STORAGE OF SOUND RECORDINGS

By Richard Warren Jr.

I. Introduction

The primary commandment of audio preservation is "Do thou nothing which cannot be undone, and document thou what thou dost."

The topic of storage is fundamental to any discussion of the subject of audio recordings. Without the continued existence of the sound carriers themselves, the consideration of all related topics, however important, is rendered irrelevant. A recent survey of archives and other institutions and individuals dealing with sound recordings revealed a readily-acknowledged lack of expertise in this area, as well as a wide diversity of storage procedures and practices. For these reasons it becomes essential to begin the study of audio preservation with a careful investigation into recommended procedures for adequate storage and to discuss as many as possible of the appropriate factors which need attention so that the sound carriers can be preserved in the best possible condition for the longest possible period of time.

In 1987, the Associated Audio Archives Committee (AAA) of the Association for Recorded Sound Collections (ARSC) conducted a survey of storage procedures and practices during its project entitled *Audio Preservation: A Planning Study*. Results of the survey reconfirmed the lack of, as well as the need for, a simple comprehensive guide to the storage of sound recordings. The 1959 Pickett and Lemcoe booklet (P-L., listed with other references at the end of the discussion) is still the most useful available resource. Additional and updated information of varying degrees of usefulness can be found in other sources, references to which will be found in the text below, and in a list of which follows this discussion.

Work on this discussion began in 1986 with a review of all accessible books and articles which seemed to offer helpful information and which produced a long list of factors related to storage. These were organized into categories and studied by the staff of the Yale Collection of Historical Sound Recordings, Yale University Library, with advice from other members of the ARSC/AAA project group, R. Gay Walker, former Head Librarian of Yale's Preservation Department, and Larry Miller of the Library of Congress. The result was agreement upon lists of current recommended practices (which appear individually in appropriate sections of this discussion, and are collected in Appendix B below), topics requiring further study, and dangerous practices.

There are many types of sound carriers, many kinds of operations which must be performed on them, and consequently many functions and design constraints which are

imposed upon storage spaces and personnel in archives. The principal materials which have served as sound carriers and thus may need to be stored in a collection include paper (including paperboard), waxes (see AES. 25:10/11: p. 713), wood (in some containers for sound carriers), various metals (see AES.: 25:10/11: pp. 718ff.), celluloid, vinyl (see AES. 25:10/11: pp. 724-728; P-L. pp. 26-28), cellulose (see P-L. pp. 15-16), lacquer, polyester, styrene (see P-L. p. 26), rubber (Vulcanite), laminates, shellac and related compounds both separately and in laminates (see AES. 25:10/11: p. 717 and 719; P-L. p. 24-26), glass, plaster of Paris, and combinations of various materials. In addition, various types of equipment will require storage, including current devices not in use, obsolete items which are still in use, and obsolete machines held for such purposes as exhibit.

The basic space and environmental needs requiring attention for an archival collection of sound recordings are as follows:

- preservation of materials.
- acoustical conditions for audio work.
- efficiency of operations.
- separation of functions.
- safety and comfort of workers and users.
- security.
- access in the sense of building-code requirements (see W. Storm article, IASA. 39: 9-18).

The types of operations and functions which normally need to be carried out in a collection of sound recordings include the following:

- receiving.
- sanitizing and fumigating.
- sorting and organizing.
- packaging for storage.
- processing, including indexing, cataloging, and labeling.
- storage, both normal and special, such as long-term with infrequent access, remote, or under conditions different from those of other areas.
- preservation, including research, transfer, special playback.
- public service.
- reception.
- reference.
- exhibit.
- classes and lectures.
- playback, individual and group.
- office work.
- storage of supplies.

In addition, several types of locations for a collection are possible, each with its own implications for storage conditions. They are (a) sole occupancy of either a new building or an existing one, and (b) shared occupancy of either a new building or an existing one.

II. Site

Under normal circumstances, the chances of having a fully open choice of site for a collection of sound recordings are slight. Most existing archives have had little, if any, input into the determination of their locations. Whether one is selecting a new site, or making do with a preset location, it is necessary to consider the natural features of the area with regard both to their suitability and to any potentially adverse factors which may need compensation. These natural features may be listed as follows:

A. Climate.
Even in the nearly impossible circumstances when one could choose a location based on climate, there are few places on the surface of the earth which could provide the conditions of absolute temperature and humidity stability for the storage of sound recordings. There may, however, be a few acceptable locations underground, such as salt mineshafts in Kansas. The point is this. Archivists must be aware of the chosen area's degrees and patterns of deviation from the ideal so as to design facilities which provide appropriate compensation.

B. Quality of air.
This factor refers to possible contaminants rather than to climate, and is mentioned to encourage awareness of such problems as the salt content of spray from oceans and smog conditions, some of which may sometimes be avoided by relatively small changes in location.

C. Terrain.
In order to provide for the storage of fragile and heavy materials, designers should try to choose the location and prepare the design based on the stability of the terrain, its composition (such as sand, mud, and rock), and its proximity to such threats as the following.
1. Flooding, in relation to such factors as the water table, sea level, rivers, lakes, aqueducts, drainage.
2. Motion, in relation to such factors as fault lines (even those long inactive), subways, railroads or other rail lines, and airports.

D. Other hazards of surroundings.
Numerous other conditions encountered either in nature, society, or both may endanger sound carriers or the conditions for their study. If they cannot be avoided by choice of site, protection must be designed to cope with them. Some of the most prominent examples follow.
1. Sources of noise, including airports, rail lines, traffic, and factories.
2. Chemical threats, including fumes, smoke, and leaks.
3. Fire threats, including tank farms, gas pipelines, and nitrate film storage.
4. Radiation hazards, including electrical sources, magnetic sources, and radioactive materials.
5. Threats of vermin, including waste-disposal dumps and food processing plants.

E. Access and relationship to scholarly communities.
Whether one is designing a new university or museum or relocating facilities for an existing collection, the factor of access is important to consider. It seems desirable for a collection's staff and users to be near the intellectual and personal support of an established research community with libraries, collections of musical scores, or other appropriate resources and to establish a suitable working relationship with that community. Proximity to more than one research community would seem to be an additional advantage. The appeal to researchers of the locality and the ease of community access to the collection need to be carefully weighed, however, in relation to constraints such as security.

III. Design of building

The chances of having a completely open choice of building design for the reconstruction or rehabilitation of an existing structure are no greater than those for site selection as discussed above. Obviously, flexibility is more likely if a new facility is being planned. The following factors should be considered in the design of any building used as sound archives:

A. New building.
   1. For sole occupancy by sound archives.
      a. Single-level vs. multi-level. Because of the weight and fragility of many types of sound carriers, as well as the numerous special types of equipment and wiring required for sound collections, sound archivists indicate a strong preference for facilities on a single level, though they fully realize that space constraints may make such a design impossible.
      b. Grounds design. The design should provide access from ground level with such features as paved walks and loading docks, level and flat approaches, no steps, with security for all entrances, and with protection against flooding.
      c. Landscaping.
      d. Security.
      e. Accessibility in relation to security.
      f. Doors, elevators, dumb-waiters which are easy to open, easy to load, and easy to secure, facilitating the movement of heavy and fragile materials.
      g. Functional areas and their relationships to each other (see the introduction for a list of operations and functions).
      h. Traffic flow, both external and internal.
      i. Capacity to bear weight (see chart below in section IV.A.1.b).
      j. Lighting, with attention to such factors as natural vs. artificial lighting, the necessity for ultra-violet screening, windows versus no windows in relation to functions, and appropriate levels in different areas. (see section IV.A.10 below).
      k. Acoustics, including insulation: maximum acoustical isolation is essential for all areas in which playback will occur, as is isolation of each such area from all others. The acoustical design of all areas is critical. Information on acoustical isolation, ambient noise levels, reverberant characteristics, and monitor system design appears in section IV.A.6 ff. below.
      l. Heating, ventilation, and air conditioning (HVAC). A virtually silent air-handling system is needed, and the possibility of a backup system needs to be considered. More specific information on this subject appears in IV.A.7 below.
      m. Filtration. Specific information on these needs appears in section IV.B.7.a. below.
      n. Electrical power source. The location of the source must protect storage and playback areas from all types of electromagnetic radiation. A pure, protected, and completely stable power source is needed to ensure correct operation of equipment.
      o. Insulation. In relation to climate, insulation can assist greatly in many cases in meeting the goal of completely stable conditions for the collection.
      p. Energy conservation considerations.
      q. Mechanical design specifications.
      r. Garage/Parking.
      s. Fire-protection.
      t. Water-protection, including drains, cut-off valves, and pumps.
      u. Roof system.
      v. Vermin-protection.
      w. Aesthetics, both exterior and interior.

x. Building materials. Materials which threaten to leak or emit contaminants or are not sound-proof should be avoided or completely sealed. This category of materials includes plaster, cinder block, plywood, gypsum board, and particle board, as well as finishes which might emit contaminants which could endanger collection materials.
y. Insurability.

2. Shared occupancy.

All the factors appearing in section III.A.1 above need to be considered to avoid unfavorable impacts on the sound archives by other activities and functions carried out in the building.

B. Existing building.

1. Sole occupancy.

The factors noted in section III.A.1 above pertain in terms of rehabilitating space to properly store sound recordings and effectively operate the archives.

2. Shared occupancy.

a. The factors noted in section III.A.1 above pertain in terms of rehabilitating space to properly store sound recordings and effectively operate the archives.
b. Protection from adjacent unrelated equipment. Especially in existing buildings or in those designed for occupancy by anything or anyone not involved in the collection of sound recordings, all of the factors noted in section III.A.1 above need to be considered in relation to all areas of facilities. Extensive plumbing or HVAC mechanical equipment in direct proximity to a sound studio, for example, can produce threatening conditions or drastically increase the expense of providing protection. Staff and researchers in more than one archives have had to endure the type of noise which results from the location of a listening room directly adjacent to an elevator or escalator.

C. "A Bibliography of Materials on the Planning and Construction of Library Buildings" with annotations on attention given in the sources specifically relating to sound recordings, prepared in 1986-87 by Linda W. Blair, appears below as Appendix C of this discussion.

IV. Environment for archival materials within the building

Current Recommended Practice No. 1. Sound archives must have protection from weight-overload, climate variations, and intrusion of motion, vermin, water, sound, electromagnetic radiation, vibration, air pollution, dust and dirt, and fire.

All factors apply to all types of facilities housing archives, for a new or existing building, and sole or shared occupancy. For an existing building, the factors should be considered in terms of (a) rehabilitation and (b) operating considerations. For shared occupancy in either a new building or an existing one, it is important to add consideration of the impact upon the archives of other functions to be housed in the building. (See W. D. Storm. IASA 39, pp. 9-18 as a general reference for this section).

It is also important to consider the relationships of different areas within the collection. Essential factors include the amounts and types of traffic between areas, the advantages and disadvantages of adjacency, and the relationship of locations to security.

There are several possible types of storage which may be needed for sound recordings. One is "general" storage, adequate for reference materials as well as recordings kept for relatively frequent use. This type of storage is described in this section. In addition, several archives maintain areas with special storage conditions,

either for long-term storage of materials to which access is needed infrequently, for materials which require special types of climate or insulation, or for off-site (remote) storage. These special categories are mentioned only briefly in this discussion.

A. Interior architecture.
   1. Stability and strength.
      a. Protection against motion and vibration.
         Because of the fragility of many types of sound carriers and the delicacy of much of the equipment used for the mechanical aspects of playback, the whole environment for a collection of sound recordings must have the greatest possible stability. Types of motion and vibration which can threaten the preservation or study of sound carriers include causes ranging from earthquakes to transmitted effects from nearby heavy motor vehicles, especially trains, trucks, or industrial equipment.
      b. Floor loading (See LC memo, 3/1/82)
         Table 1, slightly modified from that in the reference source, allows planning to account for the weights of the most frequently encountered types of sound carriers, which are listed with weights per shelf or linear foot (e.g., .305 m), rounded to the next higher whole pound and then converted with 1 lb. equaling .45 kg, with discs in sleeves, tapes in cardboard boxes, and films in cans.
      c. Wall loading.
         Most library shelving loads the floor upon which it rests, but shelving does exist which hangs directly from walls. This factor is mentioned only to call attention to cases in which such shelving already is in place or is required.
   2. Type or types of ceilings.
      Such factors as acoustical design, lighting, avoidance of threatening types of construction materials, and air systems will affect the choice of ceilings.
   3. Type or types of walls.
      The same comments as in IV.A.1.c. and IV.A.2. above apply here. Decisions concerning windows also will affect this factor.
   4. Type or types of floor system and subflooring.
      The comments in IV.A.1 above also apply here, and the factor of loading of course will be important to consider. Because of the need to move heavy and fragile materials, level flooring with level entry, exit, and access (for example, to elevators and the outdoors) is essential for each area of the collection, a condition which may be difficult to achieve in view of the needs for acoustical controls and variations in floor loading. The difficulty and danger of moving heavy and fragile items on ramps and stairs should suggest that elevators are essential for significant changes of level.
   5. Floor covering.
      Avoidance of materials, such as adhesives, which may exude contaminants, will affect choices. Because of various types of contamination by both materials and fastening systems, carpeting never should be used; other types of coverings and installation methods used for them should be tested for contaminants. The types of loading for each area also should be considered (see IV.A.1.b. above).
   6. Acoustics, based on function.
      While special conditions will dictate special designs for studios in certain types of collections, two types of factors are important to consider for any sound archives to achieve the degree of silence needed for study and the proper

