MARY LYNETTE LARSGAARD

Assistant Head, Map and Imagery Laboratory Library
University of California at Santa Barbara

Conservation of Cartographic Materials

INTRODUCTION

Conservation and preservation of cartographic materials are a challenge chiefly because so many different media are to be found in what is modestly termed a map room—maps (flat, rolled, or folded), profiles, sections, diagrams, views, globes, atlases, remote sensing imagery (in many different forms, such as positives, negatives, roll film, and slides), plastic models, and just recently, data in digital form (magnetic tape, CD-ROM, and probably more to come). In fact, it often seems that the map room is home to any object that depicts a geographic area or carries cartographic information and is also awkward to handle. In the last ten years or so, conservation has had a greatly heightened image in the library world and, by extension, in the map library world. Consequently, map librarians have been forced to consider conservation far more than they did in the past, as evidenced by the appearance of columns on preservation and conservation in the leading map library journals, such as the *Information Bulletin* of the Western Association of Map Libraries, the *Newsletter* of the Association of Canadian Map Libraries, and *base line*, the newsletter of the American Library Association's Map and Geography Round Table (WAML, ACML, ALA MAGERT).

CARTOGRAPHIC MATERIALS ON PAPER

Most map librarians deal mainly with products on paper. Paper can be extremely stable, depending upon how it is made and how it is taken care of. As is commonly known, paper made of rags is remarkably long-

lived; but paper made from ground wood, a highly acidic and deteriorative material, decays quite readily, as evidenced by newspapers, which may almost fall apart before one's eyes. While the maps received in the U.S. Depository Program, and especially those issued by the U.S. Geological Survey, are on reasonably good paper, still, those that came out during the early part of this century are becoming yellowed and brittle, as any map librarian can discover by a quick trip to the map cases.

An additional deteriorative element of twentieth-century library life is the extensive use of photocopying, some forms of which seem to be not just impermanent but close to evanescent. Blueline prints, especially, are burdens for the map librarian for two reasons: the ink fades when exposed to light, and the paper itself is often of poor quality and will readily discolor (usually yellowing) relatively quickly. It is thus singularly unfortunate that some state and foreign geological surveys, and some commercial firms (such as those dealing with oil well locations) use this form of reproduction frequently.

Generally speaking, black printing inks are permanent and will probably outlast the paper on which they are printed. But one must beware of other inks, such as nutgall, which will turn brown and fade out, weakening the paper on which they are printed. Fortunately, this type of ink appears in the main only in pre-1900 maps (Larsgaard, 1987, pp. 164-166).

The other major factor that affects the stability of paper is, as previously mentioned, the environment in which it is stored, including the methods of storage. Heat and light have deleterious effects on paper because paper deterioration is a chemical process, and any increase in energy input speeds up that process. The atmosphere in which paper is kept is therefore important, but not only for temperature; relative humidity is also of considerable interest, since paper is at its most durable at about 50 or 60 percent relative humidity, with lower humidities causing desiccation and high humidities inviting mildew and mold. Dust and sulfur dioxide in the air also do paper no good, nor do fungi, insects, rodents, or bacteria. Another hazard of environment is the physical location of the library; those sited on flood plains in tornado-prone areas obviously are at risk. Indeed, every library should have a disaster plan that takes into account what water and fire hazards exist and how to deal with them. Towards this end, Thomas Nagy (1984) wrote a disaster plan especially for the then National Map Collection of Canada.

Considering all of the above, the ideal map library would have items made out of rag paper, stored in pollutant-free air, in total darkness, with appropriate and constant temperature and humidity, housed in a

fireproof structure on high ground, and with no organisms about, especially not human beings with their dirty, sweaty hands (Larsgaard, 1987, p. 170). However, the purpose of map libraries is to provide materials to be used, and the map librarian must figure out a way of making maximum use and maximum preservation come as close together as possible.

