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The Museum Environment and its Effect on Coins (Storage and Display Materials: Problems and Solutions at The Numismatic Museum of Athens)

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The fundamental responsibility of a museum is good preservation of its collections, therefore the maintenance of proper and stable environmental conditions is essential in order to prevent or minimize deterioration.

The intention of this paper is to approach the subject in the light of our experience at the Numismatic Museum of Athens.

It is known that metals and particularly alloys of metals which coins are made of are vulnerable to humidity, temperature, and atmospheric pollutants. Moisture is a main factor in metal corrosion since most metals corrode faster at higher relative humidities. We hope that nowadays this is well appreciated by curators, directors and other museum staff. The control of humidity and temperature which are expressed by the term 'relative humidity' can be easily achieved either by installing separate units called dehumidifiers, in the store or exhibition rooms or by connecting the show-cases with a dehumidifier. These units work automatically and can create a dry and constant environment, which is very important for the good preservation of coins. The best control can be achieved by installing a central unit distributing fully conditioned air through ducts to all parts of the building or at least to all exhibition or storage-rooms. In parallel, lower levels of R.H. inside a case can be achieved either by connecting the case with a separate unit or by placing desiccants such as silica gel, art sorb etc. in a non-conspicuous side of the display case. These substances have been widely used, although their effectiveness is uncertain if the R.H. of the museum room is uncontrolled and at high levels. Temperature and R.H. are interdependent. The level of R.H. is affected by temperature changes. Fluctuations of temperature should be avoided. The humidity problem in our old museum was faced by installing a dehumidifier in the storage room, while in the exhibition we succeeded, at an early time, to minimize R.H. levels by using silica gel. Perforated fire-resistant glass tubes, filled with silica gel, were placed in the non-conspicuous sides of the display cases and we regenerated this substance when needed. The lower the level of R.H. the better for storage or display of metals. From our experience, in the case of active corrosion or presence of salts a safe level of R.H. is 30%. Lower levels would provide for more safety, especially in the case of iron objects.

Light has no serious effects on metals but may have some adverse effect on the coatings used on coins or on the materials used for the construction of the show-cases. Elevated temperature inside a display case should be

avoided by ensuring that light sources generating heat are located outside or by using cool light sources.

Atmospheric pollutants such as sulphur oxides, nitrogen oxides, chlorides, suspended particles, together with oxygen and humidity which exist in the atmosphere, have a strong corrosive effect on metals. The concentrations of these pollutants vary depending on the location of the museum. The situation is worse in cities, industrial areas, or airports than it is in the countryside. In coastal, areas the air contains chlorides. Suspended particles such as dust, grit, soot settle on the surface of the objects and can absorb moisture and air pollutants, thus accelerating corrosion rates. There are special filters which can hold these contaminants. They can be installed either in the central air distribution system or individually.

However, coins are not so much in danger of atmospheric pollution since they are enclosed in show-cases or store-cabinets. The major problem for deterioration of coins in a museum has been proved to be the materials used in the construction of show-cases and storage furniture such as wood, textiles, paints, adhesives, varnishes cardboard, papers etc. These release gases and vapours with particularly adverse effects on metals. Furthermore, coins are in close proximity to these materials and the confined space of a show-case or cabinet drawer has little or no ventilation. Thus, the concentration of these gases is high and their harmful effect is more drastic and quick. This is not a new problem. It has long been known that wood can lead to corrosion of metals and in the early 1970s the other materials, mentioned above, were recognized as the cause of active corrosion. Today a lot of research has been carried out on the subject by many institutions and a rich bibliography exists.

Wood, especially oak and plywood, produces organic acids such as acetic and formic, formaldehyde and other harmful gases and vapours which cause corrosion of metals, especially lead and alloys containing lead. A further danger exists with modern composite woods since volatile materials can also be evolved by the adhesives and coatings used to fabricate them and the storage cabinets as well. The cardboard trays and paper labels, used in storage of coins, are made of different materials (adhesives, dyes, surface, finishes) and they cause the same problems.

Numismatic Museums and collections, mainly those with a long history are fully furnished with wooden show cases and storage cabinets with series of shallow drawers and cardboard trays.