16" (40.6 cm) acetate discs.	0.9 per item @ 66 items per foot. 60 lbs. (27.3 kg)/ shelf foot. Lead-based acetate discs also exist, although they are encountered rarely in the U.S. The estimate for them is 5.0 lb. (2.3 kg) per item.
16" (40.6 cm) vinyl discs.	0.6 per item @ 66 items per foot. 40 lbs. (18.2 kg)/ shelf foot.
12" (30.5 cm) vinyl discs.	0.51 per item @ 66 items per foot. 34 lbs. (15.5 kg)/ shelf foot. Since it seems sensible to use shelving designed for 12-inch (30.5-cm) vinyl discs for 10-inch (25.4 cm) discs also, no separate figure is included.
12" (30.5 cm) "shellac" discs.	0.83 per item @ 66 items per foot. 55 lbs. (25 kg)/ shelf foot. See note just above for 10-inch (25.4-cm) discs.
7" (18 cm) vinyl discs.	0.22 per item @ 66 items per foot. 15 lbs. (6.8 kg)/ shelf foot. 7" (18 cm) "shellac" discs should be estimated at ca. 0.5 lbs. (.23 kg) per item, or should be treated as 7" (18 cm) open-reel tapes for estimating purposes.
cylinders.	11 per 3 feet (.91 m). 0.27 per item @ 3.6 items per foot. 1 lb. (.45 kg)/shelf foot.
audio cassettes.	0.16 per item @ 18 items per foot. 3 lbs. (1.4 kg)/ shelf foot.
audio cartridges.	0.30 per item @ 13 items per foot. 4 lbs. (1.8 kg)/ shelf foot.
10 1/2" (27 cm) reels of tape.	1.77 - 3.0 per item @ 13 items per foot. 23-39 lbs. (10.5 - 17.6 kg)/shelf foot. (1/4" [6.35 mm] tape).
7" (18 cm) reels of tape.	0.73 per item @ 15 items per foot. 11 lbs. (5.0 kg)/ shelf foot. (1/4" [6.35 mm] tape).
1/2" (1.27 cm) video cassette.	1.77 per item @ 9 items per foot. 16 lbs. (7.3 kg)/ shelf foot.
3/4" (1.91 cm) video cassette.	1.71 per item @ 7 items per foot. 12 lbs. (5.5 kg)/ shelf foot.
1" (2.54 cm) video cassette.	5.0 per item @ 7 items per foot. 35 lbs. (15.9 kg)/ shelf foot.
2" (5.08 cm) video cassette.	17.5 per item @ 4 items per foot. 70 lbs. (31.8 kg)/ shelf foot.
16mm film. 2000' (610 m)	3 cans high @ 21 cans per 8' (2.4m). 13 lbs. (5.9 kg)/ shelf foot.
16mm film. 1000' (305 m)	3 cans high @ 24 cans per 8' (2.4m). 7 lbs. (3.2 kg)/ shelf foot.
35mm film. 2000' (610 m)	3 cans high @ 12 cans per 5' (1.5m). 22 lbs. (10 kg)/ shelf foot.
35mm film. 1000' (305 m)	3 cans high @ 24 cans per 8' (2.4m). 15 lbs. (6.8 kg)/ shelf foot.
70mm film.	One reel measuring approximately 35" (89 cm) square weighs 110 lbs. (50 kg). (The correct weight is indeed 110 lbs. or 50 kg)

Table 1. Weights per shelf (linear) foot for types of sound carriers

acoustical conditions to prevent the room from distorting the sounds to be studied. The achievement of even minimally satisfactory acoustical conditions will have a major impact upon the design and construction of both the appropriate rooms and the air-handling systems for them. The experience of Syracuse University in the design and construction of its Belfer Audio Laboratory has shown that satisfactory results can be achieved at high, but affordable, cost. In buildings with shared occupancy, planning of functions in relation to the layout of the sound collection may reduce the need for of insulation.

a. Allowable levels of ambient noise (specification of noise-criteria levels).
Current Recommended Practice No. 2. The recommended Noise Criteria level (NC-level) for critical listening areas is 20-25 dB. The ambient noise level in general working quarters should not exceed an NC-level of 45 dB.

b. Acoustical design of areas for playback.
For the purposes of study in recorded sound collections, William Storm has recommended the Live-End/Dead-End room (see W. D. Storm. IASA 39, pp. 12-14).

7. Heating, Ventilation, and Air Conditioning (HVAC).
As a result of considerable unfortunate experience as well as a considerable amount of study, there are a number of significant specifications in this vital area. Experts suggest that if a collection of sound recordings is to share space with any other type of operation, a separate fail-safe HVAC system should be designed for the sound collection, or at least any parts of its facilities in which sound recordings are to be stored, studied, or used in any way.

a. Purity.
Filtration of air (0.3 mm bag filters have been recommended) will be necessary in most cases to achieve conditions approaching those of the "clean room." The filtering used should have an efficiency rating of at least 90 percent based on the National Bureau of Standards Dust Spot Efficiency Test-Atmospheric Dust. In addition, special filtering may need to be installed for protection against known specific types of pollution in the local air.

b. Distribution of air flow.
This should be as full and even as possible to avoid variations in conditions in any part of the facilities. See also Section IV.A.6 above concerning noise levels.

c. Specification of ideal temperature & range of variation allowable.
Current Recommended Practice No. 3. The recommended temperature level to be maintained with minimal variability (+ or -5%) for service copies and other frequently used sound recordings manufactured up to 1987 is 68 degrees F. (20 degrees C.). For long-term storage of tape recordings a temperature of 50 degrees F. (10 degrees C.), but no lower is recommended, with facilities to provide for 24 hours' adjustment and stabilization for items removed from storage for playback. Cylinders should be stored at 55 degrees F. (12.8 degrees C.). Work in preparation for a forthcoming American National Standards Institute (ANSI) document has concluded that any one of several levels in this range is satisfactory and that the stability of the level chosen is the most important factor (see Gibson. 5, pp. 13-15; Smolian. 40, p. 48).

d. Specification of ideal relative-humidity level and range of variation allowable.

Current Recommended Practice No. 3. The recommended relative-humidity level to be maintained with minimal variability (+ or -5%) for service copies and other frequently used sound recordings manufactured up to 1987 is 45%. For tapes 35-40% has been recommended; for cylinders 45%; and for long-term storage of tapes, bagging and sealing at 25%. Work for the ANSI document mentioned in IV.B.7.d above has concluded that within the range mentioned it is the stability of the level chosen which is the essential factor. (see Gibson. 5, p. 15; Smolian. 40, p. 47).

e. Protection from leaks at location of necessary fixtures.
All such fixtures (ducts, pipes, outlets, inlets, machinery, filters, tanks, and other supporting equipment) should be located *away* from the walls of areas used to store or study sound recordings, unless those walls are designed to insulate safely and securely the recordings from any such effects, including noise, leaks, and temperature variations.

8. Plumbing.
Aside from the factor of protection from leaks (see IV.A.7.e above), especially in storage areas for water-sensitive items such as recordings, or playback areas containing special equipment, planning the location of plumbing naturally will be based on function as well as the outlets and fixtures needed. Particular attention is necessary for acoustics and sound insulation needs.

9. Electromagnetic radiation.
Planning for electrical supply lines based on function may create dilemmas in certain areas because of the conflict between the need for electricity and the necessity for the protection of materials and equipment sensitive to electromagnetic radiation (see also IV.B.6 below). Careful and protected location of lines in relation to storage areas is essential. Given the proliferation of useful electronic devices in recent years and the apparent trends in the field, it would be best to design facilities with the greatest reasonable number of electrical outlets in areas to be used for equipment, allowing provision for new technologies. Special types of cables and fixtures also may be needed for audio, video, digital, and computer (including on-line) signals, as well as telephone, broadcast, or other long-distance communications lines and special circuits for special equipment. Cables and conduits for different purposes must be isolated to prevent any interference of one with another or with installed equipment. Power for all equipment must be "clean," that is, filtered, spike-protected, and fully controlled and regulated to constant stable voltage and constant frequency for AC. Accessibility and safety of lines, fixtures, and circuit-breaker panels, and the clear marking of all circuitry are also important (see Smolian. p. 39).

10. Lighting.
Special factors for consideration in the planning of lighting include heat-production, noise-production, and electromagnetic radiation (ultraviolet and electrical) in addition to the functions of the areas in question. Glare-free, unobtrusive lighting adequate for reading and close study of small items and small print (50-FC, including portable 50-FC for use in storage areas) has been recommended. Natural lighting, unless fully screened against the introduction of heat and ultraviolet radiation into the area, should not be planned for any area in which sound recordings are to be stored or studied (see also III.A.1.j). But if windows are present or required, their dimensions and types (classes) must be carefully planned.

a. ***Current Recommended Practice No. 4.*** The use of silent, heat-shielded, minimum-ultraviolet-producing lighting methods (preferably transformerless and ballast-less, or with remotely mounted transformers or ballasts) is recommended. Inside the sound collection there should be NO use of ballasts, transformers, or other components because of their potential to produce sound or electrical, radio-frequency, or magnetic fields. If such devices must be used, they must either be located entirely outside the facility or completely insulated from it. Noise and any sort of electromagnetic radiation can threaten not only certain sound carriers but the condition and operation of certain types of equipment (see Smolian. 39 for tapes).

b. ***Current Recommended Practice No. 5.*** Design of storage areas and playback areas without windows to the outdoors, or the elimination, covering, or at least ultraviolet screening and protection from forcible entry of windows is recommended in storage areas (see P-L. 47; Smolian: 39 for tapes).

c. Because of their potential for holding dust and emitting particles, curtains or draperies should not be planned for any area which will contain sound recordings. If their use cannot be avoided, the materials chosen should be as close to lint-free as possible and provision should be made for their regular cleaning.

11. Aisles.
    To permit such functions as moving and sorting which require the staff to maneuver carts, the minimum width for any aisles in a collection should be 36 inches. In work areas such as processing, laboratory, and playback, or in storage areas which must double as work areas, the minimum width should be 48 inches.
12. Doors and door systems.
    Apart from code-designated standards such as class and composition related to security, flammability, and special requirements such as sound-proofing for studios and playback areas, the general specifications for doors should designate minimum width of at least 36 inches (.91 m) and minimum height at 92 inches (2.34 m). These dimensions do not take into account protrusions of doors, hinges, or other equipment into the openings.

B. Protection.
First it is important to remember ***Current Recommended Practice No. 1.*** Sound archives must have protection from weight overload, climate variations, and intrusion of motion, vermin, water, sound, electromagnetic radiation, vibration, air pollution, dust and dirt, and fire. Section A above discussed many factors which relate to protection, so this section will consist of an outline with references back to section A, along with some additional comments.

Full-time, full-featured, fail-safe monitoring systems should be installed for each of the conditions against which protection is needed.

1. Weight.
   See IV.A.1.b. Protection should should include threats from outside the actual collection, such as from other areas of a multiple-use building.
2. Motion.
   Examples of in-area techniques which can help in protecting from motion are anchoring shelving to floors and walls, cross-bracing of shelving, use of a shelf-restraint system on each shelf to prevent dumping from shock, secure mounting of equipment to prevent dumping, and compact shelving.

3. Vermin.
4. Water, including steam (see also IV.A.7 and IV.A.8 above).
   a. Location of pipe chases unrelated to collection.
   b. Leaks from outside.
   c. Leaks from other areas of the building.
5. Sound (See above: IV.A.6 and 7).
6. Electromagnetic radiation.
   Sources include radio-TV and other transmissions, light, extremely strong magnetic fields, electrical fields, X-rays, and Gamma-rays. Monitoring is particularly important for invisible threats, of course. Attention to functions in adjacent areas of shared buildings may be important. Active security systems of the metal-detection type used in airports should not be installed because they can diminish the strength of signals stored on magnetic tape (see Smolian. 39). Please see also IV.A.9 & IV.A.10 above. For shielding, see NASA. pp.129-30, 139-41, and 146-47.
7. Climate variations.
   Monitoring systems also are particularly important for this factor. There should be full-time, full-featured, fail-safe monitoring systems for each of the conditions against which protection is needed (for tapes, see NASA. pp. 129-30, and 146-47; Smolian. pp. 39-40; Gibson. 5, pp. 13-15).
   a. Temperature and temperature cycles.
      Cylinders and tapes are particularly sensitive to damage from changes in temperature. Heat increases print-through on tape recordings (see Gibson. p. 13 for cylinders; P-L: 7, pp. 41-42 for LPs; Smolian, p. 40 for tapes).
   b. Humidity/cycles.
      Laminated materials such as many American Columbia shellac pressings and acetate-base recording tapes are particularly sensitive to damage from changes in relative humidity. See IV.A.7.e above; P-L. pp. 41-42 for lp's; 45, pp. 47-49 for discs; Smolian: 39 for tapes).
8. Air pollution.
   Monitoring is important for this sometimes-invisible threat (P-L: p. 8 for ozone; NASA. pp. 129-30, and 146-47 for tapes-carbon, sulfur, nitrogen oxides). The different gases emitted by certain types of discs and motion picture film stored together can interact in unfavorable ways (see NARA. Chapter 3, Part 1, 2C). Please see also IV.A.7.a for recommendations on filtering and air purity. In cases of some types of equipment, it may be necessary to consider capabilities for venting air in a room or area. The damaging effects of smoking, the presence or consumption of food, and the use of perfume also need to be considered (see NARA; Smolian. p. 38).
9. Dust and dirt.
   The comments in IV.B.8 above apply here also (see NASA. pp. 129-30, and 146-47 for tapes). In addition, careful planning of housekeeping and monitoring of its results (the type of system for cleaning the area and its relation to security) are needed. Nothing which can raise or redistribute dust in the air is safe; systems such as damp-mopping of floors and cleaning surfaces with treated cloths are acceptable. Self-contained vacuum-cleaning systems should never be used in storage or work areas because of their tendency to disperse particles through the air; the only vacuum cleaning system which is safe is the central type, with hose outlets in the walls to conduct particles to a remote container.