Everyday Handling, Care, and Storage

From the moment cartographic materials are received in the map room, their preservation is a primary concern. They should be unwrapped carefully. As they are unpacked, the unpacker should note any delicate or high-use materials, which should be considered for encapsulation or other treatment immediately, before they fall apart. After unwrapping, any rolled maps should be flattened; if the maps are not too tightly rolled, they may be reverse-rolled and left that way for a day or two, or just weighted down with cartography weights or any large, heavy books (bound *Congressional Records* work quite well). Maps that are at all brittle should not be reverse-rolled, since they will crack and tear; instead, they should go into a damp box with minimum dimensions of 49 inches x 36 inches x 8 inches, with a net about halfway up upon which items to be humidified are placed, along with a container with a sponge and some water in it. Failing that, the map librarian may use a large plastic garbage can with a pint of tepid water in a plastic container in the center. Unfortunately, this will work only for relatively small maps; the only recourse for larger maps is to take them home and leave them in a corner of the bathroom while one is taking a long, hot shower.

Particularly with the increase in thefts from libraries, or at least in the increasing number of reports of such thefts, a property stamp is essential; certainly a primary form of preservation is making sure that the items stay in the library. At a minimum, the stamp should contain the name of the institution and the date of receipt. A consistent location on items (e.g., lower righthand corner if the space is empty, the verso if it is not, and so on) must be selected. Certainly for rare materials, the map librarian will want to look into obtaining from the Assistant Director for Preservation at the Library of Congress a supply of black ink that is considered appropriate for use on such materials.

It is at this point, when classification and cataloging are performed, that the map librarian should have in mind a list of selective criteria based on the map room's collection development policy: which items are to be kept indefinitely, which items are "kamikaze" maps (purchased in multiple copies, with the tattered old ones being thrown out) and

which will be kept by the library only for a restricted time period. For example, a map room in Kansas may well not wish to keep superseded U.S. Geological Survey topographic quadrangles of Vermont. This sort of decision making is best done in concert with other map librarians throughout the United States, so that it may be truly said that every cartographic object is kept in at least one place in the United States.

The cartographic object is at this point ready to be labeled (most often in pencil if directly on the object, or with a typed label if it is the container that is being labeled), and then sent to the filing cabinets. Cartographic materials should be kept in acid-free containers whenever possible; for maps, this generally means the use of acid-free paper folders, with up to about fifty maps per folder. Aerial photographs can be kept in acid-free envelopes and placed in metal filing cabinets or in acid-free boxes. When at all possible, maps should be kept unfolded, since every fold is a tear waiting to happen; photographs should never be folded, since this cracks the emulsion. While the vast majority of cartographic materials, maps and imagery, may be relatively easily dealt with using standard filing methods, the very large maps are a continuing trial to map libraries. Decisions on how to handle them ranging from sectioning them (as the Library of Congress does), to storing them rolled and then placing them horizontally, to encapsulating them under ultraviolet filtering acrylic sheeting and then suspending them from a wooden rod (Marley, 1988, p. 28).

A map librarian has several different types of storage to look at because of all the formats to be dealt with. For items such as maps, sections, diagrams, plans, and views, the decision overwhelmingly is to keep these items in metal files, usually horizontal but sometimes vertical in nature. The discussions as to which to use when seem to boil down to the vertical files being most appropriate when the items to be stored in them are all of approximately the same size (Larsgaard, 1987, pp. 172-176). It is after this point that life becomes more difficult.

Atlases are very nearly the easiest of the non-flatmap items to deal with; standard book shelving, with shelves relatively close together (about six inches apart) will work if the library cannot afford the relatively expensive roller shelving such as the Library of Congress has. As previously noted, aerial photographs are best preserved when they are each put in acid-free envelopes and then stored in acid-free boxes or in standard library vertical-file cabinets. Globes and plastic raised-relief maps are superb display items, and this is the best way to store them. Cartographic data in digital form are still somewhat of a mystery to most map librarians; at present, the best answer seems to be to store them in climate-controlled, low-temperature areas, and to keep in mind that the magnetic tapes are subject to data drift and must be rewound

regularly (Larsgaard, 1987, p. 180). Microform is, mercifully, relatively easy to deal with; the map librarian may select standard microform cabinets.

