern. 1960. *Province de Belgique, Partie Est*.
Vol. I, 2 contains information about mosaics in **16 sites**.

MACEDONIA, Republic of (also FYROM, former Yugoslav Republic of Macedonia; see also Yugoslavia)

The Bulletin of AIEMA has published bibliographic references on the mosaics of Macedonia: Nos 18:1742–1745; 21:2432.

MALTA

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Malta: Nos 2:99; 5:162; 7:216; 9:374; 11:270; 12:220; 16:1755; 17:1852; 18:1746–1747; 20:1278; 21:2311.

MOROCCO

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Morocco: Nos 1:83–85; 2:100; 3:159–161; 5:162; 6:220–221; 7:216–217; 8:212–213; 9:374; 11:270; 12:220; 13:321; 14:235; 17:1853; 18:1748–1750; 19:1306–1308; 20:1279; 21:2312–2313.

A Franco-Moroccan corpus project—*Corpus des mosaïques du Maroc*—was envisioned in 1992 beginning with the site of Lixus, but no corpus publication has resulted. Under similar auspices, a doctoral thesis was completed on the mosaics of Volubilis (Z. Belcadi. 1988. *Les mosaïques de Volubilis*. Paris I-Sorbonne), but to our knowledge this also has not been published

MONTENEGRO (see also Yugoslavia)

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Montenegro: No. 21:2314–2315.

NETHERLANDS

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of the Netherlands: Nos 1:85; 7:217; 8:213.

PALESTINE

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Palestine: see references for Israel and 16:1790–1793; 17:1880; 18:1770–

1818; 19:1313–1323; 21:2342–2349.

PORTUGAL

Official corpus. The Bulletin of AIEMA has published extensive bibliographic references on the mosaics of Portugal: Nos 1:85–87; 2:100–101; 3:162; 5:163–154; 6:222–223; 7:217–218; 8:213–214; 9:374–375; 11:270–271; 12:220–221; 13:321–323; 14:235–236; 15:298–300; 16:1756–1762, 1764–1780; 17:1862–1874; 18:1751–1769; 19:1309–1312; 20:1280–1282, 1292–1322; 21:1052–1138, 2326–2341.

Two volumes of the official corpus project by the Instituto Português de Museus—*Corpus dos Mosaicos Romanos de Portugal*—have been published. They are well illustrated with color plates of the mosaics and architectural drawings.

Volume I: J.M. Bairrão Oleiro. 1992. *Conímbriga*. Casa dos Repuxos. Instituto Português de Museus

Describes **16 mosaics** from 1 house at the site of Conímbriga.

Volume II: J. Lancha and P. André. 2000. *La Villa de Torre de Palma*. Instituto Português de Museus

Describes **24 mosaics** from the Villa de Torre de Palma.

Structure of Volume I of the corpus:

- **Location (including whether in situ)**
- Materials
- Colors
- Description
- Dimensions
- References
- Comparative study
- Chronology

Volume II of the corpus is structured differently, with 19 categories of information, which include conservation-related entries such as where the mosaic is preserved (in situ, museum, etc.) and ancient and modern restorations.

ROMANIA

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Romania: Nos 1:87; 2:101; 3:163; 5:164; 6:223–224; 7:219–220; 8:214–215; 9:377; 11:271–272; 12:221; 15:302; 16:1794–1797; 17:1881; 18:1819; 19:1324–1325; 21:2453.

RUSSIA

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Russia: Nos 1:98; 2:123; 3:197; 6:258; 7:249; 8:243; 9:402; 13:344–345; 17:1882; 19:1326.

SERBIA (see also Yugoslavia)

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Serbia: No. 21: 2454.

G. Cvetković Tomašević. 2002. *Mosaïques de pavements paléobyzantines dans le palais épiscopal a Héracléa Lynkestis* (Corpus des Mosaïques Paléobyzantines de Pavement, Fascicule no. 1). Beograd: Institut pour la protection des monuments historiques de la Serbie.

A corpus of the early Christian mosaics from the basilica in Heraclea Lyncestis (not available for consultation).

SLOVENIA

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Slovenia: Nos 1:99; 3:198–200; 5:186–187; 6:260; 7:250; 8:244; 9:403–412; 11:295–298; 12:239–245; 13:345–349; 14:238; 15:302; 16:1801; 18:1820; 19:1327; 20:1323; 21:2455.

The work by Djuric (no. 1) is an early overview; that by M. Donderer (no. 2) lists **4 mosaics** from **1 site** in Slovenia.

1. B. Djuric. 1976. Les mosaïques antiques sur le territoire de la R.S. de Slovénie. *A Arch Slov* 27: 537–625.

2. Michael Donderer. 1986. *Die Chronologie der römischen Mosaiken in Venetien und Istrien bis zur Zeit der Antonine*. Berlin: Gebr. Mann Verlag.

SOMALIA

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Somalia: No. 9:377 (mosaic of the 1st century at Heis)

SPAIN

Official corpus. To date there are 13 volumes of the corpus (the most recent volume, published in 2011, is beyond the chronological scope of this study), while an independent publication (no. 2 below) lists the mosaics in the region of Barcelona. Neither publication has much information about the condition of the mosaics, and only essential information about their context. In total they contain information about **772 mosaics** in **240 sites**.

See also AIEMA bulletins Nos 1:31–35; 2:38–42; 3:55–63; 5:52–72; 6:91–101; 7:96–102; 8:100–111; 9:223–232; 11:132–143; 12:127–137; 13:169–182; 14:121–129; 15:139–153; 1756–1762; 17:631–678, 1756–1762; 18:705–764, 1751–1759; 19:484–512, 1309; 20:496–555, 1280–1282; 21:1052–1138, 2316–2325.

1. *Corpus de mosaicos romanos de España*. 1978–1998. Madrid: Consejo Superior de Investigaciones Científicas.

Twelve volumes published up to 2007:

Volume I: **65 mosaics** from **12 sites**. A. Blanco Freijeiro. 1978. *Mosaicos Romanos de Mérida*.

Volume II: **43 mosaics** from Italica. A. Blanco Freijeiro and Irene Mañas Romero. 1978. *Mosaicos Romanos de Italica*.

Volume III: **74 mosaics** from **19 sites**. J.M. Blazquez. 1981. *Mosaicos Romanos de Córdoba, Jaén, y Málaga*.

Volume IV: **95 mosaics** from **26 sites**. J.M. Blazquez. 1982. *Mosaicos Romanos de Sevilla, Granada, Cádiz, y Murcia*.

Volume V: **40 mosaics** from **12 sites**. J.M. Blazquez. 1982. *Mosaicos Romanos de la Real Academia de la Historia, Ciudad Real, Toledo, Madrid, y Cuenca*.

Volume VI: **73 mosaics** from Soria. J.M. Blazquez and T. Ortego y Frías. 1983. *Mosaicos Romanos de Soria*.

Volume VII: **51 mosaics** from **12 sites**. J.M. Blazquez and M.A. Mezquiriz Irujo. 1985. *Mosaicos Romanos de Navarra*.

Volume VIII: **47 mosaics** from **12 sites**. J.M. Blazquez, G. López Monteagudo, M.L. Neira Jiménez and M.P. San Nicolás Pedraz. 1989. *Mosaicos Romanos de Lérida y albacete*.

Volume IX: **35 mosaics** from **16 sites**. J.M. Blazquez, G. López Monteagudo, M.L. Neira Jiménez and M.P. San Nicolás Pedraz. 1989. *Mosaicos Romanos del Museo Arqueológico Nacional*.

Volume X: **35 mosaics** from **28 sites**. J.M. Blazquez, G. López Monteagudo, T. Mañanes and C. Fernández Ochoa. 1993. *Mosaicos Romanos de León y Asturias*.

Volume XI: **26 mosaics** from **10 sites**. M.L. Neira and T. Mañanes. 1998. *Mosaicos romanos de Valladolid*.

Volume XII: **61 mosaics** from **11 sites**. G. López Monteagudo, R. Navarro Sáez and P. De Palol Salellas. 1998. *Mosaicos Romanos de Burgos*.

[Volume XIII: I.M. Romero. 2011. *Mosaicos romanos de Itálica II* has been published but is beyond the chronological scope of this review]

The structure of the description is as follows:

- Site name
- When found
- **Present location**
- Dimensions
- Dimension of tesserae
- Description
- Dating
- Bibliography

2. X. Barral i Altet. 1978. *Les Mosaïques romaines et médiévales de la région Laietana (Barcelone et ses environs)*. Barcelona: Instituto de Arqueologia y Prehistoria.

Contains information about **177 mosaics** from **30 sites** in the Barcelona region, with the following structure:

- Site name
- Mosaic number
- When found
- Description
- Dimensions
- **Present location**
- Bibliography

SWITZERLAND

No official corpus, but publication no. 2 is a comprehensive catalogue updated to 1960 about **281 mosaics** in **146 sites** in Switzerland. There is some contextual information, but the emphasis is on iconography. Publication no. 3 is mentioned here because it is one of the few that uses a fully-computerized database to publish mosaics found at the site of Augst (Augusta Rauricorum).

The Bulletin of AIEMA has published bibliographic references on the mosaics of Switzerland: Nos. 1:87–88; 2:101–102; 3:163–165; 5:165–166; 6:224–225; 7:221–223; 8:215–217; 9:377–380; 11:272–274; 12:221–225; 13:324–326; 14:238–241; 15:302–307; 16:1802–1825; 17:1883–1897; 18:1821–1843; 19:1328–1341; 20:1324–1348; 21:2456–2479.

1. *Inventaire des mosaïques de la Gaule et de l'Afrique*. Paris: E. Leroux.

Tome I, 2 - A. Blanchet. 1909. *Lugdunaise, Belgique et Germanie*. See under France.

2. V. Von Gonzenbach. 1961. *Die römischen Mosaiken der Schweiz*. Basel: Birkhäuser Verlag.

Contains information about **281 mosaics** in **146 sites**.

99 of these mosaics were already published in the *Inventaire des mosaïques de la Gaule*.

The structure is as follows:

- Name of site
- When found
- Location within site
- Materials and color
- Size of mosaic
- **Present location (in situ, etc.)**

- Description of site
- Description of mosaic
- Bibliography

3. D. Schmid. 1993. *Die römischen Mosaiken aus Augst und Kaiseraugst*. Augst.

Publishes information about **47 mosaics** from Augusta Rauricorum. The study is one of the most complete with regard to context, function, history, and conservation of these mosaics. 47 different types of materials have been identified at the site. The study of the composition of each mosaic and the overall intrasite distribution of material types has provided interesting insights on the chronology, techniques, and 'sociology' of mosaic floors at the site.

SYRIA

No official corpus, although a corpus project was initiated in the late seventies under the initiative of J. Balty (see no.1 below). There are some works published by individual scholars taking into consideration one period, such as no. 2 below.

In 2004 an initiative to establish a national database corpus of mosaics was begun as a cooperation of the European Centre for Byzantine and Post-Byzantine Monuments and the Centre for Archaeological Research of the Department of Archaeology, University of Damascus (K.D. Politis, A. Al-Azm, Ch. Bakirtzis. 2008. *The Syrian Mosaic Pavement Documentation Training Program*. In *Lessons Learned: Reflecting on the Theory and Practice of Mosaic Conservation: Proceedings of the 9th ICCM Conference, Hammamet, Tunisia, November 29-December 3, 2005*, 377-79. The current status of the project in unknown.

The Bulletin of AIEMA has published bibliographic references on the mosaics of Syria : Nos 1:88–89; 2:102–104; 3:165–170; 5:166–169; 6:226–232; 7:224–227; 8:217–223; 9:380–382; 11:274–278; 12:225–227; 13:326–330; 14:241–243; 15:307–310; 16:1826–1843; 17:1898–1918; 18:1844–1867; 19:1342–1352; 20:1349–1357.

1. J. Balty. 1977. *Mosaïques antiques de Syrie*. Bruxelles.

Lists **40 mosaics**.

2. P. Doncel-Voûte. 1988. *Les pavements des églises byzantines de Syrie et du Liban*. Louvain-la-Neuve: College Érasme.

Contains information about **78 churches** with mosaics in **69 sites** in Syria and Lebanon.

TUNISIA

Official corpus. Tunisia is one of a few countries where an official corpus, compiled in 1910 (no. 1), has been replaced by an entirely new corpus project. This was initiated by the Institut National du Patrimoine with other foreign institutions in 1973 (no. 3), after an isolated attempt to compile another corpus based on the archaeological atlas in 1960 (see no. 2 below). The three projects together provide information about **2,277 mosaics** in **118 sites**. The latest and ongoing corpus project is one of the most comprehensive so far.

A project of an individual scholar (James Terry, University of Missouri) is the study and catalogue of 186 tomb mosaics of Late Roman, Byzantine, and Vandalic periods (no. 4 below).

See also AIEMA bulletins Nos 1:90–96; 2:105–110; 3:173–183; 5:171–177; 6:232–243; 7:228–236; 8:223–232; 9:383–394; 11:279–286; 12:228–235; 13:330–337; 14:243–248; 15:311–324; 16:1844–1944; 17:1919–1955; 18:1868–1912; 19:1353–1393; 20:1360–1421; 21:954–957, 2480–2546.

1. *Inventaire des mosaïques de la Gaule et de l'Afrique*. Paris: E. Leroux.

Tome II, 1 - P. Gauckler. 1910. *Tunisie*.

Tome II Supplément - A. Merlin. 1915.

This corpus contains information about **1,056 mosaics** in **105 sites**. The Supplément adds another **199 mosaics**. As in the other volumes of the *Inventaire*, the mosaics are described as follows:

- Number of mosaic
- Name of site
- Location within site
- When found
- Dimensions of mosaic
- Description of mosaic
- **Present location (in situ, in museum, lost)**
- Bibliography

2. L. Foucher. 1960. *Inventaire des mosaïques. Feuille 57 de l'Atlas Archéologique: Sousse*. Tunis: Imprimerie Officielle.

This publication contains information about **275 mosaics** in **4 sites**. **115** of these mosaics were already published in the *Inventaire*. Each mosaic is described in the following way:

- Number of site
- Name of site
- Location within site
- When found
- Description of site
- Mosaic size
- **Present location (in situ, in museum, lost)**
- Description of materials or colors
- Description of iconography
- Dating of mosaic
- Bibliography

This structure is identical to the *Recueil*, the corpus of mosaics in France.

3. M.A. Alexander and M. Ennaifer, eds. *Corpus de mosaïques de Tunisie*. 1973—Tunis: Institut National d'Archéologie et d'Art [later Institut National du Patrimoine].

Volume I :

Fasc. 1 - M.A. Alexander et al. 1973. *Utique. Insulae I-II-III*.

Fasc. 2 - C. Dulière et al. 1974. *Utique. Les mosaïques in situ en dehors des Insulae I-II-III*.

Fasc. 3 - M.A. Alexander et al. 1976. *Utique. Les mosaïques sans localisation précise et El-Alia*.

Vol. I contains information about **316 mosaics** (61 previously published in the *Inventaire*) in Utica and **2** (one previously published) in el-Alia.

Volume II :

Fasc. 1 - M.A. Alexander et al. 1980. *Thuburbo Majus*.

Fasc. 2 - A. Ben Abed-Ben Khader et al. 1985. *Thuburbo Majus*.

Fasc. 3 - A. Ben Abed-Ben Khader. 1987. *Thuburbo Majus*.

Fasc. 4 - M.A. Alexander and A. Ben Abed. 1994. *Thuburbo Majus et environs*.

Vol. II contains information about **427 mosaics** (27 previously published) in Thuburbo Majus and **9 mosaics** in 4 other sites.

Volume III:

Fasc. 1 - C. Dulière and H. Slim. 1996. *Thysdrus – El-Jem*.

Vol. III contains information about **57 mosaics** in El-Jem (2 previously published).

Volume IV:

Fasc. 1 - A. Ben Abed-Ben Khader et al. 1999. *Karthago (Carthage)*.

Vol. IV contains information about **201 mosaics** in the Parc Archéologique des Thermes d'Antonin at Carthage (64 previously published).

Among all the works consulted in this research, the Tunisian corpus provides one of the most detailed accounts of context and structure of the mosaics. The information provided is:

- Mosaic number
- Dimensions
- Location within site
- Architectural context
- **State of conservation**
- Materials
- Colors
- Size of tesserae
- **Description of bedding layers and substrata**
- Description of mosaics (including patterns typology)
- Dating
- Bibliography
- **Present location (in situ, lost, in museum) - in the Appendix**

The example of Utica provides a sense of the loss and dispersal of mosaics. According to the corpus (Volume 1), of the recorded 316 mosaics, 224 still exist in situ, 17 are lost, for 10 the location is unknown, 12 are at the Utica site museum, 19 at the Bardo Museum, 7 at Bordj Boujemaa Museum, 4 at the British Museum, 18 at the Louvre, 2 in museum in Cannes, and 1 in the museum in Warszawa, Poland.

4. James H. Terry. 1998. *Christian Tomb Mosaics of Late Roman, Vandalic and Byzantine Byzacena*. Ph.D. dissertation, University of Missouri-Columbia.

The study contains information on **186** tomb mosaics. The information is structured as follows:

- Site
- Find date
- Excavators
- Architectural context
- **Present location (in situ, lost, in museum)**
- **State of conservation**
- Length
- Width

- Size of tesserae
- Letter height
- Description of mosaic
- Transcription
- Reading
- Epigraphic notes
- References
- Dating

TURKEY

Official corpus. The first volume of the initial corpus project was published in 1977 on the Ephesus mosaics by an Austrian team (no. 3.1 below). Three further volumes (nos 3.2–3.4) were published on mosaics from Antioch, Aphrodisias and Anemurium respectively as part of the 'Canadian portion of the Mosaic Corpus' in a different series format and by one scholar. The Antioch volume represents an updating and systematic presentation of information in the corpora style of the publication by Levi (no. 2).

A new corpus initiative, *Corpus of the Mosaics of Turkey*, was begun in 2004. It divides the country in 18 historical regions to be studied by independent research teams. The first part of Volume 1 of the official corpus was published in 2009 (no. 4 below). An associated national database was established at the Center for Mosaic Research in Turkey at Uludağ University in Bursa (see M. Şahin, D. Şahin, D. Parrish and W. Jobst. 2008. The Mosaic Corpus of Turkey: A new international research project. In *Lessons Learned: Reflecting on the Theory and Practice of Mosaic Conservation: Proceedings of the 9th ICCM Conference, Hammamet, Tunisia, November 29-December 3, 2005*, 123–25).

Since the corpora published thus far are site or region-specific and cover limited areas, no attempt has been made to do a count of mosaics. Individual scholars have published collections from sites or regions (e.g. nos 1 and 2). The mosaics uncovered during salvage excavations at Zeugma were published as a 'corpus' after our 2007 cut-off date but are noted below (no. 5) since they constitute a complete catalogue of mosaics from this important site

The Bulletin of AIEMA has published bibliographic references on the mosaics of Turkey: Nos. 1:96; 2:111–123; 3:183–197; 5:177–184; 6:243–257; 7:236–247; 8:232–243; 9:394–402; 11:286–292; 12:235–239; 13:337–344; 14:248–253; 15:324–331; 16:1945–2017; 17:1956–2070; 18:1913–2068; 19:1394–1466; 20:1422–1488; 21:2547–2624.

1. L. Budde. 1969. *Antike Mosaiken in Kilikien. Band 1 Frühchristliche Mosaiken in Misis-Mopsuhestia*. Recklinghausen: Verlag Aurel Bongers; and 1972. *Antike Mosaiken in Kilikien. Band II Die heidnische Mosaiken*. Recklinghausen: Verlag Aurel Bongers.

A survey and iconographic study of early Christian (Vol. 1) and pagan (Vol. 2) mosaics from Cilicia

2. D. Levi. 1971. *Antioch Mosaic Pavements*. Roma: L'Erma di Bretschneider.

This work was superceded by publication no. 3.2.

3.1. W. Jobst and H. Vettors. 1977. *Römischen Mosaiken aus Ephesus*. Wien: Osterreichischen Akademie der Wissenschaften. Vol. I/1 of the *Corpus der antiken Mosaiken in der Türkei*.

This is the first volume of the first corpus project and contains information on **40 mosaics** from Ephesus, with the following information:

- Context
- Color
- Dimensions
- Dimension of tesserae
- Material
- **Bedding**
- Description
- **Present location (in situ, lost, in museum)**
- Discussion
- Dating
- Bibliography

3.2. S.D. Campbell. 1988. The Mosaics of Antioch, *Subsidia Mediaevalia* 15. Toronto: Pontifical Institute of Mediaeval Studies.

3.3. S. D. Campbell. 1991. The Mosaics of Aphrodisias in Caria, *Subsidia Mediaevalia* 18. Toronto: Pontifical Institute of Mediaeval Studies.

3.4. S. D. Campbell. 1998. The Mosaics of Anemurium, *Subsidia Mediaevalia* 25. Toronto: Pontifical Institute of Mediaeval Studies.

4. Marie-Patricia Raynaud. 2009. *Corpus of the Mosaics of Turkey. Volume I - LYCIA - Xanthos, Part 1. The East Basilica*, ed. M. Şahin, D. Parrish and W. Jobst. Uludag Universitesi Mozaik Arastirmalari Merkezi.

This first (and as yet only) publication of the new corpus project is beyond the chronological scope of the literature review but is noted because it represents an important resurrection of previous attempts. The structure of the catalogue in this volume includes an entry on 'preservation' that contains only minimal information on current condition of each mosaic. There is however a brief mention at the end of the corpus of recent conservation efforts and the fiche for recording information provides a broad definition of 'current state of preservation,' which includes indicating what type of treatment is recommended and the degree of urgency.

The fiche for the Corpus of Turkish Mosaics requires the following information (the publication is however organized somewhat differently):

- Corpus number
- Mosaic technique
- Title of mosaic
- Provenance
- **Present location (in situ, museum, lost etc.)**
- Architectural context
- Dimension
- Materials
- Density of tesserae/dm²
- Colors
- **Current state of preservation (treatment required; in situ, protected by roof, reburied, moved to museum, etc.)**
- Archival documentation
- Description
- Commentary
- Date
- Bibliography
- Illustrations

5. Mehmet Önal. 2009. *A Corpus. Zeugma Mosaics*. Istanbul: A Turizm Yayinlari.

This publication, entitled a corpus, incorporates a description of iconography and decoration with color photographs of 'all of the mosaics which have been brought to light from Zeugma,' mainly deriving from the Houses of Poseidon, Zosimos, Euphrates, Dionysus, Maenad, and Oceanus. Other than dimensions of the mosaics, the description does not include any of the information categories in the official corpus (no. 4).

UKRAINE

No official corpus. The Bulletin of AIEMA has published bibliographic references on the mosaics of Ukraine: Nos 12:239 (archaeological site of Olbia on the Black Sea); 13:344–345; 14:253; 15:332 (archaeological site of Pantikapaion on the Black Sea); 16:2018; 17:2071–2085; 18:2069–2074; 19:1467–1474; 20:1489–1495; 21:2625.

YUGOSLAVIA (see Serbia, Republic of Macedonia and Montenegro)

No official corpus. The Bulletin of AIEMA has published extensive bibliographic references on the mosaics of the former Federal Republic of Yugoslavia: Nos 1:98–100; 2:123–124; 3:197–200; 5:185–188; 6:259–265; 7:250–251; 8:244–248; 9:403–412; 11:294–299; 12:239–245; 13:345–349; 14:238; 15:332–334; 16:521–524, 2019–2027; 17:592–593, 2086–2088; 18:2075; 19:1475–1476; 20:1496.

CHAPTER 4

Protective Shelters for Archaeological Sites

Martha Demas



Photos: All photos © J. Paul Getty Trust, except where noted. Clockwise, from upper left: Ein Gedi, Israel (© Yael Alef); Terrace Houses, Ephesus, Turkey; Hagar Qim, Malta; Tell Mozan/Urkish, Syria (© IIMAS - The International Institute for Mesopotamian Area Studies); Orpheus Mosaic, Paphos, Cyprus; Brading Roman Villa, England; Villa del Casale, Piazza Armerina, Italy.

Protective Shelters for Archaeological Sites

Introduction

This review of protective shelters is approached somewhat differently than the other literature reviews in that it encompasses a comprehensive annotated bibliography on shelters for archaeological sites in addition to an analysis of the literature. The annotated bibliography was compiled originally for the 1990 and 1993 international courses on Conservation of Excavated Sites, organized by the Getty Conservation Institute and the Department of Antiquities, Cyprus, and was therefore not focused specifically on mosaic sites. It was periodically updated through 2000 and published in 2001 as part of the proceedings of the Shelters Colloquium held in Tumacacori, Arizona in January 2001 (CMAS 2001). For purposes of this literature review on mosaic conservation, additional searches were undertaken for the years 2000–2007, yielding many new citations.

While it was necessary to establish a cut-off date for published literature, we have allowed a few post-2007 exceptions for the annotated bibliography. Since 1977, the tri-annual conferences of the ICCM and their publications have been an important source for tracking the mosaic conservation literature on shelters. Articles relating to shelters in the publications of the eight conferences through 2005 are reviewed and cited here; the 9th Conference (Tunisia, 2005) was published in 2008 and therefore outside the chronological scope of the literature review, but it has been included in the annotated bibliography with mention of articles relevant to sheltering (Ben Abed et al. 2008). Another 2008 reference is to work on simulation models (De Santoli and Mariotti 2008), an important new tool for understanding the potential performance of shelters in mitigating environmental impacts and one that warrants greater attention.

The annotated bibliography is useful in providing practitioners and decision-makers, who may be contemplating constructing or retrofitting a shelter, with the key references on shelters around the world. In particular, there are many instructive examples and cautionary tales that may be gleaned from the literature for those who are looking at sheltering as a solution to their problems. The bibliography is not specific to sites with mosaics; rather, it aims to be a comprehensive compilation of published works on shelters over archaeological sites, which are equally applicable to mosaic sites. Those articles that are specific to sites with mosaics have been indicated with an asterisk and are thus easily identified. As will be seen from the bibliography, these articles constitute a fairly large percentage of the literature (approximately 81 citations, which however include multiple citations for shelters such as Piazza Armerina and Villa Arianna), indicating the increasing choice of sheltering as a method of conserving and presenting mosaic sites.

Review of the Literature

There are hundreds of shelters that now protect archaeological sites worldwide; many others exist only as design concepts on drawing boards. They come in a bewildering variety of shapes, sizes and materials, from primitive wooden huts and delicate, decorative nineteenth century metal pavilions to heavy slabs of concrete and high-tech designs such as space frames or membrane structures. Although there exist notable examples of nineteenth century and early twentieth century sheltering, such as those at Pompeii and Herculaneum, over the adobe ruins at Casa Grande in Arizona, or protecting mosaics in England, the majority of examples date from the 1960s onward, as does the literature about them. Compared with the number and variety of shelters actually built, however, the published information about these structures is minimal. Of the 218 primary references in the annotated bibliography (not including those cited in the annotations), only four date to the 1960s and one to the 1970s; 43 were published in the decade 1980–89; 52 in the following decade, 1990–1999; and 118 in the first seven years of the twenty-first century (2000–2007). These numbers are rough; a single monograph may yield several citations if they are individually annotated, and we have undoubtedly missed some references and deliberately winnowed out others. Nonetheless, they provide a good indicator of interest in and use of shelters on archaeological sites. Thus, it is really only in the last two decades of the twentieth century that we see the beginnings of a literature on sheltering of archaeological sites, with a noticeable acceleration (half the citations) since 2000. The source country for the bulk of these recent publications is Italy, where sheltering and scholarly writings related to design of archaeological shelters has a long tradition.

The reason for the acceleration in the number of shelters proposed, built, and published in the last ten years is not entirely clear. It may simply reflect increased interest in sheltering within the conservation profession and among architects, in addition to the proliferation of publication venues, but it has undoubtedly also been spurred by growing pressures to develop archaeological sites for tourism, which often means constructing a shelter for visitor comfort and interpretation.

Descriptive accounts of shelters

The bulk of the literature about shelters is simply descriptive in nature. A milestone for this category of literature was the publication in 1988 of Hartwig Schmidt's *Schutzbauten*, an extensive, though not comprehensive, descriptive catalogue of protective shelters in Europe and the Middle East. The publication is especially valuable in providing information about shelters that have not been published elsewhere and offering a consistent description of the types of materials and structural forms utilized for protective structures; but it is now already over twenty years old and no longer reflects the contemporary landscape of shelters. General overviews of sheltering—the

problems being addressed, the types of shelters, brief descriptions of well-known and unknown shelters, and brave attempts at assessing their efficacy (usually in the absence of data) and appropriateness—are common and reflect the need to categorize the messy world of shelters in search for some larger truths (e.g. Aslan 1997; Cerulli 1985; Architecture Project 2002; Curuni and Santopouli 2005; Demas 1990; Federico 1985; Fitch 1982; García-Bárcena 1987a; Gollman 1987; Ranellucci 1996; Stubbs 1995).

Descriptive articles or case studies about specific shelters can be useful and provide insight when the decision-making process and the criteria established for the shelter are clearly described, but this information is often lacking or cast in language too general for the reader to critically assess the relationship between established criteria and design of the shelter. Many of these articles were written either to convey a design concept—whether eventually built or not is often not known—or shortly after construction of a shelter, when expectations were high and considerable investments had been made (e.g. Altoon + Porter 1998; Bachmann and Schwarting 2005; Bianchi et al. 1996; Diplom...2003; Hadjisavvas 2000; Kuttinger 1984; Lino Bianco 2004; Manara 1995 and 2000; Piccioli 2005; Schmid 1998; Schmuckle-Mollard 1991). They are consequently full of an optimism and pride that begs the question of whether the proposed or adopted design solution is appropriate for the site or will meet the need for long-term protection. A few articles assist with the decision-making process by examining shelters in relation to other options, such as reburial (Roby 1996) or full reconstruction of the original building (Brunella and Petit 2003; Lavagne and Bassier 2002).

Architectural and museological approaches to shelter design

A sub-genre of the shelter literature are articles written primarily from an architectural perspective, rather than a conservation, or even museological, one. In this literature, the protective function of the shelter design is secondary to, or eclipsed altogether by, the architect's vision of how a designed shelter responds to site, topography, landscape, meaning and context. The concepts, language and lavish illustrations and renderings of the architect are often at odds with the more prosaic and pragmatic approaches in the conservation literature (see for instance Bachmann and Schwarting 2005; Gabbiani 2003; Manzelle 1996; Marconi 1982; Nigero 2007; Salvatore 2004; Stevens 1981; Up the villa 2003). An extreme example of the architectural approach is the futuristic coverings designed by Marcello Guido at Piazza Toscano to display the archaeological remnants within an historic town (Gabbiani 2003). Architectural competitions or studio projects have been another source of shelter designs (e.g. Bakirtzis et al. 2003; Bello et al. 1997; Bussac 1997; Krinzinger 2000; Kuttinger 1984; Lino Bianco 2004; Architecture Project 2002; and Palumbo 2001, who cites the case of Petra where an architectural competition for the construction of a shelter without sufficient criteria specified did not produce a viable design).

There are architects who design shelters and then there are designer architects ('starchitects'), a few of whom have interested themselves in shelter design for archaeological sites or monuments: Andrea Bruno's proposal for a glass structure over the column of Marcus Aurelius (Bruno 1987; see also Toraldo di Francia 1986 and Technology Trends 1985); Jean Nouvel's glass and steel shelter over a Roman villa in France (Up the villa 2003); Renzo Piano's proposal to shelter and interpret the site of Pompeii (Piano 1990); and Richard Meier's controversial design of a new enclosure and museum for the Ara Pacis in Rome (Richard Meier...2007).

These architectural studies and designs are always stimulating and innovative, and sometimes pure fantasy, such as Stevens' geodesic dome over the ruins of a Chinese stupa (Stevens 1986), but pay only nominal attention to what a conservation professional would consider to be the primary purpose in building a shelter. They are indicative of the gap that exists between the professions of architecture and conservation. Another aspect of this gap is exemplified in the long and complicated history of concept proposals and environmental study for a new shelter over the Villa Arianna (to replace all or some of existing temporary and permanent shelters). Very conceptual proposals put forth by architects in 2003 (Howe [2003]) bear no relationship to the design put forward by Merler (2002), which is purportedly based on environmental data collected by the ENEA-ICR project. Neither concept in turn bears any resemblance to the shelter design actually built on the site as a result of the ENEA-ICR conservation study and simulation modelling (Citterio and Giani 2005, Laurenti 2006, Prosperi Porta 2006). The shelter that was built follows the approach most likely to yield the best solution to preserving the site, since it makes a direct link between design and conservation criteria based on long study. It will, therefore, be of interest to follow the performance of this shelter in the future.