For the sake of security, housekeeping staff should work *only* when collection staff are on duty.

10. Fire.
    Because of the special problems of fighting fire without damaging sound carriers, an excellent monitoring system as well as a fire-fighting system should be installed in a collection. For the latter, the least threatening choice is the inert-gas, non-toxic, non-temperature-changing type. Because of halon's nearly ideal suitability the International Association of Sound Archives has applied for an exemption for sound archives to any international ban on the use of halon fire-extinguishing systems. Carbon dioxide may be next-best in spite of its possible cooling effects and its dangers to personnel. Water and dry-chemical types can cause so much damage to sound carriers and electronic equipment that their use generally is considered at least as dangerous as the effects of fire (see Smolian. p. 48).

C. Security.
Because of the involvement of intellectual property rights and copyright issues, this subject needs the broadest consideration. Carrier, equipment, personnel, content, including bugging, and inadvertent or unintentional broadcasting require attention. However, the subject of security against bugging and unintended broadcasting requires electronic expertise of a degree beyond the capability of this project to supply. Of course, the primary problem is theft of sound carriers. There are several factors involved:

1. Relationship to access.
   Careful planning of arrangement of the facilities may make possible the most efficient resolution of tension between these factors. Many collections include at least the following three levels of control, here arranged from the loosest to the tightest.
   a. Most general, via controlled entrance, for users.
      Reception, reference, reading, possibly listening to service copies.
   b. Limited, via supervision by staff.
      Offices and workplaces, playback/listening areas, studio-laboratory.
   c. Restricted, off-limits to users, accessible to staff only.
      Current Recommended Practice No. 6: Access to storage areas should be permitted to staff only. Staff of collections which lack arrangements to permit this level of control seem unanimous in recommending it.
2. Monitoring systems.
   Many collections currently operate with only the staff as monitors, a system which can be burdensome and which can dilute attentiveness even though it is essential and may be the most effective method. Systems or arrangements of space, such as locked rooms, internal windows, intercom, or video, which allow control of all areas from all other areas can reduce the burdens of watching and permit limited operations in times of minimal staffing. There should be a strong electronic monitoring system both to supplement the human one and to protect the collection during unstaffed times.
3. Labeling, encoding, placing detectors in materials.
   Some collections have marked some items with rubber-stamped library identifiers, an inadequate system useful primarily for containers and paper materials. The types of stickers which many libraries and retail shops use in conjunction with entrance-mounted detectors are incompatible with most types

of sound carrier and only can be used on containers. They prevent playback, and are oversize, unattachable, extremely obvious, or easy to remove. Testing of "invisible ink" types of systems is under way at more than one collection. This topic needs study to determine the nature of safe and useful labeling, coding, and types of detectors. Please see IV.B.6 above for cautions about active detection systems.

4. Contractual and legal implications.
   Inventory-keeping, such as shelf lists, or such microfilm records as the Rigler & Deutsch photography of the sound carriers, may be necessary for insurance coverage and certainly is a sensible procedure.

V. STORAGE, in-area

A. The room as a storage container.
   It seems useful to consider each room or area of a collection as a storage container. Specifications for the design and dimensions of storage areas, whether whole rooms or containers within rooms, should correlate to the type and dimensions of the items to be stored. The types of building materials to be avoided—or, if used, to be completely sealed from the materials being stored—are listed above in III.A.1.x.

B. Relationship to strength of floors and walls for load.
   For this factor, please consult Table 1 in IV.A.1.b above. For floor loading consult LC memo, 3/1/82. The relationship of the type of construction to the load is important to consider.

C. Arrangement by type of material.
   Current Recommended Practice No. 7. Artifacts held in sound archives should be stored by type. There are numerous advantages and efficiencies to be gained by this method of arrangement.

D. Arrangement by size of material.
   Current Recommended Practice No. 8. Division of items for storage by size is recommended. Grouping items by some aspect of size, e.g., discs by diameter, raises the problem of what range of diameters is allowed within each size. Suggestions for the most commonly-held types of materials appear below.

   1. Width.
      Except for figuring the total numbers of shelf-feet of certain types and sizes of sound carriers and except for a few extreme cases, such as non-standard cylinder records, width is not considered in arranging materials in most collections. Three feet (.914 m) seems best to set as the *maximum* length per shelf-span for recordings, especially discs; even three-foot (.914 m) lengths of normal-gauge wood or steel library shelving can be strained in bearing the load of shellac or acetate discs unless supported by weight-bearing and "lean-preventing" dividers every 4 inches (10 cm).
   2. Height (diameter).
      There follows a description of the Yale archives' current system of shelving recordings in groups, each group comprising a small range of diameters. Many years of operational experience and a number of experiments have led to this arrangement. The principal factor involved has been the safety of the materials and the prevention of warping. Mixing items of sufficiently different diameters is a threat to those smaller and lighter, which can easily be drawn from the shelf with an adjacent item and possibly dropped. Uneven pressure of different sized items on those to either side presents dangers of warping.

a. Discs.
   i. Smaller than 6 inches (15.2 cm).
   Relatively few discs of this diameter exist, so they can be housed as a separate category on shelving designed for 7-inch (18 cm) discs or tapes.
   ii. "7-inch" (18 cm).
   Larger than 6 inches (15.2 cm), but smaller than 8 inches (20.3 cm), this category can be a very large group, especially in collections involving popular culture and thus the 45-rpm "single," or the early days of the phonograph industry. This category also can be kept on shelves set for 9-inch (22.9 cm) vertical clearance. If sufficient clearance has been allowed on shelving designed for audio tapes on 7-inch (18 cm) reels, or if "oversize" items are considered part of the next-larger category, audio tapes on 7-inch (18 cm) and 7-inch (18 cm) discs can share the same type of shelving.
   iii. "10-inch" (25.4 cm). 8 inches (20.3 cm) to 10 3/4 inches (27 cm).
   Since 10-inch (25.4 cm) 78-rpm discs were the popular-music "singles" of their era, this too can be a very large group. For collections which exclude popular music, however, it may be considerably smaller than the "12-inch" (30.5 cm) category. In some collections, for the sake of flexibility or simplicity of design, this size-group can be housed on shelves designed for 12-inch (30.5 cm) discs. For collections with large numbers of 10-inch (25.4 cm) discs efficiency in the use of space may dictate the design of shelves 11 inches (28 cm) deep with 11-12 inches (28 - 30.5 cm) of clearance between shelves. 12-inch (30.5 cm) depths are required in areas which must accommodate the full length of album-set-containers.
   iv. "12-inch" (30.5 cm). 11 inches (28 cm) to 12 1/2 inches (31.8 cm).
   These can be housed on shelves with 13-inch (33 cm) clearance between shelves and with 14-inch (35.6-cm) depth required to accommodate album-set-containers in order to avoid overhang.
   v. "14-inch" (35.6 cm). 13 inches (33 cm) to 14 inches (35.6 cm).
   These should be put on shelves with 17 inches (43.2 cm) of clearance between shelves and 11 inches (28 cm) depth. Since discs of this size were not manufactured in great quantity, they can be kept in their own category on shelves designed for 16-inch (40.6 cm) discs (see V.D.2.a.6 below). The ideal design would have 15-inch (38.1 cm) vertical clearance between shelves and 14 1/2 inches (36.8 cm) of depth.
   vi. "16-inch" (40.6 cm).
   This size disc should be held on shelves with 17-inch (43.2 cm) vertical clearance between rows and 16 1/2-inch (42 cm) depths.
   vii. "20-inch" (51 cm).
   Though relatively few such discs exist, those made in the days of "shellac" discs are heavy and extremely brittle. Building shelves with the necessary 1-inch (2.54 cm) vertical clearance and 1/2-inch (1.27 cm) horizontal extra depth seems very expensive but is a safer solution to the storage problem than use of undersized shelves or horizontal storage, as in drawers with the danger of breakage from piling more than a couple of brittle discs.

b. Tapes.

Paragraphs i-iii refer to analog 1/4-inch (6.35 mm) reel-to-reel audio tapes.

i. 5-inch (12.7 cm).

Because of difficulties in playback, archives keep no reel-to-reel tapes on reels smaller than 7-inch (18-cm) or 10 1/2 inch (27 cm) diameter and therefore re-spool any tapes which are received on 5-inch (12.7-cm) reels (see paragraph iii immediately below). If necessary, 5-inch (12.7-cm) reels in boxes can be stored on shelves designed or set for 7-inch (18-cm) reels in boxes.

ii. 7-inch (18-cm).

These materials, if they must be maintained in 7-inch (18-cm) format, should be kept in the special type of plastic container recently introduced by such tape manufacturers as 3M, which can be stored on shelves of at least 8 inches (20.3 cm) depth and at least 8 inches (20.3 cm) of vertical clearance between shelves. At least until the introduction of precision 7-inch reels with slotless hubs, however, storage as indicated in the next paragraph (iii) is preferable.

iii. ALL open-reel tapes should be stored on slotless precision NAB 3-inch-diameter (7.62-cm) hubs, on precision 10 1/2-inch-diameter (27 cm) NAB reels, in plastic containers such as those recently introduced by such tape manufacturers as 3M (for example: those supplied with Type 996 tape, which are scheduled to be made available separately), on non-magnetic shelves designed or set for at least 12 inches (30.5 cm) depth and 12 inches (30.5 cm) of clearance between shelves. If necessary for the sake of economy, such materials can be stored on the type of shelving used for "12-inch" (30.5 cm) discs (see V.D.2.a.4 above). (***Current Recommended Practice No. 11,*** Gibson: 12; Smolian: 44). Please note that the wider tapes and larger reels which have been used in professional and broadcasting studios are not discussed here.

iv. Audio cassettes.

Like other tapes, cassettes should be stored so that the tape's width is horizontal and its weight is carried by the hubs. Because of the small size of the audio cassette, it seems best to use some sort of rack, case, or drawer in order to help prevent these light objects from falling. The NARA manual recommends one type of container for this type of tape, a stackable box with lid made of neutral cardboard, which holds 50 cassettes. Standard tapes can be stored in hard-plastic cases on edge in library-card-catalog-cases designed for 3-inch x 5-inch (7.6 x 12.7 cm) cards or in drawers of 4-inch (10.2 cm) depth if these types of containers happen to be available and of proper size. Numerous types of cases and racks exist for audio cassette storage but remain to be tested for safety. Cassettes in containers of non-standard types, usually of larger dimensions, can be housed on shelves set for 12-inch (30.5-cm) discs, since none so far seen have been too large for this type of shelving (NARA. Chapter 3, Part 2, 16 b (3) (b), and Appendix 3b NARATIP 3).

v. Video cassettes (Beta or VHS) containing audio.

Based on current knowledge, cabinets, cases, or drawers designed for such cassettes in their plastic cases may be satisfactory, for the same reasons as for audio cassettes (see V.D.2.b.iv immediately above).

These types of recordings can be stored in their plastic cases, oriented so that the tape's width is horizontal and its weight is carried by the hubs. Storage of video cassettes with their box-spines at the top helps keep dust out of the containers and allows about one-third more items to be kept in about the same volume of space taken by storage with spines facing the outward edges of shelves. In areas with standardized spacing such cassettes can be stored on shelves set for 7-inch (18-cm) reel-to-reel tapes in boxes.

vi. R-DAT cassettes.
These should be stored like other tape cassettes (please see immediately above: V.D.2.b.iv and v.).

c. Wire recordings.
Wire recordings may be found stored either on spools about 3 inches (7.6 cm) in diameter or larger and ca. 5/8 inch (1.6 cm) in diameter or in cassettes. It would seem best for such recordings on small spools to be stored in the same way as audio tape cassettes, on edge, with allowance for the greater weight of wire recordings, and for larger spools or cassettes to be stored with other magnetic materials of approximately similar dimensions.

d. Cylinders:
Cylinders should be stored on their ends in order to prevent warping, on wooden or metal shelves set for clearance in each category of length. They could be stored on the same type of shelves as the appropriate sizes of disc recordings. The use of drawers can ease the problems of access to items behind those in the first row, but also can pose a danger in jarring fragile materials during opening and closing (Gibson: 13).

e. Laser discs:
Laser discs should be stored in the same way as other discs (Gibson. p. 9).

3. Depth.
Please see also the discussion of height (immediately above, V.D.2). Because of the unpredictability of acquisitions, shelving of discs ranging from 11-inch (28-cm) diameter to 12 1/2-inch (31.8-cm) diameter in some collections of disc recordings is all on shelves which can accept 12-inch (30.5-cm) discs, preferably with at least 13 inches (33 cm) of vertical clearance between shelves (to allow access for hands) and 14 inches (35.6 cm) of depth to allow clearance for oversize containers, such as most of those for 78-rpm album sets. This type of shelving of course can be used for smaller discs as well as for boxed 10 1/2-inch (27 cm) reel-to-reel tapes.

E. Arrangement by factors related to access.
For a number of reasons, certain groups of recordings may be stored in locations either separate from other materials of the same types in the same facilities, or completely separate from the principal collection facilities. In an ideal world, all items would be accessible equally although the exact location might be determined by type of storage conditions. Real life conditions, however, probably will continue to require decisions about separations, made for any or a combination of several reasons, including the following.

1. Frequency of access.
   a. Items with legal or contracted restrictions
   b. Items seldom requested

2. Separation of master and service copies of the same recordings, for example, instantaneous lacquer-coated transcription recordings which already have been dubbed for preservation and which should never (well, "hardly ever," one hopes) require retrieval. (Gibson. p. 9)
3. Retention close to processing areas of items which require organization, cataloguing, or other work.