Use

At this point, it behooves the map librarian to remember the object of all this work: that the items be used. The question then becomes how to keep use from becoming misuse. The most flagrant form of misuse is stealing, and the sad fact is that the only way to safeguard most cartographic materials is to have closed stacks. Anyone who doubts this need only read Harold Otness' (1988) blood-chilling " 'Going Plating:' Stealing Maps from Libraries." His main messages are well worth heeding: identify valuable maps, especially those in book-format publications; transfer them to a secure area; improve bibliographic control, especially on the shelflist, so that items may be identified as library property in the sad event of their loss; mark all items with the library property stamp; have users identify themselves when they are handling library property (e.g., have them produce a photo identification card) and check that ID carefully; conduct regular inventories; report all thefts promptly; keep a detailed chronological record of events if a theft occurs; and encourage stronger sentences for those who steal library materials.

Thinking more positively—that the item requested has not and will not be stolen—the next decision is whether the map room will allow checkout or photocopying. The map librarian should be forewarned that checking a map out is very definitely an accelerated-aging process, so the value, stability, and frailty of the map must be considered. Any items to be loaned must be protected by being checked out in sturdy containers with stern instructions to the user that replacements will be required should the item be damaged. A form should be inserted with the item checked out that details for the user exactly how the item is to be reinserted in its container, and what sorts of damage will require replacement of the object. Another problem is that using a map for field work is not just accelerating its aging but rather guaranteeing its destruction. Should the borrower be recalcitrant about returning the item, it is frequently useful to point out the cost of a color reproduction or a replacement for the item.

Today, most users consider it a birthright to obtain photocopies, and in the main it is wise to humor them in this thought. The problem is that photocopying most cartographic materials is a bit difficult on a standard photocopier because it involves folding the item. Larger map collections are able to provide photocopiers that have removable tops

so this folding does not occur. Individuals in charge of smaller collections can certainly strongly encourage that such photocopiers be obtained for the library as a whole, since it is not just cartographic materials that need oversize copies.

Libraries with rare, valuable maps can consider having negatives made of these items, and perhaps photocopies also, so that users browse the copies instead of the actual items, and so that copies can be made quickly and inexpensively upon request. Another option is to obtain facsimiles, using a directory of facsimile publishers (Noe, 1980).

One special sort of use of cartographic materials is putting them on display. If the item is a map or other flat cartographic material and framing is to be done, the framing should be museum quality, using acid-free board and tape; the item must not touch the glass. Light is injurious, as was formerly noted; items should not be left on display for long periods of time, and an ultraviolet shield should be used (Larsgaard, 1987, pp. 186-187).

Damage and Repair

Damage may be mechanical, chemical, or both. Perhaps the most common form of damage that map librarians see is tears. The next most common is some sort of yellowing and brittleness of paper. Librarians taking care of imagery may find spots, scratches, tape residue, and fading, especially on their older aerial photographs. Those librarians in map rooms that have microforms have already heard about using other than silver halide film, and are careful to read the literature and to watch for other problems. When it comes to damage to cartographic data in digital form, the field is so new that map librarians are reduced to falling back on the precepts used for other forms of cartographic material: handle it carefully, store it correctly, and search for literature explaining what such handling and storage is (e.g., DeWhitt, 1987), thus avoiding having to deal with any damage.