An architectural trend evident in many shelter designs of the last ten years or so is utilization of new technology and materials for controlling the interior environment, while making a strong architectural statement. These include the use of passive systems (De Matteis 2002; Guex 2003; Krinzing 2000; Muceli 2004) and artificially controlled environments (Koinova-Arnaudova et al. 2003; Pellegrino and Costabile 2005; Uchida 1997). Louvered partitions or panels (utilized early on for shelters in the Piazza Armerina design), or rotating screens of various types, are especially favoured as a means of controlling light and environment (Altoon + Porter 1998; Bachmann and Schwarting 2005; Gugliermetti and Maccari 1998; Hubeli and Fumagalli 1987; Krinzing 2000; Valle 2001). There is little discussion, however, on establishing monitoring indicators to evaluate the efficacy of these systems on the preservation of the remains. An exception is the monitoring program for the glass-sheathed shelter over the ruins of Hamar Cathedral (Statsbygg 1998, and follow-up assessment in Ibenholt 2003).

The dangers of using transparent materials—the greenhouse effect—are well understood by now (although they are still used) and, fortunately, we hear little in recent years about encasing monuments in glass (see e.g. Marconi 1982; Technology Trends 1985). New types of transparent materials are investigated in Gugliermetti and Maccari 1998 and Gugliermetti 2007, intended to overcome the dangers of earlier designs, notably the use of perspex at Piazza Armerina, but also apparent in many other shelters that incorporated excessive use of glass, such as the well-known enclosure protecting the mosaics at Fishbourne, whose deterioration is attributed in part from solar gain in the glazed south facing elevation (Stewart et al. 2006). Membranes or textiles and tensile structure, which found a place in shelter design beginning in the 1980s (Agnew et al. 1996; Lolli-Ghetti 1982; Alef 2002 for the Ein Gedi shelter; Stevens 1981), are still very popular (Hebbelink et al. 2001; Krinzinger 2000; Larpin 1991; Lino Bianco 2004). Even 'living roofs' have found a home over archaeological sites (e.g. Edwards et al. 2003 for the Brading Roman Villa), but note the fate of the soil-covered roof over the site of Akrotiri (Fintikakis 2002).

In other articles, which often cross over with the 'architect's literature' the shelter is seen as a principal means of pursuing a museological approach to archaeological sites, in which the role of the shelter in revealing and presenting the historic values of the place is given emphasis (e.g. Alef 2002 for an evaluation of the effects of shelters on interpretation and presentation of mosaics in Israel; Berriochoa 2001a; Connor and Pearson 1968; Ranelluci 2005; Sivan 2003). In this approach the shelter serves primarily to interpret the archaeological site to the visitor. The visitor experience is enhanced by the architectural design itself, walkways and signage, and even exhibitions inside the shelter and gift shops outside (see, for instance, the new shelter at Brading Roman Villa, Edwards et al. 2003). Maintaining a balance somewhere between wild ruin and pristine museum is a challenge in shelter design. In some of the enclosed, museum-like interiors the sense of ruin and traces of patina or age are 'disappeared,' as for instance in the Terrace Houses at Ephesus (Krinzinger 2000), the Dionysos mosaic shelter at Zippori (Alef 2002; Sivan 2003), the enclosure over Building Z at Pergamon (Bachmann and Schwarting 2005), and the Domus dell'Ortaglia (Morandini and Rossi 2005). At the other end of the spectrum is the innovative, but far from clinical, approach taken at the site of Tell Mozan/Urkish in Syria, where the earthen walls are covered individually with locally procured materials (canvas laid over metal frames) that serve both to protect and interpret the site (Buccellati 2006)

The convergence of the architectural and museological approaches is epitomized in the shelter over the Villa del Casale at Piazza Armerina, designed by architect Franco Minissi. No other archaeological shelter has received such sustained interest and analysis. Undoubtedly, this is due to the outstanding mosaics of the villa, the innovative design and intent of the shelter (a spatial reconstruction utilizing modern materials), its historic

status, the site's popularity for visitors, and the subsequent problems that have arisen as a result of the shelter design. Contributing to the shelter's fame over the past fifty years are numerous publications, which include the architect's writings about his intentions (Minissi 1961), inspired by ideas initially put forth by the theoretician Cesare Brandi (excerpted in Dossier...2004, 64ff; discussed in Stanley-Price and Jokilehto 2001); the many individual studies of the shelter's history, performance and proposed retrofitting or re-design (Berriochoa 2001b; Laurenti et al. 2006; Ranellucci 2005; Scalisi 2006; Santalucia 2004a and 2004b; Santopuoli 2006; Stanley-Price 1997; Stanley-Price and Jokilehto 2001; Stanley-Price and Ponti 2003; Vivio 2005); the proceedings of a conference devoted to the project to study, conserve, and design a new shelter for the villa (see Meli 2007 and others from this publication); as well as mention of the Piazza Armerina shelter in every general overview of shelters. The construction of a new shelter for the site (Rizzi 2007), currently under construction, will therefore be greatly anticipated and, undoubtedly, scrutinized in terms of how it will address design, conservation, future monitoring, and museological and visitor needs.

Amphitheaters are a niche market for sheltering, mainly in the context of on-going use. The shelter designed to protect the theater in Grand, France incorporates partial re-creation of the volumes (Bertaux et al. 1998); the ruins of a Roman amphitheater in London are protected by being enclosed within a modern building (Ganiaris and Barham 2002); the Roman theater in Fiesole is sheltered with glass and steel (Gamannossi 2006); and the stage of the theater at Orange, France is protected with a minimalist modern roof (Repellin 2006).

Temporary shelters to protect sites while excavations are progressing, or until a more permanent solution can be found, are infrequent in the literature. The 'hexashelter' for the Orpheus mosaic in Cyprus (Agnew 1991) was an early example of a temporary shelter and is an exemplar of the temporary becoming permanent as a result of ineffective management (see Demas et al. in Ben Abed et al. 2008). Barker 1986 and Carroll 1998 provide simple methods for temporary sheltering of on-going excavations; Weaver (1973) describes inflatable air-domes for use during excavations; Çatalhöyük Research Project; Theoulakis 1993; and Diplom...2003 offer more sophisticated methods, in the latter case taking into consideration office and exhibition space.

Shelter research, assessment and planning

What has been largely missing from the literature, with notable recent exceptions, are critical reviews and follow-up evaluations - after the opening ceremonies are over and the champagne is drunk - of the actual performance of shelters in protecting archaeological remains. In the answers to a brief questionnaire to participants of the Shelters Colloquium held in Tumacacori, Arizona in 2001, methods of evaluation and case studies of such assessments were identified as the most critical gap in the literature. A close second, and

clearly a corollary to performance evaluation, was the need for publications that address establishing conservation criteria for shelter design and a decision-making process for when to shelter (see Identified Needs and Recommendations in Teutonico 2001).

Recent articles and initiatives are beginning to address these gaps. The *CMAS* publication of selected papers of the Shelters Colloquium, along with a review of the 2000 Bologna Conference (Fentress 2001; *Le coperture...2000*) on the Italian experience with shelters, and the shelter initiative of the Istituto Centrale per il Restauro (Rome), attest to the current interest in protective shelters and are particularly notable for the emphasis on planning for shelters (*CMAS* 2001; Sposito 2006; Laurenti 2006). These publications bring forth the need for a multidisciplinary approach in the design of a shelter and clear criteria in planning for and designing a shelter. A rare example of a methodological planning process that incorporates conservation criteria with input from the community, who have a strong affiliation to the site, is Thompson and Taylor 2001.

Assessment of shelters is increasing and takes different forms. There have been efforts over the last decade and more at environmental monitoring to assess performance of a shelter or in advance of shelter construction to inform the design (e.g. Agnew et al. 1996; Citterio and Giani 2005; Citterio and Giani 2006; Edwards et al. 1996; Kotlik and Heidingsfeld 2002; Laurenti 2006; Miura 2002; Theolakis 1993). The reports on the environmental monitoring of the sheltered mosaics at Chedworth are particularly valuable in terms of conceptualizing the monitoring strategy and forthrightly pointing out the difficulties of monitoring, especially as regards instrumentation and sub-surface monitoring (Stewart et al. 2003, Stewart and Staniforth 2004). Modeling of shelter environments has also been undertaken, but its efficacy in creating the best environment for a shelter has yet to be proven (Aslan 2001; Citterio and Giani 2005; Gugliermetti and Dell'Omo 2000 and Gugliermetti et al. 2004; De Santoli and Mariotti 2008). Nishiura et al. 2002 reports on performance testing using replica materials. A different type of monitoring has been focused on the effects of soiling and biological growth under shelters (see Altieri et al. 2005; Altieri et al. 2006; Bartolini et al. 2006), also utilizing replica materials. The link required between deterioration mechanisms, environmental monitoring results, and design of a shelter in order to address environmental conditions remains a real challenge. As a case in point, at Aquileia the new shelter deals with microbiological growth on mosaics by incorporating a biocidal spray system (Di Blasi 2000) rather than by controlling ventilation and light through the design. In the design of the shelter for the mosaics in the Nile festival building at Zippori, it is not known the extent to which the conservation criteria set forth in Costanzi Cobau and Nadi 2003 were followed.

Numerous historical overviews and critical assessments of older shelters have emerged. The voluminous literature on Piazza Armerina has already been mentioned. Less well

known but of much greater age are many of the enclosures over mosaics in England, dating back to the early nineteenth century (Cosh 2002; Stewart and Cosh 2005); the venerable shelter designed by Frederick Law Olmstead in 1932 over the ruins of Casa Grande in New Mexico (Matero 1999); the nineteenth and early twentieth century shelters over the mosaic site of Obre-Boscéaz (Weidmann 1987 and 2005); and the long history of sheltering at Pompeii (Coperture...2000; Federico 1985), including the performance of early reinforced concrete roofs at the site (D'Agostino and Stendardo 2000). There are important lessons to be learned from evaluating these long-lived shelters. Many older shelters have been judged inadequate to protect the site or to please the visitor and are either retrofitted, in order to improve performance or correct faults (Carvalho Dias et al. 2003; Weidmann 1987; and Stanley-Price and Ponti 2003 for the many attempts to retrofit the Piazza Armerina shelter as problems developed), or replaced altogether with a new shelter.

Replacement of old shelters with new has either happened or been proposed for a prehistoric site at Blackwater Draw Archaeological Site, USA (Jerome 2001); at San Vincenzo al Volturno, Isernia, Italy (De Santoli and Moncada Lo Giudice 1998); the Late Bronze Age ruins at Akrotiri on the island of Santorini, Greece (De Matteis 2002; Dumas 1997); the Terrace Houses at Ephesus, now in their second replacement (Wiplinger 1990; Krinzing 2000); the Roman baths at Badenweiler, Germany (Filgis 2001; Schmidt 2003); and the mosaics in the basilica at Aquileia, Italy (Di Blasi 2000), at Brading, England (Edwards et al. 2003), in the Domus dell'Ortaglia, Italy (Morandini and Rossi 2005) and in the Roman villa at Patti Marina, Italy (Ceschi 2004). Critical assessments are not limited to elderly shelters. The petroglyph shelters in Sweden and Canada (see Wainwright et al. 1997 for the Canadian shelter) are vehemently criticized by Bahn and Hygen 1996 and Bahn et al. 1995, respectively, for their failures, demonstrated in the case of the Swedish shelter and prophesied for the Canadian one.

Shelter research initiatives

Two studies with similar goals have attempted to address design and performance assessment of shelters in a comprehensive manner. The one was a multi-year (1997-2002), multi-disciplinary study undertaken by the Istituto Centrale per il Restauro (ICR) and the Ente per le Nuove Tecnologie l'Energia e l'Ambiente/Organization for New Technology, Energy and Environment (ENEA) aimed at developing a methodology for design of shelters based on an assessment of the performance of 120 shelters in Italy, environmental monitoring of four selected shelters, and design of new shelters for two sites based on the results. The final results of the study were published in 2006 (Laurenti 2006), preceded by many earlier articles during the course of the study (Laurenti 1998a, 1998b, 2001, 2003; Altieri et al. 2005 and 2006). The annotated bibliography includes extended abstracts of many of the articles in the final publication in order to give the contents the attention they deserve (see Altieri et al. 2006; Bartolini

et al. 2006; Cacace et al. 2006; Citterio and Giani 2006; Ferroni and Laurenti 2006; Laurenti and Prosperi Porta 2006; Prosperi Porta 2006).

Also of note in Italy is the work of the Herculaneum Conservation Project, which includes investigation of the full range of shelter-related interventions from repair of existing shelters to temporary roofing interventions and medium and long-term shelter solutions (Pesaresi and Rizzi 2007). Easy maintenance and low cost were important criteria in selecting designs for implementation. Performance of the built shelters is being monitored.

The second study (2004-2009), a collaboration of the Israel Antiquities Authority (IAA), English Heritage (EH) and the Getty Conservation Institute, was also aimed at shelter performance and design criteria. It was based on assessing performance of all shelters over mosaics in England and Israel, where independent shelter initiatives by the IAA and EH were already underway, using a common methodology for a rapid assessment of the condition of mosaics and their shelters. An overview of the study was published in 2006 (Stewart et al. 2006), but fuller publication of results are presented in the proceedings of the 9th ICCM Conference in Tunisia, which was published in 2008 (see Neguer and Alef, and Stewart in Ben Abed et al. 2008) and are anticipated in the forthcoming publication of the 10th ICCM Conference in Palermo.

Both projects have in common regional surveys to provide an overview of the state of sheltering followed by more in-depth investigation of shelters. While better synthesis of results and integration between the two studies would be highly desirable, it is clear from these studies that assessment of performance of existing shelters and establishing performance criteria for design of new shelters can only be undertaken on a case by case basis. These studies do, however, provide baseline data and models for undertaking detailed site-specific assessment, including environmental monitoring needs, as well as more refined criteria for design of a new shelter.

Concluding remarks

Sheltering is foremost a preventive measure, the intention being to mitigate the causes of deterioration and thereby avoid direct intervention or remedial actions in the future. Other functions and attractions of shelters, whether visitor comfort and interpretation, compatibility with the setting, or creative architectural design, are indeed more compelling, which is why they often take precedence over protection. Despite indicators of a more rigorous and sophisticated approach to design of shelters, we remain severely hampered by an incomplete understanding of causes and mechanisms of deterioration and the potential impact of a shelter on the site's environment and, therefore, we are

ill-equipped to provide architects with a specific conservation brief for the protection of the site. Indeed, there is little clarity regarding the types of environmental data, including subsurface, that are most useful or needed, the best instrumentation for data collection, or for how long such data should be collected.

General criteria for protective shelters have long been understood (e.g. the need for effective drainage, a design that mitigates environmental fluctuations, prevents microbiological growth, has a minimal impact on archaeological remains, deters birds from nesting, and so forth; see e.g. Agnew 2001; Aslan 2007; Sgarbi 2007) but these are still ignored, or not sufficiently understood to translate into design concepts. The integration of environmental data with simulation modeling is a potentially productive collaboration that needs further investigation. Indeed, designing for visitor comfort and experience, museological needs, and architectural expression is easier to achieve and allows the architect more creativity. Architects seem still to be working apart from conservation professionals and true integration among these disciplines is required if we are to advance the frontiers of research and if protective shelters are to serve their primary function.

Finally, we need to understand the larger management context (which includes the social, political, and economic context) in which decisions will be made and shelters must survive in the long term. Agnew and Wade 1986 and Campanelli 2005 are among the few articles to examine the impact of the larger context in which decisions are made and failures and unintended consequences occur. The requirements for long-term maintenance of shelters is rarely seriously considered in planning and therefore too often not carried out (e.g. Curuni and Santopuoli 2005). The results of a testing program at Caesarea Maritima aimed at documenting the role of maintenance in the preservation of mosaics (Piqué et al 2003) highlight the type of information regarding long-term maintenance that is important for sustainable decision-making. The immediate and long-term financial and human resource commitments required for design, implementation and future maintenance of a shelter are substantial. A commensurate investment in time and resources to carry out assessments and prepare for such an intervention and expenditure is surely warranted.

Annotated Bibliography on Protective Shelters for Archaeological Sites

A note on the bibliography and annotations

Citations selected for annotation were limited only by language (not type of site): English, French, German, Italian, Spanish, and a few in Portuguese. All of the citations are annotated, but as the number and content of publications has increased in the 2000s, greater winnowing of references has occurred and annotations of those selected have lengthened. Most of the annotations are simply indicative, summarizing the contents or salient points of the article or monograph; some are more analytical; a few contain editorial remarks. The annotations are especially important for the subject material that is buried within monographs or even articles covering wider topics. Because relatively little had been published on the subject of sheltering in the earlier decades (1960s–1980s), the bibliography includes citations that contain only brief references to or documentation of shelters, which are otherwise not available in published form. Due to language restrictions there is little representation of published works on shelters in Asia generally; for instance, construction of shelters or enclosures in China is more extensive than is represented by the English-language references (e.g. Chen 1980; Hu 1986; Wu 1985). Post-2007 contributions to the literature, especially as they relate to mosaic sites should be noted: the publication of the 9th ICCM conference (Hammamet, Tunisia) in 2008 is cited in the bibliography (Ben Abed et al. 2008), though articles are not individually annotated, and the publication of the 10th conference in Palermo is forthcoming.

A number of shelters are discussed in multiple articles; every attempt has been made to cross reference multiple publications in the bibliography: internal cross-referencing is indicated simply with author and date (e.g. see also Stanley-Price 1997 herein); additional references that the reader may wish to consult, but that are not annotated in the bibliography, are noted in brackets with the full citation or web link. Online publications and web sites related to shelters are becoming more common, but while very useful, web links tend to disappear over time or change URLs; the links cited in the bibliography have been verified as of January 2012. The date of 'publication' or last revision of a website used as the principal citation is in the same location as the publication date for other references in this bibliography (i.e. after the author).

The annotators are indicated at the end of the annotation, identified by their initials. Most of the annotators have been interns with the mosaic project at the GCI over the years. We are very grateful for their dedication to this work. Annotators: A.O. (Anne Oliver); B.L. (Bettina Lucherini); B.L.M. (Benjamin Marcus); Chris de Brer (C.B.); L.F. (Leslie Friedman); K.K. (Kenza Kahrim); M.D. (Martha Demas); J.S. (Jane Sunderland); S.T. (Sibylla Tringham).

Annotated Bibliography on Protective Shelters for Archaeological Sites

- Agnew, Neville. 2001. Methodology, conservation criteria and performance evaluation for archaeological site shelters. *Conservation and Management of Archaeological Sites* 5 (1 & 2): 7-18.

This article explores the issues that arise in the planning process to shelter a site and advocates a careful and rigorous methodology at all stages of the project. The author discusses the methodology of the decision-making process and examines the protective, aesthetic and interpretive criteria for a shelter. Evaluating shelter performance is also emphasised and the author addresses ways to incorporate it into the planning process. The arguments are well illustrated with case studies. (S.T.)

- Agnew, Neville H., and Mary Wade. 1986. A case study of a palaeontological site: The need for planning and protection. In *Preventive Measures During Excavation and Site Protection: Conference Ghent, 6-8 November 1985 = Mesures préventives en cours de fouilles et protection du site: Gand, 6-8 novembre 1985*, 257-70. Rome, Italy: ICCROM.

This general discussion of the problems of conserving a fragile fossil site includes a brief description of the metal-framed protective roof over this dinosaur trackway in Australia and the problems associated with its construction and performance. The absence of a fence around the site allowed kangaroos to enter the shelter; the open shelter provided no protection against wind-blown dust and rain. [For a more contextual overview see also Agnew, Neville, Heather Griffin, Mary Wade, Terence Tebble, and Warren Oxnam. 1989. Strategies and techniques for the preservation of fossil track sites: An Australian example. In *Dinosaur Tracks and Traces*, eds. David D. Gillette and Martin G. Lockley, 397-407. Cambridge: Cambridge University Press.] (M.D.)

- *Agnew, Neville and Richard Coffman. 1991. Development and evaluation of the hexashelter. In *The Conservation of the Orpheus Mosaic at Paphos, Cyprus*, ed. Nicholas Stanley-Price, 36-41. Los Angeles: Getty Conservation Institute.

Description of the materials, design, and construction of a light-weight, modular, temporary shelter, the 'hexashelter', over the Orpheus mosaic in Paphos. The potential advantages of this prototype shelter are its low cost; aesthetic compatibility with the environment and adaptability to irregular terrain; its ease of dismantling, reuse, and extension; and its use of on-ground concrete footings to prevent damage to the archaeology. The disadvantages are that the aerotextile side panels do not exclude water completely and the covering membrane cannot withstand heavy vertical loads. (M.D.)

- Agnew, Neville, Shin Maekawa, Richard Coffman, and Jeff Meyer. 1996. Evaluation of the performance of a lightweight modular site shelter: Quantitative meteorological data and protective indices for the 'hexashelter.' *Conservation and Management of Archaeological Sites* 1 (3): 139-150.

The authors describe the rationale behind the development of a prototype shelter, the six-sided 'hexashelter,' for protection of archaeological sites. The shelter was

designed as a lightweight, modular system, which would be easy to erect and relatively inexpensive. The performance of the shelter was evaluated quantitatively by comparing meteorological parameters inside and outside the shelter, and by the use of adobe test walls for comparative weathering, likewise under and outside the shelter. See also Agnew and Coffman 1991 herein for use of the hexashelter to protect a mosaic site. (M.D.)

- *Albini, Marco. 1988. La villa romana di Desenzano del Garda: Una proposta di musealizzazione. In *I siti archeologici: Un problema di musealizzazione all'aperto. Primo seminario di studi, Roma, febbraio 1988*, eds. Bruna Amendolea, Rosanna Cazzella and Laura Indrio, 207-212. Roma: Multigrafica.

Italian. This article describes a proposed shelter for the Roman period site of Desenzano del Garda, Italy. The authors address the challenges of designing a shelter for a mosaic within a tightly-spaced urban context, as well as the design process, which evolved from a recreated historic roof form to a modern modular structure. The modules are at the same height with small concrete foundations and a roof membrane of woven translucent polyester. The sides of the shelter are removable panels of the same translucent polyester, in order to adjust the exposure of the site according to weather conditions. Criteria for the shelter included minimal foundations, reduction in temperature changes, adequate ventilation and drainage, re-creation of historic circulation routes with raised visitor pathways, and applicability to other areas of the site in the future. (B.L.M/ L.F.)

- *Alef, Yael. 2002. Evaluation of Shelters over Mosaics in Israel. Masters thesis, Raymond Lemaire International Centre for Conservation, Katholieke Universiteit Leuven.

The performance of shelters as interpretative tools for the display and presentation of mosaic sites in Israel is the subject of this dissertation. After examining varying approaches to presentation, specific assessment criteria and evaluation methodology are defined and then employed in a survey of sheltered sites. Twenty-five sites are examined in total, and three at Zippori are discussed in detail. The numerous illustrations demonstrate the variety of site sheltering solutions in Israel. (S.T.)

- Altieri, Antonella, Annamaria Giovagnoli, and Sandra Ricci. 2005. Analisi dello "sporciamento" di superfici per una diagnosi speditiva del degrado di dipinti parietali antichi. In *Sulle pitture murali: Riflessioni, conoscenze, interventi: Atti del convegno di studi, Bressanone 12-15 luglio 2005*, eds. Guido Biscontin and Guido Driussi, 539-47. *Scienza e Beni Culturali* 21. Marghera-Venezia: Arcadia ricerche.

Italian. The effects of shelters on the state of conservation of mural paintings were evaluated by comparing levels of soiling of the mural surface. Four Roman sites in different environments were studied: a rural marine site (Villa Romana at Varignano), an urban marine site (Villa Arianna at Castellammare di Stabia), a rural mountainous site (Domus di Piano S. Giacomo at Corfnio), and a rural site in a hilly area (Villa del Casale at Piazza Armerina). The authors created plaster coupons, painted in fresco technique using standard colors and left either untreated, or differentially treated

with biocides and consolidants. The coupons were then placed in different locations at each of the sites. Chromatic measurements and microscopic observations were carried out at intervals to compare soiling development. While accounting for other factors, in general, soiling was found to be heavier under shelters, particularly when the samples were placed near vertical walls, elevated structures, or near ongoing excavation. Increased soiling was also found near lateral openings in the shelter which allowed in outside dust, as well as in areas lacking pavement, and in areas recently excavated. (B.L.M./L.F.)

Altieri A., M. Bartolini, E. Giani, A. Giovagnoli, M.P. Nugari, and S. Ricci. 2006. La sperimentazione scientifica. In *Le coperture delle aree archeologiche: Museo aperto*, ed. Maria Concetta Laurenti, 143–158. Roma, Italy: Gangemi Editore.

Italian. This article describes environmental monitoring, mock-up sample testing, and studies of deterioration primarily in rooms containing wall-paintings located at the four study sites of the ICR-ENEA project on shelters for archaeological sites (see Laurenti 2006). It provides a detailed description of locations and methods used for interior and exterior microclimate monitoring, air quality monitoring, studies of deterioration performed on original materials, and the use of painted plaster mock-ups to monitor surface soiling and biological growth and to test treatments. The authors also provide a list of analytical instrumentation used and how it was applied. This is the final report on the testing, which is also covered in Altieri et al. 2005 herein.

Altoon + Porter Architects, and Nancy Egan. 1998. Siqueiros Mural Shade Structure. In *Altoon + Porter Architects: Context and Conscience*. 62–65. Milan: L'Arca Edizioni S.p.A.

A brief description with photos of a model and architectural drawings of a proposed shelter design to protect the David Alfaro Siqueiros mural in Los Angeles. The design by a Los Angeles architectural firm was part of a project by the Getty Conservation Institute to conserve the 1932 mural. The design concept (which included seating and audio-visual facilities for interpretation) and innovative use of materials and technology (teflon-coated fiberglass and rotating vertical screens to shield the mural from light) are described. The shelter design was never implemented. (M.D.)

Alva Balderrama, Alejandro, and Giacomo Chiari. 1995. Protection and conservation of excavated structures of mudbrick. In *Conservation on Archaeological Excavations with Particular Reference to the Mediterranean Area* (second edition), ed. N.P. Stanley-Price, 101–112. Rome: ICCROM.

This report includes a restatement of the 1980 Ankara proposals for research into the design and construction of protective shelters and for the requirements of temporary protection, as well as a brief description and evaluation of the metal-framed protective shelter at the Neolithic site of Tenta, Cyprus (Plate 1) and the temporary shelter utilizing traditional materials at Chan Chan, Peru (Plate 2). (M.D.)

Amendolea, Bruno, ed. 1995. *I siti archeologici: Un problema di musealizzazione all'aperto: Secondo seminario di studi, Roma, gennaio 1994*. Rome: Gruppo Editoriale Internazionale.

Italian. This compilation of articles focuses on the in situ preservation of archaeological heritage in Italy, although other sites in the Mediterranean region are presented as well. At many of the sites, shelters have been proposed and/or erected to protect the ruins; a diverse selection is illustrated and discussed in five of the case studies. See also Amendolea et al. 1988 herein. (A.O.)

Amendolea, Bruno, Rosanna Cazzella, and Laura Indrio, eds. 1988 *I siti archeologici: Un problema di musealizzazione all'aperto: Primo seminario di studi, Roma, febbraio 1988*. Rome: Multigrafica Editrice.

Italian. This is a compilation of articles on the problems of and solutions to preserving sites in the open; most of the sites are in Italy, a few in the UK and elsewhere. Includes discussion and/or photos of various actual and proposed protective schemes, which are presented in the context of the larger efforts to preserve and present these sites. (M.D.)

Apeland, K. 1993. EU 446 Eurocare Carebuild. In *Conservation of Stone and Other Materials: Proceedings of the International RILEM/UNESCO Congress, Paris, France, 29 June - 1 July 1993*, ed. M.-J. Thiel, 748-757. London and New York: E & F N Spon.

The research program Eurocare Carebuild was initiated in 1989 to develop principles and methodologies for finding architectural solutions during the design of protective buildings for archaeological sites. The sheltering of Hamar Cathedral is examined as a test case for the program. This project is notable as one of the first initiatives to address how the design of a shelter can make it an effective protective building. See also Ibenholt 2003 and Statsbygg 1998 herein. (S.T.)

Architecture Project. 2002. Une couverture pour cinq églises, Lalibela, Éthiopie. *L'Architecture d'aujourd'hui* 340: 52–53.

French and English. An architecture competition was launched to design a temporary shelter over the monolithic 12th century churches in Lalibela, Ethiopia while restoration work was carried out. 'Architecture Project' proposed an aluminium structure with a white fibreglass canopy, which was judged to provide better insulation and diffusion of daylight than textile. [The winning entry can be viewed at Teprin Associates. 1999. Concorso: Shelters of Five Churches in Lalibela Ethiopia 1999/2008, <http://www.teprin.com/lalibela.htm>] (S.T.)

Aslan, Zaki. 1997. Protective structures for the conservation and presentation of archaeological sites. *Journal of Conservation and Museum Studies* 3: 9–26.

This article provides a broad overview of the research the author undertook at the Institute of Archaeology, University College, London. Using selected examples mainly from Europe and the Mediterranean, the author explores the types of protective shelters over archaeological sites and offers a general assessment of their effectiveness

and common problems. Sheltering is looked at in the overall context of issues of conservation and presentation of archaeological sites. The author concludes with an emphasis on the need to develop a methodology for shelter design. (M.D.)

Aslan, Zaki. 2001. Designing protective structures at archaeological sites: Criteria and environmental design methodology for a proposed structure at Lot's Basilica, Jordan. *Conservation and Management of Archaeological Sites* 5 (1 & 2): 73–85.

In light of the problems associated with existing shelters over archaeological sites, the author proposes a new methodology for shelter design. The climatic design approach for a protective building focuses on the environmental requirements for the preservation of the site. The building design is based on passive methods of environmental control to address the climatic changes at a site. The author illustrates the methodology at Lot's Basilica, Jordan and the design is tested and improved by computer simulation. [This valuable approach and its application in evaluating protective structures is also published in Aslan, Zaki. 2003. Assessing the efficiency of protective structures for in situ conservation and presentation of mosaics on archaeological sites: A planning and design methodology for architects and site managers. In *Les mosaïques: Conserver pour présenter? VIIème Conférence du Comité international pour la conservation des mosaïques, 22-28 novembre 1999, Musée de l'Arles antique, Arles, Musée archéologique de Saint-Romain-en-Gal: Actes = Mosaics: Conserve to Display? VIIIth Conference of the International Committee for the Conservation of Mosaics: Proceedings*, ed. Patrick Blanc, 89-101. Arles, France: Éditions du Musée de l'Arles et de la Provence antiques] (S.T.)

Aslan, Zaki. 2007. The design of protective structures for the conservation and presentation of archaeological sites in the Mediterranean. *ICCROM Newsletter* (33): 14–15.

Through training and technical assistance, ICCROM has developed several planning and design guidelines for the construction of shelters at archaeological sites which, if applied, can be used to evaluate the potential effectiveness of proposed designs. Design criteria should consider the following: stakeholder inclusion, range of site values and significance, physical condition of the site, and management aspects. The author lists basic principles and considerations of shelter design guidelines, including putting the shelter within the context of a site management framework, committing to future monitoring and maintenance, and conducting environmental monitoring. (L.F.)

*Bachmann, Martin and Andreas Schwarting. 2005. *Pergamon Bau Z: Schutzbau über römischen Mosaiken = Building Z: Protective Shelter for Roman Mosaics*. Dresden: Thelem.

German and English. Mosaics from Bldg Z at Pergamon were excavated by the German Archaeological Institute in 1990. Excavation was followed by a long planning and design process for a shelter to protect and display the Roman mosaics and remnants of Hellenistic wall painting. The shelter was completed 2004, based on an architectural concept described as 'both self-evident and concise.' The shelter employs partial

reconstruction of walls to give a sense of original spaces, distinguishing old from new material, combined with a modern roof comprised of a series of three gable roofs with local tiles. The walls on one side of the building are of steel louvers ('blinds') to allow light and air. (M.D.)