In our museum, the effect of these cabinets made of oak caused us great problems. First we detected it in the lead seals and tokens collections where the problem was extensive and uniform. The view was shocking since the surface of the objects with the inscriptions and designs had turned into a white powder of lead carbonate (FIG. 1). The first thought was to ventilate these cabinets or to make new ones well ventilated but then

dust would be collected on the surface of the objects. So, we designed and ordered new cabinets made of inert materials. In the 70s we replaced the old storage with these new cabinets made of aluminium, trays of plexiglas and polyethylene envelopes to seal in the paper labels on which the lead seals rest (FIG. 2). Today a slight variation of this cabinet is available on the market by a Dutch company. In parallel, we started a long term project of conservation, applying the consolidative reduction treatment. The whole project was published in 1987 (Petrou-Lykiardopoulou M.) and 1991 (Oeconomides M., Lykiardopoulou M.). After dealing with the problem of lead seals and tokens we started inspecting the coins of our collection. We noticed that a remarkable number of coins presented active corrosion. Thus, the replacement of our cabinets was extended to the other collections as well.

Another example was given to us while examining a private collection which was stored in a cabinet made of oak in adverse humidity conditions (FIG. 3). The coins which came to our museum for conservation and study were all affected, presenting active corrosion no matter what period they belonged to (Classical, Roman, Byzantine, Frankish), what alloys they were made of and whether they had been cleaned or not (FIGS. 4 & 5).

Experts have carried out investigations into various coatings to assess their potential as sealants for display-case woods. Unfortunately, these can only reduce the rate of transfer of compounds. Cathrene Miles from Canada proposed some coatings but she pointed out that no coating will render oak wood completely safe. Furthermore, these materials can be a source of volatiles, particularly when freshly applied. She suggested that the safest choice is a well seasoned soft wood coated with a latex product which will be left to dry for some months.

It is also generally recognized that the application of protective coatings on coins does not give adequate protection.

Other scholars have suggested, as the only sound treatment, vapour barriers to isolate wood. One of the best is a sheet of plastic laminated aluminium (Marvelseal). Although wood is an aesthetically pleasant material and it absorbs moisture it should be avoided in the construction of storage cabinets and/or display cases due to the danger of emission of harmful gases and vapours. Metal (aluminium, stainless steel) is suggested instead. It is obvious that coins should not be in contact with the metal surface since there is the danger of galvanic action. An isolation sheet should be used, such as polyethylene or plexiglas.

Textiles are another category of materials used for the lining of show-cases mainly, which have proved to be particularly damaging to coins that are usually placed directly on them. Some textiles can be considered unsuitable for use in the museum environment, due to their chemical composition. Their structure contains groups which can break down to

produce volatile materials. Such materials are: wool and other proteinaceous materials which will give off hydrogen sulphide. Hydrogen sulphide will react with silver to form a surface film of silver sulphide. The same will happen on polished copper coins. Cellulose acetate fibres can release acetic acid, with corrosive effects on lead. Textiles which contain polyvinyl chloride release hydrogen chloride which is harmful to copper based coins. Viscose, rayon may contain residual sulphur. Textiles which are considered to be safe are cotton, linen, silk, nylon, polyester, polyacrylonitrile and polyethylene. However, the dyes and finishes used in their manufacture can also cause problems (some dyes contain sulphur). The results of tests on textiles, in the past, have shown that it is impossible to be sure whether a textile will be safe or not and it is therefore essential to test a sample before use.

In the old exhibition of our museum, the show-cases were lined with pure un-dyed silk which proved to be safe for the exhibits. However, we noticed that in a wall-mounted show-case a blue velvet with which the case was dressed, caused the rapid and extensive tarnishing of modern silver and copper coins. There was no other possible source of damage detected in the exhibition room. The floor was made of mosaic and the whole room was big and well ventilated.

Plastics, Foams, Adhesives and Paints used in storage and exhibition may contain impurities and additives known only to the manufacturer. Therefore, they must be tested for acidity and effect on metals. Plastics that are considered to be safe are polyethylene, polystyrene, polymethyl methacrylate and most acrylics, polycarbonates. PVC sheets should not be used.