F. Arrangement by need for special storage conditions.
Please see the introduction to IV, above. Such conditions might include the following.
1. Special environmental conditions required for a class of item (because of fragility, toxicity, flammability, need for "cold storage," etc. Note that results of testing done at the Manchester (England) Polytechnic suggest that polyester tape stored at temperatures below 60 degrees F. (15.6 degrees C.) may not begin to deteriorate until after 20-30 years. This was reported in an address given at the August, 1989 conference of IASA by Dr. M. Edge].
2. Rarity of items.
3. Availability of shelving for special needs, for example, items over a certain diameter.

G. Configurations (Dimensions) and locations of containers.
As common sense dictates, heavier or larger items should be stored lower than smaller or lighter ones. The following considerations also are important to bear in mind during the design process: human capabilities, relating the designs of containers to the types of materials being stored, and grouping together items of a given type and size (P-L. pp. 47-48, p. 51 for discs; pp. 61-62 for tapes).
1. Weight.
Apart from problems of loading, this factor includes consideration of maximum height of top shelves from floors. Sound archivists in facilities which include shelving for heavy recordings as high as 18 feet (5.5 m) from the floor strongly suggest that, for reasons of preservation, storage should be designed to be convenient for humans of average size. Certainly items which weigh more than one pound each should be stored no higher than 6 feet (1.8 m) from the floor, with heavier items no higher than 4-5 feet (1.2-1.5 m).
2. Height.
Obviously this factor is related closely to that of weight, discussed immediately above, in dealing with the maximum allowable height of top shelves from the floor. The concept of human engineering suggests that when exceptions to the maximum of 6 feet (1.8 m) are necessary, sturdy moveable ladders, or possibly hydraulic lifts or even fork-lifts, will be needed for the safety of both staff and collection materials.
3. Accessibility to personnel who must retrieve items.
This topic is covered by the discussion of other items in this section.
4. Length of containers.
Most standard shelves in current library use are about 3 feet (.914 m) long. For sound recordings of weights up to those of 12-inch (30.5 cm) long-playing records which are stored on shelves designed for books, the 3-foot (.914 m) length is the maximum recommended shelf span. For items with greater weights the use of additional supports within a maximum 3-foot (.914 m) span is necessary: for example the use of dividers at 4-inch (10-cm) intervals for vertical support of, as well as for holding, materials in vertical positions.

5. Depth of containers.
   The depth of shelves and containers should be sufficient to provide full support for the bottom surfaces of the normally-used containers for all types of items stored. For safety during storage, materials should never overhang shelves.
6. Minimum distance from floor to bottom shelf.
   This factor relates to human access, dirt on floors, housekeeping, flooding, and other potential problems. Most facilities are built with either 3-inch (7.6-cm) or 6-inch (15.2-cm) clearance from floor to bottom shelf. Since 3 inches (7.6 cm) is insufficient for minimal safety from dust, impact of cleaning tools and feet, and other threats, 6 inches (15.2 cm) should be the absolute minimum. If there is any unavoidable threat of flooding, or if human considerations (leaning over or squatting to retrieve heavy items) are included, the minimum should be 1 foot (30.5 cm).

H. Tolerance to be allowed for access and oversize:
It is recommended that at least 1 inch (2.54 cm) beyond both the height and the depth of materials be allotted, particularly for oversize containers, to allow for relatively easy retrieval. Standardization of shelf heights for economic reasons may provide greater clearance than actually needed for certain size containers. Although an indentation of materials in excess of one inch (2.54 cm) from the shelf edge may lead to poor visibility or difficulty of access, this problem is not nearly so serious as that of overhang. The use of oversized shelving may tempt designers to run devices such as stop-blocks behind materials. Such devices can cause damage and permit the accumulation of dirt, and should *not* be used.

I. Internal supports for storage-sections:
Current Recommended Practice No. 9. Vertical storage of discs and tapes is recommended; and ***Current Recommended Practice No. 10:*** Support by the principle of NO-LOAD (or at least minimum-load-possible), use of dividers on shelves, and use of end-of-shelf full-size supports is recommended (P-L. pp. 35, 41-42 for discs, 49). "Load" is defined as BOTH a) more pressure on any part of the edge or surface of an item than that necessary to keep it supported in a vertical position on a shelf, AND b) uneven distribution of pressure on any part of the edge or surface of an object.
   1. Supports, dividers, and props.
      a. Types of containers.
         The principles discussed in this section apply to all types of containers which might be used to hold more than a single item such as shelves, cases, cabinets, drawers, and boxes (P-L. pp. 35, 41-42 for discs).
      b. Type of back.
         All types of containers should have full-height, full-width, smoothly finished backs.
      c. Type of sides.
         All types of containers should have full-height, full-width, smoothly finished sides.
      d. Type of supports.
         All types of containers should have supports which keep them strictly horizontal and which provide full support and permit full use of their ends, that is, which do not provide uneven ends such as protrusions of metal tracks or clips or such.
      e. Spacing, dimensions, and composition.

It is recommended that full-size dividers be placed a minimum of 4 inches (10 cm) apart for shelving groups of discs. Tapes should be supported by their hubs and, whether shelved in cardboard boxes or the recommended inert containers, also should have dividers at least every 4 inches. Such dividers should provide full and even support for the shelved items to prevent loading and should be constructed of and finished with materials compatible with the items being shelved and with the composition of the shelving, for example, free of acids or contaminants. Their surfaces should be flat and smooth (P-L. p. 49: 1-24 discs in each "bin"). Stationary dividers are stronger than movable ones, but prevent adjustability for items temporarily removed from storage. If open shelving is the only type available, housing materials in boxes of design appropriate to meet these specifications can be considered.

f. Allowance for weight bearing.
Experience suggests that weight-bearing dividers are useful for any items as heavy per item as "shellac" or "acetate" pre-lp discs. Since, however, such dividers are either immovable or difficult to move, they are best alternated with moveable dividers on the same shelf.

g. Space-holding.
Moveable, and thus not weight-bearing, space-holding props for incompletely filled sections and dividers for shelves of relatively light materials are desirable in addition to the necessary weight-bearing type. Such props and dividers should be attached by means which prevent items from moving, yet which remain moveable themselves, and which place no uneven load upon adjacent materials.

h. Edge-protection.
All types of shelves should have protection along their edges to prevent items from falling off, for example, bars, gates or doors. These devices must be both securely latchable and easily detachable, or moveable for access to the full extent of each shelf. They must be located so as to support any type of material and prevent materials from sliding off shelves. These features, combined with compact moveable shelving, provide even greater protection, but compact shelving alone is not a substitute for other edge-protection. Especially in areas where shelf-movement occurs (e.g., earthquake areas) edge-protection is essential.

2. Surface configuration.
Surfaces of props must be flat, smooth, non-contaminating, and compatible with the items being stored.

J. Special containers:
The principle of *no-load* dictates that any such containers as a special slipcase or special box, the configuration of which might provide an uneven load to either its other contents or adjacent items, should be removed and stored separately.

K. Separate notes, booklets, or other matter:
Any materials which accompany sound carriers should be stored separately. It is not always practical to enforce this policy, however, because of space, staff, and access problems. As a minimum precaution, notes on highly acidic paper should be copied onto neutral paper and stored with the tapes or discs, and paper clips and protruding staples should be removed (Smolian. p. 47).

L. Shelf-marking:
Shelf-marking is, of course, a matter of local option as to type and degree. The Yale collection, which has operated for many years in facilities which resemble open stacks, uses a system of small marks on shelves to indicate the beginning of each new letter in the shelving alphabet, and at the beginning of each section of shelving to indicate the position of the first item in the section. New staff in particular would profit greatly by a fuller system of marking, but the degree of subtlety does improve the security of this system.

M. Allowance for growth of collection:
The projection of collection growth, whether through donation or purchase, is a hazardous art, particularly in these times of changing tax regulations and fluctuations in the world market. Perhaps the only sensible method of estimation is to average the past years' actual increases. A projection covering a period of 25 years is usually recommended for purposes of long-term planning for library storage facilities.

N. Width of aisles, in relation to:
1. Personnel.
Aisles in sound archives seen by the authors range in width from 24 inches (61 cm) to over 48 inches (122 cm), with 36 inches (91.4 cm) and 48 inches (122 cm) the most common. 48-inch (122-cm) aisles allow sufficient space for such areas to double as storage and work space in an existing facility, but are considered a wasteful extravagance in planning new construction or rehabilitation. A 24-inch (61-cm) aisle makes access and shelving work difficult and thus dangerous for fragile materials. 36-inch (91.4-cm) aisles are planned for storage areas in at least one current building plan.
2. OSHA (U.S.: Occupational Safety and Health Administration) and Building codes.
Although codes may vary from region to region, the evidence of one current building plan suggests that 36-inch width is permitted.

O. Space for loading and unloading.
No exact data has been found, but normal library facilities, designed to accommodate heavy oversize volumes, seem adequate. In addition, because of the fragility and climate-sensitivity of many types of sound carriers, loading areas should be designed for completely level loading and unloading, that is, adjustable to cope with varying heights of vehicle-beds, and should be enclosed, with suitable HVAC systems.

P. Composition of containers
1. Wood.
Wood, fully and safely sealed and finished (see Q. in this section below) to prevent emission of any possible contaminants, with low-gloss finish to prevent slipping of fragile materials, is the first choice for shelving for sound recordings, in spite of the problem of expense. Adequately constructed wooden shelves do not sag or bend and do not conduct electricity or become charged magnetically, nor do they conduct vibration or heat well—the latter characteristic a benefit in case of fire. Plywood, because it contains substances which emit possible contaminants which can threaten recordings and is more difficult to seal, is a less satisfactory alternative. Particleboard and chipboard are to be avoided on the basis of contaminants, weight-versus-strength considerations, stability, and workability.

2. Metal.
   Steel is often the only choice for shelving because of the availability of ready-made library shelving. It has, however, a number of problems for storage of sound carriers, for example, the usual lack of full-size end supports, the lack of dividers, material thin enough to sag under full loads of heavy recordings, a norm of finish which allows recordings to slip too easily. Steel shelving, if properly designed with ends and dividers, of stock heavy enough to prevent sagging, and finished without gloss to prevent sliding, would be a good second choice in spite of its potential for damaging materials by heat-transmission in case of fire. The use in at least one archive of industrial metal shelving of high quality suggests that this type of shelving may be more satisfactory than standard metal library shelving.
3. Plastic.
   Currently, the best advice would be to avoid plastics because of problems of strength, sagging, and possible emission of fumes, especially in fire or other unusual conditions. In cases of fire, tapes stored in cardboard containers have been less damaged than those stored in plastic. Ideally speaking, plastic reels should not be used for storage of tape recordings because of the danger of damage from the reels warping under normal conditions (Smolian. p. 47).

Q. Composition of finish on containers.
Any materials which might emit possible contaminants, for example, wood and plywood, should be sealed completely with a flat-to-dull-gloss (to permit access and prevent slipping) emission-free sealant.

R. Carrying capacity (P-L: 35 for discs).
This is another factor which is extremely difficult to quantify; probably common sense is the only guide. The principal matter to consider is the allowable degree of tightness of fill. Sections should be filled to the extent that materials stand vertically, but not so tightly as either to prevent easy withdrawal of individual items (so as not to place a load on adjacent items) or to allow items to lean. The problem is that "easy withdrawal" varies with the composition of the containers and the finish of the shelving, so that no exact rules can be stated, and measurement would be very difficult.

S. Packaging. (for tapes see NASA. pp. 141-147, and Smolian. pp. 43-47; for discs see Gibson. pp. 8, 12, 14; and P-L. pp. 47-49)
   1. Chemical relationships of containers.
      All sound carriers should be stored in containers physically and chemically compatible with the items.
      a. For storage of all types of discs Pickett and Lemcoe presented the criteria for containers, and the Library of Congress has developed specifications for multi-layered, heat-sealed storage envelopes currently used in that collection. These containers have proved to exhibit disadvantages: i) financial, because of the shelf space occupied by the several layers of material on each side of each disc, and because of cost of manufacture, and ii) practical, because of difficulty of access to contents, danger of breakage of fragile discs which, inside sealed envelopes, are difficult to feel in handling, problems with the heat-sealed bottom edges not standing neatly on shelves, and tendencies to deviate from upright postions on shelves. As a result, some libraries do not use such containers at all, others use them unsealed, and still others use them only for preservation of discs to which access is rarely needed, such as original transcriptions of which service copies have been made.

b. Because of the problems of the Pickett-Lemcoe type of sleeve, many pre-LP discs are stored in neutral envelopes made of neutral heavy paper or light board. Experience suggests that such envelopes should be acquired in sizes appropriate for each type of disc, *without* central circular cuts which allow viewing of labels and *without* slots cut for finger-access in the open edge. Flaps to cover the open edge, which should be shelved at the top for safety, would be desirable if their thickness did not tend to cause uneven loading in storage. In addition to the dangers of open edges and lack of padding, such sleeves may deposit "paper flour" (dust composed of fibers and other components of the paper) on discs.

c. Because of the problems of the Pickett-Lemcoe "Shield-Pack" type of sleeve, many archivists choose to store microgroove discs in neutral plastic inner liners made of high pressure polyethylene contained in neutral envelopes, with acidic original covers stored separately. Neither inner nor outer sleeves should load their contents with folds, raised seams, etc. In most archives, unfortunately, such discs are stored in their original containers, with plastic inner sleeves added if needed (but the use of soft polyvinyl inner sleeves should be avoided since their chemical similarity to vinyl discs can result in damage by migration of sleeve material to the disc surfaces. The resultant "printing" causes noise in playback and can become impossible to remove). If original containers are not in good condition, originals should be repaired or replacement sleeves used. "Paper flour" deposits of dust, fibers, and flakes make original acidic paper sleeves especially unsuitable for archival storage of microgroove discs. The many microgroove discs which arrive in archives either with only the original paper board sleeves or with acidic paper inner sleeves should be slated for some sort of protective action as soon as possible.