Bahn, Paul G., Robert G. Bednarik, and Jack Steinbring. 1995. The Peterborough petroglyph site: Reflections on massive intervention in rock art. *Rock Art Research: The Journal of the Australian Rock Art Research Association (AURA)* 12 (1): 29–41.

The authors offer a critical and extensive assessment of the enclosed shelter constructed over the petroglyph site at Peterborough, Canada (see Wainwright et al. 1997 for a detailed description of the shelter and rationale for its construction). The shelter is severely criticized as a massive intervention to a rock art site and its associated environment, without clear criteria or a rationale for construction (i.e., the main threats or causes of deterioration). The authors state the need for objective performance evaluation of shelter interventions and candid reporting if we are to learn from others' experience. Extensive commentary on the controversy surrounding the Peterborough shelter in response to this article can be found in *Rock Art Research: The Journal of the Australian Rock Art Research Association (AURA)* 1996. 13 (1): 47-60 and 1997. 14 (1): 53–58. (M.D.)

Bahn, Paul G, and Anne-Sophie Hygen. 1996. More on massive intervention: The Aspeberget structure. *Rock Art Research: The Journal of the Australian Rock Art Research Association (AURA)* 13 (2): 137–138.

A brief critical review of a structure built to protect temporarily a rock art site in Sweden. The temporary, experimental shelter was built in 1989 after it was clear that the rock art was suffering from exposure to the environment. By 1996 it was recognized as a failure and removed. Further experimentation for sheltering the petroglyph panel was proposed to take place on sites with no rock art. (M.D.)

*Bakirtzis, Arghyris, Charalambos Bakirtzis, Pandelis Xydias and Michalis Kamilis. 2003. Protection du pavement en mosaïque de la 'Basilique de Paul' à Philippes. In *Mosaics Make a Site: The Conservation In Situ of Mosaics on Archaeological Sites: Proceedings of the VIth Conference of the International Committee for the Conservation of Mosaics, Nicosia, Cyprus, 1996*, ed. Demetrios Michaelides, 83-89. Rome: ICCM.

French. Although rare in Greece, a protective structure was proposed to protect and preserve the (relaid) 4th century mosaics at the Christian priory at Philippi. Four shelter designs were proposed and are briefly evaluated; the final choice is a roof construction with lightweight steel supports covered by sheets of honeycombed polycarbonate. This was judged to sufficiently protect the mosaics while being an appropriate aesthetic and interpretive environment for the remains. Monitoring of the environmental conditions under the shelter is being undertaken to assess the efficacy of the shelter, but no details are provided. (S.T.)

Barker, Philip. 1986. Temporary shelter and site protection. In *Preventive Measures During Excavation and Site Protection: Conference Ghent, 6-8 November 1985 = Mesures préventives en cours de fouilles et protection du site: Gand, 6-8 novembre 1985*, 45–50. Rome: ICCROM.

The author describes methods of providing temporary shelter over archaeological remains during excavation, utilizing simple polyethylene-covered "horticultural tunnels". (M.D.)

Barruol, Guy. 1984. Archaeological reserves and the integration of remains in France. *A Future For Our Past (Council of Europe)* (23): 8-10.

Some of the problems that arise when integrating archaeological remains into an urban environment are presented, with an emphasis on sites in France. The author briefly describes open air sites and sites where the archaeological remains are integrated into public or private buildings. (S.T.)

Bartolini, Marco, Maria Pia Nugari, Sandra Ricci, and A. Roccardi. 2006. Valutazione dello stato di conservazione dei materiali in opera. In *Le coperture delle aree archeologiche: Museo aperto*, ed. Maria Concetta Laurenti, 193-204. Roma, Italy: Gangemi Editore.

Italian. A section of the final report of the ICR-ENEA shelter study (see Laurenti 2006 herein) contains four separate entries (by the authors noted in the citation) dealing with biological growth at the four study sites. The first entry provides an introduction to the bio-growth study and a list of rooms chosen for testing at each site. In the second entry, the authors observe lichen growth, identifying lichen species and comparing growth rates in sheltered and unsheltered areas. The third entry describes the location and appearance of various kinds of bio-growth observed at the sites and provides tables which identify species. Factors that contribute to bio-growth such as moisture, light, and shelter-generated microclimates were also observed. The fourth entry describes biocide tests carried out at all four sites which compared the performance of two biocides, Metatin N58 and Algophase, over a period of 12 months. (B.L.M.)

Bello, José María, Fernando Carrera and Fernando Cebrián. 1997. El proyecto de conservación del Dolmen de Dombate. *Brigantium* 10: 393-408.

Spanish. Following investigations into the deterioration mechanisms of stone and paintings at the megalithic tomb of Dolmen de Dombate, a permanent shelter is one of several measures proposed for preservation of the site. The environmental parameters for the preservation of the paintings on the interior of the tombs have been defined and the shelter may include a climate control system to meet the necessary conditions. Further monitoring of the condition of the tomb is foreseen. The website of the commission of Coruña announced a competition for site plan proposals to include site display facilities and sheltering of the megaliths. [For details of the investigations conducted at the site and photos of the Dolmen with its current temporary shelter see Cebrián del Moral, Fernando, José Yáñez Rodríguez, Manuel Lestón Gómez, Francisco Vidal Pérez, and Fernando Carrera Ramírez, eds. 2011. *El dolmen de Dombate: Arqueología, arquitectura*

y conservación. [A Coruña]: Diputación de A Coruña, <http://www1.dicoruna.es/deputacion/patrimonio/dolmen-dombate/catalogo-dombate.pdf> (S.T.)

- *Ben Abed, Aïcha, Martha Demas, and Thomas Roby, eds. 2008. *Lessons Learned: Reflecting on the Theory and Practice of Mosaic Conservation: Proceedings of the 9th ICCM Conference, Hammamet, Tunisia, November 29-December 3, 2005 = Leçons retenues: Les enseignements tirés des expériences passées dans le domaine de la conservation des mosaïques: Actes de la 9ème conférence de l'ICCM, Hammamet, Tunisie, 29 novembre-3 décembre 2005*. Los Angeles: Getty Conservation Institute.

The publication of the 9th ICCM conference contains several articles related to shelters, which are noted here but not annotated separately as they fall outside the 2007 cut-off date for the bibliography. These are: Bethell, Philip. 140 years of mosaic conservation at Chedworth Roman Villa, United Kingdom. 230–237; Demas, Martha, Thomas Roby, Neville Agnew, Giorgio Capriotti, Niki Savvides, and Demetrios Michaelides. Learning from past interventions: Evaluation of the project to conserve the Orpheus Mosaic at Paphos, Cyprus. 15–25; Dobrowolski, Jaroslaw. Villa of the Birds five years later: Early Roman mosaics in Alexandria, Egypt. 51–56; Gonçalves, José Lourenço. Reburial versus sheltering: Experiments in preventive conservation of the mosaics in the Roman Villa of Rabaçal, Penela, Portugal. 281–88; Ha'obsh, Mervat Ma'moun. Um Er-Rasas (Um Al-Rasas): Preservation of the mosaics at a new World Heritage Site in Jordan. 144–50; Michaelides, Demetrios, and Niki Savvides. Lessons not learned: The shelters at Kourion, Cyprus. 215–23; Neguer, Jacques, and Yael Alef. Rapid assessment of shelters over mosaics: Initial results from Israel. 193–203; Stewart, John. Rapid assessment of shelters over mosaics: Methodology and initial results from England. 181–92; Tringham, Sibylla, and John Stewart. Protective shelters over archaeological sites: A review of assessment initiatives. 204–14; Weidmann, Denis. Orbe-Boscèaz (Canton de Vaud, Suisse) 1975–2005: 30 ans de réflexions sur la conservation d'anciennes et de nouvelles mosaïques. 46–50.

- *Berriochoa, Sánchez-Moreno V. 2001a. Casa Hippolytus en Alcalá de Henares. *R & R: Restauración & Rehabilitación* 54: 62–63.

Spanish. A brief critical review of a large protective building erected over a Roman Villa in Spain. The building, which includes large glass panels in the walls, is assessed primarily in terms of the presentation and interpretation of the mosaics and the author concludes that the building and the museum-like presentation of the site is an appropriate solution. (S.T.)

- *_____. 2001b. The villa romana de Casale en Sicilia. *R & R: Restauración & Rehabilitación* 57: 60–61.

Spanish. This critique of the famous shelter at Piazza Armerina reviews the history and values of the site and discusses some of the problems encountered today including excessive sunlight and visitor discomfort. The author concludes that the shelter does not provide sufficient protection for the mosaics, makes an inappropriate interpretation of the site and calls for a complete revision of the presentation of the mosaics. See Minissi 1961 for other articles on Piazza Armerina cited herein. (S.T.)

Bertaux, Jean-Paul, Michel Goutal, Jean-Michel Mechling, Patrick Meistersheim and Jean-Pierre Crevoisier. 1998. The Gallo-Roman sanctuary at Grand, France. II: The protection and development of the amphitheatre. *Conservation and Management of Archaeological Sites* 2 (4): 217–228.

An innovative shelter was designed to protect the vulnerable stone remains of the amphitheatre, to partially recreate the original volume and shape of the structure, and to provide a venue for cultural events. The shelter incorporated tiers of seating and was constructed of a metal and reinforced-concrete frame covered with laminated wooden beams (glulam). Conceptual drawings, cross-sections, and photographs are provided. Entertainment types and spectator/production infrastructures are also considered. (A.O.)

Bianchi, Camillo, Simonetta Bonomi, and Maria Perissinotto. 1996. L'area archeologica di Montegrotto Terme: Note su un progetto di copertura. In *Dal sito archeologico all'archeologia del costruito: Conoscenza, progetto e conservazione: Atti del convegno di studi, Bressanone, 3–6 Luglio 1996*, eds. Guido Biscontin and Guido Driussi, 387–95. *Scienza e beni culturali*, 12. Padova, Italy: Arcadia.

Italian. The article addresses a new series of shelters proposed for the site of Montegrotto Terme, a Roman town founded for its therapeutic hot springs, recently compromised by steady urban development. The first excavation undertaken in 1781 revealed the site's three large interconnected baths, to be later rediscovered and accompanied by detrimental restoration by the *Soprintendenza Archeologica* in 1965. The authors propose a modular shelter design, capable of expansion, with distinct architectural components in each archaeological area to offer protection from aggressive atmospheric agents, to highlight the site remains and to provide for public pathways. Information relevant to design criteria, chosen materials and construction requirements is included. Though the shelter is proposed without solid walls, the archaeological site could be enclosed if deemed necessary. (K.K.)

*Bikai, Pierre M., and Patricia M. Bikai. 1997. Caring for the cultural heritage: Shelters. *ACOR Newsletter* 9(1): 1–3. <http://www.acorjordan.org/images/pdf/ACOR%20Newsletter%20Vol.%209.1.pdf>

The authors describe five shelters in Jordan, four at Madaba and one at Petra. The shelters range from an environmentally controlled, tile-roofed stone building in an urban setting to an open-air space frame construction within a larger archaeological site (Petra). A table is included which lists the final cost and the criteria that influenced the design of each shelter. (A.O.)

Brunella, Philippe and Jean-Paul Petit. 2003. Entre l'air et le couvert: Le parc archéologique européen de Bliesbruck-Reinheim (Moselle, France/Land Sarre, Allemagne), un parc au milieu extrême? In *Vestiges archéologiques en milieu extrême*. 164–178. Paris: Monum, Éditions du Patrimoine.

French. This article discusses the conservation, management and presentation of the large Celtic/ Gallo Roman archaeological park in the French-German border area.

A variety of approaches to conservation and display are adopted at the complex site, including a museum/shelter building over a Roman bath, temporary roofing, stabilization of exposed ruins, and full reconstruction. The authors examine the choices and reasoning behind these presentation solutions. (S.T.)

Bruno, Andrea. 1987. Protecting and preserving the column of Marcus Aurelius. *Museum* 39 (1): 2–7.

Urban pollution was destroying the monuments of Rome, many of which were consequently covered with scaffolding and protective netting in the 1980s. Architect Andrea Bruno discusses the proposal for the protection of the column of Marcus Aurelius, which called for the construction of a glass structure with steel supports and a mobile (elevator) platform. This design allowed for the protection and continued viewing of the monument while restoration work proceeds. See also Miarelli Mariani 1986 and Technology Trends 1985 herein. (M.D.)

Buccellati Giorgio. 2006. Conservation qua archaeology at Tell Mozan/Urkes. In *Of the Past, For the Future: Integrating Archaeology and Conservation: Proceedings of the Conservation Theme of the 5th World Archaeological Congress, Washington, D.C. June 2003*, eds. Neville Agnew and Janet Bridgland, 73-81. Los Angeles: Getty Conservation Institute.

At Tell Mozan in northeastern Syria, an innovative sheltering system was designed to protect the earthen walls of an extensive palace complex after excavation. Metal frames or cages covered with canvas were installed along the wall profile, set close to, but not touching, the walls and the frames rested on the ground. A low-cost solution using local materials and labor, and reversibility were essential criteria in the shelter design. A monitoring program to assess the effect of the coverings identified problems including damage from strong winds and stagnant water and the necessary periodic replacement of fabrics; these issues have since been addressed and experimentation and monitoring is on-going to improve the system. The 'wrapped reconstruction of the walls' is also used for interpretation and presentation of the site, with different colored fabrics representing functions of the palace. [This project is also reported in Italian in Buccellati, G. 2000. Ukesh: Archeologia, conservazione e restauro. *Kermes: La rivista del restauro*, 13(40): 41–48; and Buccellati Giorgio and Sophie Bonetti. 2003. Conservation at the core of archaeological strategy: The case of ancient Urkes at Tell Mozan. *Conservation: The GCI Newsletter* 18 (1): 18–21. For further information and images see Buccellati, Giorgio, ed. 2006–2008. Urkes: An overview, <http://128.97.6.202/urkespublic/overview.htm>] (S.T./M.D.)

Bussac, G. de. 1997. *Archi-archéo: 12 structures de protection de fouilles archéologiques*. Clermont-Ferrand: Ecole d'architecture de Clermont-Ferrand.

French. This document presents a very brief overview of 12 studio design projects of structures to protect and present archaeological sites. The designs, done in 1995, are the work of architectural students of the Ecole d'Architecture Clermont-Ferrand. (M.D.)

Cacace, C., S. D'Agostino, A.M. Ferroni, and M.C. Laurenti. 2006. La vulnerabilità archeologica: Efficienza e adeguatezza delle coperture di protezione. In *Le coperture delle aree archeologiche: Museo aperto*, ed. Maria Concetta Laurenti, 45–64. Roma, Italy: Gangemi Editore.

Italian. The article gives a detailed description of the shelter evaluation form used in the ICR-ENEA shelter project (see Laurenti 2006) for mapping risk and rating the performance of a shelter. Shelter evaluation incorporates two parts: performance of the shelter construction independent of its protective function and performance related to protection. Criteria for protective performance include roof characteristics, roof overhang, surrounding terrain, elements of the shelter (i.e. impact of foundations), and impacts of light, drainage and climate control system on the site. The method of determining how shelter performance is used to determine the overall vulnerability of a site to deterioration, and how the risk database can be used to compare statistical information from many different shelters are also described (B.L.M.).

Campanelli, Adele. 2005. Sito archeologico o "luogo della storia"? Alcuni esperimenti di musealizzazione in corso in Abruzzo. In *Conservare il passato: Metodi ed esperienze di protezione e restauro nei siti archeologici: Atti del Convegno, Chieti-Pescara, 25–26 settembre 2003*, ed. Claudio Varagnoli, 19–52. Antico Futuro, 1. Rome: Gangemi

Italian. This article notes some of the factors that impact the viability of constructing shelters, including lack of funding, absence of available expertise, political pressures, the difficulty of interpretation, and challenges of specific site locations and configurations. The successes and failures of a number of shelters are illustrated through four case studies in Abruzzo, Italy. At the site of Corfinio, a shelter, that in its design recreated the historic volumes of a Roman building, was never completed due to lack of funding. At the site of Benedetto dei Marsi, a city street was closed in order to construct a shelter. A politically unpopular decision, interpretive signage was never completed and the site is not maintained. In comparison, the well-preserved site of Castel di Leri used a shelter, fencing and interpretive features to draw attention to its unusual archaeological significance and to prevent looting. Lastly, a large museum space to house reconstructions of temple facades, which also includes an auditorium, gallery and laboratory was constructed at the site of Chieti, and has become a vital space to the community. (B.M./L.F.)

Caperton, Thomas J. 1993. Long-term preservation issues related to earthen archeological sites. In *7ª Conferência Internacional sobre o Estudo e Conservação da Arquitectura de Terra: Actes*, 324–329. Lisboa: DGEMN.

This article makes a critical evaluation of past preservation techniques used to stabilize the adobe walls at Fort Selden, New Mexico. These have included alterations to site drainage, repair of wall bases and installation of wall caps using adobe bricks and shelter 'coats,' and test applications of chemical consolidants and amendments for earth. Field trial techniques are described, including the reburial of several low walls and the protection of taller walls with geotextile shelters. See Thompson and Taylor 2001 for discussion of the plans to shelter the site. (A.O.)

Carroll, Scott. 1998. Temporary protection of a tel site excavation in central Turkey. *Conservation and Management of Archaeological Sites* 2 (3): 155–62.

The shelter used at Kaman-Kalehöyük is a rare example of a temporary structure designed to protect an excavation site between seasons. The reusable shelter, an alternative to backfilling, is constructed over the main excavation trench at the end of each season and dismantled at the start of the next. Wooden timbers are used for framing, and vertical members are set on flat boards which serve as footers. The large structure (40 m wide and 120 m long) is roofed with corrugated metal and fitted with gutters to control drainage. After considering the advantages and disadvantages of the system, the author argues in its favor and advocates similar measures at other sites. (A.O.)

*Carvalho Dias, Ana, Laurence Krougly and Magda MonraVal Sapina. 2003. Sauvegarde et présentation in situ des mosaïques de la Villa romaine de Torre de Palma (Monforte-Portugal). In *Les mosaïques: Conserver pour présenter? VIIème Conférence du Comité international pour la conservation des mosaïques, 22–28 novembre 1999, Musée de l'Arles antique, Arles, Musée archéologique de Saint-Romain-en-Gal: Actes = Mosaics, Conserve to Display? VIIIth Conference of the International Committee for the Conservation of Mosaics: Proceedings*, ed. Patrick. Blanc, 379–85. Arles: Musée de l'Arles et de la Provence antiques.

French. The authors present, in a poster, the conservation of the mosaics at a Roman villa in Portugal and comment on the shelter constructed at the site in 1993. The shelter is a metallic roof which, with a transparent center over the *peristyle*, also refers to the original architecture. Subsequent problems from wind, rain and condensation were mitigated by a variety of measures which include changing the roof incline. (S.T.)

Çatalhöyük Research Project, Institute of Archaeology University College London. 1993–2010. Çatalhöyük Excavations of Neolithic Anatolian Höyük: Archive Reports. http://www.catalhoyuk.com/archive_reports.

The archive reports detail developments in the excavations at Çatalhöyük and include information on the construction of the shelters built at the site. For description of the temporary shade roof over the South area and the Building 5 shelter which is a steel-framed 'double-skin tent' and open to the public, see Lindsay Falck Sheltering and shoring construction, *Çatalhöyük Archive Report 1999*. In 2003 the construction of a large (45 m x 27 m) shelter over the south area was completed. It is a continuous reinforced concrete plinth with a steel-frame truss system superstructure; the roof and sides are translucent polycarbon material and contain removable panels. Some construction details of this shelter can be found in the archive report for 2002. The archive reports of 2003 discuss the experience with the shelter which produces a good even light for excavation but problems with high temperatures and humidity are apparent. (S.T.)

Cerulli Irelli, Maria Guiseppina. 1985. Il problema delle coperture dei complessi archeologici di Pompei ed Ercolano attraverso due secoli e mezzo di scavi. *Restauro: Quaderni di restauro dei monumenti e di urbanistica dei centri antichi* 14(81): 7–11.

Italian. One of three articles in *Restauro* 81 devoted to "Coperture e protezione di zone archeologiche." This contribution is an historical outline of solutions adopted for the protection of excavated structures in Herculaneum and Pompeii. (M.D.)

- *Ceschi, Franco. 2004. La copertura protettiva permanente della villa romana di Patti Marina. In *Apparati musivi antichi nell'area del Mediterraneo: Conservazione programmata e recupero: Contributi analitici alla carta del rischio: Atti del I convegno internazionale di studi, La materia e i segni della storia, Piazza Armerina, 9-13 aprile 2003*, ed. Guido Meli, 203–211. I quaderni di Palazzo Montalbo, 4. Palermo: Dario Flaccovio.

Italian. The author offers a critical examination of the design for a permanent shelter to replace the failing temporary shelter at the Roman villa at Patti Marina, Italy, which contains extensive mosaic pavements. A set of functional requirements (e.g. ease of site access, illumination and protection from the sun, maximum transversal transparency, simplicity, reduction in supportive elements, low maintenance) are identified and addressed by the proposed permanent shelter. A curvilinear roof with supports, corresponding to the ancient walls, and a suspended walkway offer the advantages of minimal invasiveness and harmony of form with the natural environment. The article provides extensive design, material and construction detail that address conservation issues relating to drainage, light, ventilation, the greenhouse effect, site expansion, and the possibility of harnessing solar energy for site consumption. Also discussed is the integration of the lighting system within the shelter to best view the mosaics. (K.K.)

- Chen Jianzheng. 1980. Xian: An archaeological site museum at Banpo. *Museum* 32 (4): 184–187.

The archaeological site museum at Xian incorporates a barrel-vaulted shelter over 3,000 m² of the excavated Neolithic remains. Inside the hall are viewing galleries and didactic exhibits; adjacent is the museum building. Construction details of the shelter are not provided. (M.D.)

- *Citterio, Marco and Elisabetta Giani. 2005. I dipinti murali del sito archeologico di Castellammare di Stabia: Monitoraggio microclimatico per lo studio di nuove coperture di protezione. In *Sulle pitture murali: Riflessioni, conoscenze, interventi: Atti del convegno di studi, Bressanone 12-15 luglio 2005*, eds. Guido Biscontin and Guido Driussi, 839–47. Scienza e Beni Culturali, 21. Marghera-Venezia: Arcadia ricerche.

Italian. Environmental monitoring was conducted in two areas at the Roman Villa Arianna at Castellammare di Stabia, Italy. One area was covered by a temporary shelter of corrugated steel and tube scaffolding, and the second covered by a permanent shelter (no details are given about the design or materials of the permanent shelter). Air current speed and direction and surface temperatures of the wall paintings were measured, and the exterior environment near the shelters was monitored. High variability in temperature and significantly increased humidity in the summer were measured in the temporary shelter; while a more stable temperature range, particularly during summer, was found in the permanent shelter. Exterior and interior wind speeds tended to correlate, except during the summer when the solar heating of the steel roof caused internal convection currents.

The design of a new shelter must account for the function of shelter materials in relation to the solar exposure and prevailing winds of a site, which are important in determining the shelter's microclimate, and include an understanding of the area's climate, the physical characteristics and geometry of the site's walls, characteristics of the surrounding terrain, and the microclimatic conditions. Two computer applications were used to simulate the performance of shelter materials in relation to temperature and humidity: thermal dynamic simulation (TRNSYS) and multizonal code (COMIS). Different roof materials were simulated with dangerous conditions, including large diurnal temperature swings and condensation on the roof interior and on painted wall surfaces. Simulations showed that an insulated roof material reduced the risk of large temperature swings and condensation, natural ventilation was important in reducing humidity levels, and closing the sides of the shelter with a transparent material with good insulation qualities would limit dust. For the Villa Arianna see also Altieri et al. 2005; Howe [2003]; Laurenti and Prosperi Porta 2006; Laurenti et al. 2006; Merler 2002; Nigero 2007; and Prosperi Porta 2006 herein. (B.L.M./L.F.)

*Citterio, M. and Elisabetta Giani. 2006. Clima e microclima. In. *Le coperture delle aree archeologiche: Museo aperto*, ed. Maria Concetta Laurenti, 159-178. Roma, Italy: Gangemi Editore,

Italian. As part of the ICR-ENEA shelter study (see Laurenti 2006), this article describes monitoring of climate and microclimate at the four study sites. For each site, the selection of monitoring locations is explained, instrumentation is given, and results are provided. At Piazza Armerina, the study aimed to understand the relationship between air circulation and deterioration observed in the mosaic pavements. The monitoring at Villa di Arianna and Villa Romana di Varignano compared microclimates under both improvised and permanent shelters of varying materials and heights. At Corfino, monitoring compared microclimatic conditions of a reburied mosaic which is partially sheltered. See Citterio and Giani 2005 herein for an earlier publication on the monitoring and simulation modeling for the Villa Arianna. (B.L.M.)

CMAS. 2001. Protective Shelters, Special issue, *Conservation and Management of Archaeological Sites* 5 (1 & 2).

This entire issue of the journal is devoted to papers on protective shelters for archaeological sites. The majority of papers are the result of a colloquium on protective shelters organized in January 2001 by the US/ICOMOS Specialized Committee on Earthen Architecture, the U.S. National Park Service, New Mexico State Monuments, and the Getty Conservation Institute. The papers cover the decision to shelter, establishing conservation and design criteria, and evaluating shelter performance. Additional papers on a research project for protective shelters in Italy and a conference on shelters held in Bologna in 2000 are included. The publication constitutes a comprehensive overview of the issues relating to protective shelters. Individual articles are annotated in this bibliography. (M.D.)

- *Connor, Patricia, and Kenneth Pearson. 1968. The birth of the Fishbourne Roman Palace Museum. *Museums Journal* 68 (3): 115–17.

The decision-making process and rationales for the interior design of the Fishbourne Museum, which protects a Roman palace with its mosaics, are discussed by those responsible for much of the interior display. A key element of the interior design was that the visitors should follow a prescribed pathway, along which the history of the site would unfold. The design of the actual shelter is not discussed. (M.D.)

- Coperture per aree e strutture archeologiche: Repertorio di casi esemplificativi. 2000. *Arkos: I Grandi Restauri: Materiali e Strumenti* (supplemento n. 1): 1-32.

Italian. This supplement to *Arkos* is a useful source of case-studies of protective shelter design, including an 11-page gazetteer composed of short descriptions of shelters at 22 archaeological sites in France, Italy and Greece. The descriptions are prefaced by introductory discussions by archaeologists prominent in the management of archaeological sites in Italy. Most notable is the site of Pompeii whose long history of sheltering is discussed. There is also a selected bibliography of over 115 entries. [For a review of the publication see Rachel Burch. 2003. Recent publications on protective shelters. *Conservation and Management of Archaeological Sites* 6 (1): 47–48.] (S.T.)

- *Cortes, Javier. 1989. Sistemas de cobertura de mosaicos conservados in situ. In *I Coloquio Nacional de Conservación de Mosaicos, Palencia 1989*, 143–149. Palencia: Diputación Provincial, Departamento de Cultura.

Spanish. The author discusses shelters for mosaics in Roman villas in the region of Palencia, Spain, in general and in relation to the construction of a permanent shelter over one villa. The main criterion for a shelter is to respect and protect the archaeological remains; all other criteria are subjective. Enclosed shelters are essential for harsh climates as in Palencia, but control of the internal climate can be problematic depending on selection of construction materials. For mosaics it is suggested that illumination be from the north to avoid shadows. (J.S./M.D.)

- *Cosh, Stephen. 2002. Cover buildings over Romano-British mosaics. *Mosaic: The Bulletin of the Association for the Study and Preservation of Roman Mosaics (ASPROM)* 29: 4–8.

While enclosed shelters may be one of the best ways to protect mosaics in situ, neglect and lack of maintenance can result in the building's destruction and ultimately, the loss of the mosaic. As illustrated in the article, many shelters built in the 19th century and first half of the 20th century in England no longer survive and the exposed mosaic was either lifted, buried, or destroyed. The reasons for the buildings' failure are examined. (S.T.)

- *Constanzi Cobau, Andreina and Roberto Nardi. 2003. Conservation and protection of archaeological mosaics: The case of the Building of the Nile in Zippori. In *Mosaics Make a Site: The Conservation In Situ of Mosaics on Archaeological Sites: Proceedings of the VIth Conference of the International Committee for the Conservation of Mosaics, Nicosia, Cyprus, 1996*, ed. Demetrios Michaelides, 321-35. Rome: ICCM

As a component of the long-term conservation plan for the in situ preservation of the 3rd century AD mosaic at Zippori, a protective structure is proposed for the Building of the Nile. The article details the implementation of the conservation plan and the conservation criteria for the shelter. Since the publication of this paper, the open-sided structure has been built. See Sivan 2003 for discussion of the issues in displaying this site and Alef 2002 herein for evaluation of the shelter. (S.T.)

Curuni, Spiridone Alessandro and Nicola Santopuoli. 2005. Archeologia e restauro: Problemi di conservazione. In *Conservare il passato: Metodi ed esperienze di protezione e restauro nei siti archeologici: Atti del Convegno, Chieti-Pescara, 25-26 settembre 2003*, ed. Claudio Varagnoli, 97-116. Antico Futuro, 1. Rome: Gangemi.

Italian. This article provides a general introduction to the conservation problems and design considerations posed by shelters on archaeological sites. Provisional coverings might be helpful during excavations, but coverings that are considered permanent are often not maintained. The authors also discuss the architect's role in archaeological site conservation and describe some current practices in the consolidation of archaeological surfaces, referencing archaeological sites in the Mediterranean region. However, the most useful parts of the article are photographs that show various shelters and the authors' commentary on the shelter designs. (B.L.M./L.F.)

D'Agostino, Salvatore and Luigi Stendardo. 2000. La conservazione delle coperture di calcestruzzo armato nell'antica Pompei. In *La prova del tempo: Verifiche degli interventi per la conservazione del costruito: Atti del convegno di studi, Bressanone, 27-30 giugno 2000*, eds. Guido Biscontin and Guido Driussi, 287-96. Scienze e beni culturali, 16. Venice: Edizioni Arcadia Ricerche.

Italian. The use of reinforced concrete roofs to protect archaeological remains at Pompeii has a long history. The authors undertook a study to assess the structural stability and extent of deterioration associated with the early use of reinforced concrete roofing on the archaeological structures at Pompeii. Three case studies are analyzed: House of the Vettii, Julia Felix House, and the Silver Wedding Anniversary House. The assumed durability of reinforced concrete has not been fully justified, resulting in deterioration such as crumbling of the concrete and corrosion of the iron reinforcement and structural stability is in some cases severely compromised due to the excessive weight of roofs on the partly rebuilt ancient walls. (M.D.)

*de la Casa, Carlos, Pablo Luis Yagüe, and Juan Carlos Zarza. 1994. Propuesta de intervención en la villa romana de Cuevas de Soria, Soria (España). In *Mosaicos, no. 5: Conservación in situ: Palencia, 1990: IV Conferencia general del Comité internacional de mosaicos*, ed. ICCM and ICCROM, 105-14. Palencia: Excm. Diputación Provincial, Departamento de Cultura.

Spanish. A cover building is proposed for a Roman villa in Spain to protect the site from the extreme climate and biological growth. Along with proposals for the conservation of the mosaics, various sheltering options are discussed including a reconstruction of the building with an opening over the *impluvium*. (S.T.)

- De Santoli, Livio and Gino Moncada Lo Giudice. 1998. Ventilazione ibrida nei ripari chiusi di siti archeologici. In *Atti del V colloquio dell'Associazione italiana per lo studio e la conservazione del mosaico, Roma 3–6 novembre 1997*, eds. Federico Guidobaldi and Andrea Paribeni, 485-94. Ravenna: Edizioni del Girasole.

Italian. A new shelter is proposed to replace the existing shelter at the archaeological monastic complex of San Vincenzo al Volturno (Isernia) which is considered to be intrusive on the site and insufficient for the interpretation of the remains. The new dome-shaped building will be constructed of two layers of glass sheets with an airspace between: the external is clear tempered glass and the internal is electrochromic glass (which changes the light transmittance in response to an electric signal). The shelter will include facilities for controlling the internal climate by mechanical and natural ventilation. (B.L./S.T.)