The list of unsuitable adhesives include: protein based glues which can release volatile sulphides, epoxy, polysulphide adhesives, polyvinyl acetate solutions, cellulose nitrate, polyvinyl chloride, polyvinyl alcohol, synthetic rubber adhesives. Silicon sealants, the adhesive used for sealing show-cases, produce acetic acid vapours while setting and this is very corrosive to lead.

Polyethylene foams have been shown to be safe for storage and could replace polyurethane foams which contain harmful volatile additives.

Paints based on lead evolve hydrogen sulphide which causes the tarnishing of silver. Oils in air-drying paints evolve formic acid vapours.

Additionally, paints, adhesives and cleaning products release a high concentration of volatiles when freshly applied, and these diminish with time. Consequently an adequate time should be allowed before placing the objects in the same environment as these high emission materials.

It should also be mentioned that vapours generated outside the show-cases may well be harmful to the coins. Thus, care should be taken in selecting the appropriate type of floor for the exhibition room. Synthetic materials or carpets and carpet adhesives are suspicious unless they are tested for their suitability. Products containing ammonia and chlorine should be avoided in the cleaning of floors.

The vulcanized rubber used to seal show cases or to dress floors is an unsuitable material since it evolves sulphur compounds.

All the materials should be tested for their suitability before use. Several authors have published simple tests to detect possible harmful effects of such materials (Oddy, Williams, Sannders, Hopwood, Collins and Young and others).

At the Numismatic Museum of Athens, in order to detect potentially harmful materials we have used an accelerated corrosion test developed at the British Museum and named after its proposer, '*Oddy t*est', which has also been adopted by many institutions and is easy to use. With a view to investigating active corrosion products of coins caused by adverse storage and display conditions, we started a project of analysis by means of X-Ray Diffraction and Infrared Spectroscopy in cooperation with certain research centres (Institute of Geological and Mineral Exploration). The project is in progress. While there have been great advances in research on storage and display materials, scientific study of the corrosion products caused by these materials started a few years ago and is still a complicated field of research.

Another recommendation which could be given in order to minimize the level of volatiles in a show-case or storage cabinet is the use of pollutant absorbers. An acid gas absorber is a carbonate-buffered paper which is not only commercially available but can also be made in the conservation departments of museums. It is placed in the show-case but not in contact with coins. It has a short life time. Paper impregnated with active charcoal is also available but it needs to be regenerated periodically. Other products are suggested by experts such as fabrics impregnated with finely divided silver particles. These are effective when they can surround an object. Subsequently, they cannot be used on display.

In the last years specialized companies have been established which deal with the design and manufacture of museum show-cases, storage cabinets and display equipment. These firms have been successful in solving conservation problems.

They can also provide museums with safe display materials, such as inert textiles, labels, acid free papers polyethylene sheets or boxes etc.

In the new museum (Schliemannãs house), we had the opportunity to design and mount the exhibition from the beginning. Since the building is of a historic value, with wall-paintings and mosaics, we had to design display cases that would match the surroundings and to have them fitted clear of the mosaics and wall painting. In order to achieve this we organized a public competition with given specifications (inert material, low R.H., cool light sources, avoidance of atmospheric pollutants) for the control of a proper environment for the display of coins. We accepted the company which proposed the best ideas. The show-cases are made of aluminium, the board inside the case on which the coins are placed is made of plexiglas dressed with cotton fabric. The designers' decision that the textiles in the show-cases should be of a similar colour to that of the existing wall-paintings presented problems for us. We tackled these problems by first buying several meters of a natural unbleached cotton fabric, and subsequently co-operating closely with the chemists from a well-renowned pharmaceutical company in order to choose suitable inert dyes which would give us the tones of colours that the designers requested. Afterwards, we found a dye manufacturer who accepted to undertake this small-scale work in accordance with our instructions.

The show-cases are hermetically sealed and nitrogen gas which is supplied to the cases through pipes placed inside the adjacent railings, circulates inside them. The alarm and electricity cables are placed in the aforementioned railings too (FIG. 6).

Finally, two storage rooms were converted into a safe by covering their walls with stainless steel sheets. The cabinets were specially designed; that is, they are made of stainless steel and the drawers are lined with plexiglas to protect the coins against contact with the metal surfaces. The R.H. and the filtration of atmospheric pollutants were controlled by the installation of an air conditioning unit.