d. Audio cassettes usually are stored in protective hard plastic containers or, for commercially recorded items with non-standard containers, in their original containers, if these are deemed to provide sufficient support and protection. Since cassettes are such a poor medium for long-term storage of sound, most archives prefer to copy the sound to a more permanent medium than to spend funds and effort in study of or attempts to preserve this type of object.

e. ***Current Recommended Practice No. 11.*** Reel-to-reel audio tape used in sound archives should be professional-quality, low-print-through, polyester-based, 1.5 mil (.005 cm) thickness, without splices, with buffer-tape-pack at both ends, wound uniformly tails-out (end-out) onto slotless-hub 10 1/2-inch (27-cm) NAB precision metal reels. In addition, tape should be sealed at 25% relative humidity in closed high pressure polyethylene plastic bags with protective foil layers on slotless filled hubs in neutral, inert containers (please see V.D.2.b. Tapes above for type of reel). Currently, however, tapes in many archives are stored, some on reels, some on hubs, in cardboard boxes. If this recommendation must be ignored and cardboard boxes are used, they should be composed of neutral material. Notes, even those on neutral paper, should not be enclosed with tapes. Metal reels with bent flanges, plastic reels, debris-producing hold-down tape, splicing tape, leader tape, and other damaging products should be avoided. Dustless hold-down tape such as 3M #83 or #8125 should be used if it is necessary to secure tape ends (Gibson. pp. 15-16; Smolian. pp. 43-47).

f. All wire recordings seen are stored in original containers (cardboard boxes) or original cassettes. There has been no study to determine if neutral boxes would be preferable.

g. Cylinders should be stored in neutral containers designed to support them vertically, bearing the weight at the bottom and protecting the surface from any pressure or contact with the container. Despite several attempts no satisfactory containers of this sort have been manufactured. Consequently, most cylinders are stored in their original containers in spite of knowledge that these are unsatisfactory. If original containers are used, packing material such as cotton and paper must be removed (Gibson. pp. 5, 13).

2. Original package & contents.
Original packages, if designed for a particular item, should be kept. If chemically or physically not compatible with the sound carrier, they should be treated or insulated from it, that is, treated for acidity or encapsulated in mylar, or else stored separately. The same is true for such contents of original packages as notes and booklets, aside from the sound carrier(s).

3. Added or substituted archival packaging.
For treatment of the original in case of the use of substitute packaging, please see section V.S above.

4. Policies on separation of parts of original sets.
This factor relates to recordings published with special containers, covers, notes, booklets, or other materials which do not carry sound but whose composition, design, or size may cause problems. Since the principle of *no-load* applies, please consult the discussion in V.I, J, & K above. For problems of chemical incompatibility (see S.1 above), any such items should ideally be separated, treated, or insulated from the sound carrier. Conditions of real life suggest that the ideal policy will be difficult, if not impossible, to carry out except perhaps for treatment (especially so unless ample space should be available). For reasons of preservation, however, sound archivists should at least formulate a policy and should try to achieve its execution as closely as circumstances permit.

5. Shrink-wrap:
Current Recommended Practice No. 12: Immediate removal of shrink-wrap and similar constricting packaging from recordings and their containers is recommended.

6. Plastic slipcovers.
In some archives loose-fitting plastic slipcovers with one open edge are used for protection of selected covers with special artistic merit or on damaged covers needing protection from further abrasion. This subject needs study. For covers in reasonably good condition the danger of abrasion is slight, and thus the effort of using slipcovers may not be justified.

7. Cleaning:
Current Recommended Practice No. 13. Cleaning of all sound carriers, at least before playback, by the least threatening possible method is recommended. Any item to be stored should be cleaned prior to packaging and storage. In view of the great number of methods and substances which have been suggested or marketed for the purpose of cleaning recordings, this subject suggests itself as a prime candidate for research. One set of tests has resulted in the recommendation that products for cleaning discs should not be tacky, should have low pH (ca. 6.0-6.8), and should leave no residue (Gibson. p. 7).

8. Other.
   a. ***Current Recommended Practice No. 14.*** Avoidance of the use of adhesives such as splicing tapes on tape recordings to be stored is recommended. When splicing tape must be used, such dustless non-bleeding types as 3M #67 are considered safest. When hold-down tape must be used, a dustless type such as 3M #83 or #8125 should be used (Smolian. p. 43).
   b. Avoidance of the use of leader tape on tapes for archival storage is recommended. Paper leader absorbs moisture which can damage tapes, and plastic leader accumulates static electricity which can cause problems. Also, the use of leader involves its attachment by means of splicing tape (Smolian. p. 46).
   c. Labels affixed to boxes, such as tape boxes, should be neutral and affixed permanently with adhesive such as that used by the Library of Congress (3M #7110). The Nopper Beckett Corporation, Lionville, PA is one supplier of labels using this type of adhesive (Smolian. p. 47).

T. Digital data.
   1. Computer experts recommend that backup copies of files should be kept. Their advice about keeping storage devices for computer files on magnetic media is, not surprisingly, similar to that for storage of audio tapes.
   2. Until the use of digital magnetic signals has proven itself, digitally processed signals and digital recordings made on tape should be stored as analogue tape recordings in addition to digital tape formats (Smolian. p. 50).

U. Pamphlets, vertical-file type material, and printed material.
   Please consult preservation staff members at your own institution or seek advice from library preservation experts for advice or reading materials on the subject of preservation of paper, photographs, and other materials.

V. Microforms.
   There are ANSI standards for preservation microfilm and its storage; here again it is well to seek advice from library preservation experts.

W. Determination of type of storage.
   A collection containing several types of sound recordings can best be preserved by a variety of storage conditions determined by the composition and contents of the various materials. The provision of several sets of conditions is likely to be extremely expensive, though, especially as such conditions diverge further and further from those natural to the archives' location. One well-chosen set of climatic conditions can serve fairly well for the preservation of most types of sound recordings, and most institutions will probably elect to maintain a single storage environment. In this case, high priority should be placed on the transfer of contents of carriers which require environmental conditions greatly divergent from those recommended for general storage. The most efficiently obtainable "variant" type of condition may be that for long-term storage of polyester-base audio tapes, 50 degrees F. (10 degrees C.) and 25% relative humidity (P-L. p. 49 for discs; Smolian. p. 48 for tapes).

X. Policy on monitoring.
   Archives should have a policy for monitoring the state of preservation of its sound recordings, the state of its security systems, the conditions of storage, and other pertinent matters. There are various means for carrying out such policy: informal spot checks, continuous eyes-open attitude of staff, emergency-driven inspections (examination of everything of a certain type or in a certain area under certain conditions),

regular inspections, special periodic inspections (for example, of any stored audio tapes to which splicing tape may have been affixed), tests such as various types of chemical tests on the state of the materials which comprise certain sound carriers (this is a subject which needs further study; at present no such tests are known).

Y. Information on projected shelf-life.
Ideally each sound archive should have on file the fullest possible set of information for each type of material in its collection, on the projected shelf-life of both carrier and signal under normal conditions in the archives and under such other types of conditions as those in the normal climate outside the archives' controlled conditions. Currently, there is very little specific information on many types of sound carriers, so this is a very important topic for further study. For example, sources used in preparing this discussion state the following:

1. With proper handling and extremely stable storage conditions, polyester-base tape, the first types of which were introduced about 1960 in the U.S., should have a life of perhaps 50 years; but kept under casual storage conditions in northeastern U.S.A., it may last less than half that long. (Smolian. p. 40).
2. With proper handling and storage, acetate-base tape, introduced in about 1949 in the U.S., may have a life of about 30 years.
Please note that acetate-base tape is damaged easily by various environmental factors, especially moisture, and is therefore likely to arrive in archives in less than ideal condition. The base material in polyester-base tape is considered more environmentally inert and less subject to hygroscopic damage than is cellulose acetate.

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National Archives and Records Administration, 1992. *Sound Recordings Procedure Manual*, Washington, D.C.: National Archives, Motion Picture, Sound & Video Branch. (cited above as *NARA*)

Pickett, A. G., and Lemcoe, M. M. 1959. *Preservation and storage of sound recordings.* Washington, D.C.: Library of Congress, 1959; 1991 by Associated Audio Archives Committee, Association for Recorded Sound Collections. (cited above as *P-L*)

Smolian, Steven. 1987. "Preservation, deterioration, and restoration of recording tape." *ARSC Journal*, Vol. 19, no. 2-3: 37-53. (cited above as *Smolian*)

Stanford University. 1983. *Program for the Stanford Archive of Recorded Sound.* Palo Alto, CA: Stanford University, November 14, 1983. (cited above as *Stanford Un.*)

Storm, William D. 1984. "Construction and rationale of building the Belfer Audio Laboratory and Archive at Syracuse University." *Phonographic Bulletin*, No. 39: pp. 9-18. (cited above as *W. D. Storm: IASA 39*)

***Credits*:**

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Appendix A: List of Topics for Study.

1. Shelving.
2. Effects of preservation of containers & notes on storage & handling of recordings.
3. Longevity of sound carriers, for both the technology (signal) and the carrier.
   A. In storage.
   B. In playback.
4. Containers for sound carriers, composition and shape.
5. Discovery or development of a permanent archival storage medium for audio.
6. Splicing tape.
7. Effects on sound carriers (discs & tapes—sound film has been studied) of contamination by commonly found chemical vapors: for example, paints, resin finishes, housekeeping products such as solvents; adhesives such as those used in plywood, particleboard; wood & its finishes.
8. Labeling and/or marking of sound carriers and containers for sound carriers, including security in the sense of labeling, encoding, placing detectors in or on materials.
9. Damage repair: Preservation of the structural integrity of the sound carrier—mechanical and chemical considerations (this topic relates strongly to the technical and engineering aspects of the study), related to all integral parts of the sound carrier.
10. Cleaning methods and materials (Larry Miller of the Library of Congress has in progress a project on LPs)
11. Instrumentation measurements related to storage.
    A. Humidity (hygrometers).
    B. Electrostatic charges in plastic materials (particularly discs).
    C. Magnetization (magnetometers).
12. Floor covering: In reference to acoustics, composition in relation to possible contaminants, cleanliness and cleaning systems, safety of materials stored, efficiency in permitting moving of materials, etc.
13. Aisles: dimensions, as related to functions such as moving, loading and unloading carts, carts themselves, personnel.
14. Treatments for recordings (additives & coverings such as hardeners, protectants, lubricants) in regard to safety of materials for carriers and signals and in regard to reversibility.
15. Combustion-detectors and fire-control systems.
16. Security: the whole subject as related to Audio Preservation.

Appendix B: Current Recommended Practices.

1. Protection from weight-overload, climate variations, and intrusion of motion, vermin, water, sound, electromagnetic radiation, vibration, air pollution, dust and dirt, and fire (Refer to IV.Introduction & IV.B).
2. The recommended Noise Criteria level (NC-level) for critical listening areas is 20-25 dB. Ambient noise level in general quarters should not exceed an NC-level of 45 dB. (Refer to IV.A.6).
3. The recommended temperature and relative humidity levels to be maintained with minimal variability (+ or -5 %) for service copies and other frequently used sound recordings manufactured up to 1987 are 68 degrees F. (20 degrees C.), 45 % relative humidity. (Refer to IV.A.7.c & IV.A.7.d).
4. Use of silent, heat-shielded, minimum-ultra-violet-producing lighting methods, preferably transformer-less & ballast-less, or with remotely mounted transformers & ballasts. (Refer to IV.A.10.a)
5. Prevention or elimination, covering, or at least ultra-violet screening and protection from forcible entry of windows in storage areas (Refer to IV.A.10.b).
6. Access to storage areas permitted to staff only (Refer to IV.C.1.c).
7. Division of items for storage by type (Refer to V.C).
8. Division of items for storage by size (Refer to V.D).
9. Vertical storage of discs and tapes (Refer to V.I).
10. Support for the principle of NO-LOAD (or at least minimum- load-possible), use of dividers on shelves, & use of end-of-shelf full-size supports (Refer to V.I).
11. Reel-to-reel audio tape used in sound archives should be professional-quality, low-print-through, polyester-based, 1.5-mil-thickness (.005 mm), without splices, with buffer tape pack at both ends, wound uniformly tails-out (end-out) onto slotless precision NAB 3-inch- diameter (7.62 cm) hubs on precision 10 1/2-inch- diameter (27 cm) NAB metal reels (refer to V.S.1.e).
12. Immediate removal of shrink wrap and similar constricting packaging from recordings & their containers (Refer to V.S.5).
13. Cleaning of all sound carriers, at least before playback, by least threatening possible method (Refer to V.S.7).
14. Avoidance of use of splicing tape on tape recordings to be stored (Refer to V.S.8).

Appendix C: A bibliography of materials on the planning and construction of library buildings

Compiled by Linda W. Blair, 1987

Intent of the study.

The purpose of this project is to create a bibliography of materials pertinent to the designing, planning and construction of library or archive buildings, and to note the attention given in the sources to spaces specifically for sound recordings. Many of the sources are of a general nature and are included to acquaint the professional with the concepts and processes of planning. Others are included because they deal in some way with sound recordings.

Research strategies.

The time span selected for the study was the twenty-year period from 1967 through 1987, with older references of importance in the field. Of the recently developed digital formats only the compact disc is covered.