- De Santoli, Livio and Matteo Mariotti. 2008. Tecniche di ventilazione naturale nella progettazione delle coperture archeologiche. *Restauro archeologico: Bollettino del Gruppo di Ricerca sul restauro archeologico* 5 (2): 54–60.

Italian. The authors propose several models for the natural ventilation of archaeological shelters, using Computational Fluid Dynamics (CFD) to simulate air circulation and generate empirical data for each model. The simulations have not yet been applied to any existing shelters, nor are the models reflective of common shelter types utilized in the protection of archaeological sites. The article explains the importance of understanding the climatic conditions of the site and using the natural forces of wind, combined with shelter design, to create an optimal microclimate. Different systems of natural ventilation are discussed in detail and a simulated model is provided for most types, including frontal ventilation from wind, passive ventilation from wind, convective ventilation, ventilation balanced by convection, ventilation from a double-layered shelter, and solar ventilation, of which there are three possible methods. (B.L.M./L.F.)

- De Silva, T.K.N. 1986. Roof over a monument: Sri Lankan experience. In *Preventive Measures During Excavation and Site Protection: Conference Ghent, 6-8 November 1985 = Mesures préventives en cours de fouilles et protection du site: Gand, 6-8 novembre 1985*, 271–280. Rome: ICCROM.

The author discusses both temporary and permanent roofing solutions utilized for Sri Lankan monuments. Permanent roofs over stupas, statues, and image houses have ranged from traditional designs (e.g., the re-creation of an image house of brick over the Buddha statue at Aukana) to concrete roofs and proposed wood-framed structures. The difficulties of reconciling the religious-cultural-aesthetic values of the monuments with the technical-conservation requirements are underscored. (M.D.)

- Demas, Martha. 1990. Protective shelters. In *Preserving the Archaeological Record: Post-Excavation Site Conservation*, 231–313. Masters thesis, Cornell University.

An overview of the practice of protecting archaeological sites with shelters, based mainly on a review of the literature prior to 1990, with particular reference to Schmidt's

1988 shelter categories and information about the types of materials used for shelters. The overview is arranged by category of shelter: open shelters (metal frame, reinforced concrete, and wood constructions) vs. closed shelters (representational and extra-mural shelters). (M.D.)

*Di Blasi, Ottavio. 2000. Nuova copertura e percorsi di visita in vetro per l'Aula Nord della basilica di Aquileia. *Progetto Restauro* 16 (7): 28–32.

Italian. At Aquileia, the mosaics in the north room of the basilica are sheltered with a concrete roof. To mitigate the problems of iron oxidization in the cement pilings from the previous shelter, a steel construction was designed that allowed a system of transparent walkways to be suspended from a new false ceiling of honeycomb aluminium. These walkways permit an unimpeded view of the mosaics, while protecting them from foot traffic. The ceiling incorporates germicidal sprays to prevent mould forming on the mosaic. [For more details see also Ottavio Di Blasi & Partners. 2000. Percorso nella Basilica. *Abitare* (392): 102-105; and Di Blasi Associati. 2000. Glasbrücke In der Basilika Von Aquileia = Glass Bridge in the Basilica of Aquileia, Italy. *Detail* (3): 364-66. <http://www.detail.de/Db/DbFiles/archiv/1794/ansichts.pdf>.] (S.T.)

Dimacopoulos, Jordan E. 1995. *A Shelter in the Style of a Tumulus: Vergina, an Underground Archaeological Site and Museum in the Type of a Crypt*. Athens: Archaeological Receipts Fund.

A detailed account of the excavation and elaborate protection of five Macedonian monuments at Vergina, Greece, which were originally buried under a large earthen tumulus. The tumulus was destroyed during the excavations, but to protect the structures and house a museum, four interconnected hexagonal shelters were constructed and buried under a new tumulus. (A.O.)

Diplom-Entwurf einer Ausgrabungshalle für die Römerstadt Augusta Raurica, Basel: *Mags.* 2003. *Intelligente Architektur* 43 (Nov./Dec.): 12–13.

German. This article presents a movable shelter building that has been designed for the Roman site Augusta Raurica in Basel to protect and display the site during excavation. The lower steel and aluminium construction contains space for office, exhibition, and visitor facilities. The roof of the hall is a flexible barrel vaulted design covered with a PVC coated polyester membrane which can be drawn back to expose the site to the open air. Includes photos, sections, diagrams, and axonometric drawings. (S.T.)

*Dossier: Salviamo Minissi a Piazza Armerina: Anangi. 2004. *Anagkē: Cultura, storia e tecniche della conservazione* 44: 36-97.

Italian. This is both an overview and tribute to Franco Minissi and his work on ancient sites (Gela, Eraclea Minoa) and archaeological museums (Palermo, Gela, Morgantina and others) in Sicily (1957-1985). The Villa Del Casale at Piazza Armerina receives

special attention, from intention, construction, and context of the shelter to the development of problems over time (Greco Lucchina, Rosalia and Salvatore Settecasì, *La Villa Romana del Casale e la copertura di Franco Minissi: Due architetture a rischio*, 47–61). Included in this section is a brief chronology from 2003-2005 of the steps taken to address the issue of renewal or replacement of the shelter and the concepts (with schematic drawings) put forth by architects Lucio Trizzino and Mario Bellini; Guido Canali; and Flavio Camerata along the way toward a resolution. An excerpt from Cesare Brandi's 1956 writings on Piazza Armerina [fully published in Cesare Brandi. 1956. *Archeologia siciliana. Bollettino dell'Istituto Centrale del Restauro* 27–28, 93–100], and numerous illustrations and drawings make this an interesting compilation, but one that feels much like a farewell to the Piazza Armerina shelter. See Minissi 1961 for other articles on Piazza Armerina cited herein. (M.D.)

Doumas, Christos. 1983. *Thera, Pompeii of the Ancient Aegean: Excavations at Akrotiri, 1967–79. New Aspects of Antiquity*. New York: Thames and Hudson.

This account of the excavations at Akrotiri includes a brief description of the huge metal-framed (Dexion) shelter constructed over the remains. The advantages of the system are its ease of erection, its ability to expand as the excavations proceed, and its wide internal spans. Numerous interior views and one exterior view of the shelter provide a sense of context. See Doumas 1997 and Fintikakis 2002 herein for the new shelter erected over the site. (M.D.)

_____. 1997. Management considerations at a Mediterranean site: Akrotiri, Thera. In *The Conservation of Archaeological Sites in the Mediterranean Region: An International Conference Organized by the Getty Conservation Institute and the J. Paul Getty Museum, 6–12 May 1995*, ed. Marta de la Torre, 277–40. Los Angeles: Getty Conservation Institute. http://www.getty.edu/conservation/publications_resources/pdf_publications/arch_sites_medit_eng.pdf.

At Akrotiri, metal shed roofs have long protected the site but have required high maintenance, have created less than optimal conditions for visitors and staff, and are considered an intrusion on the landscape. A pilot replacement shelter, sponsored by the European Union, has been constructed that is architecturally more distinguished and more aesthetically compatible with both the ruins and the surrounding landscape. Based on the pilot study, plans are underway to replace the old shelter with a new shelter that is more ecologically and environmentally sensitive. See Fintikakis 2002 herein for details on the new shelter. (A.O.)

*Edwards, Carol, Mike Corfield, Barry Knight, Jeanne Marie Teutonico, and John Adams. 2003. The investigation and conservation of 4th century mosaics at Brading Roman villa, Isle of Wight, England. In *Mosaics Make a Site: The Conservation In Situ of Mosaics on Archaeological Sites: Proceedings of the VIth Conference of the International Committee for the Conservation of Mosaics, Nicosia, Cyprus, 1996*, ed. Demetrios Michaelides, 101–10. Rome: ICCM.

A new large cover building opened at Brading Roman Villa, Isle of Wight (England) in August 2004. The site has fine 4th century mosaics in situ which were previously under a corrugated iron building. An extensive program of investigations was carried out before the shelter was constructed. These investigations informed a series of interventions aimed at eliminating causes of decay and stabilizing the villa environment. A virtual tour and images of the new building and interior with museum-like interpretation panels and exhibits can be viewed at the official Brading Roman Villa website (<http://www.bradingromanvilla.org.uk/>), although it does not offer any construction details. A unique aspect of the shelter is its 'green roof', a vegetation blanket designed to camouflage the roof in the countryside and to help stabilise the internal environment, details of which are available from the living roof website: Livingroofs.org. 2004. Green Roof Case Study - Brading Roman Villa, Isle of Wight, <http://livingroofs.org/20100312137/industry-case-studies/case-study-brading-villa.html>. (S.T.)

Federico, L.I. Federico. 1985. Protective coverings for archaeological sites: The case of Pompeii. *ICOMOS Information* 1985 (4): 7–12.

English with French, Spanish, and Italian summary. This article is a review of the various roofing types and concepts employed at Pompeii over the last century, beginning with the reconstruction philosophy of the nineteenth century through the 1970s, which witnessed the use of light and reversible structures of metal with asbestos-cement roof panels. The debate continues and the problem of reconciling competing values must be faced calmly. New roofing structures with potential application to archaeological sites are briefly discussed, e.g., membrane structures, wood laminated structures, and space-frames. [Essentially the same article, with different plates, is published in Federico, L.I. Federico. 1985. Pompei come caso emblematico. *Restauro: Quaderni di restauro dei monumenti e di urbanistica dei centri antichi* 81: 13–19, one of three articles in *Restauro* 81 devoted to "Coperture e protezione di zone archeologiche."] (M.D.)

Fentress, Elisabeth. 2001. Protective shelters for archaeological areas and buildings: A one-day conference held at the Museo Civico Archeologico di Bologna, October 2000: Conference Report. *Conservation and Management of Archaeological Sites* 5 (1& 2): 106–8.

The proceedings of this one-day conference comprised presentations on a variety of sheltering projects. The projects ranged from traditional roofing approaches on more complete buildings, to some creative solutions for urban sites and for sites with more degraded remains. The author notes that several important issues were not raised during the proceedings such as what should be displayed, the costs and benefits of displaying a site, and reburial. (S.T.)

Ferroni, Angela Maria and Maria Concetta Laurenti. 2006. Coperture di protezione: Studi progressi e ricerche in corso. In *Le coperture delle aree archeologiche: Museo aperto*, ed. Maria Concetta Laurenti, 77–109. Roma, Italy: Gangemi Editore.

Italian. Part of the ICR-ENEA project on shelters for archaeological sites (see Laurenti 2006), this article provides a broad overview of the history of shelters at archaeological sites in Italy from the seventeenth century to the modern era; a summary of the modern debate on the subject and ideas behind design of modern shelters, using Piazza Armerina, Ara Pacis and others as example; a review of literature and recent conferences on shelters; criteria for measuring shelter performance (protection against rain and condensation, allowing light and air, etc.); the problems inherent in certain materials used for shelters and the importance of a shelter's microclimate; and finally the selection of test sites for evaluation in the risk database and statistical information on age, year of construction, and materials used in the construction of 120 shelters in Italy. (B.L.M.)

Fiandra, Enrica. 1960. A museum amid the ruins of a Minoan villa. *Museum* 13 (2): 130–32.

English and French. In a rather early example of thoughtful conservation, the Late Minoan villa site at Kannia (Gortyna) was provided with a protective roof. The lightweight, metal-framed structure with green plastic sheathing protects areas of the site where large storage jars were found and can now be preserved in situ. The important issue of how various conservation policies affect the researcher is briefly addressed. (M.D.)

Fiero, Kathleen. 2001. Preserving dirt-walled structures in Mesa Verde National Park. *Conservation and Management of Archaeological Sites* 5 (1 & 2): 55–62.

There have been protective shelters over the earthen structures at Mesa Verde, Colorado for almost 90 years. This article traces the history and development of shelters and evaluates their varying success in terms of protection from environmental elements as well as aesthetic and maintenance criteria. The most recent design comprises of pre-cast concrete structures with removable side panels installed during winter and seasonal wildfires. Based on the experience at Mesa Verde, the author stresses the importance of specifying criteria for shelter design, planning for shelter maintenance and avoiding temporary shelters which have a tendency to become permanent. (S.T.)

Filgis, Meinrad, N. 2001. Römische Badruine Badenweiler: Historische Wurzeln des Kurortes neu präsentiert. *Denkmalpflege in Baden-Württemberg* 30 (4): 166–79.

German. The Roman Bath of Badenweiler (2nd - 3rd century AD) was excavated in 1784 and has been sheltered ever since. The article focuses on the construction and history of the site, and concludes with a short description of the new shelter which was built over the ruins in 2001 after conservation. The large barrel vaulted glass and steel structure covers the whole site (area 68 x 40 m) and is notable for being free of any vertical uprights. In fact, the shelter has become a tourist attraction in itself. The construction and design details lacking in this article are provided in more detail in Schmidt 2003 herein. (S.T.)

Fingerlin, Gerhard. 1987. Konservierung einer römischen Villa in Grenzach. *Denkmalpflege in Baden-Württemberg* 16 (2): 87–90.

German. This article describes the enclosed wood-framed shelter with tile roof over Roman ruins at Grenzach, an example of a suburban design for archaeological protection; also included in Schmidt 1988 herein. (M.D.)

Fintikakis, Nikos. 2002. Copertura per il sito archeologico di Akrotiri, Santorini, Grecia. *L'Industria delle costruzioni* 36 (363): 88–95.

Italian and English. This article by the project architect provides details of the shelter erected over the Late Bronze Age site of Akrotiri in 2000. The enormous open shelter was designed according to specific criteria to provide a protective environment for the wall paintings and the article describes the passive control measures taken to avoid strong temperature and humidity differentials, which include partial covering with earth for insulation and to re-create something of the landform before excavation, with northward facing openings for light and southward louvers for ventilation. The modular roof is formed of multiple joining arches and constructed from a large steel space frame supported by pillars with piling foundations to minimize intrusion. The article contains plans, profiles and photographs of the shelter. For a historical context for sheltering Akrotiri see Dumas 1997 and 1983 herein. [The collapse of the shelter in September 2005, possibly as a result of the weight of its 'living roof,' is covered in press articles at the time (see Kathimerini newspaper archives <http://www.ekathimerini.com>)] (S.T./M.D.)

Fitch, James Marston. 1982. Protection and interpretation of sites and ruins. In *Historic Preservation: Curatorial Management of the Built World*, 293–306. Charlottesville: University Press of Virginia.

Chapter 14, Protection and Interpretation of Sites and Ruins, includes a brief discussion of protective structures over archaeological sites. The author presents well-known examples such as Piazza Armerina, as well as lesser-known examples such as the shelter at Dinosaur National Monument in Utah, and oddities such as the protective "shrine" over the log cabin of Abraham Lincoln. (M.D.)

*Frankovic, Maja, Danijela Stojilkovic and Dusan Maksimovic. 2007. The condition of mosaics on the archaeological sites in Serbia from the point of view of preventive conservation. In *Condition of the Cultural and Natural Heritage in the Balkan Region: Proceedings of the Regional Conference Held in Kladovo, Serbia, from 23th to 27th October 2006*, ed. Mila Popovic-Zivancevic, 149–56. Belgrade, Serbia: National Museum Belgrade.

The author reviews the state of conservation of mosaics at three important sites in Serbia. Shelters were built (as early as 1936) only over mosaics at Mediana. Some of the common problems that affect long term stability are noted, such as a change in the hydrology of the area (by the utility company) leading to a rise in ground water; shelters built for temporary purpose becoming permanent and failure to extend shelter coverage to adequately protect mosaics; absence of sufficient ventilation; and the lack of regular and well-informed monitoring and maintenance. Two of the 'temporary' shelters also combine 'coverings' directly on the mosaic pavements as additional protection. (M.D.)

Gabbiani, Bruno. 2003. Piazzeta Toscano a Cosenza: Sistemazione degli scavi archeologici: Il progetto di Marcello Guido. *Recupero e conservazione* 9 (50): 64–67.

Italian. Brief review with photographs of the controversial polemical, futuristic, deconstructivist modern design by Marcello Guido of coverings for the archaeological remains in Piazza Antonio Toscano, Cosenza. The steel and glass, multi-angled structures sprout like shards of glass from islands of archaeological excavations in the midst of the historic town. For additional photos and drawings see Marcello Guido. [2001]. Piazzeta Toscano a Cosenza, <http://marcelloguido.wordpress.com/2010/07/02/piazza-antonio-toscano-cosenza-1999-2001/>. (M.D.)

Gamannossi, Elisa. 2006. Progetto di una copertura in vetro ed acciaio del Teatro Romano di Fiesole. *Bollettino ingegneri: Mensile di ingegneria ed architettura* 54 (5): 14–18.

Italian. Architectural design, with renderings and details and brief description, of a proposed space structure of glass and steel to span the entire Roman Theater, which is located in the urban center of Fiesole. Design concept proposes two different structural solutions, utilizing either a single or double grid system. (M.D.)

*Gambogi, Pamela, Walter Tuccino, and Rossano Fontanelli. 2003. Pavimenti musivi della mansio d'età imperiale di Collesalvetti (LI): Problemi di restauro e conservazione in situ: Un progetto per la pubblica fruizione. In *Les mosaïques: Conserver pour présenter? VIIème Conférence du Comité international pour la conservation des mosaïques, 22–28 novembre 1999, Musée de l'Arles antique, Arles, Musée archéologique de Saint-Romain-en-Gal: Actes = Mosaics: Conserve to Display? VIIIth Conference of the International Committee for the Conservation of Mosaics: Proceedings*, ed. Patrick Blanc, 67–74. Arles: Musée de l'Arles et de la Provence antiques.

Italian. This article reports the conservation work continuing on the in situ mosaic floors of the Collesalvetti (Livorno) imperial *mansio* since 1996 and, as part of the conservation plan, a permanent structure is proposed to cover the whole site to protect and display the mosaics and buildings. A sketch of the proposal shows a large glass building with multiple barrel vaults. (S.T.)

Ganiaris, Helen and Liz Barham. 2002. From arena to art gallery: The preservation of London's Roman amphitheatre. *Conservation News* 80: 22–25.

Remains of a Roman amphitheatre were discovered in London during excavations for the construction of a new art gallery. This article describes the conservation and engineering work that enabled the art gallery to be built around the remains while they were prepared for long-term display in situ. The amphitheatre rests on a suspended floor and two further basements are constructed beneath the Roman levels. Conservation measures focused on preventing the timbers and masonry from drying out too rapidly. (S.T.)

García-Bárcena, Joaquín. 1987a. Cacaxtla: Un proyecto de conservación del patrimonio: Antecedents de las obras de conservación de Cacaxtla, Tlaxcala. *Antropología (Instituto Nacional de Antropología e Historia)* (12, suplemento): 1–9.

Spanish. In the context of consideration for sheltering the site of Cacaxtla, the author reviews well-known protective shelters worldwide, such as that over the tomb of Qin Shi Huang, Fishbourne, Stevens' proposed Babylon project, and Kara Tepe. Less well publicized is the large metal-framed shelter at Kisnana, Hungary. See also García-Bárcena 1987b herein. (M.D.)

_____. 1987b. Cacaxtla. In *In Situ Archaeological Conservation: Proceedings of Meetings, April 6-13, 1986, Mexico*, ed Henry W. M. Hodges, 202-5. Mexico City: Instituto Nacional de Antropología e Historia de Mexico and Marina del Rey: Getty Conservation Institute.

Roofing options and criteria are discussed in relation to the proposed solution to protect the Great Platform at the site of Cacaxtla, Mexico. Criteria for selection included an analysis of the causes of deterioration and consequent conservation needs, architectural and aesthetic considerations, engineering requirements, and costs. The three options considered were a reconstruction of the original volumes, modular partial roofing, and a single roof covering the whole platform. The last option was judged most feasible and effective. (M.D.)

Gauss, Norbert. 1996. Die Entwicklung eines Schutzdachsystems. In *Zum Thema Fassadenmalerei = Painted Façades*, 67-76. Forschungsprojekt Eurocare 492 Muralpaint; Restauratorenblätter, 16. Wien, Austria: Mayer & Comp.

German. A special roofing system has been designed to protect painted facades in Austria from rain. The proposed roofs project from the wall, are frameless and constructed of transparent safety glass plates. The design of the roofs was informed by climate and topographical data as well as historical and aesthetic considerations. Some construction details and plans are provided. (S.T.)

*Ghalia, Taher. 2003. Mise en valeur des mosaïques chrétiennes de Tafekhsite-Chatt Menzel Yahia (Région de Kélibia). In *Les mosaïques: Conserver pour présenter? VIIème Conférence du Comité international pour la conservation des mosaïques, 22–28 novembre 1999, Musée de l'Arles antique, Arles, Musée archéologique de Saint-Romain-en-Gal: Actes = Mosaics, Conserve to Display? VIIth Conference of the International Committee for the Conservation of Mosaics: Proceedings*, ed. Patrick Blanc, 387-89. Arles: Musée de l'Arles et de la Provence antiques.

French. This poster presents the discovery of an early Christian basilica near Kelibia (Tunisia) and a site museum project for the in situ preservation of its mosaic floors. The shelter/museum proposed is a semi-enclosed design, inspired by antique basilicas. The structure will facilitate air circulation and natural lighting, and contain raised walkways for visitors. Illustrations are provided. (S.T.)

Gollman, Karl Friedrich. 1987. *Architektur und Archäologie: Schutz von Antiken Ausgrabungen: Habilitationsschrift, Thesis, Fakultät für Architektur, Technischen Universität Graz.*

German. The author explores the concept of protective sheltering of archaeological sites from an historic, functional, technical, and design perspective. Part A investigates the causes of deterioration of archaeological materials left in situ and the degrees of protection that can be implemented (e.g., preservation, restoration, anastylosis, reconstruction). Part B examines the requirements of an archaeological shelter, the main types of shelters (during excavation, temporary, permanent), construction methods and materials, and ends with a review of existing shelters. Part C explores the design and presentation of an archaeological site, and Part D presents two case studies: the early Christian church of Teurnia and the amphitheatre at Carnuntum in Austria. (M.D.)

*González, Antoni. 2002. Consolidación y protección de las termas romanas de Sant Boi de Llobregat (Barcelona). *Loggia: Arquitectura & Restauración* 4 (10): 60–71.

Spanish. The author traces the conservation and presentation of the large well preserved Roman baths at Sant Boi. Intervention criteria were specified for conservation of the walls and mosaics following an interdisciplinary study and a building was constructed over the site to protect the site and permit visitation. The interior of the building provides a panorama of the baths, and the roof has both opaque (copper covered) and translucent (honeycomb polycarbonate) areas. Abundant photographs provide a sense of context and building plans are also included. [For a brief article and exterior photography see also *Exposició permanent de les Termes Romanes. 1995. Quaderns d'arquitectura i urbanisme* (207-209): 94-95.] (S.T.)

*Guex, François. 2003. Vallon (Canton de Fribourg, Suisse): Tenants et aboutissants d'une réalisation en cours. In *Les mosaïques: Conserver pour présenter? VIIème Conférence du Comité international pour la conservation des mosaïques, 22–28 novembre 1999, Musée de l'Arles antique, Arles, Musée archéologique de Saint-Romain-en-Gal: Actes = Mosaics, Conserve to Display? VIIth Conference of the International Committee for the Conservation of Mosaics: Proceedings*, ed. Patrick Blanc, 75-85. Arles: Musée de l'Arles et de la Provence antiques.

French. A site museum has been built to display the two large floor mosaics discovered in a Roman villa at Vallon, near Aventicum. To preserve the mosaics passive methods of environmental control were sought and implemented where possible; in addition, a ventilation system and entrance air lock were installed in the building. Assessment of this solution is pending. (S.T.)

Gugliermetti, Franco and Augusto Maccari. 1998. L'impiego di coperture trasparenti di tipo innovativo nella protezione in situ dei mosaici. In *Atti del V Colloquio dell'associazione Italiana per lo studio e la conservazione del mosaico: Roma, 3–6 novembre 1997*, eds. Federico Guidobaldi and Andrea Paribeni, 471-84. Ravenna: Edizioni del Girasole.

Italian. The author characterizes some of the new transparent materials available for shelter construction that reduce the effects of solar radiation associated with traditional materials. 'High performance materials' minimize thermal transmittance

without reducing the transparency of the natural light; 'chromogenic materials' change their optical properties from external impulses such as electrical charges, exposure to ultraviolet light or change in temperature; and 'selective angle materials' address solar radiation at specific angles and, based on computer modeling, are judged to be the most efficient in reducing both direct and reflected solar radiation. One such 'selective angle material' examined is an insulating glass which incorporates reflective louvres, made by Okalux. (B.L./S.T.)

Gugliermetti F. and P. Dell'Omo. 2000. Influenza sul microclima interno dei materiali trasparenti impiegati nella protezione in situ dei mosaici. In *Atti del VI colloquio dell'Associazione italiana per lo studio e la conservazione del mosaico: Con il patrocinio del Ministero per i beni e le attività culturali (Venezia, 20–23 gennaio 1999)*, eds. Federico Guidobaldi and Andrea Paribeni, 621–26. Ravenna: Edizione del Girasole.

Italian. This article addresses the importance of selecting appropriate materials in the design of a shelter to optimize the conservation and visibility of the cultural heritage in question. The author distinguishes between protective macro-structures (large-scale shelter for archaeological site) and protective micro-structures (local structure in proximity of individual archaeological remains), investigating the latter via fluid-dynamic calculations and mathematical modeling. Calculations are performed to determine how the chosen transparent material affects the sheltered microclimate with particular attention to temperature gradients and air velocity. The author provides information regarding computational software and choice of parameters in executing the calculations. (K.K.)

*Gugliermetti, Franco, Luciano Santarpia, and Gianluca Zori. 2004. Le simulazioni numeriche come strumento per lo studio, la progettazione e la valutazione degli impianti tecnologici destinati alla salvaguardia degli apparati musivi da agenti aggressive. In *Apparati musivi antichi nell'area del Mediterraneo: Conservazione programmata e recupero: Contributi analitici alla carta del rischio: Atti del I convegno internazionale di studi, La materia e i segni della storia, Piazza Armerina, 9–13 aprile 2003*, ed. Guido Meli, 350–356. *I Quaderni di Palazzo Montalbo*, 4. Palermo, Sicily: Libreria D. Flaccovio Editrice.

Italian. This article traces the development of computational thermo-fluid dynamic models which are used to predict microclimate behavior; describes the many simulation programs, both zonal and field models, that are available for planning interventions to improve a site's microclimate; and provides an example of simulation program application at the sheltered archaeological site of the Domus Aurea in Rome. Typical parameters that can be entered and manipulated into these models include the volume of a space, entering and exiting air currents, air sources, and transformation and consumption of gaseous pollutants. The Domus Aurea was sheltered in 1980 and has suffered from large fluctuations in humidity levels, causing condensation and efflorescence. The purpose of the study and intervention was to regulate the ventilation and to determine the maximum number of visitors allowable in order to maintain environmental conditions ideal for conservation. Zonal models were used to study the distribution of the air, which provided information for field models that predicted air flow and humidity in each room. (B.L.M./L.F.)

- *Gugliermetti, Franco. 2007. Il microclima. In *Progetto di recupero e conservazione della Villa Romana del Casale di Piazza Armerina*, ed. Guido Meli, 223–34; 341–345. Quaderni di Palazzo Montalbo, 12; I Grandi restauri, 1. Palermo: Regione Sicilia, Assessorato dei beni culturali ed ambientali e della pubblica istruzione, Dipartimento beni culturali ed ambientali ed educazione permanente.

Italian with English summary. Since its construction in the 1970s, the acrylic glass shelter at Villa del Casale, Piazza Armerina, Sicily, has deteriorated and subsequent renovations have reduced interior ventilation. The transparent roofing magnifies the dynamics of temperature, light, and the deterioration processes of the mosaics, which include the formation of soluble salts and algae. Relative high humidity and poor ventilation keep salts in solution but favor the growth of algae. Monitoring of the microclimate showed significant temperature and humidity differentials on the interior, relative to the exterior. The requirements for a new shelter included: low levels of direct sunlight on mosaic surfaces and infrared radiation exchange with mosaic surfaces; minimum airflow over mosaic surfaces; negligible levels of air stratification and overheating; as well as stability, ease of repair, lightweight, safe, and cost efficient. See Minissi 1961 for other articles on Piazza Armerina cited herein. (B.L.M.)

- *Guiachetti, Maurizio. 1994. Soluzioni architettoniche per la salvaguardia dei mosaici e aree archeologiche: Problema di competenze e non di metodologia. In *Conservation, Protection, Presentation: Fifth Conference of the International Committee for the Conservation of Mosaics: Proceedings = Actas, Faro e Conimbriga, 1993*, eds. Adilia Alarcao, Virgilio H. Correia, and Carlos Beloto, 145–49. Conimbriga: ICCM

Italian. The article reviews the state of sheltering as a protective device for mosaics, criticizing shelter designs for incompatible use of materials for new constructions in relation to original materials, for impeding the visitor's experience of the site, lack of relationship to the original volumes of the building, and visual intrusion on the environment. The author proposes a change in decision making involving greater collaboration among various disciplines and raising the level of competency and professionalism for those involved in shelter design. (J.S./M.D.)

- *Hadjisavvas, Sophocles. 2000. Developing a World Heritage site: The case of Paphos, Cyprus. In *Mosaics Make a Site: The Conservation In Situ of Mosaics on Archaeological Sites: Proceedings of the VIth Conference of the International Committee for the Conservation of Mosaics, Nicosia, Cyprus, 1996*, ed. Demetrios Michaelides, 354–57. Rome: ICCM.

The proposed management approach at Paphos, the largest Roman site in Cyprus, with extensive remains of mosaic floors is briefly reviewed. The Master Plan, devised by a landscape architect, is an ambitious integrated sheltering and landscape scheme for the whole site. The plan includes the installation of walkways between the buildings and the construction of a large wooden protective roof over 8000m² of excavated area. The roof design will reflect the ancient room function and membrane structures will also be selectively used. Other general roofing criteria are described although conservation criteria and sketches of the proposals are omitted. (S.T.)

- Hansen, Eric F. and Carolina Castellanos. 2004. Some considerations for the reburial of painted lime stucco façades in the Maya region. *Conservation and Management of Archaeological Sites* 6 (3&4): 259–74

During the 2003 field season at El Mirador - a preclassic Maya site in the Peten region of Guatemala - a large roof was erected over Structure 34 to protect the exposed stucco masks. The roof is made of UV filtering polycarbonate sheets and is designed to prevent heat and humidity retention and other problems experienced in Central American sites. The shelter is discussed (268-269) in the context of the preservation strategy at the site, which includes reburial. The reference to the project newsletter, which contains photos, is no longer available. [For photos see Mirador Basin Project. 2010. Conservation Efforts in the Mirador Basin, http://www.miradorbasin.com/resources/misc/site_conservation.php]. (M.D.)

- Hebbelinck S., A. H. Hendrickx, M. Mollaert, and J. Haase. 2001. New ideas on the use of systematically constructed tension structures to cover historical and archaeological sites. In *Structural Studies, Repairs, and Maintenance of Historical Buildings VII*, ed. C. A. Brebbia, 29-38. Southampton: WIT Press.

This article evaluates pre-fabricated lightweight tension structures in terms of their applicability for archaeological sites. Often used to cover parts of existing historic buildings, they have qualities that are favorable for covering archaeological sites, including the ability to provide protection against the climate and cover large areas with few, low-impact foundations. The authors present a modular tension structure in development (through a computer program) which addresses some of the limitations of these structures for archaeological sites. The article is well illustrated with examples of tension structures over historic buildings and on archaeological sites. (S.T.)

- Herrmann, Fritz-Rudolf. 1991. Der römische Ehrenbogen von Mainz-Kastel: Die museale Gestaltung des Monumentes und seines Umfeldes. *Denkmalpflege in Hessen* (1): 2–9.

German. Reports on the discovery, excavation and museum presentation of remains of a Triumphal Arch in Mainz-Kastel Germany. A small archaeological museum was arranged around the foundations of the monument below street level. The walls and concrete supports were painted black to draw visitors' attention to the arch, architectural pieces and presentation boards. (S.T.)

- Hinkel, F. 1968. Progress report on the removal of endangered monuments from Sudanese Nubia. *Kush: Journal of the Sudanese Antiquities Service* 16 (1967/68): 79–84.

This report on the removal and erection of the Semna temples from Nubia to Khartoum includes a description of the shelters erected in 1966 to protect the temples. A moveable shelter, which runs on rails, was chosen as a means of providing protection only during the rainy season. The arched roofs of the shelters are covered with aluminium sheeting and Perspex panels; the sides are of glass panels. (M.D.)