The rules for repair of cartographic materials are the same as for repairing other library materials: do only what is reversible; make sure that no information is lost during the repair procedure; and, unless the map librarian is also a trained conservator, keep the repairs simple ones. What most map librarians do, very sensibly, is to confine repairs to tears and to the removal of surface dirt. Tears may be repaired either by using archival-quality tapes or by using flour paste and tissue. The method used very much depends upon the value of the item being repaired; tape is never used on rare and valuable materials, but rather on such items as a U.S. Geological Survey topographic quadrangle that is in print and therefore relatively easily and inexpensively replaced.

Surface cleaning is another repair that map librarians may attack on their own. Dusting and washing of plastic models is easily done; the point at which one must be careful is when the plastic begins to get brittle with age, at which time the librarian should consider purchasing another copy if it is still in print, or filling the verso of the model with plaster of some kind. Cleaning dirt from maps involves working gently with an eraser or drafting a drycleaning pad and a brush; the item should be weighted down and work should proceed from the center, away from the weight. Dusting off a globe or occasionally cleaning it with a damp cloth is well within the abilities of most map librarians, but anything more detailed should probably be left to experts (Baynes-Cope, 1985). Imagery tends to be more difficult to work with than paper, since one is also dealing with an emulsion and often a nonpaper base; gently wiping off dust and grease pencil marks may mark the limits for most caretakers of these materials.

Another form of repair which is also an important form of microstorage is encapsulation in polyester film. Mounting, varnishing, and lamination are all out of favor in conservation circles, so any strengthening to be done for flat cartographic materials must be in almost all circumstances via encapsulation. Although the encapsulated object is heavier and thicker than the original (thus taking up more space in the file cases) and has a gloss, it has the tremendously important benefits of being relatively quick, easy, and inexpensive to do, and also of being strong and instantly reversible. In addition, it does not harm or change the original item in any way. The materials needed are polyester film (generally 3 mil, although 5 and 7 mil may be used to provide the necessary support for larger maps) and double-sided adhesive tape. Tools needed are a sharp knife or pair of scissors (the knife is better, since it enables one to make long, straight cuts), a few weights, a large table, a rubber roller (helpful but not essential), and a long metal straightedge. For each item to be encapsulated, two pieces of film about two inches longer and two inches wider than the item are cut; the item is centered on one piece of film, tape carefully placed at the outside edges of the film, the top protective cover of the tape peeled off, and the second piece of film placed on top, thus making a sandwich (*Polyester Film Encapsulation*, 1980; Rieke et al., 1984, p. 7).

While most map librarians will not want to proceed beyond these simple techniques, it is still a good idea for them to know what else can be done. The next level of repair procedures is that of washing the item; of course, the major problem with printed objects such as maps is that the print may well not survive a bath. A conservator considering washing a map will always test, with a small drop of water in an inconspicuous area, to see if inks are waterfast; color inks are particularly

liable to blurring. What makes maps even more difficult to wash than other paper is their sheer size and the fact that finding supports for wet maps (since paper is far weaker when wet than when dry) may be almost impossible. Once the difficulties of finding a container and supports are conquered, one can proceed with soaking the map in cold water for about an hour, then drying it slightly, placing it between blotters, putting weights on top of the blotter, and leaving it to itself for three or four weeks (Akers, 1980; Larsgaard, 1987, p. 189).

Removing stains, varnish, and foxing are also techniques that require considerable expertise, not to mention a willingness to work with toxic chemicals. For example, removing adhesive-tape stains may require the use of benzene or carbon tetrachloride, and foxing may be removed only by bleaching with chemicals such as chloramine. Working with items that have colored inks makes any such procedure even more complicated, as can be clearly seen by reading "A Search for Procedures for Restoration and Stabilization of Sixteenth and Seventeenth Century Netherlands Atlases Damaged by Green Paint" (Blank et al., 1984). The problem in this particular case involved one hundred or so atlases that had severe brownness on the reverse of where green paint had been applied. The green paint itself was badly browned and the paper was brittle. After a considerable expenditure of time and materials—which included rapid aging of prepared model scraps of paper—the workers finally came up with a procedure: fix the paints, bleach the paper, wash in running water, neutralize with a bicarbonate solution, remove the film that fixed the paints, and impregnate the paper to strengthen it; then, if additional strengthening is needed, laminate the pages with tissue.