The first sources consulted were the Theodore Besterman *World Bibliography of*

Bibliographies and supplements. They contained very few listings, most of which were too outdated for this study. A manual search was then conducted of *Library Literature* and *Bibliographic Index* for the above time span, as well as a ten-year search of *Resources in Education* and the *Monthly Catalog* of United States Government Publications. *Current Index to Journals in Education* was not searched because the pertinent journals indexed there also were covered in *Library Literature.*

Using CD-ROM, *Books in Print* was searched by means of subject headings and key words. Also, bibliographies in sources already retrieved were used to generate further citations. Finally, a card catalog search was undertaken, using the headings "Library architecture" and "Library planning."

At first a wide net was cast, and all citations that seemed even remotely related to the subject were examined. Later, as it became clear that certain types of books or articles were not useful, the search was narrowed. In some areas of the subject, such as cost and financing, only the most recent sources were examined, as this type of information becomes outdated very quickly. Finally, some types of information which tended to appear over and over again, such as articles on the role of the building consultant, at first were examined each time they appeared but later were examined only if written by a noteworthy individual, or if they seemed in some way unusual.

The bibliography which follows contains a selection of the most useful items examined and is classified by subject. Annotations describe each item and point out unique aspects.

Note: The word "program" is used in the sense of "written plan or design."

Bibliographies

Casper, Dale B. *Library Architecture: Trends and Construction 1980-1985.* (Architecture series, bibliography A-15555), Vance Bibliographies, 1986. 11 p.

This article is the only source included here which actually was not examined. Nevertheless, its recent publication date indicates that it should be of use as a bibliography of the field.

Eisenbeis, K., and Holloway, C. Building or renovating libraries: a bibliography of government documents. *North Carolina Libraries* 39: 42-8 Fall, 1981.

Bibliographic sources were selected for this article from the *Monthly Catalog*, the *GPO Sales Publication Reference File, PAIS*, and *State Publications Index.* It is somewhat helpful for locating federal and state building codes, but the largest part of the bibliography is dedicated to issues of access for the handicapped and in this it is quite helpful. Also included are some sources on energy conservation and crime prevention.

Evans, Frank. *The Administration of Modern Archives: A Select Bibliographic Guide.* Washington: GPO, 1970.

This book is a bibliography of all aspects of archives administration. There is a chapter on buildings, and also a chapter on sound recordings, which includes references on care and handling of audio tapes from industrial sources such as Eastman Kodak. It is the only source of its kind to cover pertinent literature from fields other than library science or architecture, such as engineering.

Kelly, R.Q. Planning update: commentary and bibliography. *Law Library Journal* 66: 173-7, May, 1973.

This is a short bibliography and covers mostly the major works in the field. Still, it is useful for its annotations.

Kreidler, J.A. Bibliography on library planning (In Mount, B.E., ed., *Planning the*

Special Library. Special Library Association, 1972, p. 80-94).

This is one of the finest bibliographies of the field, classified and with annotations. Its only major flaw is its age.

Melnyk, A. Architecture of academic libraries in Europe: bibliography, 1960-1970. *College and Research Libraries* 33: 228-35, May, 1972.

Although somewhat outdated, this bibliography provides information about sources on library architecture outside the United States, and is helpful in gathering together large, comprehensive works on the subject, Some of these sources may now be in later editions and would be very useful to those seeking a broader perspective.

Rogers, A.R. Library buildings and equipment : sources of information. *Library Journal* 96: 3876-7, Dec., 1972.

In spite of its age, this article is a good starting point in the bibliography of library architecture. It provides a brief annotated bibliography of the major sources in the field and also suggests LC subject headings and classifications to aid in the search for more information.

Schutze, Gertrude, Annotated bibliography. (In Lewis, Chester M., ed., *Special Libraries: How to Plan and Equip Them.* p. 92-102. SIA Monograph No. 2, Special Library Association, 1968)

This is a good annotated bibliography of the subject, classified into categories such as acoustics, air conditioning, and equipment. Once again, however, it is somewhat outdated.

Weis, Ina J. *The Design of Library Areas and Buildings.* (Architecture Series, January, 1981), Vance Bibliographies, 1981.

This is a very comprehensive bibliography on general planning. It considers some types of special libraries in particular, but music libraries or recorded sound collections are not among them.

Wheater, Delma. *Environmental Design: An Analysis of the Field and a Guide to the Literature,* CPL Bibliographies, 1975.

This is a bibliography of the field of environmental design, with respect to libraries. The field is interdisciplinary. involving aspects of the humanities, social sciences and pure sciences. This is a useful source for locating general materials in this field, but already old.

Other fine sources for bibliographies are major works in the field, such as those by Keyes Metcalf and Ralph Ellsworth. Their works are listed in the section on general planning.

General planning

Adams, S., Library building issue. *Illinois Libraries* 67: 771-831, November, 1985.

This article is an excellent, clear treatment for beginners in the planning process. One article especially—"Planning aids for a new library building"—is in outline form and covers overall processes such as project sequence and components, architect selection, space planning, floor loading, and energy management. The outline was prepared by HBW Associates Inc, Library Planners and Consultants.

Alexander, Christopher *The Timeless Way of Building* and *A Pattern Language: Towns, Building, Construction.* Oxford University Press, 1977.

Although these books were unavailable for examination, they are included here because they currently are seen as philosophically important in the field of architecture. They deal with the ways in which people respond to architecture and they offer methods by which buildings and entire communities may be designed so as to be wholesome environments for their users.

Anthony, L.J., Library planning (In Ashworth, W., ed., *Handbook of Special Librarianship and Information Work,* 4th ed. Aslib, 1975, p. 8-71.)

This article is a relatively complete treatment of the planning process which is somewhat different from others in that it uses systems-analysis techniques as planning tools. There is a good classified bibliography included also.

Barkey, P.T. Office landscape: a new concept for library planners. *Library Journal* 94: 4358-9, December 1, 1969.

This article is interesting to those who wish to consider modular design for office areas. It advocates flexible, standing dividers rather than fixed cubicles or rooms. At this point, however, modular design is receding in favor, and fixed function design is on the ascendancy once more.

Beder, R.M. Structural requirements of library buildings. (In Mount, H.E., ed., *Planning the Special Library.* Special Library Association, 1972, p. 13-17.)

In spite of the shortness of this article, it offers concrete suggestions concerning ventilation, lighting and electricity, noise control and flooring. It does, however, advocate modular space planning, which seems to be falling from favor in the latest sources.

Brawne, M. *Libraries, Architecture and Equipment* [text also in German]. Praeger, 1970. 188 p. il, plans.

Beautiful black and white photography and clear plans make this a good idea book, but the shortness of the text makes it less useful for informational reading.

Campbell. D.E. and Schlecter, T.M. Library design influences on user behavior and satisfaction. *Library Quarterly* 49: 26-41, January, 1979.

This article is a discussion of a study done in a university library examining the effects of library design on user behavior and satisfaction. Results were significant enough that the authors recommend that libraries be planned by teams of architects, librarians, and behavioral scientists.

Cave, R. Housing of special collections. (In Cave, R. *Rare Book Librarianship.* Bingley, 1982, p. 89-99.)

This article includes comments on buildings, lighting, environmental control, and fire protection. It is useful in that it is written from the point of view of an archivist, to whom protection of rare materials is of the highest priority. But treatment in general is too brief for it to be considered a major source.

Christian, J.F., and Finnegan, S. On planning and archives. *American Archivist* 37: 573-8, October, 1974.

This brief article offers some good suggestions for beginning the planning process, mostly in the form of a list of good questions to ask. It also contains some process diagrams and floor plans which may be helpful to some.

Cohen, Aaron and Cohen, Elaine. *Designing and Space Planning for Libraries.* Bowker, 1979.

Some interesting ideas on the psychological aspects of design begin this book. Other chapters on writing the program, acoustics, lighting, and space planning are well written, but the information is duplicated in many other sources. No attention is given to the planning of audiovisual areas.

Dickenson, D.W. and Broome, E.M. Building together. *Library Association Record* 65: 440-52, December, 1963.

This is an older article which is worth reading. It consists of two papers given at the County Libraries Weekend School, 19-22 April 1963, one from the viewpoint of the architect, the other from the viewpoint of the librarian. The architect tells

what he needs from the librarian: what should be in the brief, how arranged, preparation of estimates, and working relations. The librarian covers similar topics from his own point of view. Because of the concrete nature of the examples, this makes very good background reading for those beginning the planning process.

Draper, James and Brooks, James. *Interior Design for Libraries.* ALA, 1979.

This book is a helpful guide to drawing up floor plans, types of flooring materials, and space planning of storage areas. A glossary gives help in dealing with design terms. It is very simply presented, but contains many useful ideas.

Duchein, Michel. *Archive Buildings and Equipment.* Verlag Dokumentation, 1977. 201 p.

This book covers all the standard aspects of planning with regard to buildings where preservation and security concerns outweigh those of patron access, and therefore it is a good source for the planning of archival sound collections. The treatment of sound recordings is brief and somewhat controversial, however (e.g., magnetic tape should be stored in metal containers).

Ellsworth, Ralph E. ABC's of remodeling/enlarging an academic library building: a personal statement. *Journal of Academic Librarianship* 7: 334-43, January, 1982.

This article provides a useful checklist of situations which may make remodeling inadvisable. The procedures are based on fixed-function rather than modular library buildings, and it contains good floor plans illustrating successful remodeling schemes. Even though sound collections are not specifically addressed, the principles for deciding whether or not a building is suited to remodeling are useful to anyone in the early stages of planning.

_____. *Academic Library Buildings: A Guide to Architectural Issues and Solutions.* Colorado Associated University Press, 1973.

This book is an unusual treatment consisting mostly of photographs of existing facilities. It may be useful for this study in that it shows several pages of audiovisual equipment and audio equipment for music libraries.

_____. Consultants for college and university library building planning. *College and Research Libraries* 21: 263-8, June, 1968.

This article gives good suggestions for how to select and hire a consultant, how long the consultant's services will be required and what his primary duties are. A very good article, written by a very experienced consultant.

_____. *Planning the College and University Library.* 2nd ed. Pruett Press, 1969.

This book, one of the major sources in the field, has a very good chapter on the early stages of planning: choosing a building committee, choosing a consultant and writing the building program. It does not contain specific information for the planning of space for sound recordings.

Faye, B. Design of archives buildings. *UNESCO Journal of Information Science* 4: 88-93, April, 1982.

Although this article does not specifically concern archives of sound recordings, it is nevertheless useful in planning for them. It addresses pertinent issues such as climatic control and the design of buildings for which a large percentage of the premises will not be open to the public. Site selection is considered not only from the standpoint of proximity to the user, but also in relation to climatic factors. Internal climate control and planning for future extensions to the site also are discussed.

Fraley, R.A. and Anderson, C.L. *Library Space Planning: How to Assess, Allocate, and Reorganize Collections, Resources and Physical Facilities.* Neal-Schuman, 1985.

This book is a very useful, up-to-date guide on planning space for collections of all different types, including sound recordings, probably the best of its type currently available. Also included is a good bibliography with a special section on moving the library.

Freeman, M.S. College library buildings in transition: a study of 36 libraries built in 1967-68. *College and Research Libraries* 43: 478-80, November, 1982.

This article reports the results of a study examining how well library buildings in 1967-68 have adapted to their growing collections, how serious are their storage and space problems, and what physical modifications have been made since they opened. It is interesting to note that 14 of the 36 responding libraries had moved their audiovisual departments since building, generally due to service expansion and consolidation of sources.

Fuhlrott, Rolf. The impact of technology on library buildings. In International Federation of Library Associations. Library Buildings and Equipment Section. Papers presented at the annual conference (49th: Munich: 1983) ED 239 645.

This article is informative reading for those involved in a building planning project of any type. The noted authority Rolf Fuhlrott discusses the impact of three types of technology (construction technology, technical building equipment, and library technology) on library buildings.

_____. Underground libraries. *College and Research Libraries* 47: 238-62, May, 1986.

This article cites the advantages of underground construction for (1) preservation of historical or natural character of an area, (2) energy efficiency, (3) naturally lower temperatures, which are good for preservation, (4) long-life materials, and (5) protection from temperature variation. The disadvantages are largely psychological in nature. From a preservational standpoint, this seems a viable alternative building type for a sound collection, and therefore would be useful reading as background material in the planning process.

Gondos, Victor, Jr. Archival buildings—programming and planning. *American Archivist* 27: 467-483, October, 1964.

This is a good article, written from the viewpoint of planning special archival buildings. It discusses site selection, program writing, and joint planning with the architect.

_____, ed. *Reader for Archives and Records Center Buildings.* Committee on Archival Buildings and Equipment. Society of American Archivists, 1970.

This book contains articles on programming and planning, descriptions of existing buildings and fire management. Although sound archives are not considered, it is a useful source for the general principles of archive planning, The bibliography, however, is even more out of date than the date of publication would suggest.

Haas, W.J. Role of the building consultant. *College and Research Libraries* 30: 365-8, July, 1969.

This article identifies the stages of program planning in which a consultant may participate: (1) initial program, (2) program development, (3) early design, (4) final design, and (5) working designs and specifications. It also identifies the consultant as the team member who works to resolve divergent points of view between the architects and librarians.

Hall, R.B. Library space utilization methodology. *Library Journal* 103: 2379-83, December 1, 1978.

This article outlines a concrete methodology for space planning. At the time of publication, the method had been tested at only one library, so its effectiveness was largely unproven. Its use of computer analysis, however, may make it an attractive alternative to some.

Haymand, J. Adaptive reuse of old buildings for archives. il. plan. *American Archivist* 45: 11-18, Winter, 1982. Discussion. 45: 261-2, Summer, 1982.

This brief article advances several arguments for the reuse of old buildings rather than building new ones. Most of the article is concerned with the conversion of a railroad depot into a facility for the Utah Historical Society.