Historic Scotland. 2005. *Carved Stone: Scottish Executive Policy and Guidance*. Edinburgh: Historic Scotland.

This publication provides policy statements and guidance notes for the care and protection of stone monuments in Scotland and includes brief recommendations for shelters over stone monuments. Among the recommendations are that the shelter provides a suitable internal environment for the stone with due regard for the surrounding conditions and locations and a secure setting for the monument, and allows good visibility. (S.T.)

Howe, Thomas Noble. [2003]. Developing a design approach to roofing the Stabiae archaeological site. In *Summary of the Proceedings and Papers Presented at the Symposium: Conservation in the Shadow of Vesuvius: A Review of Best Practices (November 20-23, 2003)*. New York: World Monuments Fund. http://www.wmf.org/sites/default/files/wmf_publication/Conservation%20in%20the%20Shadow%20of%20Vesuvius%20a%20Review%20of%20Best%20Practices.pdf

Under the 'Restoring Ancient Stabiae' project, a collaboration of the Superintendency of Pompeii, University of Maryland, and other institutions, was formed with ambitions to create an archaeological park. This summary of a presentation outlines approaches to roofing the site. The 2001 Master Plan specifies that roofs appear lightweight and temporary so as not to overwhelm the Roman remains, be more effective than existing shelters at the site (built in the 1950s, 1960s and post 1980 earthquake), and suggest spatial and light conditions of the original villas. Three design approaches are outlined: for the Villa Arianna, approaches with light framing, light-control glazing, tent or tensile coverings and 'conventional scaffolding put to unconventional uses'; a double-roofing is being considered whereby a large roof spans the entire area of exposed remains with pavilions below that suggest the original spatial arrangements based on 'floating foundations and a six-meter-steel grid frame'; and for the Villa San Marco a continuation of the 'philological' approach of the 1960s. Mention is made of an experimental shelter by ENEA but the relationship of this shelter and the approaches discussed with the work of Laurenti et al. in the same proceedings is not clear. For Villa Arianna see also herein Citterio and Giani 2005; Laurenti et al. 2006; Merler 2002; and Prospero Porta 2006. (M.D.)

Hu Jun. 1986. A museum on the site of an ancient copper mine. *Museum* 38 (2): 115–19.

An enclosed shelter cum museum was constructed over the remains of the ancient copper mine of Tonglushan in China. The building, whose design and materials are not discussed, contains a great hall with viewing gallery where the remains are preserved in situ, and an adjoining exhibition room with artefacts and didactic exhibits. This type of structure is characteristic of the Chinese response to site protection; compare Wu 1985 and Chen 1981 cited herein. (M.D.)

Hubeli, Ernst, and Paolo Fumagalli. 1987. Eine Anschauung der Dinge: Schutzbaute für römische Funde, Welschdörfli bei Chur. *Werk, Bauen + Wohnen* 10: 40–43.

German. The article contains a brief description and numerous photos and drawings of an enclosed shelter over Roman ruins in Switzerland. Similar in concept to the shelter over the Piazza Armerina mosaics, this structure is an abstract reconstruction in timber, incorporating louvered walls. (M.D.)

Ibenholt, Harald. 2003. Les ruines de la Cathédral de Hamar (Norvège) et leur protection. In *Vestiges archéologiques en milieu extrême*, 94-101. Paris: Monum, Éditions du Patrimoine.

French. After investigating the major threats to the 12th century Hamar Cathedral ruins in Norway, a large steel and glass shelter with internal climate control was constructed to protect the remains. The author provides insights to the historical context and the project development as well as conservation measures and investigations. A brief assessment of the shelter two years after its construction indicated that refinements in the internal environment and operative systems were necessary and the structure has high maintenance (cleaning) requirements. See also Apeland 1995 and Statsbygg 1998 (S.T.)

ICOM. 1982. *Musées de site archéologique*. Paris: UNESCO.

French. Included in this study of archaeological site museums is a brief discussion (p. 17f.) of temporary and permanent shelters over *in situ* remains with specific mention of those at Phaistos; Pylos and Lerna; the Maritime Museum in Piraeus (Greece); Konya (Turkey); and Stara Zagora (Bulgaria). (M.D.)

Jerome, Pamela. 1995. Proposed permanent shelter for Building 5 at the Bronze Age site of Palaikastro, Crete. *Conservation and Management of Archaeological Sites* 1 (2): 134–36.

Presents two proposals for a permanent shelter over the remains of a recently excavated Minoan structure of stone and adobe. In developing the proposals, the author considers the issues of reversibility, low technology/cost/maintenance, microclimatic effects, recreating the form and volume of the original structure without reconstruction, aesthetic compatibility, interpretive function, and separation of the visitor from the ruin. See also *Conservation and Management of Archaeological Sites* 1 (2): 134-36, for correction of illustrations to this article. (A.O.)

Jerome, Pamela, Michael R. Taylor and John Montgomery. 2001. Evaluation of the protective shelter at Blackwater Draw Archaeological Site, New Mexico. *Conservation and Management of Archaeological Sites* 5(1 & 2): 63–72.

All stages of the design, construction and evaluation of a new shelter built over Blackwater Draw Archaeological Site (a partially excavated type site for Clovis culture, 10,000 BCE) are presented in this article. This sheltering project highlights the conflict between shelter design and budgetary constraints. When assessed in terms of visitor experience and maintenance demands, the metal shed structure is considered successful. Solutions are proposed to address the environmental and drainage problems which continue to affect the preservation of the site. (S.T.)

- *Kantareva-Decheva, Elena, Mina Bospachieva and Cynthia Luk. 2007. Archaeological sites with mosaic floors from ancient Philippopolis, Plovdiv, Bulgaria: Problems and condition. In *Condition of the Cultural and Natural Heritage in the Balkan Region: Proceedings of the Regional Conference Held in Kladovo, Serbia, From 23th to 27th October 2006*, ed. Mila Popovic-Zivancevic. 227–31. Belgrade, Serbia: National Museum Belgrade.

The authors describe the various and varying degrees of conservation interventions at the site of Philippopolis in Bulgaria, which contains numerous mosaic pavements. Temporary shelters were constructed at two basilicas, the last of which was removed in 1999 after the shelter collapsed. A temporary shelter was built over another basilica, which was removed along with its mosaics. The article mentions the baptistery being covered in 1999 by a thin concrete slab, but it is unclear if this is a shelter. Mosaics from a residential building were kept on site from 1984-2003 inside a protective building, but poor drainage and lack of climate control exacerbated their deterioration. In 2003 a new conservation effort was begun on a residential building complex, now displayed along with its in situ floor mosaics inside a modern museum. No details are provided about the temporary shelters, protective building, or new museum (L.F.)

- *Karivieri, Arja. 2005. Floor mosaics in the early Christian basilica in Arethousa: Conservation, maintenance and presentation. In *8^o Synedrio Diethnous Epitropes gia te Synterese ton Psephidoton (ICCM): Entoichia kai epidapedia psephidota: Synterese, diaterese, parousiase: Thessalonike, 29 Oktovriou–3 Noemvriou 2002: Praktika = VIIIth Conference of the International Committee for the Conservation of Mosaics (ICCM): Wall and Floor Mosaics: Conservation, Maintenance, Presentation: Thessaloniki, 29 October–3 November 2002*, ed. Ch. Bakirtzis, 191-202. Thessaloniki: Europaiko Kentro Vyzantinon kai Metavyzantinon Mnemeion.

This article presents the conservation efforts on the mosaic pavements at the site of Arethousa in Macedonia. The building of a protective shelter is discussed as a future measure, to be part of maintenance plans (at the time of publication, the mosaics were reburied). The authors suggest a protective roof or shelter would protect the mosaics from the weather while allowing them to be viewed. This should be designed so as not to aesthetically impact the site, and the authors further suggest seasonal coverage of the mosaics during the winter, leaving the pavements open to the public during the summer. The type of coverage is not specified. (L.F.)

- *Keen, Laurence. 1999. Preservation and presentation: The Roman town-house, Dorchester, Dorset. *Rescue News* (78): 4.

A partially enclosed shelter constructed at the Roman town-house in Dorchester, UK, was designed to suggest the form and mass of the original building. The spaces are articulated by a tiled gable roof and glass panel walls which are supported by a (red) steel framework. The author provides insights into the history of the site and conservation of the mosaics and remains as well as some of the decisions in the shelter design, such as the choice not to use a suspended walkway. (S.T.)

- Koinova-Arnaudova, Lorinka, Krassimir Krushev, Michail Enev, Lidia Kinova, and Ivan Penev. 2003. The Thracian tomb near Sveshtary village. In *Proceedings of the 5th EC Conference*

Cultural Heritage Research: A Pan-European Challenge, eds. Roman Kozłowski, Michel Chapuis, Miloš Drdácý, Rainer Drewello, Johanna Leissner, Pedro Redol, J. M. Vallet, and Jean-Marc Vallet, 291-95. Luxembourg: Publications Office EC.

Extensive investigations have been carried out on the 4th century B.C. Thracian tomb near the village of Sveshtary, Bulgaria since being uncovered in 1982. A thorough condition assessment was conducted and resulted in the construction of temporary protective buildings in front of the tomb's entrance, in the south-east part of the tomb, and in other places on the tomb's hill. Temporary air-conditioning equipment was also installed. The construction of a permanent air-conditioned protective building over the tomb was the second stage of the conservation plan. The controlled environment provided by this permanent structure has allowed for less intrusive conservation measures on the material fabric, in particular avoiding consolidation of the paint layers, which the authors refer to as a "passive" approach. Monitoring and periodic measurements of the polychrome are conducted. No further detail about the structure is provided. (L.F.)

Kotlík, Peter and Viktor Heidingsfeld. 2002. Monitoring of stone sculptures and reliefs in Bethlehem near Kuks (Eastern Bohemia, Czech Republic). In *Understanding and Managing of Stone Decay (SWAPNET 2001): Proceedings of the International Conference on Stone Weathering and Atmospheric Pollution Network 7-11 May 2001, Prague*, eds. Richard Přikryl and Heather A. Viles, 285-293. Prague: The Karolinum Press.

The 18th century sandstone reliefs created by M. B. Braun in Bethlehem, Czech Republic were covered by protective shelters after investigations indicated that water and its related effects were the most significant causes of deterioration. This article describes how the performance of the shelters was assessed during a two year program which monitored the condition of the stone and the microclimate under the shelter. The shelters resulted in both positive and negative effects on the sculptures and modifications to the shelters are proposed. (S.T.)

*Krinzinger, F., ed. 2000. *Ein Dach für Ephesos: der Schutzbau für das Hanghaus 2 = A Roof for Ephesos: The Shelter for Terrace House 2 = Efes İçin bir Çati: Yamaç ev 2 Korum Binası*. Sonderschriften 34. Vienna: Austrian Archaeological Institute.

German, English, Turkish. An architectural competition for protecting the Terrace Houses at Ephesos resulted in the selection of a shelter design consisting of a metal frame structure with a membrane roof and louvered panel side walls. The shelter replaces an earlier protective structure constructed in the 1980s, which covered only part of Terrace House 2 (see Wiplinger 1990 herein), and provides protection for the remainder of the Terrace House, which contains wall and floor mosaics, mural paintings and other architectural and decorative elements typical of a wealthy Roman house. The publication covers the design and construction process. Computer modeling was done to implement passive climatic controls in the design. [See also F. Krinzinger. 2003. Ephesus. *Current World Archaeology* 1 (1): 25-34, <http://www.world-archaeology.com/features/ephesus-turkey/>; and Rachel Burch 2003, Recent publications on protective shelters, *Conservation and Management of Archaeological Sites* 6 (1): 47-48 for a review of the publication]. (M.D.)

Kuttinger, Georg, and Rudolf Schlamberger. 1984. Nr. 22: Dach für ein Ausgrabungsfeld in Weißenburg, Bayern. In *Holzbau Konstruktionen: Dachtragwerke, Hallen, Brücken*, 108–11. Munich, Germany: Institut für internationale Architektur-Dokumentation GmbH.

German. This report contains a description, photos, and drawings of the timber-framed, radial-roofed protective enclosure over the Roman ruins at Weißenburg. This enormous free-span structure was chosen as a result of an architectural competition. Visual documentation is more extensive than the Römerbad 1980 article or Schmidt 1988.(M.D.)

Larpin, Dominique. 1991. L'ancienne abbaye de Gigean: Étude pour la mise hors d'eau de l'église gothique. In *Faut-il Restaurer les Ruines? Entretien du patrimoine*, 275–280. Actes des colloques de la Direction du patrimoine, 10. Paris: Ministère de la culture, Direction du patrimoine: Diffusion, Picard.

French. The ancient abbey of Saint-Félix-de-Montceau in the south of France is exposed to the effects of rainwater and frost due to the lack of a roof. Rather than a reconstruction of the original vaulted form, a solution is proposed to install a textile roof below the top of the walls to protect the ruins. Supported by a metallic framework, the textile would follow the approximate shape of the original vaulting, yet remain an unambiguous contemporary solution. (S.T.)

*Laurenti, Maria Concetta. 1998a. Field experience for students at the Domus of the Coiedii (Castelleone di Suasa). *Newsletter = Chronique (International Committee for the Conservation of Mosaics)* 10: 35-37.

Describes the in situ conservation of the mosaic pavements at the Roman house of the Coiedii, Italy by students of the Istituto Centrale per il Restauro. The paper discusses the planning process for a large permanent shelter for the house and specifies criteria for the internal and external climate and construction materials. The structure will have a regular and flat insulated roof, except for areas which were originally unroofed where polyhedric volumes in glass are planned. Microclimatic monitoring is planned to assess the effect of the shelter after the roof is constructed. See also Laurenti 1998b herein. (S.T.)

*_____. 1998b. La conservazione delle aree archeologiche: Sistemi di copertura e di protezione dei resti archeologici, progetti e prospettive. In *Atti del V Colloquio dell'Associazione Italiana per lo studio e la conservazione del mosaico, Roma, 3-6 novembre 1997*, eds. Federico Guidobaldi, and Andrea Paribeni, 495–502. Ravenna: Edizioni del Girasole.

Italian. The Istituto Centrale per il Restauro has initiated several research projects to investigate the protection of archaeological sites by sheltering and to broadly define the parameters for planning a shelter. At the Roman house of the Coiedii, environmental data is being collected to evaluate the performance of the new shelter. Secondly, a survey and evaluation of some existing sheltered sites is being carried out. Information is also being gathered on shelter construction materials and original materials, samples of which are placed under the shelter and periodically monitored. See also Laurenti 1998a, 2001, 2003 and 2006 herein. (B.L/S.T.)

- _____. 2001. Research project on protective shelters for archaeological areas in Italy: A status report. *Conservation and Management of Archaeological Sites* 5 (1 & 2): 109–115.

Reports on the progress of the project developing a methodology for the design and planning of protective shelters. A 'risk map' database of sites has been compiled and the author reports the investigations into the assessment of protective shelters. To illustrate and verify the methodology identified during the research two new representative shelters are being built. Note that this article presents the most current status of the project. See also Laurenti 1998a, 1998b, 2003 and 2006 herein. (S.T.)

- _____. 2003. On-site protection of mosaics: Covering and protecting archaeological remains. In *Mosaics Make a Site: The Conservation In Situ of Mosaics on Archaeological Sites: Proceedings of the VIth Conference of the International Committee for the Conservation of Mosaics, Nicosia, Cyprus, 1996*, ed. Demetrios Michaelides, 289–98. Rome: ICCM.

In addition to the earlier articles by Laurenti, this paper provides more detail of the goals and methods of the project initiated by ICR to standardize the planning process for sheltering by defining a guiding methodology. See also Laurenti 1998a, 1998b, 2001, 2006 herein. (S.T.)

- * _____ ed. 2006. *Le coperture delle aree archeologiche: Museo aperto*. Roma, Italy: Gangemi Editore.

This book presents the final report on a project by ICR (Istituto Centrale per il Restauro) and ENEA (Ente per le Nuove Tecnologie l'Energia e l'Ambiente /Organization for New Technology, Energy and Environment) to develop a methodology for designing ideal shelters for archaeological sites. The study culminated in the design of two shelters, one of which was constructed at over the Villa Arianna at Stabia, Italy. The book is organized into three parts; part one discusses the Carta del Rischio (Risk Map) database, a GIS-based program designed to record information on Italian cultural heritage sites. The study used the database to assess natural and man-made threats affecting the study sites, to record condition information, and to assign a statistical rating system to shelter performance. The second section covers scientific experimentation and treatment testing including environmental, microclimate and air quality monitoring, biological analysis, study of surface deposition, and materials analysis. The third section of the book discusses guidelines for shelter design and includes a description of preliminary scientific study and preventative conservation work carried out at Villa di Arianna. Designs of two proposed shelters and a detailed description of the shelter that was built are provided. Selected articles within this monograph are annotated separately: see 2006 entries herein for Cacace et al.; Ferroni and Laurenti; Altieri et al.; Citterio and Gianì; Bartolini et al.; and Laurenti and Prosperì Porta. For earlier publications during the course of the study see Laurenti 1998a, 1998b, 2001, 2003 herein. [For a review of the publication see Gionata Rizzi. 2007. Review: *Le coperture delle aree archeologiche: Museo aperto*. Maria Concetta Laurenti, ed. Istituto Centrale per il Restauro, Roma. *Conservation and Management of Archaeological Sites* 8: 177–78]. (B.L.M).

- *Laurenti, Maria Concetta and Claudio Prospero Porta. 2006. Realizzazione di un prototipo di copertura protettiva. In *Le coperture delle aree archeologiche: Museo aperto*, ed. Maria Concetta Laurenti, 271–78. Roma, Italy: Gangemi Editore

Based on the results of the ICR-ENEA sheltering project (see Laurenti 2006) two shelters were designed for the Villa Arianna at Stabia and the Bronze Age site of Vivara. The Villa Arianna shelter was built, the Vivara shelter was not. The two sites vary greatly in that the Vivara site is located in a natural context, while the Villa Arianna shelter is located among many other shelters in a monumental complex. The two sites also share commonalities, as they are both located near the sea on an elevated area and have ongoing excavations. The potential shelters must therefore protect the sites in the long term while allowing continued excavation and research. This must also be considered in terms of economics; particularly how much funding should be devoted to continued research and how much to protecting the exposed remains. The value of a discovery and its relationship with the land and community around it must also be considered, as these are often major reasons for sheltering a site. The installation of a shelter can change the context of a site not only in a climatic sense but also through the creation of a confined space over an otherwise open environment. Based on these and other considerations, guidelines were created for design of the two shelters. The shelter design also utilized climate simulation software to predict solar radiation, humidity and temperature under different types of shelter designs. See also Altieri et al. 2005; Citterio and Giani 2005; Howe [2003]; Laurenti et al. 2006; Merler 2002; Nigero 2007; and Prospero Porta 2006 herein for Villa Arianna. (B.L.M.)

- *Laurenti, Maria Concetta, Annamaria Giovagnoli, and Sandra Ricci. 2006. Valutazione dello stato di conservazione di pavimentazioni musive archeologiche protette da coperture definitive: Tre casi a confronto. In *Pavimentazioni storiche: Uso e conservazione: Atti del convegno di studi, Bressanone, 11–14 luglio 2006*, eds. Guido Biscontin and Guido Driussi, 199–205. Scienza e beni culturali, 22. Marghera-Venezia: Arcadia ricerche.

Italian. The authors compare the effects of protective shelters on the state of conservation of mosaics at three archaeological sites in Italy: San Benedetto dei Marsi, near L'Aquila; Villa Arianna at Castellammare di Stabia; and Villa del Casale at Piazza Armerina. The article describes in detail the type and design of the shelters at each site, the state of conservation of the mosaics, the presence of water and its effect on the mosaics, light levels, and types of mosaic deterioration. The shelter at San Benedetto di Marsi has a flat wood roof covered in bituminous material with 14 pyramidal skylights of transparent material. The Villa Arianna features a large variety of shelters, both temporary and permanent. One shelter is constructed of modular units of stamped steel supported by H-shaped elements attached to the walls of the site. At the Villa del Casale, there are large fluctuations in temperature, humidity, and levels of CO₂ caused by the transparent shelter material and heavy visitation during the summer. The authors note that while shelters offer protection against some forms of growth (lichens, for example), they can also become "aging chambers" that cause premature deterioration. Periodic monitoring and maintenance is recommended to ensure the long-term protection of a site. See Minissi 1961 for other articles on Piazza Armerina cited herein. (B.L.M./L.F.)

*Lavagne, Henri and Claude Bassier. 2002. La conservation des mosaïques in situ. *Monumental: Revue scientifique et technique de la Sous-direction des monuments historiques, Direction du patrimoine* Annuel 2002: 74–79.

French. To examine the technical and ethical choices involved in presenting mosaics in situ, the authors evaluate two approaches to conserving mosaics in France. At the Ganagobie priory the approach focuses on a recreation of the original 12th century environment by anastylosis and full reintegration, while at Loupian, the Gallo Roman villa and mosaics are presented as archaeological remains under a shelter designed according to conservation criteria, with selective and distinguishable re-integration. See also Rogliano and Pellecier 2003 herein. (S.T.)

*Lavas, Giorgios P. 2002. The Kathisma of the Holy Virgin: A major new shrine. *Deltion (Europaiko Kentro Vyzantinon kai Metavyzantinon Mnemeion (Thessalonike, Greece) = Newsletter (European Center of Byzantine and Post-Byzantine Monuments (EKBMM) 2: 61–101.*

Remains of a large and important Byzantine-period church with rich mosaics were discovered in Jerusalem in 1992. While most of the article describes the excavation finds, the conservation of the site is also briefly addressed which, as a sacred area and pilgrimage destination, raises complex issues in planning a shelter. The author proposes a church (dome)-shaped metal vault over the remains and a small church to be constructed nearby to accommodate visitors and pilgrims. (S.T.)

Le coperture di aree e strutture archeologiche Bologna 20 ottobre 2000. <http://people.ciram.unibo.it/~seccia/concop.htm>

Italian. This web site is the announcement of a conference organized at the Museo Civico Archeologico di Bologna on shelters for archaeological sites held in October 2000. It lists the complete program of speakers, papers, and posters, which provides an interesting overview of some of the new work that is being done on this topic, particularly in Italy. See also Fentress 2001 herein for a review of the conference. (M.D.)

Lewis, Hilary. 1980. Experiments in mudbrick conservation at Tepe Nush-I Jan. In *Uçüncü uluslararası kerpiç koruma sempozyumu: 29 Eylül-4 Ekim 1980, Ankara = Third International Symposium on Mudbrick (Adobe) Preservation: 29 September–4 October 1980, Ankara*, 109–18. Ankara: ICOMOS/ICOM. <http://www.international.icomos.org/publications/ankara13.pdf>

The metal-framed protective shelters over the mudbrick remains at this site in Iran are described, and the problems encountered are briefly discussed. The gable roof forms were designed to shed snow, but the open construction does not provide adequate protection against high winds and rain, which have caused dehydration and subsequent cracking of the walls. (M.D.)

Lino Bianco and Associates and Heritage Malta. 2004. Hagar Qim and Mnajdra Temples Conservation and Interpretation Project: Project Description Statement, http://www.lino-bianco.com/pds/images/2_hagar_qim/PDS.pdf.

This document presents the project to preserve and display the temples of Hagar Qim and Mnajdra in Malta. The proposals include plans to build a visitor centre and shelters over the temples. The shelters, chosen by an international competition, will be tent structures made of Teflon-coated membrane textiles. Information in this proposal includes details on the deterioration processes of the stone, environmental characteristics of the site, discussion of the shelters, and the monitoring and maintenance strategy for the site. [Information and photos on the winning competition entries is available at <http://www.uia-architectes.org/texte/england/Malte/2results.html>; and for the winning design by architect Walter Hunziker at http://www.hunarch.ch/pages_e/malta_e.htm] (S.T./M.D.)

Lolli-Ghetti, Mario. 1982. Tharros: Conservation of the Punic Ditch: Diversification of technologies. In *Mortars, Cements and Grouts Used in the Conservation of Historic Buildings = Mortiers, ciments et coulis utilisés dans la conservation des bâtiments historiques: Symposium, 3–6.11.1981 Rome*, 256–266. Rome: ICCROM.

In this article outlining the conservation principles followed in preserving the fortification wall at the site of Tharros, there is a brief description of the proposed use of 'suspended cloths' for additional protection. While the materials and construction specifications for the proposed shelter are vague, the concepts guiding its design are well articulated. (M.D.)

*Manara, Maurizia. 1995. Il progetto di copertura della 'Villa dei Mosaici'. *Bollettino dell'Associazione IASOS di Caria* (1): 9-10 and 2000. La copertura dalla Casa dei Mosaici. *Bollettino dell'Associazione IASOS di Caria* (7): 15-16.

Italian. In these two articles the author, who is also the architectural designer of the project, sets forth a conceptual design to protect the Villa dei Mosaici in Iasos, which contains numerous mosaic pavements. The 1995 article presents a preliminary design with rough sketches of a shelter; the 2000 article presents a more developed plan for sheltering the villa. The design incorporates polycarbonate roofing allowing for uniform light, slender supports that recreate the interior volumes, modular design, and attention to ventilation to prevent microbiological growth. (M.D.)

Manzelle, Maura. 1996. La copertura di un sito archeologico: Un problema architettonico. In *Dal sito archeologico all'archeologia del costruito: Conoscenza, progetto e conservazione: Atti del convegno di studi, Bressanone, 3–6 Luglio 1996*, eds. Guido Biscontin, and Guido Driussi, 473-482. Scienza e beni culturali, 12. Padova: Arcadia.

Italian. The author explores shelters as architecture, referencing a number of disparate designs and implemented projects to protect archaeological remains, ranging from temporary protection of excavations to complex urban contexts. Rather than placing emphasis on the shelter simply as a technical intervention to protect archaeological remains, which is described as having been the common approach, the author examines the role of architecture in establishing context, especially in an urban situation, and argues that the building of shelters is an act of critical interpretation like any architectural design. (M.D.)

Marconi, Paolo. 1982. Contributi progettuali al tema della protezione di monumenti e di scavi archeologici dall'inquinamento atmosferico: L'area della Regia nel Foro Romano, l'arco di Costantino, l'arco di Settimio Severo. *Ricerche di storia dell'arte* 16: 54–64.

Italian. The author discusses the development of two types of shelters: the 'glass dome' as an individual outer shell to enclose the monuments, and an open lattice structure covered with impermeable transparent sheeting appropriate for large excavation areas. The proposal and design sketches for a latticework structure over parts of the Roman Forum and those for transparent shelters over the Arches of Constantine and Septimius Severus are discussed. (M.D.)

Matero, Frank, 1999. Lessons from the Great House: Condition and treatment history as prologue to site conservation and management at Casa Grande Ruins National Monument. *Conservation and Management of Archaeological Sites* 3 (4): 203–224.

In this detailed discussion of the history of interventions and current condition recording and investigation of the earthen ruins of Casa Grande in Arizona, the author briefly describes the venerable shelter designed by Frederick Law Olmstead, Jr. in 1932 and its 1903 predecessor. Interesting are the results of the assessment as they pertain to the performance of the shelter in protecting the ruins from weather (significant reduction in atmospheric weathering of the ruin), as well as from numerous interventions carried out over the years on the unsheltered ruins. (M.D.)

Mazar, Amihai. 1999. The conservation and management of mudbrick buildings at Tell Qasile, Israel. *Conservation and Management of Archaeological Sites* 3 (1 & 2): 103–108.

After the Iron Age site of Tell Qasile was excavated in the 1970s, a shelter constructed of a steel frame and asbestos sheeting was erected over the site to protect the earthen walls. While criticized for its impact on the landscape, the shelter is viewed as a valuable preservation measure. Other conservation methods that were implemented (including full restoration) are also reviewed. (S.T.)

*Meli, Guido. 2007. Il progetto. In *Progetto di recupero e conservazione della Villa Romana del Casale di Piazza Armerina*, ed. Guido Meli, 140-178. *Quaderni di Palazzo Montalbo* 12. I, *Grandi restauri*; 1. Palermo: Regione Sicilia, Assessorato dei beni culturali ed ambientali e della pubblica istruzione, Dipartimento beni culturali ed ambientali ed educazione permanente.

Italian with English summary. The author outlines planned changes to the roof structure at the Villa del Casale, Piazza Armerina, Sicily, which had deteriorated, adversely affecting the condition and viewing experience of the mosaics. The original double ceilings will be removed to decrease the thermal differential between inside and outside. The new roof will be extended to protect the floor mosaics from rain and the volumes have been redefined so as to suggest the original volumes of the villa. For stability and proper lighting, translucent plastics will be replaced with opaque materials. The new plan includes a specific protocol for preventive conservation and a maintenance program for the roof systems and the building equipment. Few details are provided

about these plans. See Rizzi 2007 for a new shelter proposal and Minissi 1961 for other articles on Piazza Armerina cited herein. (B.L.M.)

- *Merler, Claudio. 2002. Le diate della villa di Arianna a Castellamare di Stabia. Progetto di una struttura protettiva. *Recupero e conservazione* 48: 32–37.

Italian. This collaborative effort between *Ente per le Nuove Tecnologie l'Energia e l'Ambiente (ENEA)* and the *Soprintendenza Archeologica di Pompei* addresses the sheltering project to be tested on one perimeter area of the Roman Villa Arianna. To better understand processes of deterioration, the study includes extensive in situ monitoring of wind, precipitation, solar radiation and air pollution, subsequently confronted with local weather readings (control). The author provides information relating to procedures and instrumental limits of detection for the year-long environmental monitoring. In order to minimize the 12-14°C fluctuations in daily temperature and to prevent further deterioration of architectural remains, the author proposes a shelter capable of spanning 650 m² and capable of future expansion. The shelter is designed as a series of repeating arcs, each composed of curved metal tubes, joining truss and multi-layered electrochromic panels (opacity as a function of electrical signal). The article includes diagrams and renderings of the shelter's engineering and construction. Post-construction monitoring of the environmental conditions is to be carried out using the dynamic simulation system TRNSYS (no further information on this provided). For the Villa Arianna see also Altieri et al. 2005; Citterio and Giani 2005; Howe [2003]; Laurenti and Prosperi Porta 2006; Laurenti et al. 2006; Nigero 2007; and Prosperi Porta 2006. (K.K.)

- Miarelli Mariani, Gaetano. 1986. Territorio, città, monumenti. *Studi romani: Rivista bimestrale dell'Istituto di studi romani* 34 (1–2): 152–162.

Italian. The first part deals with urban planning policies in Rome. The second section is devoted to the conservation of ancient monuments, with special reference to the column of Marcus Aurelius and the recent proposal for a protective shelter of transparent glass; see also Bruno 1987 and Technology Trends 1985 herein. (M.D.)

- *Minissi, Franco. 1961. Protection of the mosaic pavements of the Roman villa at Piazza Armerina (Sicily). *Museum* 14: 128–132.

English and French. This article is a full description, by its designer, of the enclosed, metal-framed protective shelter, with transparent perspex panes and louvers, over the mosaics of the Roman villa. The design protects the mosaics from inclement weather, reconstructs the spatial volumes of the villa but utilizes entirely modern materials to preclude any confusion between original and new elements and allows viewing of the mosaic by means of walkways. Drainage was addressed with gutters and downpipes that discharge water to a restored ancient sewer drainage. The article is illustrated. The Piazza Armerina shelter is discussed in numerous articles herein: Berriochoa, 2001b, Meli 2007; Ranellucci 1996, Santopuoli 2006; Stanley-Price 1997, Stanley-Price and Jokilehto 2001, Stanley-Price and Ponti 2003, and Vivio 2005. (M.D.)

- *Minissi, Franco. 1985. Ipotesi di impiego di coperture metalliche a protezione di zone archeologiche. *Restauro: Quaderni di restauro dei monumenti e di urbanistica dei centri antichi* 14(81): 27–31.

Italian. One of three articles in *Restauro* 81 devoted to "Coperture a protezione di zone archeologiche". This is a general discussion of the problems inherent in design of protective shelters. Minissi distinguishes four types of shelters: simple, purely functional and inexpensive shelters, often temporary, but usually becoming permanent, which ignore the artistic/architectural values of the original remains; single roofs covering large expanses but without any formal spatial relationship to the protected remains; shelters over particular areas with remains of artistic value that meet museographic requirements of protection and viewing, but create their own quite arbitrary volumes; and shelters over particular remains (as just noted) but which go beyond basic museographic needs and relate directly to the spatial arrangements of the ruins. (M.D.)