Another form of sophisticated conservation is that of deacidification. Deacidification attempts to lower the acid content of paper and thus prolong its life by introducing an alkaline chemical into the paper to neutralize the acid. The process used may be aqueous, nonaqueous, or vapor; and the discussions as to which is best have occupied a certain amount of library periodical space over the last few years, as the work done by the Library of Congress and by Wei T'o often appears in the pages of the library press. The final word as to whether the Library of Congress's Diethyl Zinc (DEZ) process or Wei T'o solution is best has yet to be pronounced. Given the state of library collections in the United States, with all having their share of brittle maps, it is a topic that must be viewed with interest.

It follows that when one has conservation or repair problems that one has not the technical expertise to cope with on one's own, one begins to look elsewhere and to wonder where one may have the work done. As mentioned previously, over the last ten years, libraries have

shown considerably more interest in conservation than in any earlier time, with the result that larger libraries, especially in the university world, have conservation librarians or preservation representatives; the map librarian's life is made much easier if one of these persons is *in situ*. If there is no resident conservator, the next step is to check in issues of *AB Bookman*, or to ask conservators for the names and addresses of reputable firms. One encouraging sign is the establishment of conservation centers, such as the Northeast Document Conservation Center in Andover, Massachusetts, and the Centro di Studi per la Conservazione per la Carta, in Rome, Italy.

CONCLUSION

Working with cartographic materials requires that the map librarian become familiar with conservation and preservation methods for a wide variety of materials—globes, atlases, imagery (black and white; color), plastic models, maps, sections, views, diagrams, and so on. This, by extension, means that the map librarian must keep current on the methods of preservation for every sort of medium upon which cartographic data might conceivably appear, realizing at the same time that a substantial majority of all cartographic materials are on paper and will probably continue to be so for some years. (An appendix to this paper lists sources of equipment and supplies that are useful in the preservation of cartographic materials.)

The map librarian must recognize that conservation of cartographic materials depends upon correct methods of handling, storage, and display, and upon correct atmospheric controls for the area in which the collection as a whole is kept. Insofar as possible, the map librarian should select cartographic materials with an eye to their durability if they are to be kept for an extended period of time. Newly received items should receive repair or strengthening as their future use demands. The map librarian should be aware that a well-constructed collection development policy, preferably put together while keeping in mind the policies of other map collections, is an important part of a conservation program, not only for the individual library, but for the map library world as a whole.

When a cartographic item needs repair, the map librarian needs to look at it carefully and determine if such repair is within the technical abilities of the persons available to do the work, and if the item is of sufficient value—either now or in the future—that the work is worth doing; that is, would it be sufficient to preserve the information by

microforming the item, or does the actual item have to be preserved? When repair is essential, the following principles must be observed:

—The process should be reversible.
—The process should use materials that are permanent and durable.
—The originality of the document should not be disturbed.
—Information should not be obscured or destroyed.
—The repair should be tidy, evident, but not obtrusive.
—The process should be appropriate to the item, and as inexpensive as possible while still keeping in mind the above principles.

In addition, the map librarian must remember that the map room is not just a warehouse but rather a place where items are meant to be used. And this is perhaps the most difficult: making sure that users find exactly the items they need and get the information they need without contributing substantially to the aging of the items. There is no way around the fact that use ages materials; what the map librarian must do is figure out ways so that valuable materials are handled as seldom as possible, that surrogates are available, and that multiple copies of heavy-use items (e.g., road maps of the city in which the library is located, U.S. Geological Survey sheets for the local area) are obtained.

The end result of all of this juggling of concepts should be a map room that can provide, for as along as the library is in existence, the cartographic material that users need. That result is worth the effort.