Holt, Raymond M., ed. Talking buildings: a practical dialogue on programming and planning library buildings. Proceedings of a building workshop (1st : Pasadena : 1986) ED 271 109.

These papers present all aspects of the process, such as selecting planning teams, space requirements, and funding, The presentation is very practical, and contributors are important figures in their field, such as Nancy McAdams.

Kaser, D.E. Twenty-five years of academic library building planning. *College and Research Libraries* 45: 268-81, January, 1984.

This interesting article on the rise and fall of modular planning may provide useful background information to help planners avoid past errors.

Kaula, P.N. *Library buildings: Planning and Design.* New Delhi: Vikas Press, 1970. 237 p., bibliog, il.

This is a basic planning textbook, in general, not as good as the major sources, but it does have some useful features such as the presentation of planning issues as lists of decisions to be made.

Langmead, Stephen and Beckman, Margaret. *New Library Design: Guidelines to Planning Academic Library Buildings.* Wiley and Sons. 1970.

This book contains a useful discussion of site selection. Otherwise, it is a rather general treatment of the standard subjects.

Library Journal. Architectural issue.

Since 1972, this issue has appeared in December, summarizing construction activity for the past year by type of library. An examination of several of these issues shows that they are too general an overview for this study. They may be useful, however, as background reading on emerging trends in library architecture and also for locating ongoing and completed construction projects in the planners' area which they may wish to visit. Moreover, architects' names are listed with their projects, which may be helpful in the selection process.

Lushington, Nolan and Mills, Willis N., Jr. *Libraries Designed for Users: A Planning Handbook.* Shoe String Press, 1980. 289 p.

This is a good book for background reading, because it is written by architects rather than by librarians, as most sources are. It covers all major topics, but the sections on recordings and sound equipment assume that the collections are circulating and self-service. It contains a good many case studies and plan critiques which are good for providing concrete examples of concepts discussed.

Lyle, G.R. *Administration of the College Library,* 4th ed. H.W. Wilson, 1974.

The section of this book entitled "Library buildings and equipment" is an overview of the planning process. Although it is too general, it does have some points to recommend it. Bold headings make it easier to read than some articles of this type, and the chapter features a comprehensive bibliography.

Lyles, M.A. Environmental design application. *Special Libraries* 63: 495-501, November, 1972.

This article concerns design elements such as light, color, and space and their effects on the behavior of the users. Mostly, it is useful as background reading, for it helps to balance more technical sources.

Lyllof, B. and Plovgaard, S. Library buildings 1984: a new Danish guide to the planning of premises for public libraries. *Scandinavian Public Library Quarterly,* 1985, No. 2: 34-41.

This article is a description of a landmark Danish planning guide for libraries. The book will include sections on climate control and on music listening areas, and was projected to be available in English translation in 1986, but so far has not appeared.

Lyman, W. Preliminary and final drawings, bidding and construction. (In Library Buildings Institute, 1965. Detroit. Libraries building for the future: proceedings. ALA, 1967, p. 39-41.)

This brief article, in layman's terms, of what to expect during the above processes is not very specific, but provides some of the only introductory reading material available on this subject.

McAdams, Nancy R. Buildings. (In the *ALA Yearbook of Library and Information Services,* v.ll, 1986. ALA, 1986. p. 96-100.)

This yearly article is very general, but still good background reading for those in the planning process, because it provides a summary of significant trends, such as the movement away from undifferentiated modular spaces.

_____. Super-librarian and sub-architect: the anomaly of the role of the building consultant. *Library Journal* 91: 5827-31, December 1, 1966.

This article presents the results of a survey of librarians who were asked to define what they saw as the role of the library building consultant. Results showed a discrepancy between what the literature recommends a consultant should do, and what librarians perceive he or she actually does.

McClarren, R.R. and Thompson, D.E. Architectural checklist: the steps, sequence and specific factors to be considered in planning and constructing a new library building. *Library Journal* 91: 5832-7, December 1, 1966.

This is a complete outline in checklist form of the steps in planning and constructing a new library building, from the decision to build through the dedication of the building. It is one of the most comprehensive articles of its kind, even though it is very short.

Mason, Ellsworth G. Consulting on academic library buildings. *Library Trends* 28: 363-80, Winter, 1980.

This is a very comprehensive, relatively recent article on this subject, which takes into account newer trends, such as the lack of funding for higher education. In most cases similar articles written earlier than the mid-1970s assume a bounty that no longer exists. Subjects such as networking and computerization are noted here as necessary in the planning process, while in earlier articles they are not. Other subjects include criteria for selection of a consultant, the consultant's duties, and the costs.

_____. *On Library Buildings.* Scarecrow, 1980.

The chapter on planning is similar to that in other sources, but does contain some material which has not been included in most, such as planning timetables and estimates of the cost for different areas of the project by percentage of the total budget. The chapter on library lighting is a very good and highly readable introduction to the field. Furthermore, although many works discuss the writing of

a program, this book contains a complete model program in an appendix, which provides the best illustration of the subject yet seen, including a program for an audiovisual library with listening areas.

_____. Writing a building program. *Library Journal* 91: 5838-44, December 1, 1966.

This is still the most often cited article of its type. It outlines the components of a building program in an anecdotal style completely free of jargon. It is probably the first article that a potential planner should read, although there probably will be a need for a more specific technical follow-up.

Mathers, A. S. Designing to meet new requirements of differing services. *Canadian Library Journal* 39: 210-12, August, 1982.

This article discusses problems inherent in the renovation of buildings constructed prior to 1960. It makes good background reading in this area, and it is written from the viewpoint of the architect rather than that of the librarian.

Metcalf, Keyes D. Library buildings for the future. (In *Comparative Librarianship: Essays in Honour of Professor D.N. Marshall.* Vikas, 1973, 35-43.)

This is a very broad treatment in a short article. Although not very specific, this article, by one of the most important figures in the field of library design, makes good background reading in the planning process.

_____. *Planning Academic and Research Library Buildings.* 2nd ed. by Philip D. Leighton and David C. Weber, ALA, 1986.

This large book is considered the landmark in the field, and remains the most often cited source of its kind. If a library can purchase only one book on planning, this should surely be the one. It is comprehensive in all aspects of planning, and does include rudimentary information on the housing of sound recordings, such as recommended shelf size, the need for dividers, weight considerations, and temperature control.

_____. and Ellsworth, Ralph E. *Planning the Academic Library: Metcalf and Ellsworth at York.* Edited by Harry Faulkner Brown. Oriel, 1977.

This book contains no specific information about the housing of sound recordings, but it is still a good overview for anyone planning for a new building or addition. Conceptual and humanistic rather than technical, it provides a good balance to more technical sources.

_____. The use of hindsight in planning library buildings. (In Library buildings institute, 1965, Detroit. Libraries, building for the future: proceedings. ALA, 1967.)

This article is a very general but still interesting account of mistakes to avoid in library planning, with good and bad examples from specific libraries. It is suitable as background or pre-planning reading.

Mount, H.B., ed. *Planning the Special Library.* Special Library Association, 1964.

This SLA monograph is one of the most often cited sources in planning, when planning special libraries. Articles cover all the standard aspects, such as space-utilization, equipment, floor covering, and planning teams.

Orne, J. Library building trends and their meanings. *Library Journal* 102: 2397-401, December 1, 1976.

This is a very broad outline of recent changes in library structures and of why they have come about. Interesting as background reading only, it contains very little specific information.

Park, L.M. Whys and hows of writing a library building program. charts, *Library Scene* 5: 2-5, Summer, 1976.

This article is a clear, specific outline of how the program is written, by a library director who recently had completed the project. It is a very good source of its type, with clear, comprehensible diagrams and tables.

Problems in Planning Library Facilities: Consultants, Architects, Plans and Critiques. ALA, 1964.

This book contains a good chapter on the role of the building by Keyes Metcalf. Otherwise, it seems too general, but the large number of floor plans may be helpful to those seeking ideas.

Rohlf, R.H. Library design: what not to do; successful building programs avoid these common pitfalls. *American Libraries* 17: 100- , February, 1986.

This article is a very general, but worthwhile account of the pitfalls to avoid in library planning, such as misunderstandings with architects over "form follows function" and problems of using library jargon when conversing with individuals in other fields. A common sense approach makes this good background reading.

The role of the building-planning team (In Library buildings institute, 1967, San Francisco. Library buildings: innovation for changing needs: proceedings, ed. by A.P. Tregga, ALA, 1972.)

This group of articles by various authors examines the process from the points of view of the librarian, architect, consultant, and also the governmental authority, which is often overlooked in these articles.

Stein, Richard G. *Architecture and Energy.* Anchor Press, 1977.

This book is not specific to libraries, but is of interest to planners for its non-technical treatment of the principles of energy-saving architecture. It covers topics such as building materials, lighting, and duct systems.

Stone, C.W. Planning for media within university library buildings. *Library Trends* 18: 235-45, October, 1969.

This article does not address sound recordings specifically, but it does offer a good list of questions to consider when planning an area suitable for audiovisual equipment and makes good background reading.

Thompson, Anthony. *Colloquium on National Library Buildings,* Rome, 1973.

This book contains K.W. Drozd's paper: "Methodology for elaborating a programme for a national library," which is good for examples of planning diagrams and flow charts, but in general the coverage is too broad and superficial.

Thompson, Godfrey. *Planning and Design for Library Buildings.* 2nd ed. Nichols, 1977.

This book is another of the major works in the field of library planning, and it is one of the several best sources for learning the planning process in general. It does not discuss sound recordings, but the presentation is clear and visually attractive, and there is a fine bibliography at the end, classified by subject.

Zenke, M.H. Assembling dreams and reality: the job of the library building consultant, *Illinois Libraries* 67: 792-4, November, 1985.

This informative recent article offers a description of the duties of a building consultant, with qualifications to look for as well. Also included are suggestions for interviewing and hiring and a discussion of how the consultant may participate in the selection of the architect.

Site selection

Metcalf, Keyes D. Selection of library sites. *College and Research Libraries* 22: 183-92, May, 1961.

This article addresses five major considerations in choosing a site, for example, orientation of the building and slope of the land. This is a useful short treatment of the subject, but the same information is included in the larger work, *Planning Academic and Research Libraries,* in updated form.

Environmental control

Lushington, Nolan. Designed for users [heating, ventilating, and air conditioning]. *Wilson Library Bulletin* 56: 362-3, January, 1982.

This article is a very brief but worthwhile consideration of the problems in planning for HVAC systems. It contains a very helpful list of questions to ask the architect. In general, the article is more concerned with the comfort of users than with the conservation of materials.

Peugh, R.B. Air conditioning design for a fixed humidity environment. *Heating / Piping / Air Conditioning* 55: 57-61, April, 1983.

This is a highly technical article, but it would surely be useful to technicians planning this sort of system with a concern for energy conservation. Charts and schematics are included.

Shelving and equipment

Bartkowski, P. and Saffady, W. Shelving and office furniture for archives buildings. *American Archivist* 37: 55-66, January, 1974.

Although this article mentions sound recordings as a possible type of material to be found in an archive, it does not give attention to their needs in particular. The article is of use, however, for its presentation of storage equipment problems from the point of view of the archive, as opposed to the circulating collection, where safe storage rather than easy access is the significant issue.

Brownrigg, Edwin. B. Library automation: building and equipment considerations in implementing computer technology. (In McCabe, Gerard B., Kreissman, Bernard, and Jackson, W. Carl, eds. *Advances in Library Administration and Organization,* Vol. 1, 1982. Greenwich. CT: JAI Press, 1982.)

Although not in great depth, this article still provides a useful checklist of factors to consider in planning for automation, including power requirements and security concerns.

Pierce, William S. *Furnishing the Library Interior.* New York: Marcel Dekker, 1980. 288 p., index.

This book contains very little material about sound recordings, but is highly descriptive, with many illustrations of library furniture. It also contains a helpful appendix of sample specifications for library furnishings.

Poole, Frazer G. and Trezza, Alphonse F., eds. *The Procurement of Library Furnishings: Specifications, Bid Documents, and Evaluation.* ALA, 1969.

This book is germane to library planning of all types and is still considered to be a major source in this area.

Acoustics and noise control

National Research Council. Building Research Institute. *Noise Control in Buildings.* National Research Council, 1959.

The proceedings of this research conference provide several good articles for planners of sound archives, where quiet conditions are needed. Examples include types of mechanical noise within buildings, ventilation system noise, and mechanical equipment noise. It is useful in solving problems of atmosphere control and monitoring, while preserving a quiet sound environment for listening.

Noise and Vibration Control, ed. by Leo L. Beranek. McGraw-Hill, 1971.

This book seems to cover every possible source of noise in an enclosed area, but it is highly technical. Nevertheless, an audio technician will find it very useful in developing considerations for the planning of the listening area of a sound collection.

Oluwakuyide, A. Noise in libraries: causes and control. *Special Libraries* 65: 28-31, January, 1974.

This article discusses differences between internally and externally generated noise, which may be useful to planners in thinking through these issues.

Lighting and electrical systems

Jaworski, F. Twelve common mistakes in library interior planning. *American School and University* 45: 16-20, January, 1973.

This article is, in general, about school libraries and media centers, but it does draw attention to some errors in lighting and in placement of electrical outlets which are pertinent to the planning of all libraries.

Kaufman, John E. *IES Lighting Handbook: The Standard Lighting Guide.* Illuminating Engineering Society, 1981.

This is the primary source in the field of lighting, and therefore belongs in any bibliography of building planning. It is highly technical, however, and designed for the electrician, not the librarian.

Mason, Ellsworth G. Guide to the librarians's responsibility in achieving quality in lighting and ventilation. *Library Journal* 92: 201-6, January 15, 1967.