- Miura, Sadatoshi. 2002. Conservation of tumulus in Japan: Past and present from Takamatsuzuka to Fugoppe. In *L'art avant l'histoire: La conservation de l'art préhistorique: 10es Journées d'études de la Section française de l'Institut international de conservation, Paris, 23-24 mai 2002*, 179-86. Champs-sur-Marne: SFIIC.

With mounting pressure to open Takamatsuzuka tumulus to the public, the author evaluates the approach to conservation at Fugoppe Cave. Both sites, which contain paintings and engravings, were enclosed in 1972 with air conditioned shelters and, while Takamatsuzuka remained closed, Fugoppe Cave was opened for visitation. There has been extensive investigations and long-term monitoring of the climatic conditions at the Fugoppe cave to characterize the deterioration mechanisms and assess the effect of the shelter. The data demonstrates that the shelter provides a protective environment for the cave and illustrates that this type of methodical approach is critical when deciding to open monuments to the public. (S.T.)

- *Morandini, Francesca, and Filli Rossi. 2005. Una casa romana al museo: Scavo, conservazione e allestimento di un gruppo importante di mosaici da Brescia (Italia del Nord) = From Roman dwelling to museum: Archaeological excavation, conservation and presentation of an important mosaics group in Brescia (northern Italy). In *8^o Synedrio Diethnous Epitropes gia te Synterese ton Psephidoton (ICCM): Entoichia kai epidapedia psephidota: Synterese, diaterese, parousiase: Thessalonike, 29 Oktovriou–3 Noemvriou 2002: Praktika = VIIIth Conference of the International Committee for the Conservation of Mosaics (ICCM): Wall and Floor Mosaics: Conservation, Maintenance, Presentation: Thessaloniki, 29 October–3 November 2002: Proceedings*, ed. Ch. Bakirtzis, 405–18. Thessalonike: Europaiko Kentro Vyzantinon kai Metavyzantinon Mnemeion.

Italian. This article proposes an interpretation scheme for the Domus dell'Ortaglia at the Monastery of S. Giulia in Brescia, Italy. Two periods of excavation have revealed two *domi* featuring mosaics and wall paintings. The mosaics in the house excavated earlier were rebacked with reinforced concrete and relaid on site. A heavy protective structure was built resting directly on the original walls and environmental issues such as temperature, humidity and lighting were not well considered. The second house was excavated from 2000–2001 and a new museum, proposed to replace the previous

structure, is intended to shelter and enclose both domi. The design includes an elevated walkway from which to view the mosaics and wall paintings, didactic information including signage and video, and display cases for artifacts. No information is given about the form of the proposed new building or its impact on the site. The project is a collaboration between the Commune di Brescia, Fondazione CAB, and the Soprintendenza Archaeologica. (B.L.M./L.F.)

Muceli, Cesare A. 2004. Ripari ed elementi protettivi archeologici e superfici musive: soluzioni innovativi. In *Apparati musivi antichi nell'area del Mediterraneo: Conservazione programmata e recupero: Contributi analitici alla carta del rischio: Atti del I convegno internazionale di studi, La materia e i segni della storia, Piazza Armerina, 9–13 aprile 2003*, ed. Guido Meli, 357–62. I quaderni di Palazzo Montalbo, 4. Palermo: Centro regionale per la progettazione e il restauro; D. Flaccovio

Italian. This article draws from a study (Franceschetti, G., F. Gasparri, and N. Santopuoli. *Classificazione degli interventi di copertura e creazione di una banca dati*) presented at the conference entitled "Le coperture di aree e strutture archeologiche," Bologna 2000 (see *Le coperture...2000* and Fentress 2001), during which a classification of different shelter 'types' had been established based upon structural similarities. The author provides a brief review of the shelter types by listing the advantages and disadvantages of each. To better create an enclosed, naturally ventilated environment for archaeological sites, the author proposes a new shelter type utilizing the innovative Transparent Insulating Material (TIM). Technical design, material and construction details illustrate how the proposed shelter could function differently during the summer and winter seasons to accommodate for different climactic conditions. Mention is made of the high cost of materials for this potential shelter type. (K.K.)

Nigero, Concetta. 2007. Coperture archeologiche alla luce di un innovativo approccio progettuale. *I beni culturali: Tutela e valorizzazione* 15 (6): 29–34.

talian. Through the examination of contemporary shelters in Italy from an architectural design perspective, the author provides a brief history of sheltering in Italy beginning with simple wooden shelters constructed at Pompeii in the late eighteenth century, to nineteenth century attempts at accurate reconstructions of roofs and domes at monumental sites. The author then profiles a number of contemporary projects, noting a common emphasis on "scenography," or how shelters manipulate the visitor's view of the site. Projects discussed include designs for shelters for Pompeii and the Arch of Constantine by Renzo Piano and Sergio Musmeci, respectively; and completed shelters at the sites of Villa di Arianna at Stabiae, Mokarta, Sicily, and Piazza di Italia, in Reggio Calabria. The article does not, however, relate contemporary shelter design to the conservation of archaeological sites. (B.L.M./L.F.)

Nishiura, Tadateru, Takeshi Ishizaki and Chiraporn Aranyanak. 2002. Study on the effect of a shelter, by using model structure, for the conservation of Giant Buddha at Wat Sri Chum, Sukhothai In *Conservation of Monuments in Thailand [II]: Proceedings of the Second Seminar on Thai-Japanese Cooperation in Conservation of Monuments in Thailand: September 4–5, 2001, Bangkok, Thailand*, eds. Tadateru Nishiura, and Chiraporn

Aranyanak, 40–47. Tokyo: National Research Institute for Cultural Properties and Bangkok, Thailand: Fine Arts Department.

To determine the feasibility of a shelter as a method for protecting the giant Buddha at Wat Sri Chum, Thailand, a study is being undertaken to assess the effect of a shelter on replica materials. The Buddha, which currently sits in a roofless temple, has a brick core and lime mortar exterior and was consolidated with a hydrophobic silane solution. Facsimile pillars were prepared and placed under two conditions—with and without a thatch roof—and their condition will be assessed. (S.T.)

- *Pagnano, Guisepe. 2004. La copertura dei mosaici della Villa del Tellarò. In *Apparati musivi antichi nell'area del Mediterraneo: Conservazione programmata e recupero: Contributi analitici alla carta del rischio: Atti del I convegno internazionale di studi, La materia e i segni della storia, Piazza Armerina, 9–13 aprile 2003*, ed. Guido Meli, 201–2. I quaderni di Palazzo Montalbo, 4. Palermo, Sicily: Libreria D. Flaccovio Editrice.

Italian. This article addresses a project, undertaken in 1997, to re-situate the lifted and restored mosaics of this southern Italian site and to re-define the spaces of the Villa to allow visitor access. The existing stone masonry structure (eighteenth to nineteenth century), built to protect the mosaic, will be enlarged by two new pavilions to shelter the re-laid mosaic floors. The pavilions are designed not for the purpose of integrating with the existing structure but rather to fulfil functional characteristics. The author offers general principles of design so as to ensure natural illumination and chromatic harmony with the existing structure but does not provide details relating to materials and/or construction of the added pavilions. (K.K.)

- *Palumbo, Gaetano. 2001. Sheltering an archaeological structure in Petra: A case-study of criteria, concepts, and implementation. *Conservation and Management of Archaeological Sites* 5 (1 & 2): 35–44.

The author discusses the case of Petra where an architectural competition for the construction of a shelter failed to produce feasible plans. Subsequently, more specific design criteria were defined and a shelter was commissioned and erected over the Byzantine church. The paper examines the issue of defining criteria for shelter construction, and stresses the need for cooperation among stakeholders and specialists at all stages of the conservation process, from the decision to shelter to implementation. Includes illustrations of the competition submissions and other shelters in Madaba. (S.T.)

- *Papageorghiou, Athanasios. 1985. The mosaics of Cyprus: Problems of conservation. In *Mosaics, No. 3: Conservation in Situ, Aquileia 1983 = Mosaique No. 3: Conservation in situ, Aquileia, 1983*, International Committee for the Conservation of Mosaics (ICCM), 31–37. Rome: ICCROM.

A brief mention of the shelter over the important Roman mosaics in the House of Dionysus in Paphos, Cyprus. The wood-framed, enclosed structure is partially representational, following original walls of the main part of the villa with walkways

for viewing the mosaics. Other mosaics at the site were protected with very simple sheds. The plans for an ambitious, integrated sheltering and landscape scheme over all the mosaics at the Paphos site are described in Hadjisavvas 2003 herein. (M.D.)

- *Parandowska, Ewa. 2003. Conservation of mosaics from the early Roman Villa at Kom el Dikka, Alexandria. In *Les mosaïques: Conserver pour présenter? VIIIème Conférence du Comité international pour la conservation des mosaïques, 22–28 novembre 1999, Musée de l'Arles antique, Arles, Musée archéologique de Saint-Romain-en-Gal: Actes = Mosaics: Conserve to Display? VIIIth Conference of the International Committee for the Conservation of Mosaics: Proceedings*, ed. Patrick Blanc, 103-10. Arles: Éditions de Musée de l'Arles et de la Provence antiques.

The Roman mosaics at Kom el Dikka were first discovered in 1972 and this article describes the mosaics, their condition and conservation after further excavations in 1998. A roofed shelter was erected over the site to preserve the mosaics, the walls of which are partially incorporated into walls of a Byzantine building. Visitors view the remains from a walkway above the mosaics. (S.T.)

- Pedeli, Corrado and Stefano Pulga. 2002. Coperture e protezioni. In *Pratiche conservative sullo scavo archeologico: Principi e metodi*, 53–119. Futuro anteriore 1. Florence: All'insegna del giglio.

Italian. In Chapter 6 of this manual on the conservation of archaeological sites, the authors provide an overview of considerations of sheltering in the context of methods of protection of archaeological sites from the environment. These include basic criteria for protection, materials, characteristics and simple 'traditional' types of metal-framed shelters, especially temporary and moveable structures that can be used during excavation. (M.D.)

- *Pellegrino, Angelo and Tonino Costabile. 2005. Musealizzazione di una villa con mosaici a Dragoncello (Ostia). = Museum conversion of a villa with mosaics at Dragoncello, Ostia, Italy. In *8o Synedrio Diethnous Epitropes Gia Te Synterese Ton Psephidoton (ICCM): Entoichia Kai Epidapedia Psephidota: Synterese, Diaterese, Parousiase: Thessalonike, 29 Oktovriou-3 Noemvriou 2002: Praktika = VIIIth Conference of the International Committee for the Conservation of Mosaics (ICCM): Wall and Floor Mosaics: Conservation, Maintenance, Presentation: Thessaloniki, 29 Oct-3 Nov 2002: Proceedings*, ed. Ch. Bakirtzis, 393–404. Thessaloniki: Europaiko Kentro Vyzantinon kai Metavyzantinon Mnemeion.

Italian. The site of Dragoncello near Ostia, outside Rome, contains many Roman and Imperial-era villas. This article discusses the proposal to re-install mosaics previously removed from the site. The re-installed mosaics will be protected through the use of structural glass platforms built over the rooms, and an elevated platform and walkway around the perimeter of the site would allow visitors to view the mosaics from above. Climate control systems will be installed to avoid potential condensation problems caused by the structural glass. The proposed plan does not include an overall protective shelter for the site and little detail is given about the

form of the support for the structural glass, or its potential impact on existing walls or archaeological features. (B.L.M./L.F.)

- *Pesaresi, Paola and Gionata Rizzi. 2007. New and existing forms of protective shelter at Herculaneum: Towards improving the continuous care of the site. *Conservation and Management of Archaeological Sites* 8 (4): 237-52.

A two-pronged approach was taken for protective sheltering at the site of Herculaneum: site-wide urgent measures for temporary roofing and repair of existing roofs; and new test shelters in a case study area for medium and long-term solutions. This article presents the approach of the Herculaneum Conservation Project (HCP); and discusses the deteriorated roof structures constructed in the 1930s post excavation, the repair of the existing roofs, and the new test shelters. Decisions regarding interventions were based on understanding damage through decay mapping, as well as measures that would offer maximum survival with minimum maintenance and the smallest financial commitment. In the houses where the new shelters were tested, preliminary protective measures were taken first to those areas most at risk, and then prototypes of medium-term provisional shelters to cover large-span areas were developed to meet the following requirements: protection from rainwater; allowance of air movement; prevention of dramatic changes in the microclimate; be visually acceptable; easy to build by a local, non-specialist workforce; cost-effective; and involve as little reconstruction of the walls as possible to support the new roof. Two medium-term solutions were tested: a pitched roof built on a grid of light trusses which rested on a perimeter beam supported by load-bearing frames; and a roof replicating the original Roman compluvium roof, but positioned much lower, and covered by a bituminous impermeable felt and copper sheeting. Finally, two types of permanent flat roofing were tested by reconstructing missing floor slabs: a wooden structure similar to an original Roman form with the underside visible; and a zinc coated steel for when the new structure is to be hidden with a ceiling. The floors were covered by a lightweight sloped screed for rainwater drainage, waterproofed, and topped with 5-8 cm of *cocciopesto*. The performance of each is to be monitored seasonally. (L.F.)

- Piano, Renzo. 1990. Proyecto el pasado: 1987-1988 Pompeya: Acondicionamiento de la zona arqueológica = Fitting out of the archaeological sites. In *Renzo Piano Building Workshop, 1980-1990*, Piano Renzo, and Reyner Banham, 72-73, 88. A & V: Monografías de arquitectura y vivienda. no. 23. Madrid, Spain: AviSa.

Spanish. Included in this issue devoted to Renzo Piano's work is a very brief overview of a proposal to shelter and interpret the site of Pompeii. Although never carried out, it is of interest chiefly as an example of high-end architecture entering the field of archaeological site sheltering. (M.D.)

- Piccioli, Maria Teresa. 2005. Parco archeologico di Forcona (L'Aquila): Progetto di copertura degli scavi di Civita di Bagno. In *Conservare il passato: Metodi ed esperienze di protezione e restauro nei siti archeologici: Atti del Convegno, Chieti-Pescara, 25-26 settembre 2003*, ed. Claudio Varagnoli, 227-30. Antico Futuro, 1. Rome: Gangemi

Italian. This article provides useful technical information on the design of a shelter for the site of Civita di Bagno in the Abruzzo region in Italy. Intended to be inexpensive and able to withstand extreme weather (high winds, rain and snow), the shelter designed is a modular steel frame which supports a tensioned polyester canvas roof. The roof has a low pitch to prevent lateral wind loads and reduce visual impact. The roof is tensioned with stainless steel rope (the type used in sailing vessels, which has high chrome and molybdenum content to prevent corrosion). The gage of the rope was calculated using computer modeling to simulate the maximum weight load of snow in winter. The canvas roof can be pulled closer to the ground in winter to minimize openings and reduce water intrusion, or raised in summer to increase ventilation. The shelter is anchored with small reinforced concrete piers that have minimal physical impact on the site. (B.L.M./L.F.)

- *Piccirillo, Michele. 2004. L'intervento di conservazione e copertura del mosaic omayyade di Qasr Hisham a Gerico in Palestina. In *Apparati musivi antichi nell'area del Mediterraneo: Conservazione programmata e recupero: Contributi analitici alla carta del rischio: Atti del I convegno internazionale di studi, La materia e i segni della storia, Piazza Armerina, 9-13 aprile 2003*, ed. Guido Meli, 295-302. I quaderni di Palazzo Montalbo, 4. Palermo, Sicily: Libreria D. Flaccovio Editrice.

Italian. Despite the many challenges imposed by political conflicts in Palestine, this case study presents the efforts over many years to protect the mosaic pavements of the 'Grand Hall' of the Qasr Hashim complex in Jericho. A first attempt had been made by the Jordanian Department of Antiquities in 1967, resulting in a preliminary shelter made of reeds and earth, followed by a replacement shelter of stone and cement. The restoration efforts, abandoned for political reasons, were re-ignited by the creation of the National Palestinian Authority, 1992, and the author presents their collaborative effort with UNESCO to design a shelter for the Grand Hall mosaics. The mosaics served as a pilot project for the newly formed Jericho Workshop for Mosaic restoration, thus providing the necessary training, under Italian supervision, to create local competency. The author provides some design and material information relating to the proposed shelter but very little information relating to the protective function of the shelter. (K.K.)

- *Piqué, Francesca, Jacques Neguer and Bettina Lucherini. 2003. The role of maintenance in the conservation of mosaics in situ: Comparative field-testing methodology. In *Les mosaïques: Conserver pour présenter? VIIème Conférence du Comité international pour la conservation des mosaïques, 22-28 novembre 1999, Musée de l'Arles antique, Arles, Musée archéologique de Saint-Romain-en-Gal: Actes = Mosaics: Conserve to Display? VIIth Conference of the International Committee for the Conservation of Mosaics: Proceedings*, ed. Patrick Blanc, 445-53. Arles, France: Musée de l'Arles et de la Provence antiques.

This article reports the initial stages of a three-year Mosaic Comparative Exposure Test implemented at Caesarea Maritima which aims to quantify, evaluate, and document the role of maintenance in the preservation of mosaics. A group of four test mosaics with different conditions are monitored: exposed; sheltered with a simple open wooden structure; protected with shallow layer of geotextile, sand and soil; and reburied.

Preliminary results indicate that the mosaics exposed and under shelter require significantly more maintenance than those reburied and under surface protection. (S.T.)

Planck, Dieter. 1988. Archäologische Ausgrabungen in Walheim a.N., Kreis Ludwigsburg. *Denkmalpflege in Baden-Württemberg* 17 (1): 1–8.

German. Included in this excavation report of a Roman settlement in Germany is a brief discussion and sketch of the proposed preservation of the remains by the construction of a shelter. (M.D.)

Prosperi Porta, Claudio. 1996. Arslantepe (Malatya): Una esperienza in corso: Protezione delle strutture e musealizzazione del sito. In *Dal sito archeologico all'archeologia del costruito: Conoscenza, progetto e conservazione: Atti del convegno di studi, Bressanone, 3–6 Luglio 1996*, eds. Guido Biscontin, and Guido Driussi, 549–57. *Scienza e beni culturali*; 12. Padova, Italy: Arcadia.

Italian. In 1992 the Istituto Centrale per il Restauro proposed a plan for the conservation and public display of the important 4th century buildings and mural paintings recently excavated at Arslantepe, eastern Turkey. The plan includes the construction of a permanent shelter for which various conditions are imposed including the implementation of a maintenance program, appropriate security and structural testing. (S.T.)

*Prosperi Porta, Claudio. 2006. La nuova copertura nella Villa di Arianna a Castellamare di Stabia. In *Le coperture delle aree archeologiche: Museo aperto*, ed. Maria Concetta Laurenti, 306–12. Rome, Italy: Gangemi Editore.

Italian. Part of the ICR-ENEA project on shelters for archaeological sites (see Laurenti 2006), this contribution describes the area where the new shelter for the Villa Arianna will be built, noting its different ground levels and wall heights. The recessed level of the site and location of the rooms immediately adjacent to the earthen walls of the pit have meant significant drainage and dust problems. Due to the variety of existing shelters at the site, the project attempts to address the overall appearance of the site not by creating a homogenous approach but one that respects the diversity of the site. The new shelter features: reversible and non-impacting supports held in place by ballast weights; all components prepared outside site and assembled on site over the existing shelter so as not to leave wall paintings exposed; wide spans; expandability; above ground drainage pending final excavation and possible linkage with the ancient system; sufficient height to provide ventilation and views; wood supports on metal bases; adjustable louvered side panels to better control microclimate; and roof insulation. For the Villa Arianna see also Citterio and Giani 2005; Howe [2003]; Laurenti and Prosperi Porta 2006; Laurenti et al. 2006; Merler 2002 and Nigero 2007 herein. (B.L.M.)

Ranellucci, Sandro. 1996. *Strutture protettive e conservazione dei siti archeologici*. Saggi di Opus, 5. Pescara: Carsa

Italian. With an emphasis on theoretical issues of presenting archaeological remains to the public, the author explores a wide variety of architectural projects, implemented and proposed, for protection and interpretation of sites. Sheltering is examined in relation to deterioration phenomena at archaeological sites and numerous examples of protective and interpretive interventions by well-known architects such as Franco Minissi and Renzo Piano are discussed and illustrated. See Minissi 1961 for other articles on Piazza Armerina and Piano 1990 for Renzo Piano cited herein. (M.D.)

- _____. 2005. Le coperture protettive nei siti archeologici: Lo stato dell'arte. In *Conservare il passato: Metodi ed esperienze di protezione e restauro nei siti archeologici: Atti del Convegno, Chieti-Pescara, 25–26 settembre 2003*, ed. Claudio Varagnoli, 253–60. Antico Futuro, 1. Rome: Gangemi.

Italian. The author provides a theoretical discussion of shelters, focusing on the aesthetic and visual concerns of shelter design. Noting that the archaeological community has gradually accepted the concept of archeological sites as "open museums," the author discusses past approaches to shelter design, remarking that Franco Minissi was one of the first Italian architects to view shelters as not only functional, but as interpretive elements as well. The author argues that functional considerations are still dominant when it comes to shelter construction, despite the development of new technologies and materials that allow greater freedom of design. The case studies include a modular shelter at an archaeological site in Greece, and sites in Italy where reproductions of historic stone elements and anastylosis were employed. (B.L.M./L.F.)

- Repellin, Didier [architect]. 2006. Théâtre antique d'Orange: Couverture de la scène. *Architecture méditerranéenne* 63: 36–39.

French. The Roman site of Théâtre antique d'Orange, a World Heritage site in France, was re-roofed in 2006 to protect the stonework from further deterioration. Emulating the original stage roof in its protective capacities only, the design of the new roof by architect Didier Repellin is decidedly modern. A large three-dimensional steel beam is supported by the side wings of the theater and a series of small crossbeams. A secondary lattice-like structure supports a glazed upper section and a lower section of metallic fabric. (L.F.)

- Richard Meier, *il Museo dell'Ara Pacis*. 2007. Milano: Electa.

Italian. This lavishly illustrated publication is an encomium to architect Richard Meier's design in glass, steel and travertine for a new protective building, museum and associated plaza for the Ara Pacis monument. It includes a history of the site of the Ara Pacis and its environs, including the previous protective building by architect Vittorio Ballio Morpurgo in the 1930s under Mussolini. [For a more comprehensive overview see Strazzulla, Maria José 2009. War and Peace: Housing the Ara Pacis in the Eternal City. *American Journal of Archaeology Online Museum Review* 113 (2), http://www.ajaonline.org/sites/default/files/AJA1132_Strazzulla.pdf. This article reviews the ancient history of the Ara Pacis, its history of discovery and reconstruction, the story of its transformation as a monument enclosed in a building, subsequent

alterations and finally the new project to house the altar beginning in 1996 designed by Richard Meier. Criticism leveled against the design, including by Vittorio Sgarbi (whose shelter guideline article is annotated herein, Sgarbi 2007) is discussed. The author points out that the controversy surrounding the design has resulted in record numbers of visitors to the place.] (M.D.)

- *Rizzi, Gionata. 2007. Appunti per la progettazione. In *Progetto di recupero e conservazione della Villa Romana del Casale di Piazza Armerina*, ed. Guido Meli, 235–48; 345–348. Quaderni di Palazzo Montalbo, 12; I Grandi restauri, 1. Palermo: Regione Sicilia, Assessorato dei beni culturali ed ambientali e della pubblica istruzione, Dipartimento beni culturali ed ambientali ed educazione permanente

Italian with English summary. The author provides the rationale and approaches for the redesigned roofing system for the Villa del Casale, which will be based on a wooden beam framework. This system can be constructed in various geographical combinations according to the space being roofed, without modifying the overall structure. The author also reviews the approaches to be taken for the visitor walkways and itinerary, lighting, windows, and architectural integration for the Villa del Casale. See Minissi 1961 for other articles on Piazza Armerina cited herein. (B.L.M./L.F.)

- Roby, Thomas C. 1996. Site conservation during excavation: Stabilization and consolidation of Roman funerary monuments in Carthage. In *Archaeological Conservation and Its Consequences: Preprints of the Contributions to the Copenhagen Congress, 26–30 August 1996*, eds. Ashok Roy, and Perry Smith, 149–52. London: International Institute for Conservation of Historic and Artistic Works.

As a cheaper and faster alternative to backfilling, an enclosed shelter of brick and corrugated iron was constructed to protect masonry walls decorated with plaster and stucco reliefs between excavation seasons. Vandalism and localized salt efflorescence could not be avoided, and the author argues that backfilling remains the best alternative for site protection between seasons. (A.O.)

- *Rogliano, Raymond and Christophe Pellecuer. 2003. Un musée de site à Loupian (Hérault, France): Restaurer, présenter et étudier les mosaïques de la Villa gallo-romaine des Prés-Bas. In *Les mosaïques: Conserver pour présenter? VIIème Conférence du Comité international pour la conservation des mosaïques, 22-28 novembre 1999, Musée de l'Arles antique, Arles, Musée archéologique de Saint-Romain-en-Gal: Actes = Mosaics: Conserve to Display? VIIth Conference of the International Committee for the Conservation of Mosaics: Proceedings*, ed. Patrick Blanc, 111–22. Arles: Musée de l'Arles et de la Provence antiques.

French. The Roman site of Loupian in the South of France has recently undergone a program of conservation that includes the construction of a protective building for the mosaics. The authors examine some of the issues encountered during the planning of the museum and the site, along with conservation and presentation solutions for fragmentary mosaics. There are few details about the protective structure although it is viewed as an attractive solution for presenting the mosaics in situ. See also Lavagne and Bassier 2002 herein. (S.T.)

'Römerbad' in Weißenburg. 1980. *Baumeister* 12: 1224–25.

German with English summary. Description and photos of the radial-roofed protective shelter at Weißenburg; see also Kuttinger 1984 and Schmidt 1988 herein. (M.D.)

Salvatore, Mariarosaria. 2004. Le coperture nelle aree archeologiche, status quaestionis e prospettive. In *Apparati musivi antichi nell'area del Mediterraneo: Conservazione programmata e recupero: Contributi analitici alla carta del rischio: Atti del I convegno internazionale di studi, La materia e i segni della storia, Piazza Armerina, 9–13 aprile 2003*, ed. Guido Meli, 492–99. I quaderni di Palazzo Montalbo, 4. Palermo: Centro regionale per la progettazione e il restauro; D. Flaccovio.

Italian. This examination of certain shelter types derives from a greater project undertaken by the Italian *Direzione generale per l'architettura e l'arte contemporanea* along with the *Direzione generale per i beni archeologici* to establish a set of usable guidelines for the planning of Mediterranean archaeological sites. The article does not focus upon the conservation capabilities of the types of shelters, as this study has been carried out by the ICR and ENEA (Muceli 2004 herein) but instead focuses on the implications that a shelter's design may have on the visual characteristics of the site and on the activities carried out on site. A series of existing Italian shelters, dating from the 1960s to the present, is examined in terms of the materials employed, visual intrusions posed by the structure, foundations that may inflict damage upon the site, the possibility of continued excavation in conjunction with the shelter and the shelter's conformity with the setting. (K.K.)

Sanchèz del Real, Cristina. 1992. Sauvetage du site archéologique de Cacaxtla–Mexique: Projet de conservation intégrale. In *Analyses et conservation d'oeuvres d'art monumentales*, eds. Renato Pancella, and Michèle Citti, 139–50. Lausanne: Laboratoire de Conservation de la Pierre.

French. A large shelter was designed to span extensive earthen ruins with well-preserved painted murals at Cacaxtla (see also Garcíá-Bárcena 1987a and b, cited herein). No interior supports were used, and the shelter is anchored by cables that extend from the roof to the ground beyond the roofline. (A.O.)

*Santalucia, Francesco. 2004a. La manutenzione programmata come risultato delle microanalisi. In *Apparati musivi antichi nell'area del Mediterraneo: Conservazione programmata e recupero: Contributi analitici alla carta del rischio: Atti del I convegno internazionale di studi, La materia e i segni della storia, Piazza Armerina, 9–13 aprile 2003*, ed. Guido Meli, 245–51. I quaderni di Palazzo Montalbo, 4. Palermo, Sicily: Libreria D. Flaccovio Editrice.

Italian. This article discusses the general management issues at the Villa del Casale, Piazza Armerina in Sicily. After the shelter and related conservation work was completed, the site suffered gradual deterioration due to mass tourism and lack of maintenance. The limited available resources were often diverted from maintenance of the historic fabric to the more pressing needs of maintaining the large shelter. The author notes that despite the extensive studies and body of literature produced about the Piazza Armerina, a literature review and a conservation implementation plan was

still needed as of 2003. Brief mention is made of microanalytical techniques (pigment characterization, microclimate monitoring, etc.) that are providing more information and allowing for the development of comprehensive conservation and maintenance plans. See Minissi 1961 for other articles on Piazza Armerina cited herein. (B.L.M./L.F.)

- * _____ . 2004b. La copertura dei mosaici della Villa del Casale di Piazza Armerina: Riqualficazione, restauro o sostituzione? In *Architettura e materiali del novecento: Conservazione, restauro, manutenzione: Atti del Convegno di studi, Bressanone, 13–16 luglio 2004*, eds. Guido Biscontin, and Guido Driussi, 181-88. Scienza e beni culturali, 20. Marghera-Venezia: Arcadia ricerche.

Italian. This article examines the conservation challenges of Franco Minissi's shelter at Villa di Casale in Piazza Armerina, Sicily and its relationship to the Roman site. The author proposes the Villa del Casale shelter be viewed as a work of modern architecture, comparing it to the conservation challenges facing the modern Pirelli tower in Milan, the original glass cladding of which failed and is now replaced on an ongoing basis. The author provides guidelines that were used to inform the decision to restore the shelter and argues that its problems stem not from the original design but from lack of maintenance, increased visitation, and poorly planned interventions that inhibit air circulation. He proposes "localized retrofitting" of the shelter by removing previous interventions while retaining as much of Minissi's original design as possible. Few specifics on the proposed retrofit are provided. See Minissi 1961 for other articles on Piazza Armerina cited herein. (B.L.M./L.F.)

- *Santopuoli, Nicola. 2006. Il restauro della Villa Romana del Casale di Piazza Armerina: Struttura e aggiornamento tecnologico. *Paesaggio urbano* 15 (1): 40–45.

Italian. This article describes the history of the Piazza Armerina shelter and the materials used in its construction, as well as the lack of maintenance and subsequent alterations to the structure that have caused changes in microclimate and damage to the site's mosaics. The author proposes urgent conservation interventions to stabilize the mosaics; partial or total substitution of the shelter's transparent methacrylate panels with new materials such as UV filtering polycarbonate; installation of "intelligent" devices and materials to help regulate the internal temperature; and the installation of permanent environmental monitoring stations to allow better management of critical zones. See Minissi 1961 for other articles on Piazza Armerina cited herein. (B.L.M)

- Scalisi, Francesca. 2006. Orientamenti per il progetto di protezione delle strutture archeologiche. In *Lo stato dell'arte 3: III Congresso nazionale IGIC: Volume degli atti: Palermo, Palazzo Steri, 22–24 settembre 2005*, ed. Cristina Acidini Luchinat, 320–325. Florence: Nardini Editore.

Italian. The article provides an overview of the philosophical issues related to the design of shelters, focusing on the concepts of reliability and compatibility with a given site. The author provides a classification of protective interventions for archaeological sites but focuses largely on shelters. The theoretical discussion is followed by case studies from five sites. Two case studies from the sites of Gela and Eraclea Minoa in

Sicily discuss the failure of shelters designed by Franco Minissi in the mid-twentieth century, both of which were dismantled and redesigned. These two cases provide interesting examples of the problems presented by large shelters and shelters that can be considered historical in their own right, and how these problems have been addressed. The other case studies (Soluto, Sicily; Phigalia, Greece; and San Gerusalemme, Pescara, Italy) describe either restorations of existing shelters or new shelters designed for recent excavations. The author provides a detailed description of the materials used for new shelters at each site. (B.M./L.F.)