SELECTIVE REFERENCES

THOMSON, G. The Museum Environment. Conservation in the Arts, Archaeology and Architecture, Butterworths, London, 1978.

ODDY, W.A., «An unsuspected danger in display», in Museum Journal, 73 1973, pp. 27-28.

ODDY, W.A., «The corrosion of metals on display in conservation archaeology and the applied arts», IIC, London 1975, pp.235-237.

BLACKSHAW, S.M. AND DANIELS V.D., ((Selecting safe materials for use in the display and storage of antiquities», ICOM Committee for Conservation, 5th Triennial Meeting, Zagreb, 1978, pp. 1-9.

BLACKSHAW, S.M. AND DANIELS V., «The testing of materials for use in storage and display in museums», in The Conservator vol. 3 1979, pp. 16-19.

DANIELS, V.D. AND WARD, S., «A rapid test for the detection of substances which will tarnish silver», in Studies in Conservation, 27 1982, pp. 58-60.

PADFIELD T., ERHARDT D., HOPWOOD W., ((Trouble in Store», in Preprints of the Contributions to the Washington Congress 3-9 September 1982.
PETROU-LYKIARDOPOULOU, M., «Coping with the problem of the decay of Byzantine lead seals in the Numismatic Museum of Athens», in Recent Advances in the Conservation and Analysis of Artifacts. Jubilee Conservation Conference. Institute of Archaeology 1987, pp. 165-167.
TETREAULT, J., «Display materials: the good, the bad and the ugly in exhibitions and conservation)). The
Scottish society for Conservation and Restoration. Pre-prints of the Conference held in Edinburgh 21-22 April 1994, pp. 79-87.
HOPWOOD, W.R., «Choosing Materials for Prolonged proximity to Museum Objects», Preprint of the AIC Meeting, Toronto, 1979, pp. 44-49.
WILLIAMS, S., «Belstein test», Canadian Conservation Institute, note 171, 1989.
SANNDERS, K.J., «The identification of plastics and rubbers», Science Paperbacks, London, p. 37,1966.
GREEN L.R., THICKETT, «Testing materials for use in the storage and display of antiquities. A revised methodology», in Studies in Conservation 40, 3, August 1995, pp. 145-152.
TENNENT N.H., BAIRD T., «The identification of acetate efflorescence on bronze antiquities stored in wooden cabinets», in Conservator vol. 15 1992, pp. 39-47.
MILES C.E., «Wood coatings for display and storage cases», in Studies num .31, 1986, pp. 114-124.
WEIERTER V. AND TATE J., «The corrosion of ãlead' communion tokens», in Preprints of the Meeting held in Glasgow, May 1993, pp. 57-59.
TENNENT N.H., COOKSEY B.G., LITTLEJOHN D., OTTAWAY B.J., TARLING S.E. AND VICKERS M., «Unusual corrosion and efflorescence products on bronze and iron antiquities stored in wooden cabinets», in Preprints of the Meeting held in Glasgow, May 1993, pp. 60-66.
WILTHEW P., «Bronze and silver corrosion in display galleries in the National Museums of Scotland)), in Preprints of the Meeting held in Glasgow, May 1993, pp. 67-70.
ERHARDT D., MECKLENBURG M., «Relative Humidity Re-examined», in Preprints of the Contributions to the Ottawa Congress, IIC, 12-16 September 1994.
TETREAULT J., SIROIS J., STAMATOPOULOU E., «Studies of lead corrosion in acetic acid environments)), in Studies in Conservation 43, 1998, pp. 17-32.

FIG. 1. An old cardboard tray with lead seals of the Museum's, collections. The adverse storage conditions caused disintegration of their surface.

FIG. 2. The new storage conditions of the lead seal collections. Aluminium cabinets, trays made of plexiglas and polyethylene envelopes to seal in the paper labels.

FIG. 3. The old cabinet made of oak where the private collection was stored.

FIG. 4. The coins of the private collection moved from the oak cabinet onto the new plexiglas tray. The majority of these present active corrosion.