This article is a good discussion of lighting problems for the layman, covering such areas as glare and interfiling of light rays. Also, it contains a good sequence of questions to consider when thinking about ventilation problems. In general, it is a good background article in a highly technical field.

_____. Lighting and mechanical progress in universities. *Library Trends* 18: 246-61, October, 1969.

This article is a relatively complete treatment of lighting problems for the layman, but it is probably the best source. The text is unbroken by subject headings, making it difficult to locate specific topics within it. Newer sources, in monographs where available, are preferable.

Merchant, Robert C. Comments on electronic systems for education. (In Library Buildings Institute, 1967, San Francisco. *Library Buildings: Innovation for Changing Needs,* proceedings, ed. by A.F. Tregga, ALA, 1972.)

This article is a very colloquial treatment and has relatively little actual information. Still, it is written from the point of view of an electrical engineering consultant, and his comments may be useful to those planning the installation of audio systems.

Floors and floor coverings

Berkeley, Bernard. *Floors: Selection and Maintenance.* ALA Library Technology Program, 1968.

This book is still the primary source on floor coverings for the library. It begins with selection criteria and maintenance, then discusses all alternative types of flooring separately.

Hannigan, Jane Anne and Estes, Glen, eds. *Media Center Facilities Design.* ALA, 1978.

In general, this work is concerned with media centers for public schools and does not address designing areas for sound recordings. The chapter on flooring and wiring for work stations could be of use, however, in planning listening areas.

Security

Healy, Richard J. *Design for Security.* 2nd ed. Wiley and Sons, 1983.

This book discusses all aspects of security, facility layouts, alarms, security lighting, storage, vaults, and locks. It provides a good overview of the factors to be considered in security planning.

Hopf, Peter S., ed. *Handbook of Building Security Planning and Design.* McGraw-Hill, 1979.

This book is more comprehensive than Healy's, but also more technical. It has a special chapter on library security, plus many diagrams and floor plans. A useful feature is a list of companies, complete with addresses, which produce equipment of supply services related to security.

Morris, John. *Managing the Library Fire Risk.* 2nd ed. University of California, 1979.

This book covers the subject of fire risk well, but the organization of the book makes it difficult to use. It describes a number of systems, but gives little advice as to which systems are best for what uses. The article on the advantages of Halon 1301 is quite good, however.

Access for the handicapped

ANSI. *Specifications for Making Buildings and Facilities Usable by Physically Handicapped People.* American National Standards Institute, 1980.

This book is a complete guide to creating accessible facilities for the handicapped, with very specific quantitative measures plus many diagrams and illustrations. It is a necessary source for planning a new facility of any kind.

Costs and financing

Ellsworth, Ralph E. Some observations on the architectural style, size and cost of libraries. *Journal of Academic Librarianship* 1: 16-19, November, 1975.

Even though a brief overview, this is good reading by a major figure in the field. The article makes the point that the future validity of buildings should be a more important factor than square-footage costs.

Esteves, R.M. Financing conservation improvements for libraries. *New Jersey Libraries* 16: 22-3, Spring, 1983.

Written by an energy conservation consultant for General Public Utilities Corporation, this article contains information on funding programs offered by public utilities for libraries interested in energy conservation, e.g. savings guarantees and cash flow leasing. It contains the only information of this type seen in any standard source.

Novak, Gloria J. Building planning austerity. (In *Austerity Management in Academic Libraries,* Scarecrow, 1984, p. 185-204.)

This article is worthwhile reading as background material, as it covers financial aspects which are poorly covered in other sources, such as how to perform cost-benefit analysis. It provides a good balance for articles written in the 1960s, when funding for libraries was abundant.

Examples of specific libraries

Building types study 591: libraries. *Architectural Record* Vol. 171, No. 9, August, 1983, p. 73-91.

This issue details four library buildings, either new or renovated, one of which is the Seeley-Mudd Library at Yale University. None of the buildings is concerned with housing sound recordings, but a planner may wish to take a look for inspiration's sake. As is usual with architectural journals, this article features beautiful color photographs of exteriors and interiors, and clear, easily readable floor plans.

Buildings for the Arts, ed. by J. Robinson and M. Filler. McGraw, 1978. 247 p.

This book is a compilation of plans and photographs of many arts buildings, a good number of which are libraries. It contains little specific information, but beautiful photography and clear diagrams make it a good source for design ideas.

Moore, F. Daylighting: six Aalto libraries. *AIA Journal* 72: 58-69, June, 1983.

This article features beautiful photographs and plans of library buildings designed by Alvar Aalto using natural lighting. This form of lighting would not be a viable means of illumination in a recorded sound collection, but examination of the journal provided the opportunity to discover that the photographs and floor plans in an architectural journal are of much higher quality than any in library journals. Library planners would do well to look for visual ideas in sources of this type.

New public library buildings in the Nordic countries (special issue). *Scandinavian Public Library Quarterly* Vol. 19, No. 1, p. 1-44, 1986.

One of the libraries featured in this article, the regional central library in Ebjerg, shows the best reproduced floor plans for a music department yet seen. It is useful for layout only, however. There is no specific information about storage, environmental conditions, and other matters. Also featured is a large library in Tampere, Finland, which has a large audiovisual department.

Schmertz, M.F., ed. *Campus Planning and Design: a Collection of Articles Originally Published in the Architectural Record from 1966-70.* McGraw, 1972.

The chapter on library buildings is as usual, a visual delight, but offers little to the planner of a building for sound recordings other than inspiration.

Sound recordings

Colby, Edward E. Sound recordings in the music library: with special reference to sound archives, in above, p. 556-565.

Although a highly interesting article to anyone involved in the librarianship of recordings, this article is not concerned with the housing of these materials. It is instead concerned with the justification for a recording collection, specifically an archive, and for this purpose, it is a fine article.

Duckles, Vincent H., issue ed. Music libraries and librarianship. *Library Trends* 8: 495-626.

_____. Problems of music library equipment. *Notes* 11: 213- , 1954.

This article discusses some requirements of shelving for recordings and considers the question of whether or not to leave recordings in their original packaging. There is also a section on listening facilities, but this seems to offer few helpful suggestions.

Equipment and environments for listening (In Halsey, R.S., *Classical Music Recordings for Home and Library.* ALA, 1976, p. 278-98.)

This book is concerned more with the school or public library than the academic library and with home listening. There is a short section on equipment selection for music libraries, already much out of date, but that is beyond the scope of this bibliography.

Fling, Robert Michael. *Shelving Capacity in the Music Library.* MLA Technical Reports, No. 8. Music Library Association, 1981.

This monograph makes recommendations for the shelving of recordings in terms of orientation and shelf loading. It also discusses types of shelving by material of composition and configuration. It is probably the most complete discussion of its kind, but even so, most information was taken from other sources or provided by surveys. Therefore, it tends to reflect a consensus of practice, rather than the results of a scientific study of the subject.

Freitag, Wolfgang. On planning a music library. *Fontes Artis Musicae* 11: 35-49, 1961. (Reprinted in Reader in Music *Librarianship,* ed. by Carol June Bradley. Microcard Editions Books, 1973, p. 283-94.)

This brief article on the planning of a music library seems to be the only source of its kind. The source of information for the sound recordings shelving needs is the Duckles article. It also contains some useful information on space planning for other areas of the archive, such as areas for listening and processing.

Hall, David. Phonorecord preservation: notes of a pragmatist. *Special Libraries* 62: 357-62, September, 1971.

This article contains a very useful section on shelving and storage for discs and tapes. It also contains hints on methods for cleaning.

Hicks, Warren B. and Tillin, Alma M. *Developing Multi- Media Libraries.* Bowker, 1970.

This book is concerned mostly with the selection and organization of materials, but one chapter is included on the storage and housing of materials. The chapter seems outdated, however, for only 7 and 10 inch recordings and reel-to-reel tapes are mentioned.

McWilliams, Jerry. Sound Recordings. In Swartzburg, Susan G. *Conservation in the library: A Handbook of Use and Care of Traditional and Nontraditional Materials.* Greenwood Press, 1983.

Although this article contains some useful information, it is of uneven quality. Most material for it was gathered by telephone interviews and some information seems inaccurately recorded.

Pickett, A.G. and Lemcoe, M.M. *Preservation and Storage of Sound Recordings.* Library of Congress, 1959, reprinted 1991 by the Associated Audio Archives Committee, Association for Recorded Sound Collections.

Although quite old, this book remains the only major study of the preservation of sound recordings and the factors which lead to their deterioration. The suggestions made for the storage of recordings are still the primary guidelines in the field, and this article is cited more than any other whenever sound recordings are discussed.

Poole, Frazer G., ed. *The Library Environment: Aspects of Interior Planning.* ALA, 1965.

This book contains a chapter entitled "Listening Facilities," and there is one page of information about storage and shelving for sound recordings. There is also a list of questions to consider when planning a listening area.

Wallace, Mary. Time-space and the music library. *Notes* 27: 12-18, 1970.

This article includes a discussion of shelving for sound recordings and notes some reasons why no satisfactory solutions have been found. The treatment is interesting in that it is from the point of view of planning only a small part of a building, rather than the whole thing, which is likely to be the case for a music library or a sound collection.

Weihs, Jean. *Accessible Storage of Nonbook Materials.* Oryx Press, 1984.

The emphasis in this book is on intershelving of recordings with other materials. This probably would never be done in an archival collection, but it might be done in a music library, and for that circumstance good ideas about shelving are listed.

_____. *Nonbook Materials: The Organization of Integrated Collections.* 2nd ed. Canadian Library Association, 1979.

This book is concerned mainly with cataloging and processing materials, but it does include a brief set of recommendations for the storage and handling of sound recordings, including guidelines for temperature and humidity control.

Welch, Walter L. Preservation and restoration of authenticity of recorded sound. *Library Trends* 21: 83- 100, July, 1972.

The majority of the article is about different types of sound carriers, their composition and how they best may be cleaned. There are suggestions given for proper shelving and storage conditions which make the article useful in planning a building for a sound collection.

The following materials were examined, but deemed not useful for the purposes of this bibliography:

Bard, H.E. and Hodell, J.E. Architect/librarian interface. il. *Library Scene* no. 1: 4-6, 1977.

Beckman, M. and Langhead, S. Special report: UNESCO international conference on library buildings. *Wilson Library Bulletin* 50: 114-5, June, 1976.

Brown, H.F. Academic library buildings in the United Kingdom. (In *Advances in Librarianship,* Vol. 3, Seminar Press, 1972, p. 107-18) bibliog.

Bush, M.A. Space: factors in planning and use. *Illinois Libraries* 60: 898-903, December, 1978. plan bibliog.

Cullison, B.J. Ideal preservation building. *American Libraries* 15: 703, November, 1984.

Ellsworth, R.E. Academic library buildings in the United States. (In *Advances in Librarianship,* Vol. 3, Seminar Press, 1972, p. 119-36) bibliog.

Harjanne, K. and others. Musiikkikirjaston suunnittelu ja sisustus. (Designing and furnishing a music library). il. *Kirjastolehti* 70, No. 11: 436-9, 1977 (in Finnish)

Lerup, Lars. *Building the Unfinished: Architecture and Human Action.* (Sage Library of Social Research, Vol, 53) Sage Publications, 1977. 171 p.

Lieberfeld, L. Curious case of the library building (inconsistency between what is written and built and the actual pattern of use). *College and Research Libraries* 44: 277-82, July, 1983, chart.

Lushington, N. Flow of function in libraries: some random notes on functional design. *American Libraries* 7: 92-4, February, 1976.

Rovira, M.A. Seminar on library interior layout and design. *IFLA Journal* 7 No. 1: 69-70, 1981.

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Strain, P.M. Efficiency and library space. *Special Libraries* 70: 542-8, December, 1979, il., plans.

Svensson, S.O. Sweden: a manual of public library premises. *Scandinavian Public Library Quarterly* 15, No. 2-3: 59-75, charts, il.

Sweeney, R.T. Planning from scratch: an up-to-date facility from ground zero. *American Libraries* 15: 727, November, 1984.

Thomas, P.K. Finding space: adaptive reuse. *Library Journal* 107: 2230-4, December 1, 1982, il., plan.

Thompson, A.H. Some recent trends in national library buildings. *Libri* 24, No. 1: 69-77, 1974.

University library buildings. (In Thompson, J., *Introduction to University Library Administration,* 2nd ed rev. Shoe String: Bingley, C., 1974. p. 128-39.)

The following references were identified as being of possible interest, but were unavailable for examination:

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Ammundsen, V. Problems of planning new university libraries, *IATUL Proceedings* 7: 75-82, Dec., 1974.

Anderson, J.F. and others. *Library Space Planning.* New York: Library Journal, 1976. 80 p.

Architecture and equipment (In Dyer, E.R. and Berger, P. *Public School and Academic Media Centers,* Gale Research, 1981. p. 147-56.)

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Bell, B. Designing for rare books and manuscripts [at Columbia]. il, plans. *Columbia Library Columns* 34: 20- 8, Feb. 1985.

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Bullock, C.G. and others. Energy conservation in libraries. bibliog., charts, il, maps. *Library Technology Reports,* July 1978 issue.

Ceadel, E.B. Planning and execution of new academic library buildings. (In *Essays on Information and Libraries.* Shoe String, 1975, p. 45-59.)

Clavel, J.P. Symposium on national library buildings, Rome; organized by the IFLA Committee on Library Buildings. *IFLA News* No. 46: 26-7, Nov. 1973.

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Gibson, D.B. Planning and executing a library move: the experience of the Home office library. *State Librarian* 26: 9-10, March, 1978.

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Hanif, A. Library buildings: basic principles and primary elements of design. *Pakistan Library Bulletin* 9: 6-16, January-April, 1978.

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