Schmid, Martin. 1998. Protective shelters at the archaeological sites of Mallia (Crete) and Kalavassos-Tenta (Cyprus). *Conservation and Management of Archaeological Sites* 2 (3):143–153.

This article describes the design and construction of four permanent shelters to protect excavated archaeological sites. Three of the shelters, at the Late Bronze Age site of Mallia in Crete, are composed of low, arching frames of laminated wooden beams (glulam) set in reinforced concrete foundations and covered with translucent polypropylene sheets. The fourth shelter, at the Neolithic site of Tenta in Cyprus, is more monumental, a 12-faceted conical tent composed of a frame of glulam beams covered with a coated PVC membrane. The shelters also incorporate suspended walkways for visitor access. [For the Mallia shelter, see also Schmid, Martin. 1990. Aménagement, sauvegarde et protection des monuments minoens. *Bulletin de correspondance hellénique* 114 (2): 930–39.] (A.O.)

Schmidt, Hartwig. 1988. *Schutzbauten*. Denkmalpflege an archäologischen Stätten, vol. 1. Stuttgart: Konrad Theiss Verlag.

German. Along with Gollman 1987, this remains the most complete discussion of protective shelters published although no longer current in terms of shelters reviewed. The main body of the text is an extensive, though not comprehensive, descriptive and visual catalogue of open and closed shelters in Europe and the Middle East. The catalogue is especially valuable in providing information on shelters not otherwise published and on the types of materials utilized in their construction. Schmidt employs two basic categories of shelter: open shelters (Schutzdächer) and closed shelters (Schutzhäuser); the latter type incorporates two important sub-types: shelters that conform to the plan of ancient walls, and large barn-like halls (Hallenbauten) that bear no relationship to the original form and massing. Each of the approximately 100 examples is illustrated. (M.D.)

_____. 1995. Schutzbauten auf archäologischen grabungsstätten. *Restauratorenblätter* 15: 45–61.

German. A restatement of the Schmidt 1988 book, with the addition of the striking temporary canopy installed to protect the Apollo Epikourios Temple at Bassae in Greece. See also Theoulakis 1993 herein. (A.O.)

- _____. 2003. The *Römisches Thermenmuseum* (Roman Bath Museum) at Badenweiler, Baden-Württemberg, Germany. *Conservation and Management of Archaeological Sites* 6 (1): 44-46.

A new shelter was built over the Roman baths at Badenweiler, Germany. Completed in 2001, the large barrel-vaulted steel and glass shelter replaces a series of wood and fabric structures that enclosed the baths since their excavation in the eighteenth century. The shelter is discussed with regard to its aesthetic and interpretive role and some construction and design details are provided. See also Filgis 2001 herein. (S.T.)

- Schmuckle-Mollard, Christiane. 1991. La Preservation du site archéologique de Jublains. In *Faut-il restaurer les ruines? Entretien du patrimoine*, 96-98. Actes des colloques de la Direction du patrimoine, 10. Paris, France: Ministère de la culture, Direction du patrimoine: Diffusion, Picard

French. The preservation measures at the archaeological site of Jublains in north-western France attempt to reconcile the preservation of the ruins with visitor accessibility. The temple and fort, two of the four major buildings, will be covered with a protective roof which incorporates a large central glass panel. The shelter proposal is sketched. (S.T.)

- Scichilone, Giovanni. 1986. The site of the cathedral at Atri: A case study of in situ conservation of archaeological remains. In *Preventive Measures During Excavation and Site Protection: Conference Ghent, 6-8 November 1985 = Mesures préventives en cours de fouilles et protection du site: Gand, 6-8 novembre 1985*, 309-14. Rome, Italy: ICCROM

This description of the methods employed to preserve in situ excavated Roman structures in the Cathedral courtyard includes the use of glass 'showcases' for protection and display. (M.D.)

- *Scoppola, F. 1984. Prima Porta: Villa di Livia, coperture. *Bollettino dei musei comunali di Roma* 31: 190-191.

Italian. This is a brief description of measures to protect the Villa di Livia at the site of Prima Porta, which include the erection of a metal-framed, dual-level roof over the area of the baths. (M.D.)

- *Sgarbi, Vittorio. 2007. Linee guida per la progettazione. In *Progetto di recupero e conservazione della Villa Romana del Casale di Piazza Armerina*, ed. Guido Meli, 137-39; 325-327. Quaderni di Palazzo Montalbo, 12; I Grandi restauri, 1. Palermo: Regione Sicilia, Assessorato dei beni culturali ed ambientali e della pubblica istruzione, Dipartimento beni culturali ed ambientali ed educazione permanente.

Italian with English summary. The author outlines general principles for the design and implementation of shelter structures for mosaic sites. These considerations include the cost and durability of materials; ease of maintenance; physical impact on existing structures; reversibility; structural reliability; vulnerability to risk or disasters such as fire or vandalism; microclimate created by the roof; and coherence and legibility of the meaning of the space. (B.L.M./L.F.)

- *Sivan, Renée. 2003. Presenting mosaics to the public: An Israeli experience. In *Mosaics Make a Site: The Conservation In Situ of Mosaics on Archaeological Sites: Proceedings of the VIth Conference of the International Committee for the Conservation of Mosaics, Nicosia, Cyprus, 1996*, ed. Demetrios Michaelides, 313–19. Rome: ICCM.

The author examines approaches to display and presentation issues for sheltered mosaic sites with two case studies from Zippori, Israel: the Dionysos Mosaic, an example of museum-style presentation; and the Nile festival building where the archaeological values are emphasised by presentation in an open shelter. For an evaluation of the presentation and interpretation at these sites see Alef 2002, see also Costanzi Cobau and Nardi 2003 herein. (S.T.)

- Sobrinho González, Miguel. 2000. Termas romanas de Los Bañales: Uncastillo (Zaragoza): Una ruina dignificada. *R & R: Restauración & Rehabilitación* 36: 62–63.

Spanish. The question of protecting the small Roman baths at Uncastillo, Spain was resolved with a wooden structure built on top of the partially reconstructed walls. It is a simple solution, which is clearly distinct from the original construction, removes the effect of solar radiation, and can be removed easily. The other excavated areas are not sheltered. (S.T.)

- Solar, Giora. 2003. Protective shelters. In *Mosaics Make a Site: The Conservation In Situ of Mosaics on Archaeological Sites: Proceedings of the VIth Conference of the International Committee for the Conservation of Mosaics, Nicosia, Cyprus, 1996*, ed. Demetrios Michaelides, 263–74. Rome: ICCM.

The protective function of a shelter is examined in this article and emphasis is placed on the importance of assessing shelter performance. To address the need for evaluation, the author outlines a methodological approach to evaluating shelters based on investigations into the causes of decay in order to determine the most appropriate environmental conditions the shelter must provide. The efficacy of some site shelters in Israel is briefly reviewed. (S.T.)

- *Soromenho Marreiros, Luis. 1994. Meios arquitectonicos de protecção de mosaicos os casos de Conimbriga e Torre de Palma. In *Conservation, Protection, Presentation: Fifth Conference of the International Committee for the Conservation of Mosaics: Proceedings = Actas, Faro e Conimbriga, 1993*, eds. Adilia Alarcao, Virgilio H. Correia, and Carlos Beloto, 145–49. Conimbriga: ICCM.

Portuguese. Describes two examples of shelters over archaeological ruins in Portugal that fulfill their aim of protecting mosaics while allowing viewing by scholars and visitors. The first is a space-frame shelter constructed over a Roman villa with mosaics at Conimbriga. The shelter is open on three sides, with an enclosure on the fourth to protect the mosaic from sun and rain; some attempt is made to relate the shelter with the original building using a higher roofline over the impluvium. A second shelter at Torre de Palma is simpler in design, less costly and without any reference to the architectural remains, but more intrusive in the environment. (J.S./M.D.)

*Sposito, Cesare. 2006. Esigenze conservative e prestazioni tecnologiche: Linee guida per la copertura della domus ellenistico-romana di Taormina. In *Lo stato dell'arte 3: III Congresso nazionale IGIIIC: Volume degli atti: Palermo, Palazzo Steri, 22–24 settembre 2005*, ed. Cristina Acidini Luchinat, 326–31. Florence: Nardini Editore.

Italian. The first part of this article provides useful criteria for the design of an ideal shelter, including functional and aesthetic considerations. Some of the criteria listed are: low impact on the environment and on historic materials; reversibility; distinction of new from old; ease of maintenance; security; flexibility (modularity, to allow change and addition); ease of transport and assembly; protection from environmental factors including rain and surface water, UV, humidity, etc.; and ability to adequately accommodate systems and didactic material. A second list of five design considerations include: limiting shelter movement in wind and isolating its movement from the physical remains; designing the shelter volume to suggest the form of the original structure; adequately enclosing the sides to allow for climate control; integrating local building traditions with innovative technology; and giving adequate attention to the system of water collection and drainage, especially at the margins of the shelter and in relation to any historic drainage systems. Using these criteria, the author analyzes a shelter designed for the domus at the site of Taormina in Sicily, a modular steel shelter that replicates the historic volumes. A raised walkway provides a view of the mosaics; neoprene separates the modern structural elements from historic fabric, and a French drain provides drainage to the shelter perimeter. The designers chose to recreate partial and missing columns using circular groups of steel tubing and to recreate column capitals and decorative details of the roof in fiberglass and steel. (B.L.M./L.F.)

*Stanley-Price, Nicholas. 1997. The Roman Villa at Piazza Armerina, Sicily. In *The Conservation of Archaeological Sites in the Mediterranean Region: An International Conference Organized by the Getty Conservation Institute and the J. Paul Getty Museum, 6–12 May 1995*, ed. Marta de la Torre, 65–84. Los Angeles: Getty Conservation Institute. http://www.getty.edu/conservation/publications_resources/pdf_publications/arch_sites_medit_eng.pdf.

In the context of a comprehensive history of interventions at Piazza Armerina, the author details the objectives and history of the construction of this well-known shelter over the Roman mosaics designed by architect Franco Minissi and provides insight into its performance, problems, and successes over the 40 years since its construction. See Minissi 1961 for other articles on Piazza Armerina cited herein. (M.D.)

*Stanley-Price, Nicholas and Jukka Jokilehto. 2001. The decision to shelter archaeological sites: Three case-studies from Sicily. *Conservation and Management of Archaeological Sites* 5 (1 & 2): 19–34.

The authors examine the design principles and decision-making context governing protective shelter construction in the 1950s by discussing three case studies in Sicily all designed by architect Franco Minissi: Gela, Piazza Armerina, and Heraclea Minoa. Minissi's work is examined in the context of Cesare Brandi's theory of restoration and Minissi's own philosophy of 'musealizzazione' developed for the protection of historic sites and their integration into contemporary society. While the shelters have exhibited

subsequent problems, the authors emphasise the importance of this period and these projects in the development of modern conservation thinking. See Minissi 1961 for other articles on Piazza Armerina cited herein. (S.T.)

*Stanley-Price, Nicholas and Gianni Ponti. 2003. Protective enclosures for mosaic floors: A review of Piazza Armerina, Sicily, after forty years. In *Mosaics Make a Site: The Conservation In Situ of Mosaics on Archaeological Sites: Proceedings of the VIth Conference of the International Committee for the Conservation of Mosaics, Nicosia, Cyprus, 1996*, ed. Demetrios Michaelides, 275–81. Rome: ICCM.

The protective enclosures built in the 1950s at Piazza Armerina are noted as one of the first attempts to protect and display mosaics in situ. This decision-making context is reviewed and the performance of the shelter is assessed in terms of the environment it creates and its interpretive and aesthetic role. The shelter has protected the mosaics but problems exist relating to limited environmental controls and a recent increase in tourism. This approach to sheltering is viewed as a useful model that can help inform shelter design in the future. See Minissi 1961 for other articles on Piazza Armerina cited herein. (S.T.)

Statsbygg. 1998. *Protective Structure for Hamar Cathedral Ruins = Vernebygget over Hamar domkirkeruin*. Ferdigmelding, no. 555. Oslo: Riksantikvaren: Statsbygg.

This monograph is devoted to the protective structure built over the 12th century cathedral ruins at Hamar, Norway in 1998. The text focuses on the design of the structure with discussion of its form and construction; it also includes details on the history of the site and results of archaeological excavations. The structure, a steel framework with glass cladding, is formed by two sloped planes joining to form a ridge following the axis of the ruins. Inside, a climate control system and natural ventilation are designed to facilitate slow drying of the ruins and prevent frost associated damage. A five-year program is planned to monitor the progress of the ruins under the shelter. Illustrations, plans, financial details, and project participant details are included. [For a statement of the design concept by architects Lund & Sulaatto see Lund & Sulaatto. 2004. Protective structure for Hamar Cathedral Ruins, Strandvegen, Hamar, Norway. 1987–1998. *A+U: Architecture and Urbanism* (12= no.411): 82-85]. For further references, see Apeland 1993, and Ibenholt 2003 herein. (S.T.)

Stevens, André. 1981. Proposition d'aménagement des ensembles architecturaux du parc monumental et naturel de Babylone, avec application au Temple d'Ishtar. In *Conservation, réhabilitation, recyclage: Congrès international organisé à Québec du 28 au 31 mai 1980*, 619–26. Québec: Presses de l'Université Laval.

French. Stevens discusses his proposed tent-like membrane structure to protect mudbrick ruins of the Temple of Ishtar at Babylon. Inspired by the Bedouin tent, the roof form has cultural roots in the region but at the same time would bear an unmistakably contemporary stamp. (M.D.)

Stevens, André. 1984. La protection des monuments en brique crues. *Lettre d'information archéologie orientale* 23(7): 19–27.

French. As part of a general discussion of conservation and reconstruction practices on Near Eastern mudbrick sites, the author makes brief mention of new forms of protective structures, as realized at the site of Mari in Syria (a lightweight, metal-framed roof with plastic, molded modules), and as proposed, by the author, at Babylon (membrane structure); see also Stevens 1981 herein for more detailed discussion of Babylon. (M.D.)

Stevens, André. 1986. Structures nouvelles de protection des sites archéologiques du tiers monde. In *Preventive Measures During Excavation and Site Protection: Conference Ghent, 6–8 November 1985 = Mesures préventives en cours de fouilles et protection du site: Gand, 6-8 novembre 1985*, 225–44. Rome, Italy: ICCROM.

French. This article comprises description, critical analysis, and selected photos of various traditional protective shelters and contemporary approaches utilizing new materials and structures, including the covering over the palace at Mari (see also Stevens 1984), his proposal for Babylon, and his imaginative collage of ruins within a geodesic dome. (M.D.)

*Stewart, John. 2001. Protective structures for archaeological mosaics in situ. Newsletter = *Chronique* (International Committee for Mosaics Conservation) 11: 24–27.

While shelters often have many critics, the author argues that they are effective forms of preventive conservation for mosaics if there is long-term planning in place for the structure. For those considering building a shelter, a useful methodology for planning a protective structure is proposed. A key operation of this procedure is risk assessment, involving diagnosis of the causes of deterioration, and the real and potential risks to the archaeological remains. Ideal functional requirements of a protective structure are presented. (S.T.)

*Stewart, John, Sarah Staniforth, and Janet Berry. 2003. Chedworth Roman Villa: A methodology for the monitoring of in situ mosaics. In *Les mosaïques: Conserver pour présenter? VIIIème Conférence du Comité international pour la conservation des mosaïques, 22–28 novembre 1999, Musée de l'Arles antique, Arles, Musée archéologique de Saint-Romain-en-Gal: Actes = Mosaics: Conserve to Display? VIIIth Conference of the International Committee for the Conservation of Mosaics: Proceedings*, ed. Patrick Blanc, 135–43. Arles: Musée de l'Arles et de la Provence antiques.

This article details the integrated monitoring methodology applied to a Roman villa site with shelters over mosaics, at Chedworth, England. The objective of monitoring is to characterize the environmental factors that may be contributing to the stability or decay of the mosaics. Continuous climatic monitoring is by radio telemetry, and intermittent monitoring by a variety of other methods. See also Stewart et al. 2004 herein, which includes the results of the investigations. (S.T.)

- *Stewart, John, Sophie Julien, and Sarah Staniforth. 2004. An integrated monitoring strategy at Chedworth Roman Villa. In *Preserving Archaeological Remains In Situ? Proceedings of the 2nd Conference, 12–14 September 2001*, ed. Taryn Nixon, 179–187. London: Museum of London Archaeology Service.

An integrated monitoring program was conducted at Chedworth Roman villa, England to investigate the factors contributing to the stability or deterioration of the mosaics and wall plasters under the different shelter types at the site. The methodology, which is reported in detail and evaluated with the results, attempts to interrelate ground and ambient conditions by collecting a wide variety of environmental and survey data. This investigation is notable for its thorough methodology, the results of which are viewed as a tool for implementing preventive conservation. See also Stewart et al. 2003 herein. (S.T.)

- *Stewart, John and Steve Cosh. 2005. Protection of in situ mosaics: Lessons from England, 1738-1939. In *8^o Synedrio Diethnous Epitropes gia te Synterese ton Psephidoton (ICCM): Entoichia kai epidapedia psephidota: Synterese, diaterese, parousiase: Thessalonike, 29 Oktovriou–3 Noemvriou 2002: Praktika = VIIIth Conference of the International Committee for the Conservation of Mosaics (ICCM): Wall and Floor Mosaics: Conservation, Maintenance, Presentation: Thessaloniki, 29 October–3 November 2002*, ed. Ch. Bakirtzis, 81-99. Thessaloniki: Europaiko Kentro Vyzantinon kai Metavyzantinon Mnemeion

The authors provide an historical overview of the status of mosaics in England from 1738 through 1939. They estimate that 75% of recorded mosaics have been lost; those that survive have been lifted and removed from site, left in situ, or reburied in situ, or protected under a shelter (cover building), which is the focus of the study. Early vernacular shelters from the 19th C were built and maintained by private landowners and fell outside state control; these are illustrated in case studies of the sheltered sites of Roman villas at Bignor and Chedworth as examples of dedicated ownership and good management. An overview of the performance of the other sheltered sites demonstrates that relatively simple enclosures can be effective in preserving mosaics in situ. Lack of maintenance, changes in ownership and poor construction and management are some of the reasons for loss of many of the early cover buildings, leading to destruction of the mosaics. The study emphasizes the need for sustained commitment of interest and financial resources. (M.D.)

- *Stewart, John D., Jacques Neguer, and Martha Demas. 2006. Assessing the protective function of shelters over mosaics. *Conservation: The Getty Conservation Institute Newsletter* 21 (1):16–19. http://www.getty.edu/conservation/publications_resources/newsletters/21_1/news_in_cons1.html

Basic criteria for designing protective shelters have long been understood, if often ignored, including providing effective drainage, inhibiting birds, mitigating environmental fluctuations, and minimizing the impact on archaeological remains. An understanding of the relationship between mosaic deterioration and their shelters is lacking. In 2004 the Getty Conservation Institute, English Heritage (EH), and the Conservation Department of the Israel Antiquities Authority (IAA) began a pilot project of shelter evaluation, based on prior investigations undertaken independently by EH

and IAA, to better understand the relationship between the condition of a mosaic and the environment created by the design of its shelter. The first phase involved a rapid countrywide survey of sheltered mosaics using a standard format. Prior to the survey, existing documentation of the shelter and environmental data was gathered. The on-site survey recorded mosaic materials, deterioration phenomena, site environment, and aspects of shelter construction with emphasis on features related to drainage and ventilation. At the time of publication, rapid assessment had been conducted on all sheltered mosaics in England and Israel, but the compiling of the information had just begun. (L.F.)

Stubbs, John H. 1995. Protection and presentation of excavated structures. Protection and presentation of excavated structures. In *Conservation on Archaeological Excavations: With Particular Reference to the Mediterranean Area*, 2nd ed., ed. N. P. Stanley Price, 73–89. Rome: ICCROM.

The author describes a number of protective shelters: Fishbourne, Piazza Armerina, Kara Tepe, and Roselle. Brief mention is also made of new materials and structures with potential application to archaeological sites. (M.D.)

Sultov, Bogdan. 1985. A site museum near Pavlikeni, Bulgaria. *Museum* 37(3): 136–139.

Efforts to preserve the remains of an ancient ceramics works near Pavlikeni were apparently implemented utilizing buildings of "metal, glass and fibro-cement on concrete foundations." The photographs of the site show open, gable-roofed shelters protecting some of the remains and traditional materials for a structure protecting ceramic kilns. Unfortunately, there is insufficient connection between the text and the photos to provide adequate understanding of these interesting protective devices. (M.D.)

**Summary of the Proceedings and Papers Presented at the Symposium: Conservation in the Shadow of Vesuvius: a Review of Best Practices*. [2003]. New York: World Monuments Fund. http://www.wmf.org/sites/default/files/wmf_publication/Conservation%20in%20the%20Shadow%20of%20Vesuvius%20a%20Review%20of%20Best%20Practices.pdf.

Italian and English. These brief summaries of papers presented at a symposium on Pompeii and other Italian archaeological sites include four presentations related to shelters. These are: design criteria for a modular lightweight structural system adaptable to different archaeological sites, with a prototype realized at Pompeii (Maria Rosaria Motolese); the concepts for shelters at Stabiae, including Villa Arianna (annotated separately, see Howe [2003] herein); and the shelter project of the ICR and ENEA for the Villa Arianna (since published in full, see Laurenti 2006), with no apparent connection to the concepts described in the Howe summary (Laurenti et al. 2006); and a full paper on architectural considerations of how best to reconstruct roofs to protect buildings at Herculaneum (Gionata Rizzi). (M.D.)

Technology Trends: 'Living' in a glass house...to safely stow stones. 1985. *Technology and Conservation* 9 (1): 12–13.

This brief article describes the encasement approach selected by the Italian superintendency of antiquities to safeguard the column of Marcus Aurelius (Antonine column), Rome. The criteria for the design were: no contact between the column and new architectural elements, and transparency and reversibility of the structure; see also Bruno 1987; Miarelli Mariani 1986; Toraldo di Francia herein. (M.D.)

Teutonico, Jeanne Marie. 2001. Protective shelters for archaeological sites in the Southwest USA. Conclusions and recommendations. *Conservation and Management of Archaeological Sites* 5 (1 & 2): 87–90.

This article summarizes the conclusions of the colloquium on Protective Shelters for Archaeological Sites in the Southwest USA at Tumacacori, Arizona 2001 and sets out general criteria and principles for shelter design. To improve the practice of shelter construction, the conclusions identify gaps in the field and make recommendations to improve education and professional dialogue. For the themes of the conference, see also CMAS 2001 herein. (S.T.)

Theoulakis, P. 1993. Microclimatic monitoring at the temple of Apollo Epikourios at Bassai, Greece. In *Conservation of Stone and Other Materials: Proceedings of the International RILEM/UNESCO Congress, Paris, France, 29 June - 1 July 1993*, ed. M.-J. Thiel, 808–813. London: E. and F.N. Spon.

Deterioration of the temple at Bassai led to the installation of a temporary shelter to protect the limestone structure (see also Schmidt 1995 herein). To better understand the deterioration factors and also to evaluate the impact of the shelter, climatic conditions both outside and inside the shelter were monitored, including temperature and relative humidity. The shelter has increased the RH but has diminished both humidity and temperature fluctuations; microflora populations have also been reduced. (A.O.)

Thompson, Troy D. and Michael R. Taylor. 2001. Establishment of conservation, design and construction criteria for protective shelters at Fort Selden State Monument, New Mexico. *Conservation and Management of Archaeological Sites* 5 (1 & 2): 45–54.

As a component of a site management plan at Fort Selden State Monument, the adobe structures will be sheltered. In this article the sheltering planning process is discussed with focus on the development of conservation, construction and design criteria which will also be used to evaluate the shelter performance after its construction. The contribution of public forums to the planning process distinguishes the Fort Selden Project from other sheltering initiatives. (S.T.)

Tillier, Alain. 1991. Le prieuré médiéval Saint-André de Rosans: Conservation et présentation des ruines. In *Faut-il restaurer les ruines? Entretiens du patrimoine*, 78–81. Actes des colloques de la Direction du patrimoine, 10. Paris, France: Ministère de la culture, Direction du patrimoine: Diffusion, Picard

French. This article considers the problems of conserving and presenting the ruins of the medieval priory of Saint-André de Rosans (south-eastern France) from the harsh winter climate. Three solutions were suggested: a) reconstructing the building's superstructures; b) installing a tile or metal and glass covering to protect the building; or c) consolidating and presenting the ruins in the open-air, which was the solution selected. (S.T.)

Toraldo di Francia, Antonio. 1986. Monumenti sotto vetro? *Antiqua* (5): 25–26.

Italian. The author opposes proposals for the protection of outstanding monuments in Rome and Florence against air pollution by encasing them under glass. Particular reference is made to the column of Marcus Aurelius, illustrated with its scaffolding. (M.D.)

*Trow, Stephen. 1996. The exotic mosaics of Brading Roman villa. *English Heritage Conservation Bulletin* 30 (November): 10–11.

A description and history of interventions of the mosaic at Brading (one of the few sites in the UK where mosaics are on their original beds), which was covered by shelters after excavation in the late 19th century and again in the early twentieth century with a steel-framed barn-like structure with corrugated metal siding, later severely damaged by floods in the 1990s. A more extensive article on the condition of the mosaic and shelter, environmental monitoring and holistic plans for conservation and repair can be found in Edwards et al. 2003 herein. (M.D.)

Uchida, Akito. 1997. Conservation of the engraved rock wall in the Temiya Cave, Japan. In *Conservation of Ancient Sites on the Silk Road: Proceedings of an International Conference on the Conservation of Grotto Sites*, ed Neville Agnew, 235–43. Los Angeles: Getty Conservation Institute. http://www.getty.edu/conservation/publications_resources/pdf_publications/silkroad4.pdf

Engraved characters in the Temiya Cave on Hokkaido, Japan, have been dated to about 1600 years BP. Exfoliation of the tuff comprising the cliff prompted the construction of a new shelter to replace the existing simple one. Various technical and scientific studies are outlined in relation to the geology and hydrology of the site. Computer simulations show the exterior and the interior display of the new steel-reinforced structure, which will be fully air-conditioned. This structure represents a high-tech engineering solution that seems fundamentally incompatible with the simplicity and antiquity of the petroglyphs. (M.D.)

Ulbert, G., and G. Weber, eds. 1985. *Konservierte Geschichte? Antike Bauten und Ihre Erhaltung*. Stuttgart: Konrad Thies Verlag.

German. Included in these discussions of site and regional studies are examples of some of the large enclosed halls that have become an increasingly common response to the preservation of archaeological sites in Germany, Austria, and Switzerland. (M.D.)

Up the villa. 2003. *RIBA Journal* 110 (8): 10.

A short article about the new museum building constructed over a Roman villa with wall paintings in Périgueux, south-west France. The shelter is constructed with glass walls and narrow steel vertical supports. The building layout, roof and visitor walkways follow the geometry of the villa while the architect, Jean Nouvel (France's most celebrated contemporary architect) also incorporated some signature elements. [For more photos and information see arcspace. 2003. Jean Nouvel: Vesunna Gallo-Roman Museum, Périgueux, France, available at <http://www.arcspace.com/architects/nouvel/Gallo-Roman/>] (S.T.)

*Valle, Roberto. 2001. Cubricion de ruinas, Almenara (Valladolid). *AV Monografías = AV Monographs* (87–88): 88–91.

Spanish and English. This article describes the large new shelter erected over the Roman site at Almenara, Valladolid, Spain. The industrial sheds cover a large space with minimal interference with the remains. The roof is formed from four vaulted structures made of corrugated metal sheeting. Wooden louvered walls provide ventilation and glazing on the north facade allows the surrounding landscape to form a backdrop to the archaeological remains. The article includes plans and photographs. [For further information and photographs see Diputación de Valladolid. Museo de las Villas Romanas Almenara-Puras Valladolid, http://www.diputaciondevalladolid.es/extras/extras_villa_romana/MuseoVillasRomanas.pdf] (S.T.)

*Vivio, Beatrice. 2005. Attività sperimentale alle origini del restauro critico: Primi contributi di Franco Minissi = Experimental activities at the origins of critical restoration: First contributions by Franco Minissi. *Arkos: Scienza e restauro dell'architettura* 6 (12 Ottobre/Dicembre): 18–24.

Italian. The author reviews Franco Minissi's contributions to preserving and presenting archaeological sites through the use of new materials and innovative approaches, as well as the unintended consequences attributed to lack of maintenance (Gela) and insufficient understanding of the microclimatic conditions created under transparent materials. [See also Vivio. 2006. La Villa del Casale di Piazza Armerina e il mancato restauro del restauro. *Parametro* 36 (266): 68–79.] (M.D.).

Waane, Simon A.C. 1986. Roofs and shelters: The Tanzanian experience. In *Preventive Measures During Excavation and Site Protection: Conference Ghent, 6–8 November 1985 = Mesures préventives en cours de fouilles et protection du site: Gand, 6–8 novembre 1985*, 245–56. Rome, Italy: ICCROM.

This article discusses the difficulties of preserving paleontological sites, including the use of protective shelters, based on the author's experience in Tanzania. (M.D.)

Wainwright, Ian N.M., Henry Sears, and Stefan Michalski. 1997. Design of a rock art protective structure at Petroglyphs Provincial Park, Ontario, Canada. *Journal of the Canadian Association for Conservation = Journal de l'Association canadienne pour la conservation et la restauration* 22: 53–76.

A protective structure was constructed over one of Canada's best-known rock art sites. The art, pecked into an outcrop of marble, was being damaged by frost weathering and algal growth. The primary function of the fully enclosed shelter was to eliminate rain, snow and surface run-off while allowing the maximum amount of sunshine on the rock surface. The structure is a seven-sided, column-free building with fully glazed walls. The foundations are of poured concrete, carrying a steel frame superstructure. Particular attention was paid to ventilation of the structure for visitor comfort and conservation of the rock. [See also Wainwright, Ian N.M. 1987. Rock art conservation in Petroglyphs Provincial Park. *Canadian Conservation Institute Newsletter*, December, 8–9.] (M.D.)

Weaver, Martin E. 1973. The use of an inflatable "air-dome" to produce controlled conditions for an archaeological site. *Studies in Conservation* 18 (2): 88–93.

The author first presented an inflatable "air-dome" as a potential temporary shelter for during excavation in the 1968 *Proceedings of the Fifth International Congress on Iranian Art and Archaeology 1* (Tehran), 373–379. A fuller discussion, including photographs, is presented here. Employed at the site of Can Hasan, Turkey, the "air-dome" was constructed with a tubular steel frame and a large balloon made of nylon cloth coated on both sides with white translucent polyvinyl chloride, which was inflated by large electric fans. The base of the dome could be fixed to the ground with long tent pegs, but other means of anchorage were devised because of the shallow archaeological remains. Climate conditions inside and outside the dome were measured and compared. (L.F.)

*Weidmann, Denis. 1987. Problèmes de gestion et de conservation des mosaïques d'Orbe-Boscéaz (Vaud-Suisse), abritées depuis 1841. In *Mosaicos no. 4: Conservacion in situ, Soria 1986 = Mosaïque no. 4 = Mosaics no. 4: Proceedings of the 3rd General Conference of the International Committee for the Conservation of Mosaics, held in Soria, Spain, 1986*, ed. Carlos de la Casa Martinez, 7–17. Soria, Spain: Servicio de Investigaciones Arqueológicas Diputación Provincial de Soria: Instituto de Conservación y Restauración de Bienes Culturales, Ministerio de Cultura.

French. Discusses the history of interventions and sheltering at the mosaic site of Obre-Boscéaz, Switzerland, from the mid-nineteenth century through to a conservation program that began in 1976, involving repair of earlier shelters, installation of drainage systems and likelihood of having to modify or construct new shelters. Conditions identified as contributing to decay of mosaics under the closed shelter are increased humidity, winter salts, drainage patterns, and agricultural activity. See also Weidmann 2005 herein. [There are extensive publications on the mosaics at Orbe-Boscéaz detailing the investigations and conservation of the mosaics, these include: Weidmann, Denis, Robert Flatt, Claude Félix, Fred Girardet, André Glauser, 2003. *Analyse des*

altérations et déformations de mosaïques à Orbe-Boscéaz (Canton de Vaud, Suisse). In *Mosaics Make a Site: The Conservation In Situ of Mosaics on Archaeological Sites: Proceedings of the VIth Conference of the International Committee for the Conservation of Mosaics, Nicosia, Cyprus, 24-28 October 1996*, ed. Demetrios Michaelides, 169-84. Rome: ICCM] (J.S./M.D.)