APPENDIX: ADDRESSES

I. Equipment

Hamilton Industries
1316 Eighteenth Street
Two Rivers, WI 54241

Mayline Company
627 North Commerce
Sheboygan, WI 53081

Plan Hold
17621 Von Karman Avenue
Irvine, CA 92714

Ulrich Planfile
2120 Fourth Avenue
Lakewood, NY 14750

Reflector Hardware Corporation
1400 N. 25th Avenue
Melrose Park, IL 60160

Spacesaver Corporation
1450 Janesville Avenue
Ft. Atkinson, WI 53538

Stacor Corporation
285 Emmet Street
Newark, NJ 07114

II. Supplies

Conservation Resources International
1111 N. Royal Street
Alexandria, VA 22314

Hollinger
3810 South Four Mile Drive
Arlington, VA 22206

Light Impressions, Inc.
439 Monroe Avenue
Rochester, NY 14607-3717

University Products
P.O. Box 101
Holyoke, MA 01041

Wei T'o Associates
P.O. Drawer 40
Matteson, IL 60443

REFERENCES

Akers, R. C. (1980). The cleaning and restoration of maps. *The Map Collector, 10* (March),19-23.

Baynes-Cope, A. D. (1985). *The study and conservation of globes.* Wien, Austria: Internationale Coronelli-Gesellschaft.

Blank, M. G.; Dobrusina, S. A.; & Lebedeva, N. B. (1984). A search for procedures for restoration and stabilization of sixteenth and seventeenth century Netherlands atlases damaged by green paint. *Restaurator, 6*(3), 127-138.

Book Preservation Technologies. (1988). Washington, DC: U.S. Office of Technology Assessment.

Cruse, L. (1985). Storage of maps on paper, microforms, optical disks, digital disks and magnetic memories. In E. Mount (Ed.), *Role of maps in sci-tech libraries*, (pp. 45-57). New York: Haworth Press.

DeWhitt, B. L. (1987). Long-term preservation of data on computer magnetic media, parts I and II. *Conservation Administration News (CAN), 29*(April), 7, 19, 28; *CAN, 30* (July), 4, 24.

Eastman Kodak Company. (1985). *Conservation of photographs.* Rochester, NY: Eastman Kodak Company.

Kathpalia, Y. P. (1973). *Conservation and restoration of archive materials.* Paris: UNESCO.

Larsgaard, M. L. (1987). *Map librarianship: An introduction* (2nd ed.). Littleton, CO: Libraries Unlimited, Inc.

Marley, C. (1988). Save it! Conservation/preservation news. *Association of Canadian Map Libraries Newsletter, 68*(September), 27-28.

Nagy, T. (1984). Disaster contingency planning for map collections: An ounce of prevention . . . *Association of Canadian Map Libraries Bulletin, 53*(December), 1-30.

Noe, B. R. (1980). *Facsimiles of maps and atlases: A list of reproductions for sale by various publishers and distributors* (4th ed.). Washington, DC: Library of Congress.

Otness, H. (1988). 'Going plating:' Stealing maps from libraries. *Western Association of Map Libraries Information Bulletin, 19*(4), 206-210.

Polyester Film Encapsulation. (1980). Washington, DC: Preservation Office Research Services, Library of Congress.

Rieke, J. L.; Gyeszley, S; & Steele, L. (1984). Preservation of sheet maps, lamination or encapsulation: A durability study. *Special Libraries Association Geography and Map Division Bulletin, 138*(December), 2-10.

Smith, R. D. (1987). Mass deacidification: The Wei T'o understanding. *College and Research Libraries News, 48*(1), 2-10.

Sturges, P. (1987). Policies and criteria for the archiving of electronic publishing. *Journal of Librarianship, 19*(3), 152-172.

Thompson, E. T. (1980). *Collecting and preserving architectural records.* Nashville, TN: American Association for State and Local History. (Technical Leaflet 132).