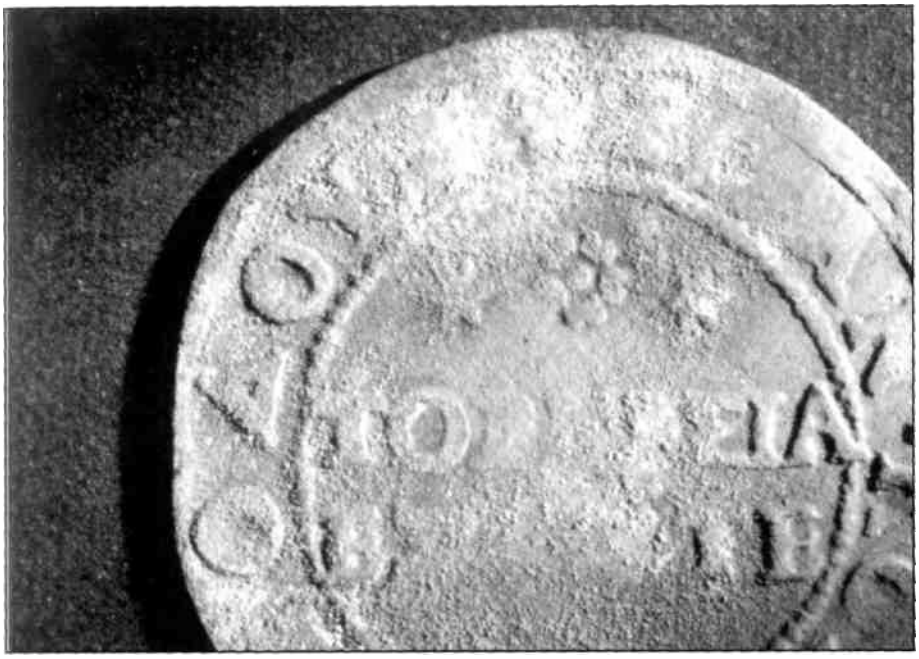

FIG. 5. One of the private collection coins in detail (17th c. A.D.)

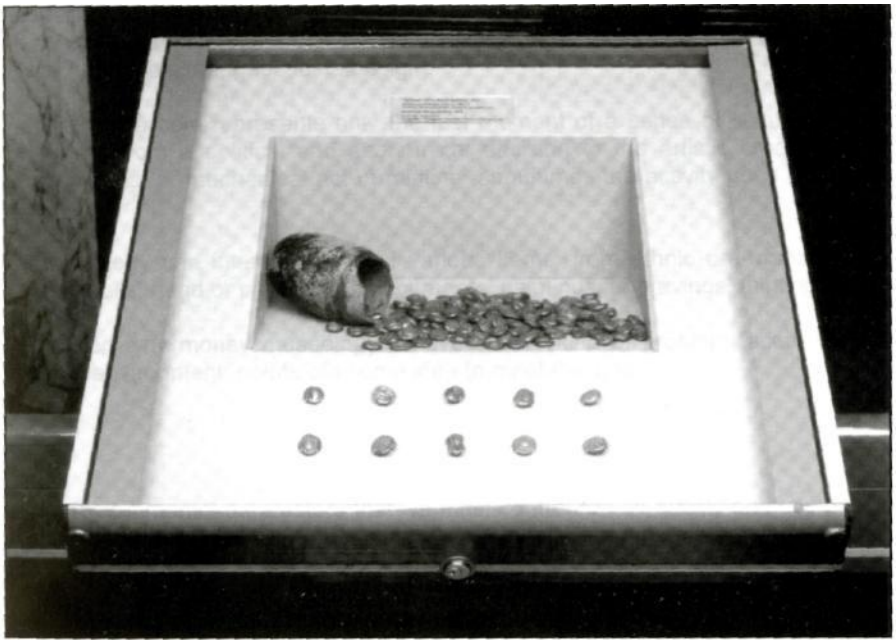

FIG. 6. One of the new show-cases exhibiting a coin hoard. It is made of aluminium. The board inside, made of plexiglas, is dressed with a cotton fabric dyed with inert dyes and other manufacture materials. The show-cases rest on railings inside which nitrogen gas pipes, electricity and alarm cables have been placed and connected with the case.