- *Weidmann, Denis and Fred Girardet. 2005. Contrôle climatique de mosaïques in situ sous abris = Climate control of in situ mosaics under shelter. In *8^o Synedrio Diethnous Epitropes gia te Synterese ton Psephidoton (ICCM): Entoichia kai epidapedia psephidota: Synterese, diaterese, parousiase: Thessalonike, 29 Oktovriou–3 Noemvriou 2002: Praktika = VIIIth Conference of the International Committee for the Conservation of Mosaics (ICCM): Wall and Floor Mosaics: Conservation, Maintenance, Presentation: Thessaloniki, 29 October–3 November 2002*, ed. Ch. Bakirtzis, 359-66. Thessaloniki: Europaiko Kentro Vyzantinon kai Metavyzantinon Mnemeion.

French. Shelters around the mosaics at the site of Orbe, Switzerland were built between 1841 and 1935, some directly on the ancient Roman walls. RH cycling within the structures was driving the evaporation of water from beneath the mosaics and causing crystallization of soluble salts on the surfaces. Although drainage was added around the shelter, water levels within the soil beneath the mosaic were still very high (water equaled 20% of the volume of the soil materials). To address this, initial alterations to the shelter included weather-stripping the doors and windows, permanent closure of the windows, installation of screens and blinds, and installation of automatic doors to limit environmental shifts during visitor entry and exit. For cycling of RH, areas of fans were constructed below ground around the mosaics. The fans converted the water from the sub-soil and the drainage into water vapor, which was pumped into the shelter above ground, creating a closer equilibrium. The ventilation system fans are remotely controlled and are set to achieve 85-90% RH within the shelter. Salts are kept in a deliquescent state and the colors of the mosaic are more vivid as the surface is moist. Tests after two years of ventilation showed reduced water levels within the soil. The authors note that the interior of the shelter feels like a cave, but as visitors only stay 5-15 minutes, the high humidity does not appear to affect their visit. Minor growth of microorganisms from the high RH was easily removed and low natural light levels from the addition of blinds has prevented the growth of more prominent vegetation. (C.B.)

- *Wiplinger, Gilbert. 1990. Restaurierungsprojekte in Ephesos. In *Echo: Beiträge zur Archäologie des mediterranen und alpinen Raumes: Johannes B. Trentini zum 80. Geburtstag*, eds. Brinna Otto, and Friedrich Ehrl, 329–35. Institut für Sprachwissenschaft der Universität Innsbruck, 27. Innsbruck, Austria: Leopold-Franzens Universität Innsbruck, Institut für Vergleichende Sprachwissenschaft.

German. A short summary of all the restoration projects in Ephesus, including the author's permanent shelter over the Roman Terrace Houses. Excavated over a 25-year period (1960–85), the houses were protected with temporary roofing until construction of a permanent shelter began in 1979. The shelter attempts to reconstruct the space of the original rooms through use of intersecting gabled roofs that make reference to the ground plan. Reinforced concrete pillars support concrete girders and a ring beam defining the

perimeter of the complex and supporting a wooden roofing truss with red tiles; new wall construction was carried out in brick. The shelter was completed over only two of the terrace houses because of controversies about its scale and visual intrusiveness. [For a very brief description in English with good photographs see also G. Wiplinger and G. Wlach. 1996. Conservation project at Terrace House 2. In *Ephesus: 100 Years of Austrian Research*, 128-35 (Österreichisches Archäologisches Institut). Vienna: Böhlau Verlag] See Krinzing 2000 herein for new shelter design that replaced this one. (M.D.)

Woolfit, Catherine. 2007. Preventive conservation of ruins: Reconstruction, reburial and enclosure. In *Conservation of Ruins*, ed. John Ashurst, 147-93. Butterworth-Heinemann Series in Conservation and Museology. London and Burlington, Mass.: Butterworth-Heinemann.

Within the chapter on preventive conservation, the author provides an overview of shelters or 'enclosures,' citing trends and problems using well-known examples from England, Israel Greece, and Turkey, but includes the obscure but interesting example of a temporary cover for a pavement at Cleeve Abbey. Particular attention is paid to designs and materials used to attain appropriate environments using specific examples, and problems with groundwater, which are typical of shelters in England. A design brief, planning process, and the critical environmental factors that must be considered are outlined in a clear and straightforward manner. Emphasis is placed on the importance of comprehensive survey work to fully assess the issues. (M.D.)

Wu Zilin. 1985. The museum of Qin Shi Huang terracotta warriors and horses. *Museum* 37(3): 140-47.

A huge barrel-vaulted, latticework structure was constructed (1974-9) over the remains of the terracotta army of the emperor Qin Shi Huang in Xian province, China. The structure serves the dual purpose of protection and museum. Architectural details of the structure are lacking in this article, which is devoted mainly to a description of the archaeological remains. Plans to expand the excavated area and create a complex of museums and protective shelters to cover about 300,000 m² are briefly discussed. (M.D.)

Zumthor, P. 1988. Schutzbau über Ausgrabungen in Chur, CH. *Detail: Zeitschrift für Architektur & Baudetail & Einrichtung* (5): 499-502.

German with English summary. A brief description of the timber-framed, louvered shelter over Roman remains near Chur is accompanied by full documentation in the form of photographs, plans, and sections. See also Hubeli and Fumagalli 1987 herein. [Also, Shelters for Roman archaeological site. 1997. *A+U: Architecture and Urbanism* 1 (316): 25-34.] (M.D.)

CHAPTER 5

Reburial and Protective Covering of Mosaics

Martha Demas



Photos: All photos © J. Paul Getty Trust, except where noted. Clockwise, from upper left: Khirbrt Minya/Horvat Minnim, Israel; Paphos, Cyprus; Cosa, Italy (© T. Roby); Hergla, Tunisia; Tel Itztaba, Israel (© IAA); Jerash, Jordan (© J.Stewart); Hergla, Tunisia.

Reburial and Protective Covering of Mosaics

Introduction

Any attempt to understand the rationale, techniques and methods of reburial as a preservation strategy for excavated archaeological remains must have recourse to a broad range of related literature, from soil science to microbiology, hydrology and site stabilization techniques. This overview is focused specifically on the published literature that relates to the protection of mosaic pavements by reburial or shallow protective coverings; it does not cover that broader range of literature, nor publications on reburial of other types of archaeological remains, much of which is directly pertinent to reburial of mosaics. The reason for focusing on mosaics is to have a clearer understanding of past practices and current issues within the arena of mosaic conservation. An indispensable reference for reburial of archaeological sites generally is the publication of papers from a colloquium organized in 2003 by the Getty Conservation Institute (GCI), the U.S. National Park Service and the International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM) in Santa Fe, New Mexico (see *CMAS* 2004); an annotated bibliography of reburial publications (with citations only through 2001) is available at http://www.getty.edu/conservation/publications/pdf_publications/archaeology_bib. Also to be noted are the publication of the *PARIS (Preserving Archaeological Remains In Situ)* conferences (*PARIS 1* and *PARIS 2* published within the chronological scope of the literature review; *PARIS 3* was published in 2008, but is cited in the references, and *PARIS 4* has yet to be published); these publications address challenges related to both buried and reburied archaeological remains and in which mosaic reburial has begun to make an appearance (see Stewart et al. 2004 and Nardi and Schneider 2004 in *PARIS 2*).

Conservation literature on mosaics that is specific to reburial or protective coverings is relatively more extensive than for other categories of archaeological sites. The reason is principally due to the role of the ICCM conferences as a forum for discussing problems and sharing information among professionals. The eight ICCM conferences published through 2007 provide the majority of mosaic-related publications. The conference proceedings are thus an important source of information about reburial as a conservation intervention and a means of gauging the trends in its practice over the last thirty years.

A comprehensive review of the literature on mosaics through 1988 was undertaken in connection with development of the first course on mosaic conservation at ICCROM (Melluco et al. 1994 and Nardi 1994). In their interesting and trenchant review of the

state of practice and thinking about mosaic conservation as reflected in the literature, the authors make clear that the emphasis had been on lifting and relaying of mosaics (67%) and "super projects," with a lack of interest in "soft interventions" such as reburial (only 8 articles of some 400 under review). A divergence between reality (that is, actual practice in the field) and the literature (what conservators chose to report on) was also emphasized. Such a divide is especially pertinent to reburial, which is practiced far more often than reported. The authors point out that the 1990 ICCM conference (*Mosaicos, no. 5: Conservación in situ: Palencia, 1990: IV Conferencia general del Comité internacional de mosaicos*), at which these papers were read, showed signs of a change in attitude which, from the vantage point of two decades, has proven prescient. A division of the literature pre-1990 and post-1990 is therefore a useful way to review what has been written and published on reburial and surface protection of mosaics.

The terminology used in the literature to describe the act of covering a mosaic for its protection has varied over time. In English, the term 'backfilling' has been prevalent; also used are phrases such as 're-covering with earth' or 'surface protection' and 'protective covering' for shallow, often temporary protection. More recently, the term 'reburial' has gained wider acceptance, and it is used in this review (see, however, *CMAAS* 2003, 140 for the term's other associations in the context of archaeology in the Americas and Australia). Frequently used terms in French are *réenfouissement*, *couverture*, *protection*; in Spanish *rentierro*, *cobertura*; and in Italian: *reinterro*, *copertura*, *protezione*.

Pre-1990 literature

Methods and materials

Prior to 1990, the meager literature on reburial consists principally of articles recommending or describing methods and materials for long or short-term protection of mosaics. These references are in the context of general articles on the problems of conserving mosaics in situ and the range of options available (Velocchia 1978, Bassier 1978; *Mosaics* 2; Mora 1984; a useful overview of these methods, which includes references after 1990, is provided in Altieri et al. 1999 and Laurenti and Altieri 2000). Recommendations for short-term protection against weather and plant growth call for polyethylene (plastic) sheeting on the mosaic covered with a shallow layer of sand or pozzolana. Long-term protection dispenses with sheeting, whose role is taken by a layer of sand, pozzolana or expanded, fired 'ceramic pellets' or 'clay pellets' (*argilla espansa*), followed by layers of earth. The importance of depth of fill for long-term protection is addressed in *Mosaics* 2 and in Bassier 1978 with respect to the insulating capacity of soil against freeze-thaw cycles. Only the work plan in *Mosaics* 2, which takes a more holistic approach, mentions the need for maintenance of a reburied mosaic, recommending herbicide treatment or annual weeding. The dangers inherent in the use of polyethylene sheeting over the long term

(creation of a micro-environment by the impermeable membrane) are also addressed. The most fulsome coverage on reburial prior to 1990 is that of Mora 1984, who incorporates guiding principles into a proposed 'backfilling' strategy for wall paintings and mosaics: backfill material should be insulating and impermeable to liquid water, but permeable to water vapor; consideration needs to be given to the ease of removing materials (e.g. sand and clay become compacted and heavy when wet); and the surface of the backfill must be stabilized. Mora clearly puts to rest the use of plastic sheeting in a reburial, recommending instead the use of plastic netting (or mesh) as a separator material between the mosaic and the bulk fill, which will also facilitate removal of fills, if needed. The purpose of clay pellets (loose or in small bags) as the first layer of fill is not clearly explained; the bulk fill is earth, covered with a bentonite (expansive clay) layer to prevent penetration of rainwater, followed by earth and shallow rooted plantings to stabilize the surface. The proposed sequence was said to be subject to experiments to check its efficacy, but no follow-up was published.

Nardi (1982, see below) and Mora are the earliest mentions of the use of plastic netting and clay pellets together. This is a combination that was to become ubiquitous in the Mediterranean region in the 1980s and 1990s, especially for shallow covering of mosaics, and most often without the overburden of soil that is a critical protective component in the reburial recommended by Mora.

A round-table discussion on in situ conservation organized at the Soria conference in 1986 (*Mosaics* 3, 345-365) brought forth numerous examples of past attempts to protect mosaics with various coverings, some as long ago as mid-nineteenth century. These range from the rational to the absurd, including pure sand, geotextiles, straw and wood, concrete, bitumen/tar paper, and expanded polyurethane - most with disastrous results. However peculiar some of this anecdotal evidence is, it highlighted the near absence within the literature of careful evaluation of past treatments and testing of different methods and materials.

Experimental testing

The only experimental testing work published in this period is that done by Nardi to find a method of temporary protection for mosaics (Nardi 1982). Testing was done in situ on a small area of mosaic (2 m. sq.), employing plastic netting, expansive clay pellets, soil and sand in four different combinations. Testing was aimed at verifying characteristics and behavior of clay pellets: compressive strength/resistance, ability to impede plant growth, and durability, practicality and re-usability. The results showed that the clay pellets were inert, not subject to compression, do not impede root growth, and were durable, practical and recyclable. The most important observation after one year of testing was that penetration of roots occurred in all test areas; the need for more study of this problem, which the author acknowledged as one of the most important for reburial,

was emphasized. The observation that clay pellets in one test area that rested in standing water showed no signs of intake of water has been the general perception about clay pellets, but it is not a reflection of their true characteristics (see below experimental lab testing after 1990).

Evaluation of past treatments

The need for evaluating past treatments is brought to the fore in the article by Stanley-Price (1985) that looks at patterns of survival of mosaics. This was done from a literature survey of a corpus of mosaics within a specified region (the Levant) and chronological period (Byzantine). While the number of mosaics reburied was significant (25% of the total surveyed) this did not reflect an enlightened trend, but rather the result of many mosaics from a single site having been backfilled after their initial excavation in the 1920s. The methodology of trying to discern patterns of preservation and deterioration requires a large sample, but as the author points out the results must remain tentative and provisional pending in situ evaluation of the effectiveness of the treatment in question. Nevertheless, this type of analysis is an important complement to the major trends in the literature on mosaics, which focus on the details of individual mosaics rather than an investigation of more regional patterns.

The literature from 1990 to 2007

Methods and materials

The methods and materials most commonly referred to in the literature from 1990 onwards are clay pellets and plastic netting, and increasingly geotextiles. Plastic netting and geotextiles are used in combination with clay pellets or in variations incorporating layers of pozzolana or soil (Martinelli 1994; Roby 1995; Costanzi Cobau 1994; and see Altieri et al. and Laurenti and Altieri 2000 for an overview of materials commonly used in reburial of mosaics). The use of 'pillows' or 'mattresses' made mainly with geotextiles filled with clay pellets becomes rather common in the 1990s, especially for temporary or seasonal reburial. The main criteria for their use are the ease of removal and re-use (Aoyagi and Foschi 1997; Bedello and Spada 1995; Demitry 1994). Roby (1995) records the unsuccessful use of perlite for temporary covering (the perlite produced fine particles that were difficult to remove from the mosaic), one of the rare mentions of other materials; and Bedello and Spada record the use for temporary protection of a geocomposite to inhibit root growth, but with no details on its function.

Alberti et al. 2006 report on an unusual reburial technique proposed to protect a mosaic covering the top of a domed sepulcher (in an archaeological park on the Appian Way), some five meters below ground level. With a restricted area for reburial and no way to easily contain loose fill, the authors proposed the use of geotextile and expanded clay pellets covered with a layer of pozzolanic mortar applied at a slight incline to

shed water. No information is provided about the type of geotextile, mortar used, or implementation of the proposed reburial.

A unique example of 'underwater reburial' of mosaics was employed at the site of Zeugma, Turkey which was under threat of inundation from the construction of a nearby dam. The intervention, which was aimed at trying to preserve the excavated remains in situ rather than resorting to the more common solution of detachment and removal of selected pieces to storage, was carried out in an area of 8700 m² that was to be submerged or exposed to lapping waves. Following conservation, mosaics were covered with a 5 cm lime wash, followed by a 50 cm layer of soil and sand (dampened and compacted to prevent shrinkage), and lastly by an average 50 cm thick layer of river pebbles and stone (depending on the slope of the trench). A few months after the reburial, further conservation and stabilization efforts were undertaken as the pebbles and stones were heavily disrupted by wave action and unexcavated areas were uncovered (Nardi 2005 and Nardi and Schneider 2004).

Separator materials, which serve primarily to separate the substrate from the bulk fill and secondarily as a means of facilitating removal of the fill during re-excavation, show a clear evolution from plastic sheeting to plastic netting to geotextiles. Although geotextiles make their first debut in brief mentions prior to 1990 (e.g. the discussion in *Mosaics 4*), they begin to have a real impact on reburial strategies for mosaics in the literature published in the 1990s, taking over to a large extent the role played by plastic netting. Geotextiles were initially favored for their characteristics of water permeability, as a defense against or deterrent to root intrusion, and as an insulator. Nowhere in this literature, however, is there a clear exposition of the characteristics and variations among geotextiles, their function and their potential drawbacks; the article by Laurenti and Altieri 2000 includes a brief review of their characteristics and points out the difficulties of comparing different geotextiles based on manufacturers' data.

With so little reliable information in print, it is not surprising that the selection and application of geotextiles has been fraught with problems from the beginning. The two major problems associated with use of geotextiles on mosaics, as reported in the literature and the conservation grapevine, were that they concentrate moisture and thereby promote root growth and microbiological activity; and that they may adhere to the tessellatum, causing damage when removed (this problem has been encountered in non-mosaic contexts as well, and with the use of netting material on mosaics, see Nardi 1982 for netting). Water retention was reported in testing by Petriaggi (1994) at Ostia, and anecdotally by Munday (1991) at Carranque: "...it was apparent that this material [geotextile], rather than allowing the mosaic to breathe whilst resisting water, was in fact saturated with water and was sustaining plant growth." The specifications of materials used is most often lacking, making such evaluations part of the problem rather

than contributing to a solution. Anecdotal information and direct experience of many of the 'geotextiles' used in the Mediterranean reveals that most of these materials are quite thick (1-3 cm), felt-like nonwoven fabrics, which tend to retain water and act as a sponge (see also Neguer 2004). Thus, as with so many product technology transfers, lack of knowledge and inappropriate application are often the source of problems. The overview of geosynthetic products published from the Reburial Colloquium in 2003, and their applications in many of the non-mosaic-specific case studies, began to directly address this problem (CMAS 2004, 377-93).

Experimental testing

Experimental testing, both field and lab, is more prominent in the literature of this period. Two short-term, small-scale field tests were reported at the 1990 Palencia conference (Petriaggi 1994; Rodríguez González 1994). Petriaggi employed geotextiles and plastic netting in combination with clay pellets, and observed that the geotextile absorbed water and led to root growth below the fabric, while the plastic netting remained dry. Rodríguez González also tested the use of geotextiles in conjunction with clay pellets or soil as a temporary protection, but no results have been reported.

An experimental project initiated in 1998 by the Istituto Centrali per il Restauro and the Soprintendenza Archaeologica per l'Etruria Meridionale at the site of Civitavecchia (the *Thermae Taurine*) focused on the comparative testing of temporary reburial systems applied to mosaic floors and plastered walls (Altieri et al. 1999; Laurenti and Altieri 2000). The testing included the use of geotextiles in combination with mattresses filled with clay pellets (two types of geotextile used – Typar and Reemay), and a sheet of Gore-tex (GORE textile) as a covering for the mosaic and floors. Gore-tex makes its first published debut here as a material for protecting mosaics. Its composite structure with a knitted polyamide base and 'teflon' coating makes it impermeable to liquid water but permeable to water vapor, thus combining, theoretically, the good aspects of an impermeable membrane (to prevent the infiltration of rain water) without the drawbacks (trapping of moisture below the membrane).

Preliminary testing carried out by the Soprintendenza and W.L. Gore & Associates at *Lucus Feroniae* in January 1997, and planned for Ostia, remains unpublished (Belluci and Cristofoli 1997), but preliminary results were published in Altieri and Laurenti 2000. A predictable result was the rapid deterioration of the exposed geotextile (assumed to be a polypropylene geotextile), which is known to be UV-sensitive and is intended only for sub-surface applications. The Gore-tex was shown not to have any ameliorating or stabilizing effect on the microenvironment below the sheet, as did the geotextiles in combination with pellets. The potential effect on microbiological growth of the reburial regime was being monitored and was difficult to interpret because of the many variables that affect such growth.

Related field testing reported by Altieri et al. 2006 is also of interest. This study evaluated geotextile materials and Gore-tex for use in temporary (seasonal) reburial at three archaeological sites: Terme Taurine at Cittavecchia and the Villa Romana Casignana near Reggio Calabria in Italy, and at Tas Silg in Malta. At the Italian sites, environmental conditions including air temperature, relative humidity and solar radiation levels were recorded. Sensors were also placed between the mosaic paving and the geotextile to measure temperature and humidity at the mosaic surface.

In the testing at Terme Taurine (initial phase reported by Altieri and Laurenti 2000 above) in situ mosaics with black and white tesserae were reburied using two geotextiles, Typar 3337 (a non-woven polypropylene) and Reemay 2033 (a non-woven polyester), covered with a 10 cm thick layer of expanded clay pellets. In a second study, two mosaics were covered with only geosynthetics: one with Reemay 2033 and a geodrain, the other using only Gore-tex. The reburials with geotextile and expanded clay pellets promoted a constant relative humidity and surface temperature. The system using only geotextile and a geodrain promoted the growth of algae on both the mosaic surface and the geotextile, attributed to the light color of the geotextile and geodrain, both of which allow moisture to penetrate to the mosaic surface, but do not significantly reduce exposure to light. The dark colored Gore-tex did not promote biological growth.

The second phase of study in Italy compared two mosaics in different states: one relaid on cement, the other on its original support. In both cases reburial was done with Gore-tex and Reemay 2033 in direct contact with the mosaic, and a layer of Geodren EdilFloor (a nonwoven geotextile) above. The study found that humidity levels at the surface of the mosaic were much higher in the mosaic on original support, attributed to the transfer of moisture through the more permeable lime mortars. The testing at Tas Silig, Malta (which was visually monitored only) evaluated the reburial of a mosaic using Reemay 2033 covered with only five centimeters of calcareous gravel. After the two-year period of study, the gravel covering had eroded revealing in a fine layer of calcareous deposit on the surface of the mosaic.

The authors conclude that understanding site specific conditions is essential for determining the correct reburial system and note the importance of adequate drainage lest the mosaic retain moisture at its surface. While undoubtedly true, the emphasis should perhaps have been equally placed on the dangers of using geotextiles with only clay pellets, shallow coverings, or no further covering of sand or soil, which has been amply demonstrated in other attempts at temporary coverings noted above and in the lab testing reviewed below. Further evaluation of the use of Gore-tex is clearly warranted as a potentially useful material for shallow reburials or coverings.

An experimental lab test was undertaken by Podany et al. (1994) to examine the characteristics of materials commonly used in the reburial of mosaics. In particular, the testing focused on addressing potential problems associated with the use of geotextiles and clay pellets by examining how these materials (in various combinations) assisted or hindered the transmission by capillarity of salt-laden water across the interface between the mosaic surface and the reburial fill. The results showed that soil in direct contact with the mosaic, or with a geotextile interface, was the most efficient transport medium. The use of clay pellets, which allow large aerated spaces at the mosaic surface, resulted in surface or sub-surface salt efflorescence. These findings point to a conflict with the main trends in reburial of mosaics, in which lightweight materials that allow aerated spaces (specifically clay pellets) are favored for practical reasons. The use of clay pellets in conjunction with pozzolana or as a first layer, covered by earth (e.g. Costanzi Cobau 1994, 135), are a means of mitigating these problems, but they require the use of soil. Although lacking in details, the reburial of mosaic pavements of brick and limestone at the site of Velia in Campania employed geotextile, sand and gravel, but with a final deep layer of soil to protect the pavements from moisture accumulation (Ferrucci et al. 2006). The lab testing also demonstrated the ability of clay pellets to take up water (after 72 hours immersion, clay pellets absorbed 30-40% of their weight while still retaining their buoyancy), also pointed out by Altieri and Laurenti 2000. The potential for microbiological growth under conditions of slow release of moisture from clay pellets has yet to be demonstrated, but could be problematic.

Beginning in 1999 a testing initiative by the Israel Antiquities Authority and the Getty Conservation Institute was begun at the site of Caesarea Maritima to evaluate the role of maintenance in preserving mosaics (Piqué et al. 2003; Neguer 2004). Mosaics were protected with four common interventions (surface treatment, sheltering, shallow coverings, and reburial), and half of each test area was maintained. The tests were monitored and documented over a three year period. The reburied mosaic was unchanged over three years, with vegetation removal being the only maintenance required; shallow-rooted vegetation grew in the non-maintained reburial fill but had not affected the mosaic in the three-year period. The shallowly covered mosaic (incorporating sandbags) was more difficult to maintain, requiring replacement of sandbags, and lack of maintenance resulted in some deterioration of the mosaic.

The use of non-UV-stabilized polypropylene materials for sandbags or other types of 'pillows' is common in temporary coverings, but given the propensity of such material to degrade in sunlight, in combination with the tendency for the temporary to become long term, caution is advised. The differences between cheaper non-UV-stabilized polypropylene materials and more expensive polyester (inherently resistant to UV degradation) applies equally to geotextiles and is one that is not sufficiently recognized in the applications described in the literature.

Environmental monitoring and evaluation of past treatments

With the exception of testing applications where environmental monitoring and performance evaluation is inherent in the design, there is an absence of reporting on these crucial activities in the literature of this period. Stewart et al. 2004 describes an integrated monitoring initiative at Chedworth, England that was targeted principally at understanding the environment of sheltered mosaics, but information on two reburied mosaics was also collected and pointed to the importance of depth of burial in maintaining a stable environment. An exception to the lack of follow-up assessment is Neguer (2004), noted below. Francovic et al. 2007 is a useful reminder of what happens to shallow reburial of mosaics intended to be temporary, but left in place for several decades. The mosaics were covered with 'nylon' (presumably polyethylene plastic sheeting based on the reported condition) and sand. In an all too familiar scene, sand layers (20 cm thick) were found to be sprouting vegetation or had been blown away, and the 'nylon' had become brittle and cracked, and was retaining moisture at the mosaic surface and promoting growth of vegetation.

The Reburial Colloquium of 2003

A landmark in the literature on reburial of archaeological sites was the convening of a colloquium in 2003 dedicated to reburial of archaeological sites, which culminated in the publication in 2004 of twenty selected papers in a volume of *Conservation and Management of Archaeological Sites* (CMAS 2004). The aim of the colloquium was to bring together professionals from a variety of disciplines with practitioners to focus on the methods, materials, and challenges of reburial of archaeological sites. The topics of papers cover decision-making, understanding the burial environment, practice in the field, testing, monitoring of the reburial environment, and the characteristics of geosynthetic materials. Three of the published papers are specific to reburial of mosaic pavements (Roby 2004, Stewart 2004, and Neguer 2004).

Roby's paper provides an introductory overview of the practice of reburial of mosaics and a comprehensive review of commonly used materials (e.g. fills and separation layers) with a table of their advantages and disadvantages. The review of materials includes discussion of unintended consequences (especially root growth) and the basic parameters that should be followed in designing a reburial, such as permeability and capillary transport, and depth of burial. In deference to the disparate audience for this publication, Stewart begins with a description of the components of mosaics and review of the main causes of deterioration. This is followed by the environmental, functional and programmatic criteria for their reburial. The section on environmental criteria looks at principles, that is, the aims of reburial in addressing deterioration and criteria for achieving them; functional requirements take into account seasonal reburial, vandalism and potential alternative uses of a reburied site; and programmatic criteria address

intended duration of the reburial. Issues of planning for reburial, maintenance and monitoring of reburied mosaics conclude the paper. Case studies of reburied mosaics in Israel (Tel Itztaba, Khirbet Minya/Horvat Minnim, and Caesarea Maritima) are presented by Neguer, and impart important object lessons, especially with regard to vegetation, the use of separator materials and maintenance, that are so critical to successful reburial.

Together these three papers provide the most comprehensive and current overview of how reburial of mosaics has been practiced, the problems encountered, and the challenges to be met. The main challenges may be summarized as twofold: a better understanding of the effects of a designed reburial environment on the mosaic (only then can the proper selection of materials be advocated); and a means to ensure maintenance and monitoring of reburied mosaics, especially against the growth of vegetation.

Concluding remarks

Interest in reburial among mosaic conservation professionals is strong. This stems in large part from the exceptionally large number of mosaics exposed in sites throughout the Mediterranean and Europe over the last century and more. Nevertheless, this interest pales in comparison with the interest, as demonstrated in the published literature, in sheltering as an intervention. This reflects a well-known reluctance on the part of archaeologists and managers to carry out reburial – an intervention that removes the 'artefact' from view (see *CMAS 2004*, 143-44, for a deeper exploration of objections to reburial of archaeological sites). Nor are there obvious advocates for reburial as exist for sheltering, namely architects and those with an interest in promoting tourism. The 9th ICCM conference (published in 2008, Ben Abed et al. 2008) revealed a distinct lack of papers related to reburial, despite its theme – *Lessons Learned* – which would seem a natural fit for reburial studies, especially following upon considerable experimental testing work in the last decade.

One of the principal observations to emerge from the literature review is the far stronger interest in temporary reburial options (shallow coverings is a more appropriate way to describe this form of protection), rather than long-term reburial. Temporary solutions are sought typically for seasonal protection of mosaics against winter rain and freezing conditions in some areas, or pending continued excavation and study of a site, final conservation treatment, or the approach of the tourist season. Most of the testing and implementation examples in the literature are aimed at addressing this need. The criteria set forth emphasize lightweight, easily removable, and re-useable materials (e.g. clay pellets, netting and geotextiles). The problems that emerge in the use of these materials are finally receiving their due in the literature; that is, that temporary reburial (and this applies equally to any temporary intervention) often become permanent and that the lightweight materials favored for temporary covering are those that are unlikely to pro-

tect the mosaic in the long term. As with most conservation treatments or intervention failures, lack of maintenance and monitoring is the main culprit.

With few exceptions, the overall approach to reburial or protective covering in the literature is one based on searching for the quickest and easiest solution; ease of removal takes precedence over protection. Lacking are in-depth case studies with a clear articulation of the design of a reburial or covering based on an understanding of principles of preservation through reburial, and a rigorous approach to selection and characterization of materials, testing, and follow-up evaluation of results. With the exception of the *CMAS* 2004 papers, rarely does the literature directly address the question of what type of reburial environment is best for a mosaic (e.g., are absence of light and stability of temperature and moisture important; is continuity of capillarity between mosaic substrate and fill required in order to prevent crystallization of salts on the surface; or which reburial conditions must be met for temporary or short-term reburial and which for long-term?).

Evaluation and follow-up of current work is particularly lacking in the literature, but there are other forms of evaluation that need also to be considered. Evaluations of long buried mosaics, such as those surveyed on a regional level through the literature by Stanley-Price (1985), or the well-known example of the Orpheus mosaic of the Roman villa at Woodchester in England, which was periodically uncovered from 1880 to 1973 (Smith 1973), would provide important information to better understand mosaics in the reburied environment. Although there has been considerable experimental testing, the time-frame for such testing has been relatively short and the results, while tantalizing, remain somewhat ambiguous. Reburial practice would gain from further refinement of the testing.

One aspect of reburial about which there is no ambiguity is the need to control growth of vegetation. This problem is repeatedly raised in the literature and is undoubtedly one of the greatest dangers of reburial, but the solutions generally suggested are the use of herbicides or geotextiles. Both have a potentially useful role to play, but ultimately routine maintenance is the only foolproof solution to this problem.

Given the pressures on those responsible for managing and protecting sites, it is not surprising that easy, one-off solutions are sought, but experience (rather than the literature) has taught that these types of solutions are rarely effective or sustainable in the long run. This highlights the need to bring interventions such as reburial into the context of management decisions for the site as a whole: How might reburial be used as one strategy among many to protect a site? How does it relate to other decisions taken for the site? What are the necessary conditions (both technical and managerial) to make reburial or protective covering a viable conservation strategy?

Lastly, a review of the literature on mosaics indicates the need for greater awareness of, and better integration with, the larger body of knowledge and practice related to reburial that was referred to at the outset of this paper. The practice of mosaic reburial has been pursued largely in isolation and would benefit from engagement with professionals from other fields and reburial work on other types of sites. This was the purpose of the Reburial Colloquium in 2003. The *PARIS* conferences offer an on-going forum for practitioners of mosaic conservation to learn from and contribute to this needed dialogue.

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